IN THE HON'BLE NATIONAL GREEN TRIBUNAL

PRINCIPAL BENCH

AT NEW DELHI

ORIGINAL APPLICATION NO. 59 OF 2024

IN THE MATTER OF: -

HASDEO ARRAND BACHAO SANGHRSH SAMITI ... INTERVENOR

Versus

In the Suo motu matter of-

NEWS ITEM TITLED "DEFORESTATION FOR MINING RESUMES IN HASDEO LOCALS ACTIVISTS ALLEGE DETETION''APPEARING IN THE HINDU DATED 22.12.2023

Next Date 03.07.2024

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Date :12.06.2024

Place:Delhi

IN THE HON'BLE NATIONAL GREEN TRIBUNAL

PRINCIPAL BENCH

AT NEW DELHI

ORIGINAL APPLICATION NO. 59 OF 2024

WITH

IA NO. 137/2024 & IA NO. 136/2024

IN THE MATTER OF:

News item titled "Deforestation for mining resumes in Hasdeo locals activists allege detention" appearing in The Hindu dated 22.12.2023.

COUNTER AFFIDAVIT ON BEHALF OF UNION OF INDIA

MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE, NEW DELHI. (RESPONDENT NO. 1)

PRELIMINARY SUBMISSIONS:

I, Chandulal B. Tashildar, S/o Babalal H. Tashildar, aged about 35 years, working as Assistant Inspector General of Forests (AIGF) residing at Nagpur in the Regional Office of the Ministry of Environment, Forest and Climate Change, at Nagpur, do hereby solemnly affirm and state as under:

1. That I am duly authorized to swear this affidavit as such conversant with the facts of the present case and competent to swear the present affidavit.

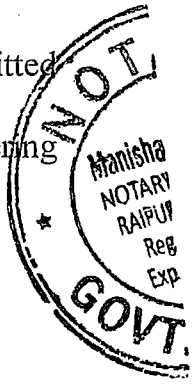
2. That I have read and understood the contents of the accompanying affidavit and state that the same has been drafted under my instructions

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based on the records maintained by the Respondent No. 1 in its normal course of business and the same are true and correct.

3. That the contents of the accompanying reply shall be treated as part of this affidavit and the same are not being repeated for the sake of brevity.

4. At the outset, all the allegations made against the Answering Respondent in the instant OA are denied except those that are specifically admitted herein. The Appeal is not maintainable against the Answering Respondent either on law or on facts.



STATEMENT OF FACTS:

5. It is humbly submitted that the Hon'ble NGT vide order dated 24.03.2014 in Appeal No. 72/2012 in the matter Sudiep Srivastava Vs State of Chhatisgarh *inter-alia* directed:

"1. *Order dated 23rd June, 2011 passed by the respondent no. 2- MoEF Government of India and consequential order dated 28th March, 2012 passed by the respondent no. 1 State of Chhattisgarh under section 2 of the Forest (Conservation) Act 1980 for diversion of forest land of PEKB Coal Blocks are set-aside;*



2. The case is remanded to the MoEF with directions to seek fresh advice of the FAC within reasonable time on all aspects of the proposal discussed herein above with emphasis on seeking answers to the

12 JUN 2014

following questions: (i) What type of flora and fauna in terms of bio-diversity and forest cover existed as on the date of the proposal in PEKB Coal Blocks in question. (ii) is/was the PEKB Coal Blocks habitat to endemic or endangered species of flora and fauna. (iii) Whether the migratory route/corridor of any wild animal particularly, elephant passes through the area in question and, if yes, its need. (iv) Whether the area of PEKB Block has that significant conservation/protection value so much so that the area cannot be compromised for coal mining with appropriate conservation/management strategies. (v) What is their opinion about opening the PEKB Coal Blocks for mining as per the sequential mining and reclamation method proposed as well as the efficacy of the translocation of the tree vis-a-vis the gestation period for regeneration of the flora? (vi) What is their opinion about the Wildlife Management plan finally prescribed. (vii) What conditions and restriction do they propose on the mining in question, if they favour such mining? Liberty is granted to the FAC to seek advice/opinion/specialised knowledge from any authoritative source such as Indian Council of Forestry Research and Education Dehradun or Wildlife Institute of India including the sources indicated in the present case by the parties.

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3. The MoEF shall pass a reasoned order in light of the advice given by the FAC in accordance with law and pass appropriate order in accordance with law.

4. All work commenced by the respondent no. 3 project proponent and respondent no. 4 pursuant to the order dated 28th March, 2012 passed by the respondent no. 1 State of Chhattisgarh under section 2 of the FC Act 1980, except the work of conservation of existing flora and fauna, shall stand suspended till such further orders are passed by the MoEF in accordance with law."



6. Thereafter, the above stated order was challenged in the Hon'ble Supreme Court in Civil Appeal No. 4395/2014 by Rajasthan Rajya Vidyut Utpadan Nigam Ltd. and the Hon'ble Supreme Court vide order dated 28.04.2014 directed "*In the meanwhile, we stay the direction in the impugned order that all works commenced by the appellant pursuant to the order dated 28th March,2012 passed by the State of Chhattisgarh under Section 2 of the Forest Conservation Act, 1980 shall stand suspended* ***till further orders are passed by the Ministry of Environment and Forests.***"



8. It is humbly submitted that the Hon'ble Supreme Court vide above-stated order stayed the direction of the Hon'ble NGT whereby the Hon'ble NGT

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directed to suspended the mining activities until further order is passed by the MoEF

FACTUAL BACKGROUND OF THE PROPOSAL UNDER THE FOREST(CONSERVATION) ACT, 1980

9. The Government of Chhattisgarh, vide their letter dated 28.04.2010 submitted a proposal seeking prior approval of the Central Government under the Forest (Conservation) Act, 1980("FCA" for short) for diversion of 1898.328 ha of forest land for Parsa East and Kete Basan("PEKB" for short) Coal block open cast mining in Hasdeo Arand forest.

10. The proposal was placed before the Forest Advisory Committee ("FAC" for short) as constituted under Section 3 of the FCA, 1980 on 10.03.2011 and 20-21.06.2011. The FAC did not recommend the proposal for diversion of forest land. However, the said recommendations of the FAC were overruled by the then competent authority vide speaking order dated 06.07.2011 and accordingly Stage I *'In Principle'* Approval subject to conditions prescribed therein was granted by the Ministry vide letter dated 06.07.2011.

11. It is pertinent to mention here that one of the mandatory conditions of Stage I Approval was:

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7. The Wildlife Management plan and programme should be prepared under the aegis of an institution like the Wildlife Institution of India. Other independent institutions with expertise on elephant-related issues especially, like the Nature conservation Foundation, Wildlife Trust of India and the Centre for Ecological Studies at the Indian and the Indian Institute of Science could also be involved in the preparation and implementation of such a management plan with funds from the project proponents (IFFCO and RVUNL). The plan should be prepared over the next four-six months and should be submitted to the Ministry for monitoring.

12. The State Government, vide their letter No. Bhu-Prabandh/Khanij/246/2285 dated 17.10.2011 forwarded a copy of Wildlife Management Plan to Wildlife Institute of India (WII), Dehradun in compliance to condition no. 7 of the Stage-I approval dated 6th July, 2011. The MoEF&CC vide its letter dated 02.02.2012 had requested the WII, Dehradun to examine the Wildlife Plan submitted by the State Government of Chhattisgarh. The WII, Dehradun examined the Wildlife Management Plan and has furnished its comments, vide their letter dated DWII/0149/2012 dated 29.02.2012.

13. That after receipt of the comments of the WII, Dehradun on the Wildlife Management Plan, the Ministry accorded Stage-II Approval to the

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proposal on 15.03.2012 *inter-alia* stipulating following additional conditions for effective implementation of the Wildlife Management Plan:

i. *"The State Government will suitably incorporate the comments, as suggested by of the WII, Dehradun, into the Wildlife Management Plan prepared for the area.*

ii. *The user agency will make provision for appropriate financial outlay for the establishment of Rescue and Rehabilitation team to mitigate human-wildlife conflicts.*

iii. *In order to ensure proper implementation of the Wildlife Management Plan, the user agency shall make necessary provisions for carrying out the monitoring and evaluation of the plan. It would be appropriate to include Chief Wildlife Warden of the State as part of the Monitoring Committee.*

iv. *The user agency will undertake and implement suitable mitigative measures as prescribed in the Wildlife Management Plan for reducing the dependency of cattle and people on the surrounding forest area.*"

14. That the above mentioned Wildlife Management Plan, involving financial provision of Rs. 22.0 crores and concurrence of the Wildlife Institute of India, Dehradun, was proposed to be implemented in the core area and buffer area over a period of 15 years. The provisions to be implemented

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in the Wildlife Management Plan include general protection of the core area and protection and conservation of the buffer zone ecosystem by carrying out various activities like fire protection, protection from grazing, illicit felling and plantation, empowerment of people for protection, soil and moisture conservation works, etc. The Wildlife Management Plan has been proposed to mitigate the impact of the mining operations on the wildlife in area, including providing for safe movement of elephants. Therefore, all the mitigative measures were considered while granting the Stage II Approval for the PEKB Coal Block.

15. The Stage II Approval dated 15.03.2012 for diversion of 1898.328 ha was granted for commencing the mining work in two phases. The condition No. 8 of the Stage II Approval is reiterated below:

"8. The mining shall be done in two phases:

I. During the Phase-I, covering 15 years, the mining shall be restricted to 762.00 ha. of forest land.

II. During Phase-II, the mining over remaining 1136.00 ha. will be linked to the reforestation and biodiversity management in Phase-I.

III. The project proponent will submit the application for permission for mining in Phase-II along with compliance report of Phase-I." (Copy of the Stage II Approval is annexed as "**Annexure –I**")

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16. It is pertinent to mention that the mining operations continued in pursuance of this Hon'ble Court's order dated 28.04.2014.

17. Subsequently, the Government of Chhattisgarh submitted a proposal in 2017 for prospecting in the Kete Extension Coal Block which is contiguous to PEKB. Generally, prospecting or survey does not result into perceptible change in the forest land use, however, prospecting being a non-forestry activity attracts the provisions of the Forest (Conservation) Act, 1980. The Ministry referred the proposal to the FAC in August, 2017 and FAC directed the Regional Office, Nagpur of the Ministry to carry out the inspection in light of the directions of NGT as contained in its order dated 24.03.2014.

18. The Regional Office submitted its inspection report in light of the directions of the Ministry. Thereafter, the matter was again examined holistically by the FAC on 25.01.2018 and the FAC *inter-alia* recommended that the following study may be conducted by the State:

"A Biodiversity Study to be conducted through ICFRE, Dehradun in consultation with Wildlife Institute of India, Dehradun for the whole HasdeoArand Coalfield comprising of Tara, Parsa, Parsa East &Kanta Basan and Kete Extension to be funded by M/s Rajasthan Rajya Vidyut Utpadan Nigam Limited (RVUNL). The study is to be awarded by state government by associating the Indian Council of Forestry Research &

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Education (ICFRE), Dehradun and Wildlife Institute of India (WII) Dehradun and Integrated Wildlife Management Plan (IWMP) will be prepared and conservation area will be identified and mitigation measures will be recommended by the expert committee. The cost of study and cost of implementation of the recommendations shall be borne by M/S Rajasthan Rajya Vidyut Utpadan Nigam Limited (RRVUNL). The report will be submitted within 2 years.".

19. It is humbly submitted that Government of Chhattisgarh vide letter dated 22.02.2021 forwarded the request of the user agency to allow mining in 1136 ha of forest land of Phase-II in the PEKB Coal block. It was stated that due to the enhancement of production capacity of mine from 10 MTPA to 15 MTPA, mining activities of Phase-I will be over in 2021.

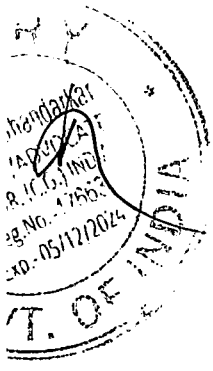
The Government of Chhattisgarh, vide their letter no. 5-17/2018/10-2 dated 08.10.2021 forwarded a copy of Report of Biodiversity Assessment Study to the Ministry. The report inter-alia recommended "*The allotted four contiguous coal blocks falling within the Gej-Jhink watershed viz., Tara (15), Parsa (13) PEKB (14) & Kente Extension (12) that are either already opened or in advance stage of getting the statutory clearances/ToR approved, can be considered for mining with strict environmental safeguards including appropriate conservation measures for management of surface water and biodiversity.*" It is pertinent to note

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that 14 out of 18 projects, falling within both the Chornai (8) and Ton-Teti (9) watershed have not been recommended for mining by the Biodiversity Assessment Study keeping in view of conserving the relatively dense moist-dry deciduous sal dominated forest tracts that provide home range for elephants. It is pertinent to mention that after receipt of the Biodiversity Assessment Study Report, all the operational directions of the Hon'ble NGT have been complied. *(*Copy of the Bio-Diversity Assessment Study prepared by ICFRE in consultation with WII is annexed as "**Annexure –II**")



20. That as a matter of abundant precaution and after due diligence on the proposal based on Biodiversity Assessment Study, Ministry deliberated the proposal in the FAC meeting dated 28.10.2021. Prior to taking any decision, FAC recommended that a subcommittee shall be formed to visit the PEKB site to assess that status of reclamation measures already implemented/being implemented in the lease area by the user agency in terms of its efficacy and provisions provided in the Mining Plan and to provide the status of compliance of various conditions stipulated in the Stage II Approval dated 15.03.2012. Sub-Committee was constituted by the Ministry vide letter dated 9.11.2021.



21. That the Sub Committee of FAC visited the site from 26th– 29th November 2021 and after thorough examination submitted its report with

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observations on 01.12.2021. The Sub-Committee recommended that the status of reclamation measures already implemented/being implemented in the area of inspection is satisfactory and ecologically sustainable. Moreover, it was also recommended that the conditions stipulated in the final approval by Ministry of Environment, Forest and Climate Change, Govt. of India, dated 15.03.2012 have been complied with, by the User Agency and the proposal can be considered for Phase II mining.(Copy of the Sub-Committee Report is annexed as **" Annexure – III"**)

22. It is submitted that Biodiversity Assessment Study Report (BAR) was carried out by the ICFRE, Dehradunin association with Wildlife Institute of India (WII), Dehradun. It is pertinent to mention that there is only one report on the BAR which is submitted by the by ICFRE, which includes report of WII. The recommendation made in the final report includes the recommendation of WII. The final report after due consultations with WII was presented by ICFRE before the FAC held on 23.12.2021.

23. That the recommendations of the Sub-Committee and detailed presentation of ICFRE Report was made before the FAC in its meeting held on 23.12.2021. The FAC, after detailed discussion and deliberations on the proposal also discussed from the Nodal Officer (FCA), Chhattisgarh, members of Sub-Committee of the FAC and after careful examination of the recommendations of ICFRE in Biodiversity Assessment Study Report (BAR) recommended the proposal for Phase-II

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mining over balance area of 1138 ha for which the Stage-II Approval was granted in 15.03.2012 subject to the fulfilment of following conditions:

i. *The recommendation in the Biodiversity Assessment Study Report (BAR) have been made keeping in view the comprehensive scenario of current production levels, biotic interference, mitigating measures, etc vis-à-vis impact on surrounding resources. Therefore, no further changes in the Mining Plan vis-a-vis land use shall be effected by the user agency without the prior approval of Central Government.*

ii. *The recommendation made in the Biodiversity Assessment Study Report shall be incorporated into the Wildlife Management Plan and the same shall be implemented by the State Forest Department at the project cost.*

iii. *Annual site inspection on compliance of conditions should be mandatorily done jointly by IRO, Raipur and State Forest Department.*

iv. *Grant of permission for mining operations in the Phase-II area of 1136 ha is subject to change as per the directions of Hon'ble Supreme Court, as may be directed in final decision, in Civil Appeal 4395 of 2014.*

v. *The user agency, in consultation with the State Forest Department, will strengthen the provision for appropriate financial outlay for the establishment and effective functioning of Rescue and Rehabilitation team to mitigate human-wildlife conflicts.*

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vi. *The State Government and the user agency shall ensure that concerned orders/directions of Courts/Tribunals, relevant provisions of the all Acts, Rules, Regulations and Guidelines pertaining to this project, if any, for the time being in force, as applicable to the project.*

vii. *Biodiversity restoration should be integral part of mining site rehabilitation and User Agency should submit annual progress report on rehabilitation of mined up areas following best practices and afforestation measures to IRO for information and verification.*

23. That, accordingly, the Ministry vide letter dated 02.02.2022 granted permission to commence the Phase II mining operation in the balance area of 1136 ha. of forest land in favour of Rajasthan Rajya Vidyut Utpadan Nigam.

24. It is humbly submitted that the Government of Chhattisgarh has notified the Lemru Elephant Reserve over an area of 1995.48 sq km on 12.07.2021 for protection and conservation of elephants in the landscape being a flagship specie. It is pertinent to mention that an area of 450 Sq. Km was proposed to be notified as Elephant Reserve, however, the elephant reserve was declared in an area of 1995.48 Sq. Km. As per said notification, neither PEKB nor any other three Coal Blocks as recommended in the BAR fall within the notified Lemru Elephant Reserve. Moreover, a Wildlife Management Plan for the proposal was

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concurred by Wildlife Institute of India (WII), Dehradun before issuance of Stage-II and a sum of Rs. 22 crores was deposited by the User Agency for the same. Further, the Ministry while according permission for Phase-II mining operations, also directed the State Government to incorporate the recommendation made in the BAR in the Wildlife Management Plan to enforce the mitigation measures for protection and conservation of the wildlife and floral diversity of the area. Therefore, the allegation of the appellant that the recommendations of the WII were not considered is factually incorrect. Thus, mitigation measures and management interventions, that remains subject to modifications as and when required, related to wildlife in the matter has duly been taken care.

25. Moreover, a Writ Petition(C) No. 1643 of 2016 titled as Forest Rights Committee Ghatbarra Vs Union of India and Ors. is pending in the Hon'ble High Court of Chhattisgarh at Bilaspur whereby vide order dated 02.05.2024, the Hon'ble High Court has allowed the petitioner to amend the Writ Petition thereby challenging the letter dated 02.02.2022 of the Ministry and consequential orders of the State Government whereby mining in the Phase II of the PEKB Coal Block was permitted. ("Annexure-IV")

26. Lastly, it is pertinent to mention that the issue related to the PEKB Coal block and the orders of the Phase II Mining have already been decided by the Hon'ble Supreme Court vide its order dated 16.10.2023 in Civil Appeal No. 4395 of 2014 in the matter titled as Rajasthan Rajya Vidyut

Utpadan Nigam Ltd. Vs Sudiep Srivastava and Ors. Hence, deciding the issue again either on merits or facts would contradict the principle of res judicata.

27. That this Ministry reserves its right to file additional affidavit as and when required till *pende-lite.*

28. That in light of the aforementioned facts and circumstances it is respectfully prayed that this Hon'ble court may pass any order as it deem fit.

DEPONENT

(सी. बी. ताशिलदार) भा.व.से
सहायक वन महानिरीक्षक (केन्द्रीय)
(C. B. Tashildar) I.F.S.
AIGF (Central)

VERIFICATION

I, the above named Deponent do hereby verify that the contents of the above affidavit are true and correct to my knowledge and are based on official records and nothing material is concealed therein.

Verified at 12 JUN 2024 on this ..... Day of 2024.

Adv. Veena T.S

IDENTIFING WITNESS

DEPONENT

(सी. बी. ताशिलदार) भा.व.से
सहायक वन महानिरीक्षक (केन्द्रीय)
(C. B. Tashildar) I.F.S.
AIGF (Central)

SOLEMENLY AFFIRMED OR SWORN BEFORE ME BY THE WITHIN NAMED

Manisha Bhandarkar
Notary/Advocate
Regd. (C.G.) India

12 JUN 2024

F. No. 8-31/2010-FC
Government of India
Ministry of Environment & Forests
(FC Division)

Paryavaran Bhawan, C.G.O Complex,
Lodhi Road, New Delhi - 110510.
Dated: 15th March, 2012

To

The Principal Secretary (Forests),
Government of Chhattisgarh,
Raipur.

Sub: **Diversion of 1898.328, ha in two phases of forest land for Parsa East and Kete Basan captive coal block open east mining project in favour of M/s Rajasthan Rajya Vidut Utpadan Nigam Limited in South Surguja Forest Division in Surguja District of Chhattisgarh – reg.**

Sir,

I am directed to refer to the State Government's letter no. FS-4/2010/10-2 dated 28.04.2010 on the subject cited above seeking prior approval of the Central Government under the Forest (Conservation) Act, 1980. After careful consideration of the proposal by the Forest Advisory Committee constituted under section-3 of the said Act, in-principle approval was granted vide this Ministry's letter of even number dated 06.07.2011 subject to fulfilment of certain conditions prescribed therein. The State Government has furnished compliance report in respect of the conditions stipulated in the in-principle approval and has requested the Central Government to grant final approval.

In this connection, I am directed to say that on the basis of the compliance report furnished by the State Government vide letter no. vide its letter no. 331-53/2455 dated 31.12.2011, approval of the Central Government is hereby granted under section-2 of the Forest (Conservation) Act, 1980 for diversion of 1898.328, ha in two phases of forest land for Parsa East and Kete Basan captive coal block open cast mining project in favour of M/s Rajasthan Rajya Vidut Utpadan Nigam Limited in South Surguja Forest Division in Surguja District of Chhattisgarh subject to fulfilment of the following conditions:

1. Legal status of forest land shall remain unchanged.

   a. Compensatory afforestation shall be raised and maintained by the State Forest Department over degraded orange forest land double in extent to the forest land proposed to be diverted at the project cost.

   b. Fencing, protection and regeneration of the safety zone area shall be done at the project cost. Besides this, afforestation on degraded forest land, to be selected elsewhere, measuring one and a half times the area under safety zone, shall also be done at the project cost.

   c. Wherever possible and technically feasible, the User Agency shall undertake afforestation measures in the blanks within the lease area, as well as along the roads outside the lease area diverted under this approval, in consultation with the State Forest Department at the project cost

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2. Following activities undertaken by the project proponent under the supervision of the State Forest Department at the project cost:

   (i) Proper mitigative measures to minimize soil erosion and choking of streams shall be prepared and implemented.

   (ii) Planting of adequate drought hardy plant species and sowing of seeds to arrest soil erosion.

   (iii) Construction of check dams, retention / toe walls to arrest sliding down of the excavated material along the contour.

   (iv) The areas shall be reclaimed keeping in view the international practice of stabilizing the dumps by grading / benching so that angles of repose (normally less than 28 at any given place) are maintained.

   (v) No damage shall be caused to the top-soil and the user agency will follow the top soil management plan.

3. The approval under the Forest (Conservation) Act, 1980 is subject to the clearance under the Environment (Protection) Act, 1986 and any other Acts/Regulation/Rules.

4. The period of diversion of the said forest land under this approval shall be for a period co-terminus with the period of the mining lease proposed to be granted under the Mines and Minerals (Development & Regulating) Act, 1957, or Rules framed there under, subject to a maximum period of 30 years.

5. The User Agency shall furnish an undertaking to pay the additional NPV, if so determined, as per the final decision of Hon'ble Supreme Court of India.

6. Demarcation of mining lease area will be done on the ground at project cost using four feet high reinforced cement concrete pillars with serial numbers, forward and back bearings and distance from pillar to pillar.

7. Mining/reclamation schedule shall be implemented by the user agency at their cost as per Environmental Management Plan / phased reclamation programme. The annual report about the progress of reclamation should be submitted to the CCF (Central), Regional Office, Bhopal.

8. The mining shall be done in two phases:

   i. During phases-I, covering 15 years, the mining shall be restricted to 762.00 ha of forest land.

   ii. During phase –II the mining permission over remaining 1136.00 ha will be linked to the reforestation and biodiversity management in phase-I.

   iii. The project proponent will submit the application for permission for mining in phase – II along with compliance report of phase-I.

Chief Wildlife Warden of the State in monitoring the implementation of the Plan.

24. The user agency will undertake and implement suitable mitigative measures as prescribed in the Wildlife Management Plan for reducing the dependency of cattle and people on the surrounding forest area.

25. Any other condition that the Chief Conservator of Forests (Central), Regional Office, Bhopal may impose from time to in the interest of conservation, protection or development of forests.

26. The user agency shall submit the annual compliance report in respect of the above conditions to the State Government and to the Regional Office, Bhopal regularly.

Yours faithfully,

(Shiv Pal Singh)
Sr. Assistant Inspector General of Forests

Copy to:-

1. The Principal Chief Conservator of Forests Government of Chhattisgarh, Raipur.
2. The Nodal Officer, Office of the PCCF, Government of Chhattisgarh, Raipur.
3. The Chief Conservator of Forest, Regional Office, Bhopal.
4. User Agency
5. Monitoring Cell, FC Division.
6. Guard file.

(Shiv Pal Singh)
Sr. Assistant Inspector General of Forests

T/C

9. The user agency will ensure the dumping of OB and phase wise rehabilitation and afforestation of the used / mined out pits / voids as per the approved plan under the supervision of the State Forest Department.

10. The user agency will make arrangement for free supply of alternate fuels to labourers and staff working on the project site so as to avoid any pressure on the adjacent forest areas.

11. The forest land shall not be used for any purpose other than that specified in the proposal.

12. Any tree felling shall be done only when it is unavoidable and under strict supervision of the State Forest Department.

13. No damage to the flora and fauna of the area shall be caused.

14. No labour camps shall be set up inside the forest area.

15. The forest land proposed to be diverted shall under no circumstances shall be transferred to any other agency, department or person without prior approval of the Central Government.

16. The user agency will implement the Resettlement and Rehabilitation Plan as per the R&R Policy of State Government.

17. The user agency will undertake transplantation of important tree species under 60 cm girth under the supervision of State Forest Department.

18. The State Government will not come up for opening up of the main Hasdeo-Arand area.

19. The user agency will ensure proper implementation of Wildlife Management Plan prepared by the State Government.

20. The user agency will assist the State Government in conservation and preservation of the flora and fauna of the area.

21. The State Government will suitably incorporate the comments, as suggested by of the WII, Dehradun, into the Wildlife Management Plan prepared for the area. The project proponent has deposited an amount of Rs. 22 crores (Rs. Twenty two crores) towards cost of implementation of the Wildlife Management Plan. Increased costs, if any, due to incorporation of the suggestions of WII, Dehradun will be borne by the user agency. Final copy of the Wildlife Management Plan will be submitted to this Ministry and the Regional Office, Bhopal within a period of three months for the purpose of monitoring. A soft copy in PDF format will also be submitted to the Ministry.

22. The user agency will make provision for appropriate financial outlay for the establishment of Rescue and Rehabilitation team to mitigate human-wildlife conflicts.

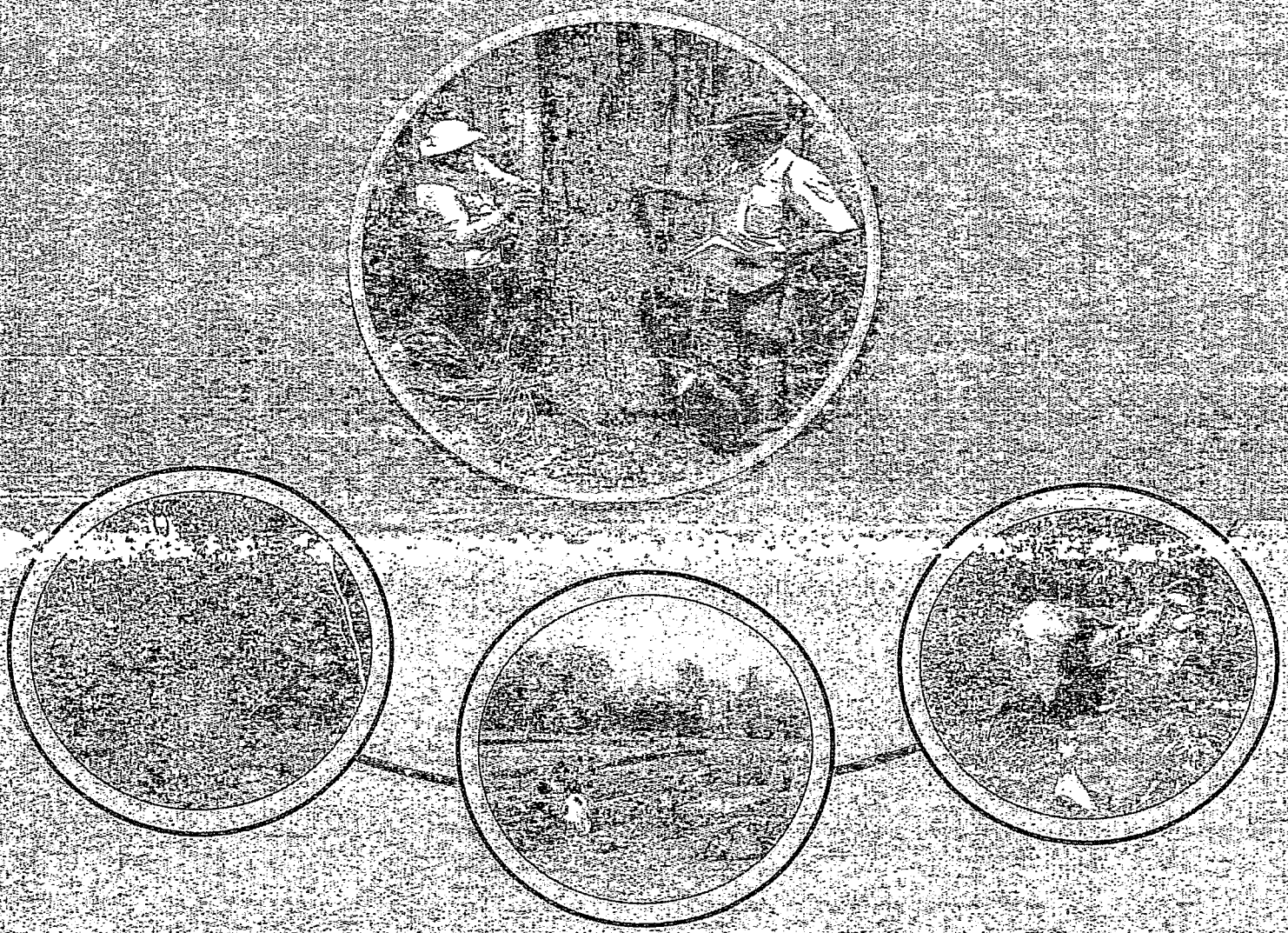
23. The Wildlife Management Plan will be implemented by the State Government and independent institutions like the Nature Conservation Foundation, Wildlife Trust of India and the Center for Ecological Studies at the Indian Institute of Science apart from the Wildlife Institute of India may be involved in implementation of the Plan. In order to ensure proper implementation of the Wildlife Management Plan, the State Government shall make necessary provisions for carrying out the monitoring and evaluation of the plan. It would be appropriate to include

Biodiversity study in the entire Hasdeo-Arand Coalfield comprising of Tara, Parsa, Parsa East & Kanta Basan and Kente Extension coal blocks in Chhattisgarh

Chhattisgarh Forest Department

For

State Forest Department
Government of
Chhattisgarh



By

Indian Council of Forestry Research and Education (ICFRE) Dehradun

In association with

Wildlife Institute of India (WII) Dehradun

EXECUTIVE SUMMARY

ES 1. BACKGROUND

The Government of Chhattisgarh *vide* letter dated 28.04.2010 submitted a proposal seeking Forest Clearance (FC) under the Forest (Conservation) Act, 1980 for diversion of 1898.328 ha of forest land under Surguja forest division for a captive coal block i.e., Parsa East & Kanta Basan (PEKB) allotted to M/s. Rajasthan Rajya Vidyut Utpadan Nigam Limited (RVUNL). The Forest Advisory Committee (FAC) considered the proposal during the meeting held on 10.03.2011 and a sub-Committee was constituted with a direction for a field visit to PEKB and submit the report. The sub-committee report was considered during the FAC meeting held on 20.06.2011 & 21.06.2011 and did not recommend for diversion of forest land; however, based on the order of the then Hon'ble Minster of State for Environment & Forests *vide* dated 23.06.2011, permission has been granted for Stage–I Forest Clearance under FC Act *vide* F.No.8-31/201-FC dated 06.07.2011 for **diversion of 1898.328 ha forest land for mining in two phases (Phase-I & II)**. Further, the final Forest Clearance stage-II has been granted by the Ministry *vide* letter No. F 5-4/2010/10-2 dated 28.03.2012. Aggrieved by the stage-II Forest Clearance granted under section 2(ii) of FC Act by the Ministry to RVUNL, Sudiep Shrivastava appellant filed an appeal (No. 73 of 2012) before the National Green Tribunal (NGT) Principal Bench Delhi. The NGT pronounced its judgement on 24.03.2014 and remanded the MoEF&CC with direction to seek advice of the FAC within reasonable time and emphasised for answer to the following questions:

1. *What type of flora and fauna in terms of biodiversity and forest cover existed as on the date of the proposal in PEKB coal blocks*
2. *Is /was the PEKB coal block habitat to endemic or endangered species of flora and fauna*
3. *Whether the migratory route /corridor of any wild animal particularly elephant passes through the area*
4. *Whether the area of PEKB block has that significant conservation /protection value so much so that the area cannot be compromised for coal mining with appropriate conservation /management strategies*
5. *What is their opinion about opening the PEKB coal block for mining as per sequential mining and reclamation methods proposed for regeneration of the flora.*
6. *What is their opinion about the Wildlife Management plan finally prescribed?*
7. *What conditions and restriction do they propose on the mining in question, if they favour such mining?*

Subsequently, the NGT directed the FAC, MoEF&CC to seek advice/ opinion/ specialised knowledge from authoritative sources such as Indian Council of Forestry Research and Education (ICFRE) or Wildlife Institute of India (WII).

Aggrieved by the NGT order, M/s. RVUNL approached the Hon'ble Supreme Court and filed Civil Appeal No. 4395 of 2014 and the Supreme Court has stayed the order of the NGT to the extent that all works commenced by the respondent/ project proponent and the Chhattisgarh State under section 2 of the FC Act, 1980, except the work of conservation of existing flora and fauna, shall stand suspended till further order passed by MoEF&CC in accordance with law for Parsa East & Kanta Basan (PEKB) coal block.

The FAC meeting held on 30.8.2017 directed the Regional Office, MoEF&CC to inspect the PEKB coal block and adjoining area sought for prospecting, in which the user agency is mining in line with the NGT and Hon'ble Supreme Court order (Appeal No 4395 of 2014). Subsequently, the FAC after thorough deliberations and discussion during the meeting held on 26.10.2017 with the user agency, the Nodal officer of the Chhattisgarh State Government and the Regional Office, MoEF&CC Nagpur, recommended in-principal approval for prospecting of coal in Kente Extension Coal Block (KECB) forest area over 1745.883 ha under the section of FC Act 1980 with general and specific conditions that include a biodiversity assessment study to be conducted by the State government through Indian Council of Forestry Research and Education (ICFRE), Dehradun in consultation with Wildlife Institute (WII) for the whole Hasdeo-Arand Coalfield comprising of Tara, Parsa, Parsa East, Kente *vide* F. No 8-46/2017-FC dated 19.12.2017.

Accordingly, the Additional Principal Chief Conservator of Forests (APCCF) (Land Management) and Nodal Officer, Forest Conservation (FC), State Forest Department, Government of Chhattisgarh, Raipur approached the ICFRE *vide* letter क्र./भू–प्रबंध/खनिज/331-228/15 dated 02.01.2018 and *e-mail* dated 03.01.2018 for conducting the above said study in the whole Hasdeo-Arand Coalfield (HAC) comprising of 23 coal blocks that include Tara, Parsa, Parsa East & Kanta Basan and Kente Extension coal blocks. The ICFRE approached WII, Dehradun *vide* letter No. 1-23/2006-ADG(EM) EOI/ICFRE-Vol-II dated 23.01.2018 for a proposal to undertake the studies as directed by the NGT and MoEF&CC. The Dean, Faculty of Wildlife Sciences, WII, Dehradun *vide* letter No. WII/ESM/BP/Chhattisgarh Assessment dated 20.04.2018 submitted the proposal and revised proposal *vide e-mail* dated 07.07.2018. Subsequently, ICFRE submitted the consolidated proposal to APCCF (Land Management) and Nodal Officer, Forest Conservation (FC), Chhattisgarh *vide* letter No.14/1-23/2006-ADG (EM).EoI/ICFRE- Vol-II dated 12.07.2018. Based on the approved Terms of Reference, the Government of Chhattisgarh awarded the study to the ICFRE Dehradun *vide* letter क्र./भू–प्रबंध/खनिज/331-228/374 dated 29.01.2019 and released the first instalment *vide* letter क्र./भू–प्रबंध/खनिज/331-228/890 dated 05.04.2019 for commencement of the study.

T/C

ES 2. SCOPE OF THE STUDY

The scope of the study is to assess the floral and faunal biodiversity of the entire Hasdeo-Arand Coalfield (**1879.6 sq.km**) comprising of 23 coal blocks that include Tara, Parsa, Parsa East & Kanta Basan (PEKB) and Kente Extension (as on the study period 2019-2020) to identify the potential impacts of mining on flora and fauna, to prepare outline for Biodiversity conservation and management plan; to suggest conservation area and mitigation measures for management of the impacts arising out of mining on forest land.

ES 2.1 Objective

1. To conduct comprehensive survey for primary baseline data collection on flora and fauna *viz*., terrestrial/ wildlife/ avian/ aquatic with special reference to endemic/threatened species, habitat description and ecology. Also, to collect information from secondary sources on:
   - Avifauna studies to assess the likely impacts due to mining activities and to suggest measure for maintaining alternate habitats/home for avifauna including design of artificially made eco-friendly nests.
   - Provide details of Forest cover, migratory routes/corridor of wild animals particularly for elephant within the study area, if any;
   - Assess the socio-economic *vis-a-vis* biodiversity values of the study area.
2. Assess the potential impacts due to on-going and proposed mining and allied activities on biodiversity and suggested mitigation measures to protect/conserve biodiversity.
3. Delineate conservation area.
4. Prepare outline for Integrated Biodiversity and Wildlife Management Plan for wildlife with budgetary provision.
5. Study the efficacy of the mine closure plan, transplanted trees, conservation measure and regeneration proposed in the operational (as envisaged in EC/FC and NGT compliance) / upcoming coal blocks and recommendations, if any.
6. Suggest and highlight measures for conservation of important resources to avoid perceived impacts; and to recommend modifications (if feasible & practical) in specific project activities/ components/ technologies for conservation of the resources.

ES 3. STUDY PERIOD

The study period was eighteen months that include twelve months for three season comprehensive data collection and six months for report writing. The field survey was initiated during May 2019 and the final data collection along with residual data for floral, aquatic diversity; efficacy of mine closure plan & tree translocation and terrestrial faunal aspects including the camera trap was scheduled to be completed in April 2020. However, due to COVID -19 pandemic and country wide lockdown the field visit could not be conducted as scheduled and the same was intimated to the

APCCF (Land Management) and Nodal Officer, Forest Conservation (FC), State Forest Department, Government of Chhattisgarh, Raipur *vide* letter F.No.1-98/2019–ADG(EM)/BAS/RVUNL/Surguja-CH/ICFRE dated 28.08.2020 for rescheduling the field work once the lockdown is over. Subsequently, ICFRE received the reply *vide* letter No. क्र./भू–प्रबंध/खनिज/331-228/1924 dated 28.10.2020 emphasising the importance of comprehensive and complete baseline data. Also, ICFRE intimated the progress of the study to MoEF&CC, GoI *vide* letter No. 1-98/2019-ADG(EM)BAS/RVUNL/Surguja-CH/ICFRE dated 02.09.2020 in response to their letter No. F.No.8-3G/2018FC dated 30.08.2020. The survey was resumed in the month of October 2020 and continued upto February 2021.

ES 4. STUDY AREA

The study area is the whole/entire Hasdeo-Arand Coalfield (HAC) comprising of 23 coal blocks that include coal blocks such as Tara, Parsa, Parsa East & Kanta Basan (PEKB) and Kente Extension (CMPDI, 2012). The area lies between 22°56'37.397" and 22°24'18.359" N latitudes and 82°22'41.579" to 83°8'53.875" E longitudes. The HAC fall partly in Udaipur tehsil of Surguja district; Premnagar tehsil of Surajpur district; and Poudi Uproda and Korba tehsils of Korba district in Chhattisgarh State. The area under forest in HAC falls in Udaipur, Laxmanpur and Mainpat Forest Ranges of South Surguja Forest Division; Lemru, Balco, Korba, Kudmora, Pasarkhet Forest Ranges of Korba Forest Division; Kendai, Atmanagar Forest Ranges of Katghora Forest Division and Ramanujganj nagar Forest Range of Surajpur Forest Division (Figure ES.1).

ES 4.1 Hasdeo-Arand Coalfield and the Coal Mine Blocks

The area under Hasdeo-Arand Coalfield comprises of 1879.6 sq.km and a total of twenty three (23) coal blocks (Based on the CMPDI information published in their website https://www.cmpdi.co.in/OCBIS/dashboard.php & shape files provided by Rajasthan Rajya Vidhyut Utpadan Limited) including the coal blocks such as Tara, Parsa, Parsa East & Kanta Basan and Kente extension were considered for the study (Table ES.1 & Figure ES.1). These coal blocks were considered for the study in consultation with the State Nodal officer, Chhattisgarh. Out of 23 coal blocks, Parogia, Sarma, Laxmangarh and Kedma are only regionally promotionally explored block (CMPDI, 2021). Two blocks *i.e.*, PEKB (block No.14) and Chotia (block 2A) are in operation. The remaining two blocks *i.e.*, Parsa (13) and Kente Extension (12) are in the process of obtaining necessary clearance. Detailed information on exploration, mining and mine closure activities envisaged are available for only 04 blocks. However, 05 blocks such as Tara, Madanpur (North), Madanpur (South), Paturia and Gidmuri have only geological, mining and mine closure proposals available. And, very limited information is available for 5 coal blocks such as Morga-II, Morga-III, Morga-IV, Morga South & Saidu and no information is available for remaining nine coal blocks (Puta Parogia, Parogia, Pindraki, Sarma, Laxmangarh, Bhakurma-Matringa, Kedma, Morga-I and Nakiya).

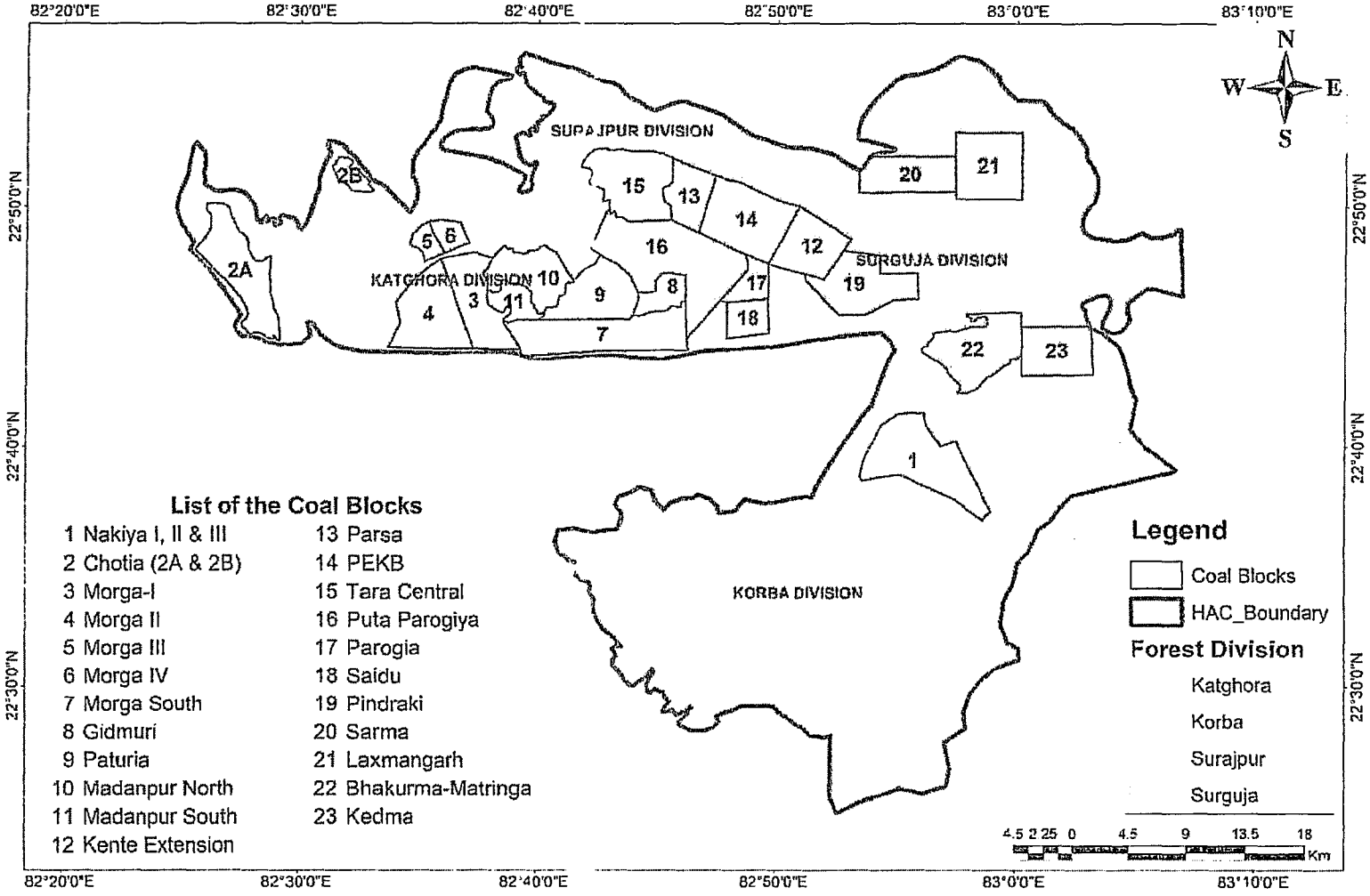


Figure ES.1: Map showing coal blocks in the entire Hasdeo-Arand Coalfield area that falls within Surguja, Surajpur and Korba Districts, Chhattisgarh

Table ES.1: Profiles of the coal block in the entire Hasdeo-Arand Coalfield area that fall within Surguja, Surajpur and Korba Districts of Chhattisgarh

Sl. No.	Name of Coal Block as per coal block allocation rule	Block No.	District	Latitude	Longitude	Allotment status	Extent sq.km.	Geological Reserves in MT	Remarks/Status
Allotted									
1	Parsa East Kanta Basan - CMSP (OC)	14	Surguja	22°47'38.02"N to 22°51'16.65"N	82°49'39.01"E to 82°47'23.51"E	Allotted to M/s. Rajasthan Rajya Vidyut Utpadan Nigam Limited	26.83	532.86	Mine is in operation in the I[st] Phase
2	Parsa-CMSP (OC)	13	Surguja & Surajpur	22°48'56.76"N to 22°52'00.66"N	82°46'41.08"E to 82°45'35.84"E		12.52	256.40	EC awaited
3	Kente Extension- MMDR (OC)	12	Surguja	22°47'00.72"N to 22°50'01.14"N	82°51'59.32"E to 82°50'58.41"E		17.60	369.22	TOR accorded
4	Chotia - Sub block-2A – CMSP (OC/UG)	02	Korba	22°50'08.23"N to 22°44'24.40"N	82°26'10.87"E to 82°29'10.75"E	Allotted to M/s. Bharat Aluminium Company Ltd. (BALCO) (Vedanta Group).	8.63	29.187	The ML has 2 sub blocks. Sub block 2A is under Fly ash dumping & backfilling; Sub block 2B is in operation
	Chotia-Sub block-2B			22°52'03.70"N to 22°50'35.42"N	82°31'37.96"E to 82°32'47.17"E		3.17	10.832	
Identified									
5	Tara-CMSP (OC)	15	Surajpur	22°49'25.44"N to 22°52'25.87"N	82°45'21.34"E to 82°42'48.95"E	Identified	24.00	317.33	Block initially allotted to CMDC
6	Madanpur North-CMSP (OC/UG)	10	Surajpur & Korba	22°45'34.81"N to 22°48'23.62"N	82°40'16.79"E to 82°38'36.67"E	Identified	21.39	213.46	Unallocated
7	Madanpur South-CMSP (OC)	11	Korba	22°45'11.15"N to 22°46'58.97"N	82°38'48.11"E to 82°38'32.10"E	Identified	7.14	169.83	APMDC Ltd.
8	Gidmuri-CMSP (OC/UG)	08	Korba	22°45'29.56"N to 22°47'14.87"N	82°44'16.63"E to 82°45'10.66"E	Identified	7.33	80.27	Chhattisgarh State Power generation Co. Ltd.
9	Paturia-CMSP (OC/UG)	09	Korba	22°45'21.64"N to 22°48'00.56"N	82°43'50.93"E to 82°42'37.53"E	Identified	16.14	269.25	NA
10	Morga– II-CMSP	04	Korba	22°47'48.78"N to 22°44'05.68"N	82°35'52.05"E to 82°37'19.42"E	Identified	26.64	350.70	NA
11	Morga– III-CMSP	05	Korba	22°47'42.56"N to 22°49'21.71"N	82°35'10.69"E to 82°35'22.65"E	Identified	6.00	36.00	M.P state Mining Corp. Ltd.,
12	Morga– IV-CMSP	06	Korba	22°48'05.06"N to 22°49'28.05"N	82°36'04.17"E to 82°35'53.02"E	Identified	6.87	34.78	M.P state Mining Corp. Ltd.,
13	Morga South-MMDR	07	Korba	22°43'48.13"N to 22°46'07.89"N	82°39'21.49"E to 82°46'10.17"E	Identified	21.92	432.54	Unallocated
14	Saidu-MMDR	18	Surguja & Korba	22°44'33.17"N to 22°46'10.26"N	82°47'54.65"E to 82°49'38.68"E	Identified	6.72	27.49	Identified Geological Report
15	Puta Parogiya-MMDR	16	Surguja, Surajpur & Korba	22°44'30.66"N to 22°49'56.74"N	82°46'12.32"E to 82°42'58.64"E	Identified	48.04*	NA	Identified
16	Parogia#	17	Surguja	22°46'03.96"N to 22°48'02.08"N	82°47'56.01"E to 82°48'40.46"E	Regionally promotionally explored block	7.16*	NA	Regionally promotionally explored block
17	Pindraki -MMDR	19	Surguja	22°45'31.36"N to 22°48'11.95"N	82°53'44.75"E to 82°52'50.52"E	Identified	23.94*	NA	Identified
18	Sarma#	20	Surguja	22°50'38.86"N to 22°52'05.64"N	82°57'28.97"E to 82°53'55.90"E	Regionally promotionally explored block	18.18*	NA	Regionally promotionally explored block
19	Laxmangarh#	21	Surguja	22°50'20.31"N to 22°53'04.94"N	83°00'10.39"E to 82°57'27.55"E	Regionally promotionally	23.64*	NA	Regionally promotionally explored block

Sl. No.	Name of Coal Block as per coal block allocation rule	Block No.	District	Latitude	Longitude	Allotment status	Extent sq.km.	Geological Reserves in MT	Remarks/Status
						explored block			
20	Bhakurma- Matringa- MMDR	22	Surguja	22°42'15.26"N to 22°45'34.39"N	82°57'55.95"E to 82°57'58.66"E	Identified	26.00*	NA	Identified
21	Kedma#	23	Surguja	22°43'01.00"N to 22°45'02.19"N	83°03'12.53"E to 83°00'12.67"E	Regionally promotionally explored block	18.95*	NA	Regionally promotionally explored block
22	Morga-I-CMSP	03	Korba	22°48'06.34"N to 22°44'04.24"N	82°37'21.81"E to 82°39'15.02"E	Identified	21.62*	NA	Identified
23	Nakiya-I, II & III -MMDR	01	Korba	22°36'57.05"N to 22°41'23.19"N	82°58'39.69"E to 82°55'11.75"E	Identified	34.29*	NA	Identified
						Total	**434.72**		

Sources: The shape files provided by RVUNL, extent of area worked out using GIS by ICFRE
CMPDI- OCBIS four mine, regionally promotionally explored blocks, will be included in HAC only after finalization of block boundary
*No documents available and therefore the area of extent was estimated using GIS & RS

ES 5. APPROACH AND METHODOLOGY

The approach adopted include desk review of relevant documents to generate project related information in detail; series of working group meetings with partner institutions and all other relevant stakeholders to work out the modality of collecting information from the field such as defining study area, sampling size and design ; standardization of methodology and to undertake comprehensive field survey, sharing of project related data /documents/ study area shape files and report finalisation.

Consultative meetings with State Forest Department (SFD) and project proponents were conducted to collect relevant detailed information related to the extent of forests falling within each compartment, ranges, divisions, etc., within the HAC, area shape files, location maps, assistance to conduct the field survey and project intervention information. Comprehensive field surveys were conducted for collection of information/ baseline data under respective components such as terrestrial flora & fauna including avifauna and wildlife, aquatic diversity, socio-economic status, mining and mine management, efficacy of mining plan/progressive mine closure plan, translocated tress and all the conservation measures including surface water/afforestation employing standard methodologies. The faunal aspect was collected by team of experts from Wildlife Institute of India. Thematic maps were generated using remote sensing (RS) and geographical information systems (GIS) with the spatial data collected from various authentic sources. Suitable statistical tools were employed for analysis of data, interpretation and preparation of report for the respective component of the study that are presented under various chapters in Volume – I of the report.

ES 6. LIMITATIONS

Based on the available information, the study considered 23 coal blocks (total extent of 472.21 sq.km put together of all the coal blocks under HAC) and 10km buffer for baseline data generation in the study area of Hasdeo-Arand Coalfield comprising of 1879.57 sq.km. Lack of required documents/reports like mining and mine closure plans, EIA/EMP reports (except for PEKB, Parsa, Kente extension and Chotia coal blocks); non-availability of documents/ reports/information for Morga-I, Nakiya, Kedma, Bhakurma-Matringa, Laxmangarh, Sarma, Pindraki, Parogia, Puta Parogia coal blocks, for which only the provisional coal block boundaries are available, were the major constraints to outline the specific impacts. Available secondary sources of information were also considered wherever applicable. In addition, the shape files of the 23 coal blocks in HAC provided by the M/s. RVUNL were used for generating various maps. Therefore, there may be slight variation with the actual coal block boundary details posted by the CMPDI site. The same may be considered carefully in future. The report prepared by the Wildlife Institute of India is enclosed as Volume -II along with this study report (Volume-I) for reference.

ES 7. GENERAL PROFILE OF THE STUDY AREA

ES 7.1 Approach to the study area

National Highway NH-130 passes through the HAC (Tara-Central). The district headquarters of Sarguja (at Ambikapur) and Surajpur are located at about 100 km east and 120 km north respectively whereas that of Korba district is situated at about 50 km south of the PEKB coal block. The nearest Railway station is at Ambikapur and the nearest airport is Swami Vivekananda Airport at Raipur. The State Capital is situated at about 300 km away from the PEKB coalfield.

ES 7.2 Land use Land cover change

The Land Use Land Cover changes (LULC) were estimated using NRSC-ISRO digital data for the year 2011-12 and 2015-16. The entire Hasdeo-Arand Coalfield (1879.6 sq.km) falls under the LULC class (2015-16) such as forests (1526.49 sq.km; 81.20%); agriculture (179.53 sq.km; 9.55%), wasteland (129.45 sq.km; 6.89 %); water bodies (29.97 sq.km; 1.59%) and the built-up area 14.33 sq.km (0.76%).

ES 7.3 River and Drainage

The river basin and drainage map of the study area were prepared using geo-rectification of Survey of India (SOI) topographic sheets as base map using Arch GIS software (version 10.1) and Carto DEM of NRSC (ISRO). It is primarily drained by the Hasdeo River, a tributary of Mahanadi River sub-basin running N-S of the HAC; and Rihand River a tributary of Sone River sub-basin (part of Lower Ganga River basin) running S-N of the HAC. The Hasdeo-Bango Dam, a multipurpose reservoir is built across the Hasdeo River, is the prominent water harvesting structure in the area. Several water courses of up to 6^{th} order leading to the reservoir take origin in the surrounding hillock where mining is active and identified.

ES 7.4 Topography and climate

The topography of HAC is highly rugged dissected by deep gorges ranging from 450 to 550 m above msl in the southern part. Physio-graphically /Geographically, Chhattisgarh state is divided into three distinct land areas/three distinct zones *viz.*, 1. Chhattisgarh Plains, 2. Bastar Plateau and 3. Northern Hill Zones. The study area of HAC falls under northern hill region that occupies parts of Surguja, Surajpur and northern part of Korba, districts. The elevation zone from 410-418 m amsl occupies a maximum area 597.60 km^2 (31.01 %) where maximum coal blocks are reported to lie in this elevation zone. The study area experiences tropical to semi-tropical climate with three well defined seasons *i.e.* summer (March to June), monsoon (mid-June to September) and winter (mid-September to February). The entire HAC area falls within the *Zone-7 Eastern plateau and Northern hills region* agro-climatic zone therefore, **the HAC falls under single environmental unit.**

ES 7.5 Soil

The soils in the HAC area are generally of clay loam with sandy loam soil in some areas. The soils developed on moderately steep slopes are marked by severe erosion. The soils have been classified as Ustocherpts/ Ustorthents/ Rhodustalfs/ Haplustalfs/ Haplusterts as per pedological taxonomy. Soils in the Hasdeo River basin are mostly composed of residual soils and the predominant soil type in the basin is fine loamy (55.2%) soil. The area is more prone to soil erosion and gully erosion is one of the prominent physiographic features in most part of the areas.

Considering the importance of soil microorganism that play a key role in nutrient cycling, litter decomposition and maintenance of ecosystem function, the status of different beneficial microbial populations (*viz.*, Bacteria, Fungi, Actinobacteria and symbiotic group of fungi-Mycorrhizal fungi) within the study area were assessed by ICFRE following standard methodologies. In the present investigation, 24 AM fungi belonging to four genera *viz.*, *Acaulospora*, *Gigaspora*, *Glomus* and *Scutellospora* were recorded. The genus *Glomus* spp., was the most abundant AM fungus; and a total of fourteen different Ectomycorrhizal (ECM) fungi (Mushrooms) belong to nine genera such as *Amanita, Astraeus, Boletus, Boletellus, Lycoperdon, Russula, Sclerodrama, Suillus* and *Tuber* was recorded. Other beneficial microbes recorded include *Actinobacteria, Azospirillum, Azotobacter* and Phosphate Solubilizing Bacteria.

ES 7.6 Geology

Geologically, the HAC falls in the south-eastern region of the Chottanagpur plateau and is surrounded all sides by Gondwana litho-units comprise of Talchirs, Barakars, and Kamthi Formations except in the east by Archean rocks. It is a part of Son-Mahanadi master Gondwana basin and has a prominent fault along the major part of its southern periphery bringing Talchair formation and Precambrian rocks in juxtaposition with Barakars, while towards north the coal measures rest conformably on the Talchir sediments.

ES 7.7 Coal Resources

The coal deposits/resources in India are primarily concentrated in the Gondwan sediments occurring mainly in the eastern and central parts of Peninsular India. The total coal resource of India is reported to be 326495 million tons as on 1st April 2019; of which about 59908 million tons (18%) occur in the state of Chhattisgarh, which is the third highest resources base in India followed by that of Jharkhand and Odisha.

- The HAC in Chhattisgarh has third highest coal resources (5529 million tons) that accounts for 9% of total coal reserves of the state next to Mand-Raigarh and Korba coal fields that consists of 530 sq.km area of which 51.25% (271.67 sq.km) has been leased in Korba Coal fields that include 62% of coal bearing area (168 sq. km) for underground mining.

ES 8. PROFILE OF THE COAL BLOCKS

- Details of coal blocks such as mining methods, environmental monitoring, conservation measures, *etc.*, of the 23 coal blocks including that of Parsa East and Kanta Basan (PEKB) and Chotia 2A & 2B including the best practices carried out and gaps identified are provided in detail in the Chapter 3 of the study report Volume-I. However, a general description of the profile of coal blocks is detailed in this Executive summary under sections ES.4.1 and Table ES.1.
- In HAC, four coal blocks *viz.*, Parsa East & Kanta Basan (PEKB), Parsa, Kente Extension and Chotia (2A & 2B) are allotted, of which two *viz.*, PEKB and Chotia are in operation and the other two are in the process of obtaining statutory clearances. These four-coal blocks put together covers an area of 68.75 sq.km *i.e.*, about 4% of HAC coal bearing area having 1198 million tons of coal resources.

ES 9. BIOLOGICAL PROFILE OF THE ENTIRE HASDEO-ARAND COALFIELD AND 23 COAL BLOCKS

The following section highlights the findings on terrestrial flora, fauna (wildlife) and avifauna, aquatic diversity and socio-economic *vis-à-vis* biodiversity values for the entire Hasdeo-Arand Coalfield (HAC) comprising of 23 coal blocks and the perceived impacts as outlined in the ToR. The HAC falls primarily under Deccan bio-geographical area, which is characterized by both tropical dry deciduous and tropical moist deciduous forests (Champion & Seth, 1968) with large area under tropical moist deciduous forests, where the tree canopy is not dense and comprises of few species.

ES 9.1 Characterisation of Forest Cover and Forest Types

Characterisation of the entire forest cover class and forest types in HAC and in 23 coal blocks were made using FSI (2017) and FSI (2011) digital data respectively.

Table ES.2: The forest cover classes and their extent in the entire Hasdeo- Arand Coalfield that falls in Korba, Surguja and Surajpur Districts of Chhattisgarh

Forest Cover Class	Entire HAC Area (Sq.km)	23 coal blocks Area (Sq.km)	Relative occupancy (%)
Water body	12.69	0.66	5.20%
Scrub	33.52	11.21	33.44%
Very Dense Forest	126.72	69.18	54.59%
Open Forest	197.57	52.65	26.65%
Non-Forest	351.05	104.16	29.67%
Moderate Dense Forest	1158.04	233.40	20.15%
Total	**1879.58**	**472.13**	**25.12%**
Source: Estimated using 2015 digital format (FSI, 2017)			

The study area (both whole HAC & 23 coal blocks) is comprised of six forest cover classes. The forest types in HAC are characterised by tropical moist deciduous forests comprises of five forest types (Table ES.2 – ES.3).

Table ES.3: Forest types and their extent within Hasdeo-Arand Coalfield that falls within Korba, Surguja and Surajpur districts of Chhattisgarh

Forest Type	Area (sq.km) HAC	23 coal blocks area (sq.km)	Relative occupancy (%)
3C/C2e (ii) Moist Peninsular Low-Level Sal Forest	835.61	198.01	23.70%
3B/C2 Southern Moist Mixed Deciduous Forest	314.53	105.71	33.61%
5B/C1c Dry Peninsular Sal Forest	70.22	16.94	24.12%
5/E9 Dry Bamboo Brakes	133.98	7.13	5.132%
5B/C2 Northern Dry Mixed Deciduous Forest	46.61	08.82	18.92%
Total	**1400.95**	**336.61**	**24.03%**
Non-Forest	464.23	133.79	25.22%
Total	**1865.19**	**470.40**	**23.70%**
Plantation/ TOF	0.03	-	-
Water	14.35	1.69	11.78%
Total	**1879.57**	**472.09**	**25.12%**
Source: Estimated using 2011 digital format			

The forest cover observed significant area under moderately dense forests followed by very dense forests. The Moderately Dense forest observed lowest 2.06 sq.km in Morga-III (2.06 sq.km) and highest in Nakiya (21.48 sq.km); and Very Dense forest in 15 coal blocks ranging from 0.04 sq.km in Laxmangarh to 16.88 sq.km in Tara. The relative occupancy area of forest cover and forest type in all the 23 coal blocks comprises of 472.13 sq.km and 336.61 sq.km respectively.

Out of the five-forest types observed in HAC, two-forest types *ie.*, 3B/C2e(ii) Moist Peninsular low-level Sal forest occupied the maximum (192.11 sq.km) area in all 23 coal blocks that accounted for 23 % of the entire HAC (835.40 sq.km); followed by 3B/C2 Southern Moist Mixed Deciduous forest (104.38 sq.km) which accounted for 33% of the total forest type in HAC (314.46 sq.km).

A total of 640 plant species belonging to 400 genera, 109 families were recorded from the entire HAC (Table ES.4). The vegetation was dominated by Poaceae family with 72 species followed by Fabaceae (64 species), Rubiaceae (31 species) and Asteraceae (27 species). Thirty-eight families were represented by single species each. Out of the total plant species, 146 species were trees, 363 herbs including grasses and ferns, 66 shrubs, 48 climbing shrubs and 17 woody climbers. Sal was the dominant tree species in the core and buffer areas of entire HAC. The vegetation composition is dominated with five families namely Poaceae, Fabaceae, Rubiaceae, Euphorbiacea and Asteraceae in HAC.

Table ES.4: Composition of vegetation within Hasdeo-Arand Coalfield comprising of 23 coal blocks that fall within Korba, Surguja and Surajpur districts of Chhattisgarh

Floral Diversity		Resources	
No. of species	640	Medicinal plants	128
No. Genera	400	Timber yielding plants	40
No. families	109	Edible plants	60
No. of Invasive species	9	Fodder plants	65
No. of threatened (RET) species	33	Fuel wood species	75
		Commercial	59

ES 9.1.1 Stand density

A comparative account on the stand density of trees and herbs in and around the coal blocks in HAC were recorded to understand the variation which is attributed to the site quality and climatic conditions. Distribution across different girth classes indicates the occupancy of a site.

- The stand density of trees in the core zone of four contiguous coal blocks (Tara (15), Parsa (13), PEKB (14) & Kente-Extension (12) was low (424 stems/ha) as compared to the respective buffer zone (535.71 stems /ha). This could be due to selective removal of lower girth-class individuals of all tree species within the core zone; while that of the remaining 19 coal blocks in HAC varied between 599.46 stem/ha and 910.55 stem/ha respectively in the core are buffer zones. The difference between core and buffer zone could be attributed to distribution pattern or occurrence of very dense forest in few coal blocks and moderately dense forest in many coal blocks and fringe forest villages.
- The density of shrubs in general found to be low in buffer of all the 19 coal blocks (1966 stems /ha) and around the four-coal blocks (1217 stem/ha). This is perhaps due to removal of vegetation for NTFP collection such as Mahua flowers, Tendu leaves, fuel wood, etc., in around the forest fringe villages (142 revenue villages in the fringe forests). In addition, frequent spontaneous forest fire used to occur in the area, and also the post monsoon vegetation survey was made immediately after the forest fire in some of the sampled areas.

Locations	Stand density (stems/ ha)	Stand basal area (m^2/ha)	Mean Basal area/ plant (m^2)
Core of 4 coal blocks	424.0	21.87	0.052
Buffer of 4 coal blocks	535.7	13.98	0.026
Core of all coal blocks	599.5	19.92	0.033
Buffer of all coal blocks & HAC	910.6	28.87	0.032

Shorea robusta was observed dominant tree species with highest IVI values in all the four category of sampling locations followed by *Diospyros melanoxylon*, *Madhuca*

longifolia var. *latifolia, Buchanania lanzan, Lagerstroemia parviflora, Terminalia elliptica* and *Anogeissus latifolia.*

- Among shrubs, *Phoenix loureirii* was the dominant species common to all blocks and their buffer areas followed by *Ichnocarpus frutescens* and *Hemidesmus indicus.*
- Among herbs, *Elephantopus scaber* was the dominant species common to all coal blocks and their buffer areas followed by *Rungia pectinata. Evolvulus nummularius, Sida cordata, Rungia pectinata, Desmodium triflorum* and *Phyllanthus urenaria.*
- In case of HAC and in all coal blocks locations S*horea robusta* was the dominant tree with highest IVI values (ranging from 87.80 to 120.06). *Diospyros melanoxylon* showed second highest values except in buffer areas of the four contiguous coal blocks.
- The diversity of trees and shrubs (represented by *H'*) ranged from 1.87 to 2.68 and from 1.67 to 2.87 respectively indicating that the area is medium diverse.
- Herbs recorded high diversity i.e., ranged from 3.83 to 4.10.
- In summary, the four contiguous coal blocks (Tara (15), Parsa(13), PEKB(14) & Kente-Extension(12) recorded less plant diversity in both core and buffer areas (Fig 10.9 &10.10), it could be due to the selective removal and impacts of open cast mining and allied activities being carried out in PEKB (15). The comparative account on the diversity index in and around the coal blocks and Hasdeo-Arand coalfield area is presented below:

Life forms	Coal Blocks	H'	λ	E
Trees	Core of 4 Coal blocks	2.28	0.17	0.66
	Buffer of 4 Coal blocks	1.87	0.21	0.65
	Core of all other coal blocks	2.40	0.17	0.63
	Buffer of all other coal blocks	2.68	0.12	0.66
Shrubs	Core of 4 Coal blocks	1.67	0.33	0.62
	Buffer of 4 Coal blocks	1.8	0.25	0.72
	Core of all other coal blocks	2.87	0.08	0.63
	Buffer of all other coal blocks	2.56	0.12	0.68
Herbs	Core of 4 Coal blocks	2.10	0.19	0.66
	Buffer of 4 Coal blocks	3.83	0.04	0.79
	Core of all other coal blocks	3.99	0.03	0.78
	Buffer of all other coal blocks	4.10	0.03	0.79
H'=Shannon Weiner index; λ=Simpson index; E=Buza and Gibson's evenness index				

ES 9.1.2 Rare Endangered Threatened and Invasive species

The HAC is very important in terms of its phytogeography and occurrence of **33** Rare, Endangered and Threatened (RET) plant species recorded both from core and buffer areas of coal blocks (Annexure 4.10, Plate 4.5). No detailed inventory is available or undertaken in the past. Based on the survey the significant occurrence of RET both in core and buffer zone indicates the nice and amplitude of RET species in HAC.

TIC

A total of nine invasive and weedy plant species having high potential to produce numerous propagules were recorded from the entire HAC region/study area, (**Ref Table 4.11 of Chapter-4**) having high potential to produce numerous propagules.

Sl. No	Name of the Plant species
1	*Ageratum conyzoides* L.
2	*Argemonemexicana* L.
3	*Chromolaena odorata* (L.) King & Robins
4	*Hyptissuaveolens* (L.) Poit.
5	*Ipomoea carnea*Jacq.
6	*Lantana camara* L.
7	*Parthenium hysterophorus* L.
8	*Pennisetum pedicillatum*Trin.
9	*Xanthium strumarium* L.

ES 9.1.3 Likely impacts on forest and flora

Out of the total coal bearing area in HAC, 1502 sq.km falls in the forest, which is reported to be the largest un-fragmented forests in Central India consisting of pristine Sal (*Shorea robusta*) and teak forests outside the official protected area system which is an important corridor for movement of flagship species like elephants and tigers in Chhattisgarh. Mining related land use changes will have negative impact on forest cover/density, forest type, forest fragmentation. In addition, forest fragmentation will contribute to decreased patch/corridor connectivity, increased edge effect, change in micro climate and promote invasive species if not taken adequate mitigation measures.

ES 9.2 Terrestrial and Avi Faunal Diveristy

- A total of 25 mammalian vertebrates were recorded in and around the Parsa, Parsa East & Kanta Basan (PEKB), Kente Extension and Tara coal blocks. Among the mammal species recorded in the HAC, **nine species are listed in the Schedule – I.**

Wildlife (Protection) Act, 1972	IUCN Red list
Schedule-I = 9 species	Endangered=2
Schedule-II = 10 species	Vulnerable=5
Schedule-III = 4 species	Near Threatened=3
Schedule-IV = 2 species	Threatened=15

- SDM model were developed to assess the distribution probabilities of mammalian species occurrence using camera trap and sign survey for each functional guild of large carnivore, meso-carnivore, ungulates and overall species richness suggested relatively high habitat-use in the Tara, Parsa, PEKB and Kente Extension coal blocks, in the surrounding for meso-carnivores; and in the vicinity of the villages.
- A total of 92 species of birds belonging to 44 families were recorded of which six species are protected under the schedule I of Indian Wildlife (Protection)

Act, 1972 and 19 species range restricted to the only Indian subcontinent. A total of 74 resident; 4 summer migrants; 14 winter migrants; 12 endemics to Indian subcontinent. This represents the importance of the landscape in providing the suitable habitat to these critical species. All the coal blocks, particularly the Morga II, Saidu and Pindraki and the surrounding habitats support high species richness and diversity of birds. Among the winter migrants' species, many are insectivores and probably migrated from the Himalayas to avoid harsh cold winter.

- The entire HAC landscape comprise of 649 forest compartments spread over 12 forest ranges in 4 forest divisions. As reported by the State Forest Department, the elephant occurrence is recorded in 148 out of 647 compartments during 2018-2020 in all the 12 forest ranges.
- Wildlife Institute of India (WII) in collaboration with Chhattisgarh Forest Department have established that, the elephants have large home ranges. A conservative estimate revealed that about 40 to 50 elephants use HAC and the surrounding landscape at different times of the year as the habitat use by elephants is not limited to any specific area, but is spread across the entire landscape. In addition, home range polygons of some of the elephants that were monitored using satellite collars also fall within the landscape.
- Chhattisgarh human-elephant conflict (HEC) situation is relatively low in number (<300, which is <1% of India's wild elephant population), but significant levels of HEC with over 60 human lives are lost every year due to conflict (>15% of the reported human deaths due to HEC) from HAC. In addition to loss of human lives, crop loss and damage to property due to HEC are severe.
- There is continuous dispersal of elephant herds from the neighbouring states of Jharkhand and Odisha. The forests that elephants currently occur are highly fragmented and degraded due to incompatible land-use resulting in reduced home range of good quality therefore the home range in HAC is large and scattered.
- The forest department at Korba Forest Division has recorded tiger presence in a few locations within Hasdeo-Arand area. *Circuitscape* models to establish habitat connectivity of tiger between Kanha-Boramdeo-Achanakmar (KBA) and HAC landscape recorded a higher conductance values indicating a strong connectivity.

ES 9.2.1 Likely impacts on terrestrial and avi fauna

Major disturbances to habitats such as that in the case of mining will not only cause habitat loss and fragmentation (as understood generally), but can affect avi faunal habitat, wild fauna including large mammals and individual herd's home ranges. Such disturbances can lead to abandonment of habitats as threats to home ranges have a threshold limits.. Infrastructure development and mining will have negative impact on quality habitat avaible due to fragmentation and mitigation will be a huge challenge.

The effect of mining on elephant habitat may not reflect in the same habitat, but could be a silent trigger for Human Elephat Conflict (HEC) in some other area within the landscape.

ES 9.3 Drainage Pattern and Aquatic Diversity

ES 9.3.1 Drainage and location of the coal blocks

The study area of HAC and its 10 km buffer falls under eleven watersheds *viz.*, Gej, Jhink, Bamni, Anjan, Ton, Teti, Chornai, Hasdeo, Mand, Chuiya and Rehar. While, all the watersheds are part of the Hasdeo drainages that contribute to the Mahanadi River, Rihar watershed forms part of the lower Ganga River basin. Of all the watersheds falling within the Mahanadi River sub-basin, mainly four *viz.*, Bamni-Anjan, Ton-Teti, Gej-Jhink and Chornai are contributing to the flow in the Hasedo River and the Hasdeo-Bango Reservoir. The Chornai watershed spreads across almost half the area of HAC and the Chornai Nadi is an important and the largest drainage system that occupies nearly one fourth of the HAC.

The Atem Nadi falls within the Gej-Jhink watershed and is joined by two streams *viz.*, ***Salhi Nala*** and ***Garjan Nala***. The area under both the streams together forms the core and buffer zone of the four coal blocks *viz.*, Tara-Central (15), Parsa (13), PEKB (14) and Kente Extension (12), of which the PEKB (No. 14) is active/ operating coal mine. Overall, these coal blocks area forms part of the Atem River system, which runs towards north from the HAC and joins the Hasdeo River at north.

- **Salhi Nala** – The area drained by Salhi Nala forms part of the core and buffer of the Parsa (13), PEKB (14) & Tara (15) coal blocks, of which PEKB is tne only active/ operating mine. Salhi Nala and its primary feeder streams drains the core/buffer area of the PEKB coal block (14). The Salhi Nala joins the Atem Nadi at Shivnagar.

Before the PEKB (14) coal block came into operation, the Salhi Nala drained the area upto Kete, Basen, Ghatbarra, *etc.* Presently, the open cast coal mining and related land use land cover changes in the core/buffer area of the PEKB is observed to have signficant ***influence on the Atem Nadi mainly through the Salhi Nala .***

- Besides PEKB (14), the core/buffer area of Sarma (20) and Laxmangarh (21) coal blocks is also drained by the Salhi Nala at its origin. Overall, the Salhi Nala is most likely to be infleunecd by the **Kente Extension (12), Parsa (13), Tara (15), Sarma (20) and Laxmangarh (21)** coal blocks, in addition to the active coal block i.e., PEKB .

Chornai Nadi: It is an important sixth order drainage systems that spreads across almost half the area of the entire HAC . It is fed by two fifth order streams (i) the **Chornai Nala** (ii) the **Rapta Nala (Lemru).**

- **Chornai Nala:** This stream drains the area falling under the influence zone of 12 coal blocks Nos. 7-9, 12-19 and 21 *viz.*, **Morga South (7), Gidmuri (8), Paturia (9) Kente Extension (12), Parsa (13), PEKB (14), Tara-Central (15), Puta Parogia (16), Parogia (17), Saidu (18), Pindraki (19),** and **Laxmangarh (21),** of which the coal blocks such as Kente Exension (12) , Parsa (13) PEKB (14) and Tara (15) are either active/ advaned stage according statutaory process /ToR approved.

Rapta Nadi (Lemru): The network of streams of Rapta Nadi together with Chornai Nala form one of the major drainage systems that originate and occupies nearly one fourth of the HAC. The main portion of the stream is formed by two fourth order streams - the **Gandher Nala** and **Rapta Nala**. Another fourth order stream joins the main water course of the Rapta Nadi on the left bank downstream near Kuturuwan. The Rapta Nadi, at its origin, drains the area under the coal blocks of **Nakiya-1** (I, II & III).

- **Both Gandher Nala and Rapta Nala with its** stream networks namely Lamti Nala and Bimalta Nala drains the core/buffer areas of the Coal Block **Nakiya-1 (I, II & III).** The are under these stream networks are characterized by rugged mountainous terrain having deep cut valleys and relatively dense mountainous/ riparian forest.
- **Rehar River** originates near the villages Bhakurma and Kedma, **where the proposed two coal blocks Bhakurma-Matringa (22) and Kedma (23) is located.** Two out of the three important tertiary feeder streams (Barka Nala & Balu Nala) of the river drain the core zone of the coal blocks 22 & 23. In addition to these two coal blocks, nearly half of the area of the coal block No. 21 (Laxmangarh) is drained by one of the secondary streams that join the River near Udaipur.

The streams under **Ton-Teti watershed/** other smaller streams *viz.*, **Bisrar Nala/ Dhajag Nala/ Bamni-Manasi Nala/ Maniari Nala** drain the areas that form the core/buffer of as many as nine proposed coal blocks *viz.*, **Morga-I (3) Morga-II (4), Morga-III (5), Morga-IV (6), Morga South (7), Paturia (9), Madanpur north (10), Madanpur south (11) and Puta Parogia (16)** . These streams directly drain into the Hasdeo River at the upstream of the Hasdo-Bango reservoir. The lower reaches of these streams particularly the surrounding area of Dhajag/Manasi Nala are occupied relatively **undisturbed dense forest cover.**

- In general, the physico-chemical water quality parameters of the streams varied within their expected natural ranges characteristic to the general features of the study area. Among the parameters studied, comparatively higher values were recorded for pH, Conductivity and TDS during winter compared to that of the post-monsoon. The surface water temperature varied according to both diurnal and seasonal changes in solar radiation.

T/C

- The assessment of community (Biotic) metrics of the aquatic macroinvertebrates, one of the most prominent indicator organisms of water quality of freshwater streams, in different stream networks revealed a total of 9924 individuals of macro-invertebrates belonging to 04 phyla (Platyhelminthes, Annelida, Arthropoda and Mollusca), 06 classes (Rhabditophora, Clitellata, Insecta, Malacostraca, Gastropoda and Bivalvia), 19 orders and 61 families.
- The insect taxa constitute the most dominant taxonomic group in macro-invertebrate assemblages of the entire sampling location with a relative abundance of 86.82% and a total richness of 45 families. The Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) with Odonata (*EPT/O*) taxa accounted for nearly half (52.61%) of the abundance of all taxa. The relative abundance of *EPT/O* were high in both Chornai Nadi-Left bank (71.96%) and right bank streams (71.67%) compared to that of all other stream networks sampled, including the Atem Nadi and Salhi-Garjan Nala, where active mining is being undertaken.
- The probable biological water quality of the sampling locations, based on different biotic indices employing aquatic macroinvertebrates *viz.*, ***Taxa Tolerance Score (TTS), Average Score Per Taxon (ASPT)*** **and** ***Macroinvertebrate Water Quality Index (MWQI)*** revealed that :
    - Both Chornai Nadi-Right and Left bank streams had high value of *TTS* (>100) with water quality category 'Very Good' (Unpolluted, Un-impacted) compared to that of all the other locations sampled. Also, the TTS recorded at Atem Nadi and Salhi-Garjan Nala with water quality category 'Good' (Clean, but Slightly Impacted) were on par with that of locations other than Chornai Nadi-Right and Left bank streams.
    - The Average Score Per Taxon *(ASPT)* indicated 'Good' water quality in five sampling locations *viz.*, Bisrar & Maniar Nala, Bamni Nala, Chornai Nadi-Right and Left bank streams and Khadpadi & Parla Nala as well as 'Moderate' water quality in the remaining three locations *viz.*, Atem Nadi, Salhi & Garjan Nala and Rehar River.
    - The Macroinvertebrate Water Quality Index (MWQI) indicated 'Very good' water quality with 'Slight organic pollution' for Chornai Nadi-Left bank streams, Chornai Nadi-Right bank streams and Khadpadi & Parla Nala; 'Good' water quality with 'Some organic pollution' for Bamni Nala; 'Fair' water quality with 'Significant pollution' for Atem Nadi and Bisrar & Maniar Nala; 'Fairly Poor' water quality with 'Significant organic pollution' for Rehar River and 'Poor' water quality with 'Very significant pollution' for Salhi and Garjan Nala.
- A relatively high diversity (based on indices *viz.*, Shannon and Fisher's alpha) of aquatic macroinvertebrates was observed at two locations (Chornai Nadi-Right

bank streams and Salhi & Garjan Nala) and a low diversity at two locations (Bisrar & Maniar Nala and Bamni Nala).

- It is to note that, in terms of diversity of aquatic invertebrates, Salhi & Garjan Nala followed by Atem Nadi, which are located in the core/buffer area of the active coal block (PEKB), were one of the relatively good/moderate diverse locations. On the contrary, the Taxa Tolerance Score and ASPT indices ascertained that these locations ranked relatively low in terms of the abundance of pollution sensitive aquatic organisms.
- Overall, the biotic metrics, diversity indices and biotic indices of water quality calculated for the aquatic macroinvertebrates revealed that the water quality and the likely impacts of various natural and anthropogenic stresses on aquatic resources at the forested stream locations such as:
    - Chornai Nadi- Right and Left bank streams were not observed to be impacted very significantly.
    - The two prominent sampling locations *i.e.*, core/buffer to the active mining areas *viz.*, Atem Nadi and Salhi & Garjan Nala were more or less similar in all respects of aquatic macroinvertebrate biodiversity , biological water quality and both varied significantly from that of the other sampling locations.
- A total of 13 common indigenous fish species and 02 introduced exotic fish species *viz.*, *Cyprinus carpio carpio* (Common carp), *Oreochromis mossambicus* (Tilapia); few crustaceans that include prawns and crabs were recorded and reported to occur in the streams of the area. Most of the catch hardly consists of few grams to 1-2 kg, which is often utilized for individual consumption, and therefore, do not attract significant commercial value. Of the 13 fish species recorded three fish species (*Garra mullya; Cirrhinus reba* and *Channa gachua*) are categorized under Vulnerable (VU) and six species under Lower Risk near threatened (LRnt) category of conservation status (CAMP, 1998).

ES 9.3.2 Likely impacts on the drainage and aquatic diversity

Mining in forested landscape involves significant land use changes that most likely result in geo-morphological/hydrological changes in the river water courses. In the present scenario, mining is being done in a relatively small geographical area as compared to the total extent of the all the coal blocks allotted/re-allotted and identified (23 coal blocks as on date) in the entire HAC; however, the direct and indirect impacts are significantly evident from the observable changes in the forest cover and natural drainages. Deterioration in the quality and quantity of surface water is an important issue and is likely to increase further with the expansion of mining. Majority of the drainage that drains the core and buffer zone of the coal blocks are of primary and secondary feeder streams and therefore, they will be greatly affected due to retention, flow restriction, low discharge, reduced channel morphology, etc.

More importantly, the cumulative impacts perceived out of the mining in the contiguous coal blocks *i.e.,* 12-15 & 19 as well as its adjacent ones 20-21 would perhaps be more severe on the HAC landscape and the drainage system particularly the Atem Nadi, a part of the Gej-Jhink watershed and the Chornai Nadi, a part of the Chornai watershed.

ES 10. SOCIO-ECONOMIC *VIS-A-VIS* BIODIVERSITY VALUES OF HAC

The HAC is a notified *Scheduled Area* under the 5th Schedule of the Constitution of India due to preponderance of tribal population. The society is dominated with scheduled communities to the extent of 76.33% of total population, comprising of Scheduled Tribes (69.74 %) and Scheduled Castes (3.92 %).

- A total of 142 revenue villages are situated in rural areas and in the fringes of the forest within the landscape Hasdeo-Arand having a total population of 124948 belonging to 28948 households (HHs) with 1.25 million population dependant on forest for fuel wood, fodder, timber and NTFP.
- The average population density is 95 persons per sq.km and the average family/household size of 4.32 individuals with an average sex ratio of 981. Household population is dominated with age group of 6-15 followed by 16-25 years age group.
- Ethnic groups of different religious, social and cultural backgrounds inhabit in the HAC represented by 24 STs, 12 SCs, 23 OBCs amongst the notified ST, SC and OBC communities of Chhattisgarh state and 05 general communities.
- No Particular Vulnerable Tribal Group (PVTG) were recorded or reported within the core zone of any of 23 coal blocks. However, Birhor PVTG were reported from Lalpur village of Lalpur Gram Panchyat of Poundi-Uproda CD block, Korba district; and Pahari Korwa is reported to be inhabited in Kadamjheriya village, a solely Pahrai Korwa inhabited tribal village.
- Household land holding pattern are in the order of marginal>small>semi medium> medium> large. Overall 89.39 % of total working population are engaged in agricultural related activities, 9.46 % as other workers and 1.22 % as household industrial workers.
- Weekly markets locally known as "Hats' satisfies the daily needs of the local communities and also provides an opportunity to sell their minor farm produce, forest produce and handicrafts to supplement the household income. Surplus paddy production is sold at Primary Co-operative Societies by medium and large farmers.
- Paddy is the main crop and taken as single crop during kharif season besides Maize, Kodo, Kutki *etc.* Wheat is grown as rabi crop in irrigated areas and low laying areas to a limited extent. Average productivity of Paddy is 13 quintal/ha, Maize (18 quintal/ha) and Wheat (13 quintal/ha). Vegetable and fruit production are mainly for subsistence use; however, the surplus vegetable and fruit production, are sold in weekly markets.

- There are about 25,494 priority and 9,831 Antodaya (poorest of poor) eligible ration card holders (HHs) for subsidized ration as on 2020-21 (National Food Security Act 2013) in the study area.
- Area under village forest land use is 798.28 sq.km, nearly 98.57% households are dependent on forest for fuel wood, small timber, non-timber forest produces for their livelihood and sources of income.
- Estimated average annual household fuel wood removal from forest in surveyed villages is 2.47 tonnes with a maximum of 4.12 tonnes by the villagers living in fringes of Lemru forest range under Korba Forest Division and a minimum of 1.7 tonnes by villagers in the fringes of Udaipur forest range under South Surguja Forest Division.
- Estimated annual fuel wood dependence on forest in HAC accounts for 0.07 million tonnes. Estimated annual household dependence on forest for small timber in HAC is 6368.56 cu m.
- There are about 129 Tendu leaves collection centres belonging to 10 Primary Co-operative Societies under 04 district unions in the study area. During the 2019 season Tendu leaves removal from study area was around 20,003 standard bags of value Rs .80 million from HAC. In addition, unregulated trade of Mahua, Chirongi seeds etc also contributes to substantial income to house hold.
- Animal rearing was not a common practice in the HAC in the past however it has become popular for milk, ploughing agricultural fields, cart pulling; and as source of meat in the last decade, which has resulted in increase of livestock. Livestock constitutes cattle (76221), goat (62533), buffalo (14767) and pig (2043).
- A total 128455 Adult Cattle Unit (ACU) are dependent on forests for grazing besides grazing in agricultural fields and road side.
- Majority of the (96.70 percent) households graze their livestock in nearby pasture and forest land. Estimated per capita annual fodder requirement in HAC is 9.10 tonnes/ACU and annual fodder dependence from forest accounts for 1.13 million tonnes.
- Per capita annual fodder requirement is estimated to be 9.10 tonnes/ACU 1.13 million tonnes as annual dependence on fodder from forest.
- Locals practice fishing for subsistence use. Most of the catch hardly consists of few grams to 1-2 kg, which is often utilized for household consumption.
- Estimated average annual household income of sample households is Rs. 86,341/-, of which Rs. 17,195/- from forest; Rs. 28,381/- from cultivation and Rs. 40,763/- and secondary sources of income like manual casual labour in cultivation /agriculture, jobs and business.
- There is no place of religious, cultural, and archaeological importance within core zone of any coal block. However, there are three notified sites by the Archaeological Survey of India (ASI) namely Jogimara caves, Sita Bengra caves and Mahespur Shiva temple falling within influence zone

(*i.e.*, 10 km aerial radius) of PEKB and Laxmangarh Coal blocks respectively.

ES 10.1 Likely Impacts

Hasdeo-Arand Coalfield (HAC) area is a home to socially, economically backward vulnerable schedule population dominated by scheduled tribes and others traditional forest dwellers. Over 90% of the households are dependent on agriculture and forest produce for their livelihoods from forests. The forests also maintain the hydrological and other ecosystem services on which the locals are dependent for agriculture and other allied activities. Cumulative Impact of displacement due to mining operations will have serious impact on community in form of loss of livelihood, identity and culture.

ES 11. RECOMMENDATIONS BASED ON THE FINDINGS OF THE BIODIVERSITY STUDY

The recommendation under respective components include mitigation measures for respective components for the coal block in operation and HAC are detailed in report Volume -I in Chapter- 10.

ES 11.1 Observation on the Conservation Measure and Recommendations - Parsa East & Kanta Basan (PEKB)

The PEKB coal block has been undertaking systematic reclamation and rehabilitation activities including, stabilization of external waste dumps and internal backfilling's with adequate engineering measures (Toe/retaining Wall, Garland drain, gully plugs, miscellaneous drainages alongside haul road/avenue areas, water harvesting structures like settling ponds, catch water drains along coal block boundary to maintain required flow in the natural water courses, check dams, etc.) and biological measures include extensive afforestation with suitable mixed native plant species all over the reclaimed areas that include both within the statutory areas and vacant lands. Except few failures in the implementation/ maintenance of flow arresting structures on the waste dump particularly East External Dump, all measures implemented by the PEKB observed to be adequate enough to protect the mining environment from further damages.

Detailed survey was made based on the environmental compliance conditions in the PEKB open cast coal block. Observation and the recommendation under respective components such as Geological Reserve, mining and transportation, environmental measures, efficacy of mine closure plan, Reclamation and Rehabilitation and safety zone are provided in detail in the in Chapter-8 and Chapter-10.

ES 11.2 Observation about opening the PEKB Coal Block for mining as per the Sequential Mining– NGT Query

As proposed in the mining plan, the mine pit has been opened all along the strike length of coal seam for a length of 6.12 km along mine surface with 650 -700 m wide

and up to a depth of 40-45 m depth. The extensive mining operations is being carried out by three contractors confined to their designated area of mining in the entire strike length of coal seams. This has resulted in inadequate bench width in over burden (OB) benches ranging from 8 to 12 m than that of 20 m minimum bench width planned. Height of the benches in OB is below 6 m and well maintained except at cross-section C-1, on dip side three benches have height more than 6 m (534 m to 501.9 m).

- Opening of such a long mine face for extensive mining has seriously impacted the land degradation. Such practice will not only expose huge area but also result in land degradation which is not specific to particular time, but carry further for the entire life of the mine.
- ***Therefore, it is suggested that opening of long mine face shall be minimized by undertaking intensive mining i.e. mining in smaller strike length up to the bottom of the ore body with simultaneous backfilling.***
- Mine benches are comparatively clean with not much of blasted/spilled material scattered on the mine faces. ***However, seepage water was seen accumulated on lower coal seam (IV) floor at surface miner operational area. Such seepage water may be properly channelized to mine sump for keeping coal seam floor clean.***

ES 12. EFFICACY OF MINE CLOSURE PLAN

There are 23 coal blocks identified by CMPDI; of which four blocks were re-allotted and the remaining 19 blocks are divided into three groups such as Group A, B and C:

GROUP A: Five (05) coal blocks such as Tara, Madanpur (North), Madanpur (South), Paturia and Gidmuri have only geological, mining and mine closure proposals.

Group B: Limited information is available for another 05 coal blocks such as Morga-II, Morga-III, Morga-IV, Morga South and Saidu

GROUP C: Remaining 09 coal blocks (Puta Parogia, Parogia, Pindraki, Sarma, Laxmangarh, Bhakurma-Matringa, Kedma, Morga-I and Nakiya) no information is available.

The detailed information on the Feasibility Report, Mining Plan, Mining Scheme, Mine Closure Plan, EIA/EMP reports for the above mentioned 19 mines were not available.

ES 12.1 Efficacy of Parsa mine closure plan

State of the art technology in respect of coal beneficiation through coal washeries and dispatch of coal through rapid loading system with pit head rail siding is envisaged. Strike length of coal seam along the floor of the pit proposed is 2.95 km (approx.), advancement of mining operations towards dip direction; strike length of the ore body

divided into two and haulage roads of 1 in 16 gradient and conveyer are planned at the middle of the pit. Ultimate depth of the pit envisaged is 275 m from the surface/ground level.

- Assumed life of the mine is 45 years; therefore, dedicated long-term planning, simultaneous reclamation and rehabilitation for stabilizing internal dumps for short and long term should be formulated. Therefore, five yearly reclamation plans with definite target should be incorporated in the mine closure plan.
- One third of area acquired for mining is private land. Proposal may be inbuilt in the mine closure plan to bring back original topography and original land use to the extent possible through reclamation, which may mitigate impact on land use pattern.

ES 12.2 Efficacy of Kente Extension mine closure plan

Kente Extension coal block has been fully explored by drilling 137 boreholes for cumulative meterage of 14388.8 m. Density of bore hole is 8 per sq.km. Total geological reserves estimated is 410.25 million tons, of which 323.70 million tons (79%) are minable. It is reported that coal seam IV A has been developed locally on the northern part has average thickness of 1m with parting of 6 to 8m, however the coal seam has not been considered for estimation of resources.

- ***Resources of the coal seam and economic feasibility of mining needs to be assessed in the interest of mineral conservation.***

Open cast and fully mechanized mining proposal are envisaged in Kente Extension Coal Block with envisaged production of 9 million tons per annum and life of the mine envisaged is 49 years with stripping ratio of 3.65 cum.

- ***Developing mine pit for entire strike length of 3.7 km over a period of 49 years may result in huge land degradation for longer period. To minimize land degradation intensive mining may be emphasised instead of extensive mining, alternatively life of the mine may be reduced by increasing production level.***

Proposal has been inbuilt to have external dump accommodating 27.67 Mcum mine waste and the proposed height of the dump will be 60 m at the end of the life of the mine, **it appears that external dump will be active for entire life of the mine.**

- ***It is suggested to stabilize external dump at the earliest and reclaim, subsequently mine waste may be accommodated in the internal dumps/ back filling alternatively external dump may be planned as retreating dumping method so that simultaneous reclamation can take place.***

ES 12.3 Efficacy of Chotia (sub block 2A and 2B) mine closure plan

Chotia mine has two sub blocks *viz.* Chotia 2A and Chotia 2B and the details are provided in the Chapter-3. These two coal blocks are situated 10 km apart. Mining operations planned in both the blocks through open cast and underground methods. Open cast mining operations in Chotia 2A have been completed and mining operations suspended from September 2016. Exhausted mine pit partly converted into water pond and remaining portion is being backfilled with flyash. However, presently planned to operate some portion of Chotia 2A under opencast mining from 2023-24 onwards.

- ***The haul roads do not have one-way traffic, due to limited quarry area and also there is no sufficient width for two-way traffic and movement of light and service vehicles;***
- ***Haul road within the pit for OB and coal haulage are quite steep (gradient more than 1 in 15 and at some places as 1 in 12) due to very limited area of operation in the quarry. Ramp/approach road to benches in OB is also found to be quite steep (1 in 10 to 1 in 12). It is to be maintained with relatively flat gradient.***
- ***Road surface of approach road to mine benches and haul road is found to be quite rough/bumpy and undulating and need proper grading.***
- ***Mine benches are not clearly maintained a lot of loose material is found to be lying on OB bench faces. All such loose material should be lifted/ removed from mine benches to provide sufficient width for deployment of HEMM.***
- ***Dust suppression within the mine for OB excavation, haul road for OB and coal and at waste dump (backfilling) is not found to be satisfactory and needs considerable strengthening.***
- Terracing (decking) has been done very systematically in the internal waste dump.
- Use of Personal Protective Equipment (PPE) is quite satisfactory except dust mask, which shall be made mandatory and monitored.
- ***Lighting arrangement at the periphery of the pit as well as at operating benches appears to be inadequate as power supply to lighting towers is through DG Set and sufficient numbers of such lighting towers are not provided.***
- Computerized mine planning is adopted at Chotia OC Mine using 'Auto CAD' and 'Minex Software' for mine survey and calculating volume of OB removal , actual coal bench top and floor OB level. It is used by Geology Department for coal seam modelling and revalidation of borehole data earlier provided in geological report. ***It is a very good practice and may be further strengthened when underground mining operations are planned.***
- Presently no mine water from the sump/void is discharged outside the ML area even during rainy season both from Chotia 2A (exhausted pit) and

Chotia 2B pit with the result of water quality in the vicinity is not getting adversely affected.

- ***Chotia 2A OC Mine has exhausted and it has a very large sump with clean water. The mine area (sub-block area) has been fenced and not the quarry area. To avoid unauthorized entry towards sump area and possible accidents, the quarry area should be protected and fenced.***
- As per recent proposal (mining plan 4th revision) mine is likely to be operated by OC from 2023-24. Chotia 2B mine is likely to get exhausted for open cast mine operation by 2022-23. ***Virtually there will be two underground mining in operations (may be connected by a drive/cross cut) in Chotia sub-block 2A and one underground mining operation in Chotia sub-block 2B, which needs to be planned very meticulously.***
- External dumps are close to Bango Reservoir backwaters, no protective measures adopted to arrest wash off and silting. Most of the OB dumps are active and not much attention has made to reclaim the dumps. Since the open cast operation of the Chotia 2B is likely to be completed by 2022-23, ***it essential to implement all mine closure activities in respect of waste dump disposal, land reclamation and rehabilitation with suitable environmental protective measures.***
- Overall working condition of Chotia 2B coal block is not satisfactory and needs improvement in bench formation, haul road management and dust suppression system.
- ***Chotia 2B coal block is likely to get exhausted for open cast mine operation by 2022-23 and proposed to undertake mining operations by underground mining method, which will less impact on land use and environment, which may be permitted to continue subject to conditions that present external dumps has to be stabilized, reclaimed and prevented from wash offs etc.***

ES 12.4 Other blocks

The detailed information on the Feasibility Report, Mining Plan, Mining Scheme, Mine Closure Plan, EIA/EMP reports for the rest of the 19 coal blocks were not available. **In the absence of technical inputs in field of exploration, mining and mine closure, no comments on these blocks could be offered.**

ES 13. EFFICACY OF TRANSLOCATED TREES

To comply with the FC condition, the PEKB mine authorities have translocated/transplanted mainly Sal saplings/trees falling under the girth class 20-60 cm from forest blocks and few other common species at various sites within mine lease in consultation with the State Forest Department (SFD). A total number of **8177** trees belong to **18** different species have been transplanted during the period i.e., 2012-2020. They have employed modern technology and a dedicated team in the

transplantation process with detailed pre-planning and post care for those trees translocated. The overall cost of transplantation has been worked out to **Rs 4,468/-** per tree excluding cost of technology and maintenance. The cost of nursery for raising the seed-based tree species is **Rs. 30/-** per seedling.

- Sal (*Shorea robusta*) and Mahua (*Madhuca longifolia*) trees having girth class of 20-60 cm together with other tree species having aesthetic & economic values have been transplanted. The Standard Operating Procedure (SoP) followed by the mine lessee is confined to suggestion by the SFD such as specific girth class of trees, site identification for translocation, pre-planning, post care for translocated trees and gap filling to replace dead trees.
- The translocated trees have been planted at random. Lack of documents/records on girth class, site characteristic, systematic translocation symptoms due to transport, damage during transport, growth pattern at translocated sites, new foliage growth, death, insect/termite/disease attack, *etc.*, were the major constraints to assess the efficacy of translocated trees in different sites, except for the survival.
- Translocation sites were within the PEKB mine lease area. Used *Trans-Planter Model-100d* machine along with adequate manpower for uprooting, transport and planting. Only few precautions were followed during transplanting and post-case such as pruning of branch to avoid any damage while transporting, planting of the uprooted trees on the same day, re-planting of the trees in the treated pit with fertilizers/pesticides/fungicides, watering at regular intervals, monitor for survival and gap filling for the dead one at few places either with Sal or *Pongamia* (Safety zone) or Neem (Front of Mahua Dev dump site). This was a major impediment for the team to assess the performance of the transplanted trees.
- Therefore, the efficacy assessment made by ICFRE team is confined to survival and health status of the translocated trees in 16 different translocated sites in PEKB coal mine lease area.

ES 13.1 Recommendations

- The survival rate at few places are significant, however overall, it is poor due to lack of monitoring in terms of follow-up activities after planting like pest/disease surveillance, recording of growth measurements and replacement of dead trees, etc.
- Species and site specific Standard Operating Procedures (SoP) needs to be framed by the State Forest Department (SFD) for local species (Sal, Tendu, Char, Mahua, etc.,) for translocation of forest trees species.
- It is further suggested that a long-term site-specific scientific study for suitability assessment of indigenous species of HAC shall be undertaken by the SFD in association with the coal block in operation to assess the success rate and to develop species specific SoP.

ES 14. COAL RESOURCES

India is second highest and largest coal consuming country in the world and consuming about 11% of world production, however the per capita consumption is lowest among top 10 coal consuming countries. The coal production in India was reported with 24% shortage for the year 2017-18; and 26% shortage for the year 2018-19 against the internal demand. Import of coal during the same period substitute to 23% and 24% for the years 2017-18 and 2018-19 respectively indicating for accelerating the production to fill gap between demand and supply. However, it is important to note that USA produces coal about 25% lesser than India but consumes electricity about 40% higher than India. Similarly, Japan is 6th highest coal producer and third highest consumer of electricity.

- It is pertinent to mention that the *coal production and electricity consumption pattern indicates that the worldwide coal alone is not considered as energy mineral, alternately other source of energy like shale gas, green energy (solar and wind energy) and atomic energy are to be tapped to meet energy requirement by 2022. India too is targeting a fivefold expansion of the electricity generated from renewable energy sources by 2030.*

The coal mineralization in Korba Coal Fields exists up to 600 m depth from the surface therefore underground mining for such deep deposits adopted; whereas

- *coal mineralization in Hasdeo-Arand Coalfield persist up to a depth of maximum 250 m from surface and partings between two coal seems do not exceed 25 m, therefore feasibility in terms of economic and environmental stability shall be explored in case of any underground mining is recommended for sustainable development in HAC.*

ES 15. BIODIVERSITY CONSERVATION AREA

To address the concept of sustainable development in Hasdeo-Arand Coalfield (HAC), the present study involving spatio-temporal assessment of important biodiversity attributes conducted during 2019-2021, has contributed to integrate the cumulative impacts of mining due to 23 coal blocks, keeping in view the large-scale changes envisaged in the open cast type of coal mining in the central Indian moist-dry deciduous Sal dominated forest tracts. Under the long-term and high-intensity development of open cast coal mining, biodiversity and ecological integrity is a concern of great importance, as it involves large scale land use land cover changes leading to shrinking of forest quality/quantity and alteration of hydrological regimes.

The spatio-temporal baseline data on biodiversity and ecology of the entire HAC, have therefore, contributed to significant findings in terms of delineating the impacted areas in the face of vulnerability in many respects and identifying the potential areas to be suggested for conservation and management. Based on the cumulative impacts

envisaged out of the study on various environmental attributes, **Biodiversity Conservation Area (BCA)** are suggested in HAC as described below:

ES 15.1 Biodiversity and Social value of HAC

In India, the sub-tropical Sal dominated forest is covering an area of almost 10.57 million ha and that lies in the Himalayan foothill belt in Kangra region of Himachal Pradesh, north-western region in Uttarakhand, Uttar Pradesh, Bihar, Jharkhand, and foothills of north-west Bengal in north-central region; extends up to the Assam valley (including Meghalaya and Tripura) in the north-eastern Himalayas; Madhya Pradesh, Chhattisgarh, and Orissa in central region (Orwa *et al.*, 2009; Adhikari *et al.*, 2017). According to ISFR (2015) the naturally occurring Sal forest in Siwaliks, Gangetic plains and central India occupies about 13.6%, 2.2% and 8.9% of the total geographical area respectively (Figure ES.2). During last three decades, the Sal forests in India have witnessed increasing anthropogenic pressure of various magnitudes, resulted in habitat destruction, fragmentation of its native range, the regeneration problems, etc.

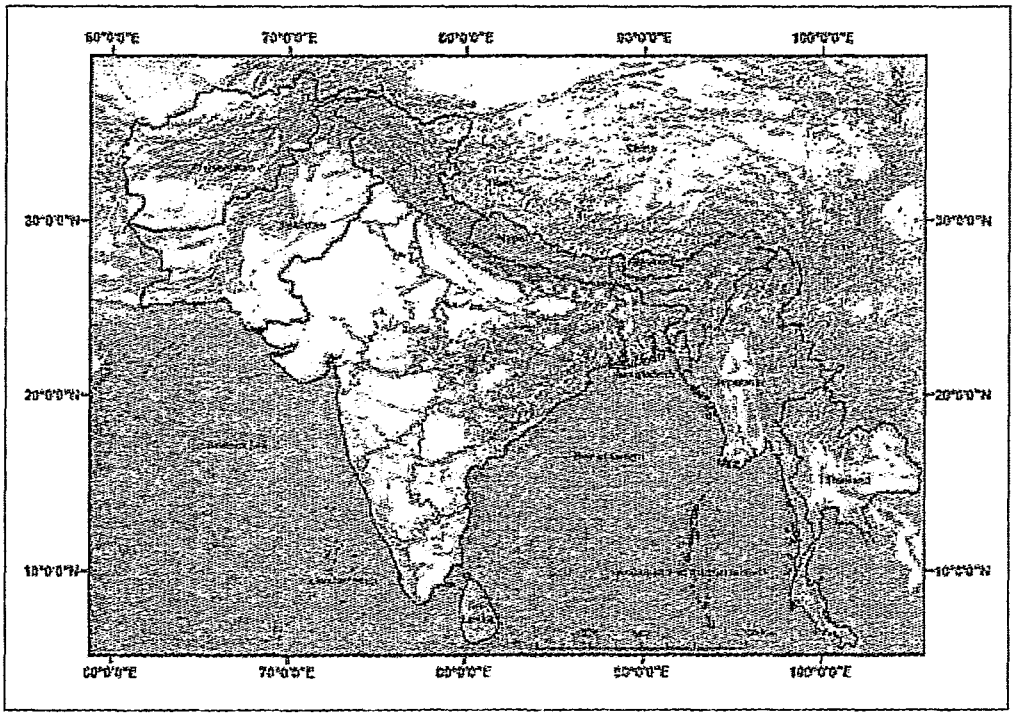


Figure ES.2: The area under Sal (*Shorea robusta*) distribution in the Indian Sub-continent (Source: *Mishra et. al.*, 2021)

The area under Sal forest is most affected owing to various developmental efforts and as a result, these forests are considerably fragmented and the fringe effects are well known. In addition, the dependence of traditional forest dwelling communities on Sal forests for their livelihood such as for NTFPs, fuel wood and fodder, forage ground of domestic animals, etc., are well prominent.

Ever since the formation of Chhattisgarh state in the year November, 2000, the exploitation/sustainable utilization of mineral rich areas falling within the forests in its jurisdiction reported to face various challenges. The HAC (1879 sq.km) in Chhattisgarh is the third largest coal bearing area (5529 MT) which is about 9% of the coal of the state falling within the largest un-fragmented forests in central India consisting of pristine Sal and teak forests, outside the protected area network, and an important habitat for indigenous forest dwelling tribal communities and large mammals.

The large forest area under HAC with its amalgamated varied landscape/habitats like very dense forests, moderately dense forests, open forests, scrub land and riparian tracts supports rich and diverse floral and faunal components. Out of the total area under HAC (1879.6 sq.km), moderately dense forest occupies about 61.6% (1158.04 sq.km) followed by very dense forests of about 6.74% (126.72 sq.km). There are five forest types under the moist and dry deciduous forests classes observed to occur in the area characteristic to HAC (1400.95 sq.km).

The study observed maximum dominance (based on high IVI) of *Shorea robusta* followed by *Diospyros melanoxylon* and *Madhuca longifolia* var. *latifolia* in HAC indicating the high regeneration capacity and greater ecological amplitude as compared to the operating PEKB and its surrounding coal blocks. Also, the stand density recorded for trees, shrub and herbs in PEKB and surround coal block recorded low as compared to the HAC indicating selective removal of lower girth class individuals in and around the operating PEKB coal block. The area under operating coal block (PEKB) and the other three contiguous coal blocks was observed with medium diverse in case of trees, indicating the overall impact due to opencast mining and allied activities in PEKB.

- Overall, the ecological processes of Sal forest in the HAC area the stand density clearly show rich diversity at the ground level, but decreasing diversity with shrub, and ultimately dominated with Sal at the top canopy. Sal ecology favours a mixture of shrub species and saplings at lower level consisting of NTFPs on which the forest fringe villagers and the large mammals are dependent for livelihood and forage respectively.
- The livelihood of local communities Hasdeo-Arand area is closely dependent on forest resources and therefore the current anthropogenic disturbance is confined to the population living in forest fringe villages for NTFPs from the forests, revenue land /forest and riparian land for agriculture purpose for their sustenance and fuel wood/fodder from forest.
- The HAC landforms are also home for rich avi-fauna and large mammals. Currently the occurrence of elephant in HAC (CSFD, 2018-19) are highly fragmented and degraded due to incompatible land use. In addition, there is continuous dispersal of elephant herd from the neighbouring states of Jharkhand and Odisha. The study carried out by WII in association with

Chhattisgarh Forest Department since 2017 clearly indicates that elephants have large home range based on the quality habitat.

- The whole of HAC landscape comprise of 647 forest compartments spread over 12 forest ranges in 4 forest divisions. Of the 647 forest compartments, elephant occurrence is recorded in 148 compartments during the period 2018 – 2020 in all the 12 forest ranges located within HAC. Elephant occurrence is not limited to any particular part of the landscape, however it spread across in HAC landscape and surrounding.
- Home range size is a function of habitat quality- in areas that support good intact habitats, the elephant home ranges are relatively small. The study conducted by WII in collaboration with Chhattisgarh Forest Department reported that the elephants have large home ranges. Because, the forests where the elephants currently occur are highly fragmented and degraded due to incompatible landuse. Therefore the elephant herds are generally interlinked to home ranges resulting in continuous dispersal of elephant herds from the neighbouring states of Jharkhand, Madhya Pradesh and Odisha.
- The large home range results in human-wildlife conflict – in the form of crop, property and livestock losses is also a major concern.

The estimated average monthly income was Rs. 7195/- out of which Rs. 1432/- from forest, Rs. 2365/- from agriculture and Rs. 3396/- from secondary sources such as labor in agriculture, etc. It is evident that there are 142 revenue fringe villages having 1.25 million population within HAC dependent on agriculture and forest produce for their livelihoods. For example, during the 2019 season Tendu leaves removal from HAC have accounted for Rs. 80 million indicating the rich resources and dependency on the forest produce by the local community.

ES 15.2 Proposed Biodiversity Conservation Area (BCA)

The major part of HAC area forms the watershed of the Hasdeo-Bango reservoir on the Hasdeo River, which is a tributary of the Mahanadi River. A relatively smaller part of the HAC area is drained by Rehar River, part of the lower Ganges Basin. The major streams of HAC are of perennial in nature and are very important in maintaining the ecological services of the landscapes.

The entire HAC falls primarily within the three watersheds *viz.*, **Gej-Jhink (north), Chornai (south) and Ton-Teti (west).**

- **Chornai watershed** contributes the maximum flow into the **Hasdeo-Bango Dam**. Also, the area under the **Chornai watershed** assumes greater importance particularly of its driange density and forest cover in both upstream/downstream areas where thirteen (13) coal blocks are located. The forest and lanscape within the Chornai watershed observed to contibute signficant hydrological flow to the Hasdeo-Bango reservoir. In addition, relatively high rainfall in the area observed to enhance the rich and varied forest as well as riparian ecosystems.

- The cluster of four open cast coal blocks i.e., Kente Extension (12), Parsa (13), PEKB 14 & Tara (15) and other two contigous blocks i.e., Sarma (20) and Laxmangarh (21) are on the **Gej-Jhink watershed** with Atem Nadi and its headwater feeder streams flowing towards north. The cumulatve impact of land use land cover changes due to these coal blocks will have infleunece of magnitude on the forest ecosystem and the Hydrology considering the quite larger area under peril.
- The area under indetified coal blocks falling within the **Ton-Teti watershed** are quite significant in terms of its proximity to the Hasdeo River, which is running west of these coal block cluster and the Hasdeo-Bango reservoir. In addition, the vegetation density and the stream networks are much significant in the area downstream to these catchments (Figure ES.3).

The proposed coal blocks falling within both the Chornai as well as Ton-Teti watersheds of the Hasdeo-River sub-basin, are as given below:

Sl. No.	Coal Block (No.)	Relative Occupancy (%) in Watersheds (approx.)	
		Chornai	Ton-Teti/Other streams
1	Nakiya-I, II & III (1)	100	--
2	Morga-I (3)	--	100
3	Morga-II (4)	--	100
4	Morga-III (5)	--	100
5	Morga-IV (6)	--	100
6	Morga South (7)	50	50
7	Gidmuri (8)	100	--
8	Paturia (9)	10	90
9	Madanpur North (10)	--	100
10	Madanpur South (11)	--	100
11	Puta Parogia (16)	70	30
12	Parogia (17)	100	--
13	Saidu (18)	100	--
14	Pindraki (19)	100	--

Open cast mining in the moderately dense and very dense sal-forested (moist-dry deciduous) sub-basins of the Hasdeo River in HAC is of great concern. The resultant land use land cover changes on account of open cast coal mining of this magnitude in the relatively moderately dense forest tracts intersected by numerous water courses will most likely to have significant cumulative impacts in terms of alteration of drainages and hydrological regime, *etc.*, mainly due to reduced stream water flow, increased erosion due to high rainfall in the area, increased sediment deposition on the river beds, reservoirs and other related environmental issues.

- Deterioration in the quality and quantity of surface water is of great concern and is most likely to increase further with the expansion of mining. The drainages are mainly comprising of primary and secondary feeder streams that fall within the

core and buffer zone of the coal blocks and are likely to be severely affected due to retention, flow restriction, low discharge, reduced channel morphology, etc.

- Presently, two coal blocks such as Parsa East & Kanta Basan (PEKB 14) and Chotia (2A & 2B) are in operation. The land use land cover changes in terms of forest cover changes due to mining in operational coal blocks of PEKB and Chotia 2A is quite evident. Therefore, cumulatively, mining, if allowed in all the coal blocks identified, will contribute to a total loss of moderately dense forest (233.44 sq.km) and very dense forest (66.30 sq.km).
- In terms of occurrence of coal blocks within HAC, PEKB coal block is in contiguous with Tara (15) and Parsa (13) on the western side (draining to Gej-Jhink watershed); Kente Extension (12) and Pindraki (19) on the eastern side i.e., largely draining to Chornai (Figure ES.4). In addition, it is in contiguous with 10 other coal blocks of a large cluster south-westerly i.e., Morga-I (3), Morga-II (4), Morga South (7), Gidmuri (8), Paturia (9), Madanpur South (11) Madanpur North (10), Puta Parogia (16), Parogia (17), Saidu (18).
- Wildlife Institute of India has reported the occurrence of large mammals especially elephant in some of the prime biodiversity rich locations. It is evident that this area supports rich biodiversity with a multitude of mammalian species including tigers and harbours forest-dependent communities and therefore sustaining the forest cover to maintain its overall ecological integrity are essential pre-requisite for the overall wellbeing of the area. Therefore, WII has suggested:
  - *It is pertinent that the Chhattisgarh State Forest Department may identify the areas for declaration as Conservation Reserves with due consultation and involvement of local communities and all other relevant stakeholders. Under the ambit of a conservation reserve, habitat improvement activities such as restoration of grasslands and degraded forests; improving surface water availability for wildlife in relatively drier tracts during summer, regulating forest fires, and improving overall protection can benefit wildlife.*

Considering the rich forest cover, floral biodiversity (640 plants species), occurrence of 33 Rare, Endangered and Threatened (RET) plant species and the different watersheds contributing the hydrological regime/hydrological flow; habitat for the fauna particularly mammals with large home ranges that is known to have established connectivity with proposed '*Lemru Elephant Reserve*' and livelihood dependence on non-wood forest products by the traditional forest dwelling community, the **ICFRE suggests Biodiversity Conservation Area** comprising of 337 forest compartments (938 sq.km) in Chornai watershed ; and 140 forest compartments (330.51 sq.km)in Ton-Teti watershed, where 14 proposed coal blocks are located, for a sustainable development and conservation (Figure ES.5 – ES.7).

Further, keeping in view, the demand for coal and thereby, socio-economic and industrial development of the area under consideration for mining, it suggested that:

- *The allotted four contiguous coal blocks falling within the Gej-Jhink watershed viz., Tara (15), Parsa (13) PEKB (14) & Kente Extension (12) that are either already opened or in advance stage of getting the statutory clearances/ToR approved,* ***can be considered*** *for mining with strict environmental safeguards including appropriate conservation measures for management of surface water and biodiversity.*

- *The total extent of 4 coal blocks of Tara, Parsa, PEKB, Kente Extension put together comprises of 80.95 sq.km, having a mineable reserve of 1143.49 MT (geological reserve of 1475.81 MT) to meet the coal requirement from HAC.*

- *However, mining in Kente Extension (12)* ***may be decided appropriately*** *with strict environmental safeguards pertaining to surface water management and biodiversity conservation measures, considering the presence of relatively more very dense, moderately dense forest cover and wildlife occurrence, particularly, elephant movements. In addition, the MoEF&CC vide letter No. J-11015/48/2019.II(M) dated 8.01.2020 issued ToR for conducting EIA/EMP studies as this coal block is allotted through auction process to M/s. Rajasthan Rajya Vidyut Utpadan Nigam Limited (RVUNL) and as per the condition No. 4(i) of the ToR, MoEF&CC has mandated to conduct Carrying Capacity study.*

- *A total of 337 forest compartments covering an area of 938 sq.km in Chornai watershed and 140 forest compartments covering an area of 330.51 sq.km in Ton-Teti watershed are suggested for* ***Biodiversity Conservation Area (BCA)*** (Annexure 10.1; Individual forest compartment wise details falling within the Biodiversity Conservation Area of Hasdeo-Arand Coalfield, Chhattisgarh are provided in Chapter-10 of main report Volume-I).

    - *However, a part of BCA comprising of two forest compartments No. P2114 and P1998 that are falling within PEKB operational mine and allotted Parsa coal block are suggested to be exempted from BCA.*

- *There are two contagious coal blocks such as Sarma (20) and Laxmangarh (21) covering a total extent area of 41.82 sq.km with 10.53 sq.km under moderately dense forest (0.91% out of 1158.04 sq.km) and a relatively smaller area of 0.04 sq.km under very dense forest (0.04% out of 1158.04sq.km) falling within the Gaj-Jhink watershed (upstream of Atem Nadi).*

- *Both Sarma (20) and Laxmangarh (21) coal blocks were observed to have high level of anthropogenic pressures and degraded forest due to extensive agriculture and allied activities and its close affinity/proximity to Udaipur – the tehsil headquarters, under Surguja district.*

- *Also, the other two contagious coal blocks i.e., Bhakurma-Martinga (22) and Kedma (23) covering an extent of 44.95 sq.km with 27.15 sq.km area under moderately dense forest (2.34% out of 1158.04 sq.km) and 5.83 sq.km area under very dense forest (5.83% out of 1158.04 sq.km) falling within Rehar watershed (at upstream).*

- *These four coal blocks viz., **Sarma (20), Laxmangarh (21) falling in** Gej-Jhink watersheds; **Bhakurma-Martinga (22) and Kedma (23)** falling in Rehar watershed, as per the information received from CMPDI are only regionally promotionally explored and the boundary demarcation is yet to be carried out*
- *Hence mining in the identified four coal blocks viz., **Sarma (20), Laxmangarh (21), Bhakurma-Martinga (22) and Kedma (23)** may be kept in abeyance till complete exploration and boundary demarcation is finalized; and the detailed assessment of the catchment and drainage networks of the Rehar River as well as the prominent agriculture activity are made to understand the impact.*

  *Overall, 14 projects, falling within both the Chornai (8) and Ton-Teti (9) watershed **may be not recommended** for mining keeping in view of conserving the relatively dense moist-dry deciduous sal dominated forest tracts that provide home range for elephant ; these forest are also intersected by dense stream channels of the higher order characteristic to the Chornai watersheds and considerable area under the coal blocks with relatively dense forests being influenced by the Hasdeo River/ Hasdeo-Bango Dam characteristic to the Ton-Teti watershed.*

- *Based on the compliance condition stipulated in the Environmental Clearance (vide letter No.J-11015/03/2008-1A.II(M) dated, 21.12.2011) a 75 km dedicated Railway corridor of South East Central Railway (SECR) connecting Surajpur Railway Station on Bilaspur - Ambikapur to pit head of PEKB mine has been commissioned in April 2018. The same may be utilized by the adjacent coal blocks in the cluster. The coal transportation through the dedicated railway corridor from these coal blocks will likely to reduce the impacts of mining and transportation on the environment and human health.*
- In addition, it is also recommended that a cumulative impact assessment of all the coal blocks mining on environment or a carrying capacity study involving physical, biological, social environment w.r.t. developmental intervention of the entire HAC shall be carried out for decision making and to achieve sustainable development.

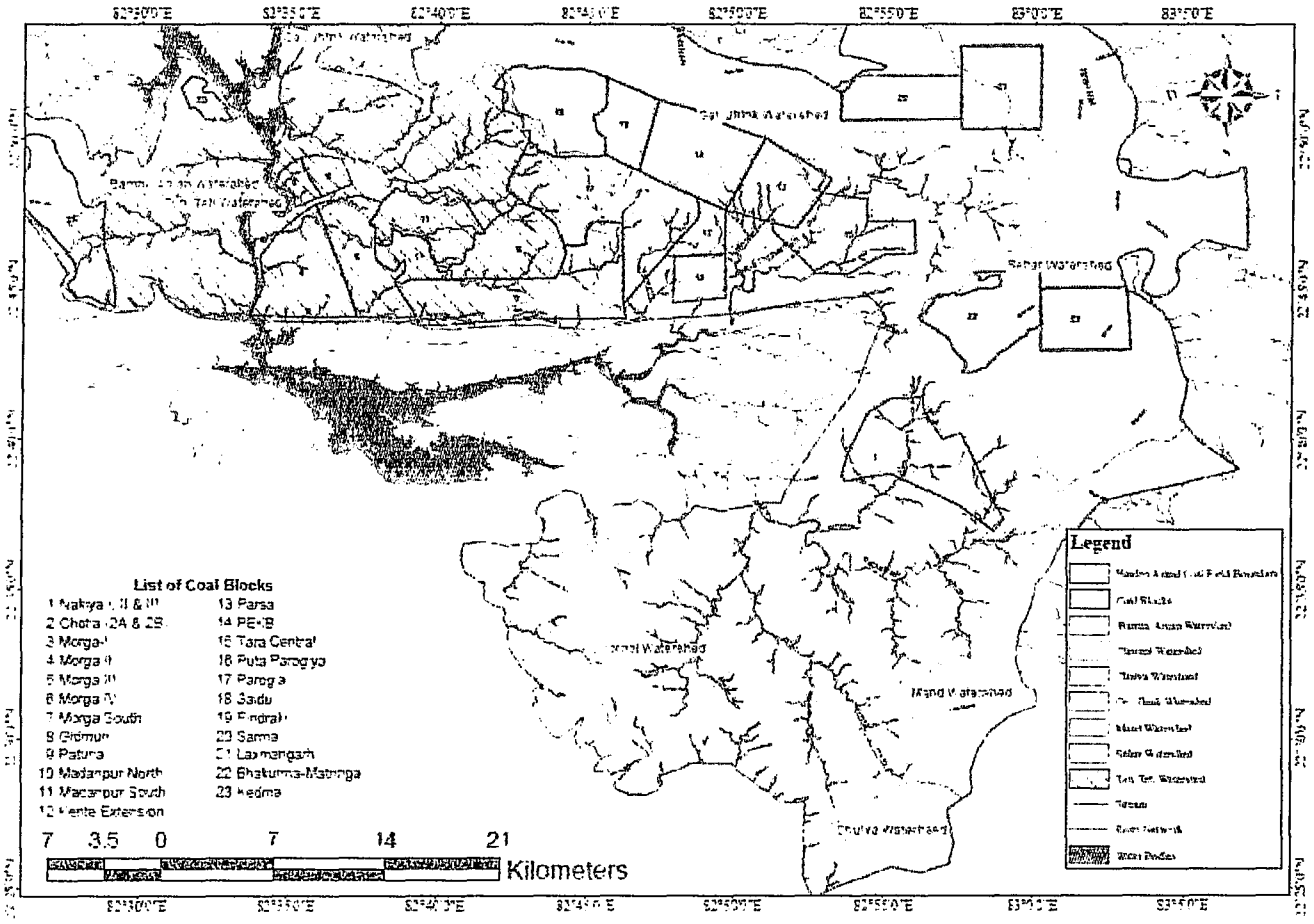


Figure ES.3: Map showing the Chornai and Ton, Teti watershed areas and drainage networks in Hasdeo-Arand Coalfield, Chhattisgarh

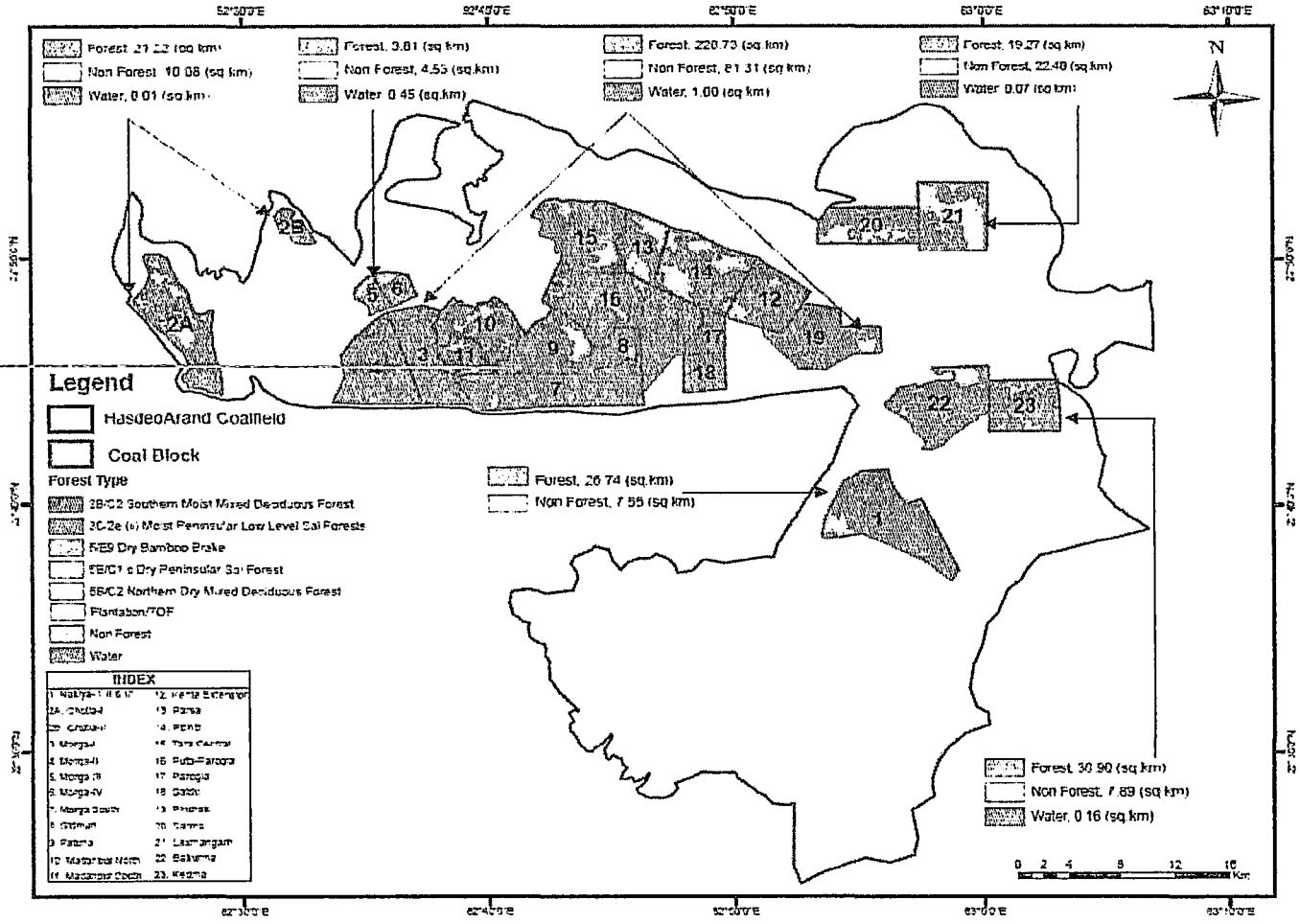


Figure ES.4: Map showing the cluster-wise estimated area of forest type, non-forest, water and to be impacted due to mining in Hasdeo-Arand Coalfield in Chhattisgarh

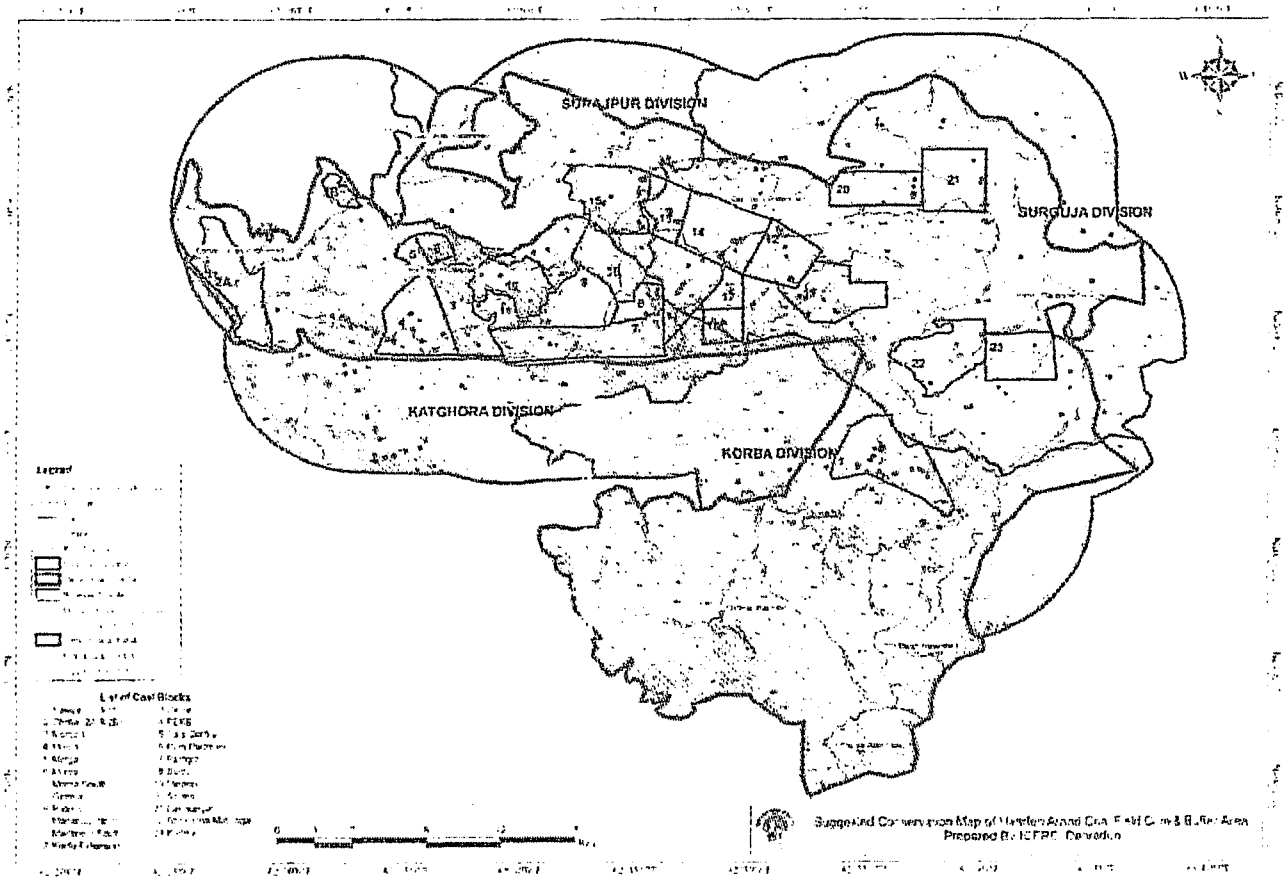


Figure ES.5: Map showing the drainage, elephant occurrence and suggested Biodiversity Conservation Area within the Hasdeo-Arand Coalfield in Chhattisgarh

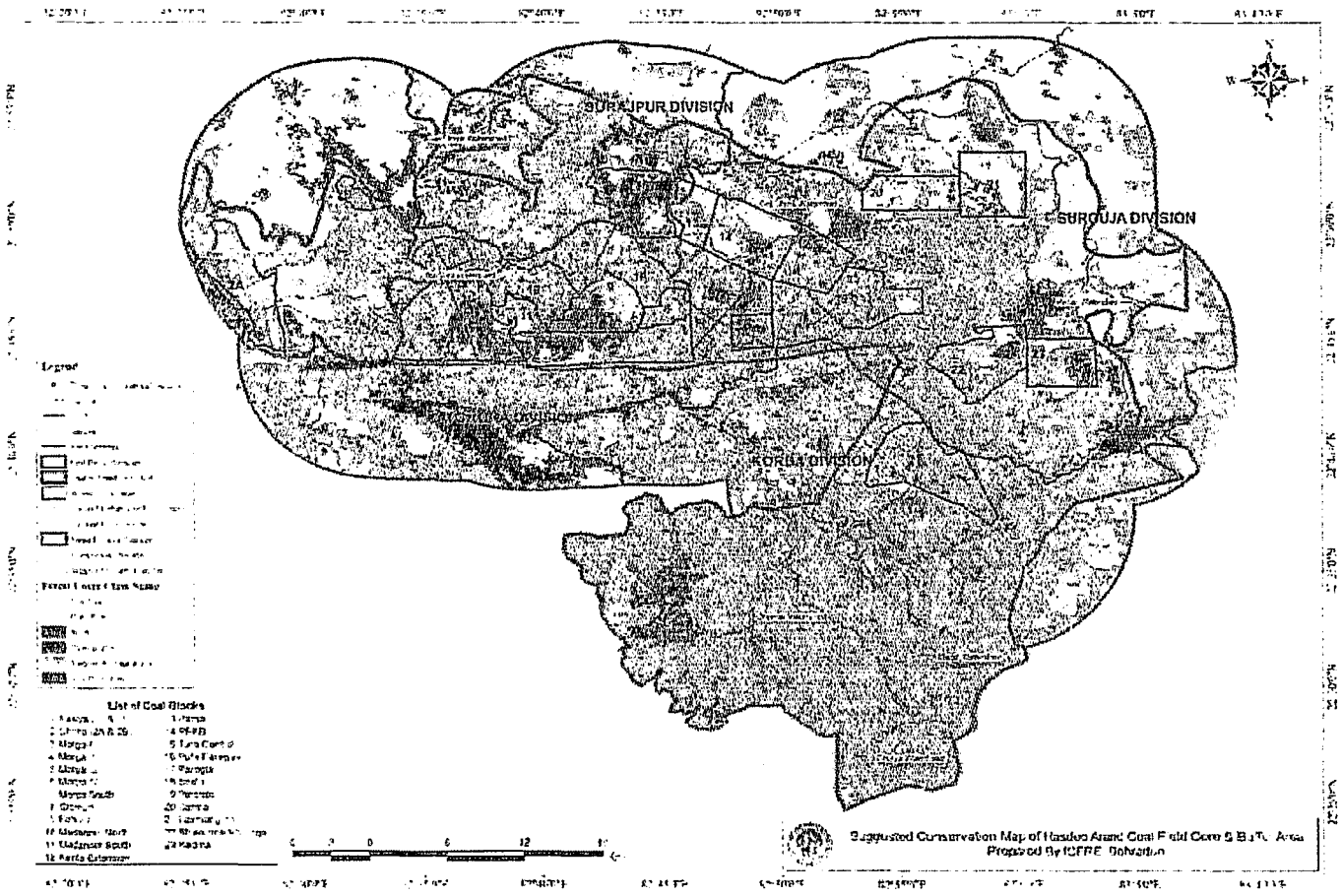


Figure ES.6: Map showing the forest cover and suggested Biodiversity Conservation Area within the Hasdeo-Arand Coalfield in Chhattisgarh

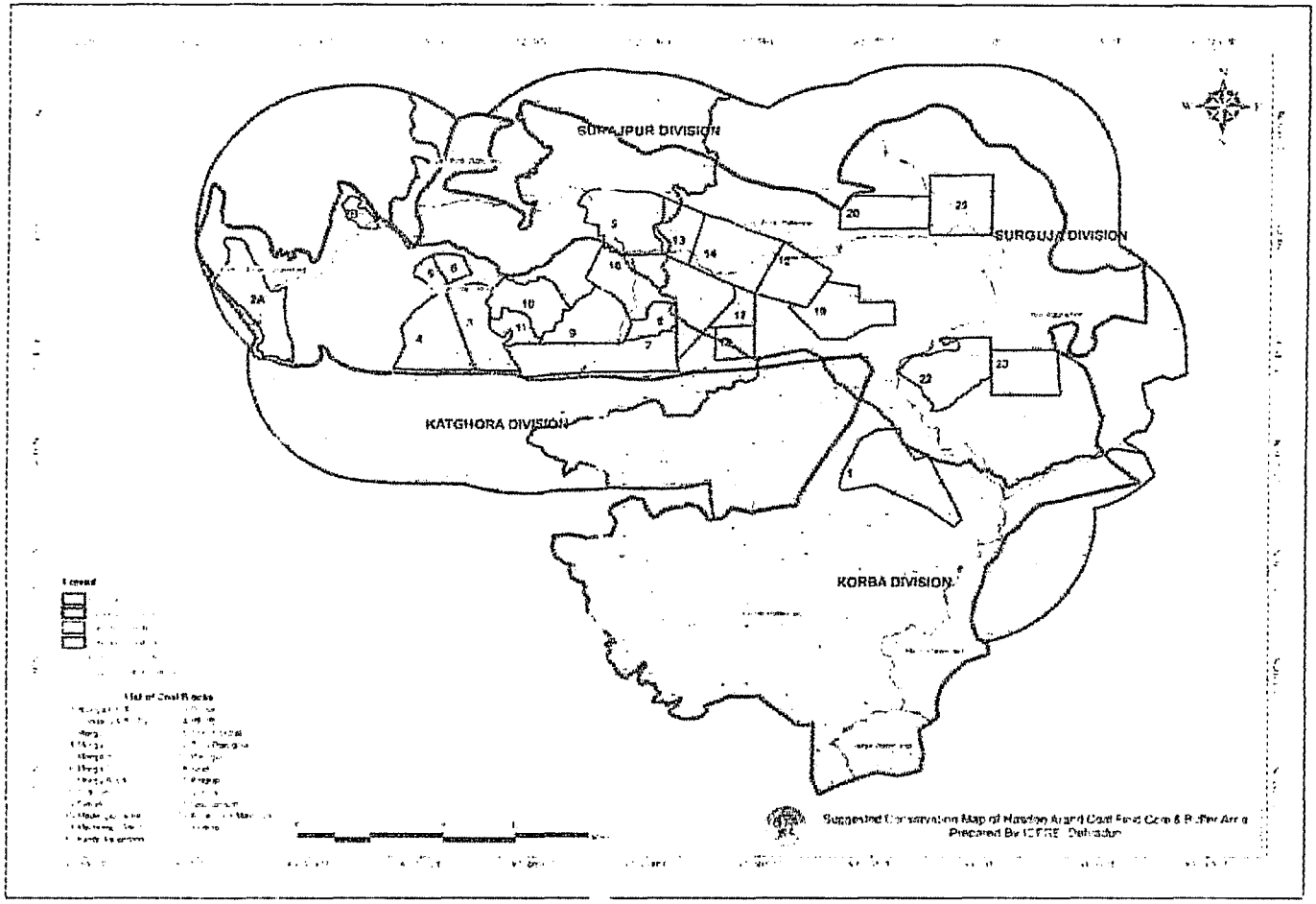
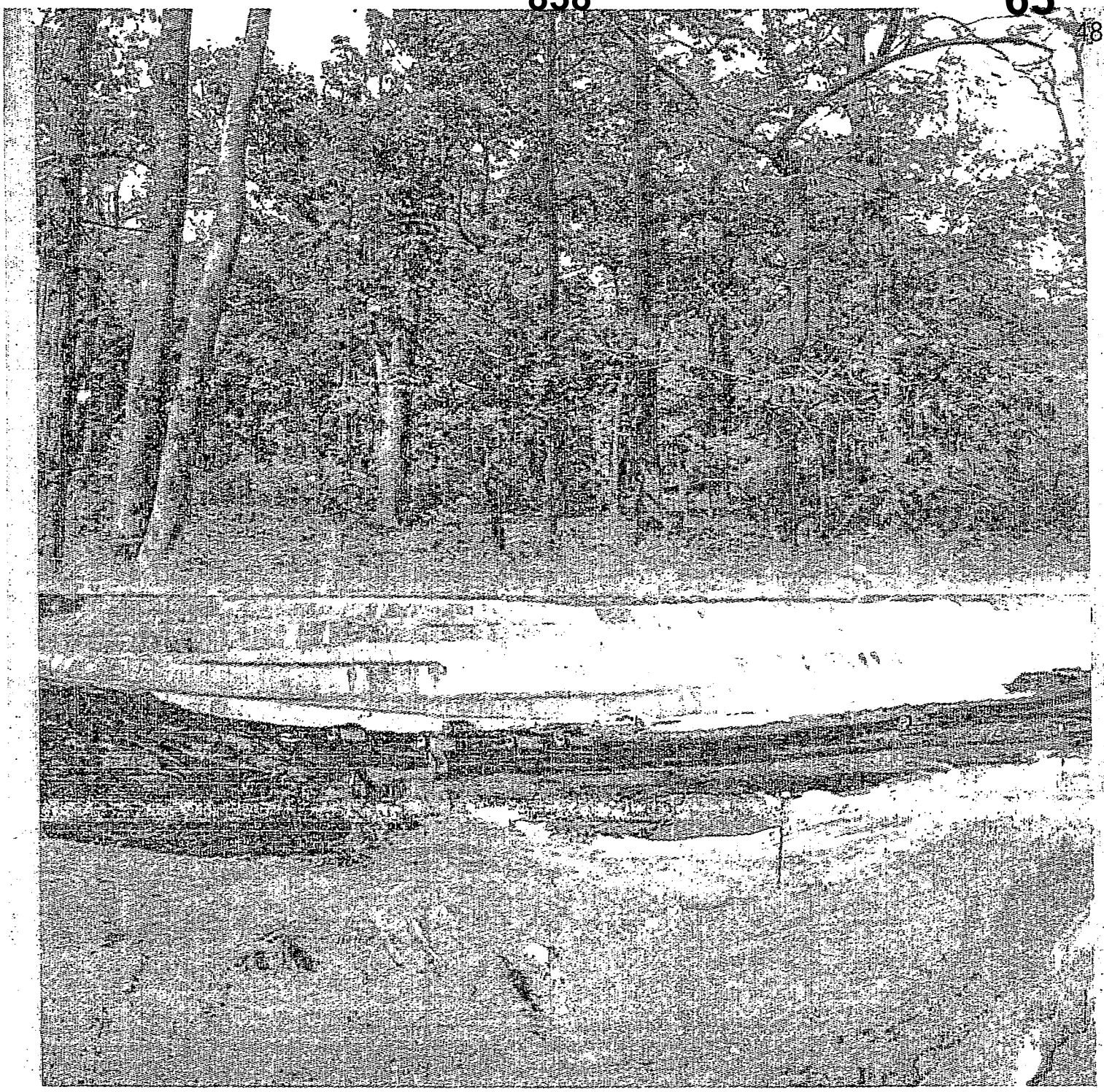


Figure ES.7: Map showing the forest compartments and suggested Biodiversity Conservation Area within the Hasdeo-Arand Coalfield in Chhattisgarh

ES 16. QUERIES OF THE PRINCIPAL BENCH OF NATIONAL GREEN TRIBUNAL (NGT) ALONGWITH THE JUDGMENT ISSUED ON 24.03.2014 TO MOEF&CC

Queries of National Green Tribunal (NGT)	Observation /Comments
1. What type of flora and fauna in terms of biodiversity and forest cover existed as on the date of the proposal in PEKB coal blocks.	*The pre-mining data on biodiversity are available in the EIA/EMP study report (as on December, 2016 for the PEKB Coal Block). However, the present study (2019-2021) in terms of floral and faunal biodiversity, forest cover and forest types for buffer area of PEKB and adjacent are detailed under the respective chapters.*
2. Is/was the PEKB coal block habitat to endemic or endangered species of flora and fauna.	Yes / was -the PEKB coal block habitat to ***rare, endangered and threatened flora and fauna.*** RET floral species observed in PEKB consists of *Aegle marmelos, Aristolochia indica, Drosera indica, Drosera burmanni, Uraria picta* and *Premna herbacea* RET faunal species - sloth bear (*Melursus ursinus*), four-horned antelope or Chousingha (*Tetracerus quadricornis*).
3. Whether the migratory route /corridor of any wild animal particularly elephant passes through the area.	*Elephant occurrence was reported in 148 out of 647 forest compartments in HAC and surrounding landscape during the period 2018 to 2020 by the State Forest Department. A conservative estimate of about 40 to 50 elephants could use different parts of the landscape at different times of the year. The HAC and the surrounding landscape are part of the elephant range in northern Chhattisgarh and serves as both habitat and corridor for movement.* *The Korba Forest Division had reported the occurrence of tigers in the vicinity of HAC and the surrounding landscape. The habitat connectivity between Hasdeo - Arand area and Achanakmar Tiger Reserve, Boramdeo Wildlife Sanctuary and Kanha Tiger Reserve is strong, and may support sporadic tiger dispersal.*
4. Whether the area of PEKB Block has that significant conservation /protection value so much so that the area cannot be compromised for coal mining with appropriate conservation /management strategies	*Presently as per FSI (2017) the PEKB coal block has 9.11 sq.km area under moderately dense forest and 2.56 sq.km area under very dense forest. Shorea robusta is recorded to be dominant followed by Diospyros melanoxylon, Madhuca longifolia, etc., contributing to the highest IVI values. The diversity index value is low in both core and buffer area due to open cast mining operation disturbance.*

	Therefore, it is suggested that the mining in PEKB may be allowed and to be continued with strict compliance / implementation of EC/FC conditions (detailed Reclamation and Rehabilitation plan, compliance to EC/FC and the observations/comments/recommendations made in this report under mine closure plan, sequential mining, biodiversity conservation, etc.)
5. What is their opinion about opening the PEKB coal block for mining as per sequential mining, reclamation methods proposed for regeneration of the flora; efficacy of mine closure plan and the tree translocated:	*Detailed observations pertaining to opinion for PEKB coal block is provided in Chapter 8 of this report for sequential mining reclamation and rehabilitation of the flora in the mine lease area and efficacy of tree translocated trees.*
6. What is their opinion about the Wildlife Management plan finally prescribed?	*The wildlife management plan is a legal document prepared for management of the notified protected areas under the Indian Wildlife (protection) Act, 1972. Since HAC is not a protected area, hence, the term wildlife conservation plan is more appropriate in this context. The wildlife conservation plan of Parsa East and Kanta Basen open cast coal mine and washery project prepared by the project proponent is basic and generic in nature. Due to this, it requires substantial revision and the management prescriptions need to be spatially explicit and closely consider the ecological, behavioural and social dimensions of the landscape. A detailed review of the same was carried out and specific comments to improve the plan have been provided in Annexure I of WII report enclosed as Volume-II.*
7. What conditions and restriction do they propose on the mining in question *ie.*, sequential mining, if they favour such mining?	*ICFRE- Suggestion and recommendation for further improving the mining environment in PEKB coal block are detailed in the Chapter 3 and 8 of this report* *WII- As certain portions of the PEKB coal block has already been opened for mining, the mining operation may only be permitted in the already operational mine of the block.*
Answer to the above questions Sl. No. 1 – 3 are addressed in detailed in the Chapter-4, Chapter-5 and Chapter-6; question Sl. No. 4 pertains to compliance are discussed in the Chapter-4 floral diversity, Chapter-5 faunal diversity, Chapter-6 aquatic diversity and chapter -7 socio-economic *vis-à-vis* biodiversity values, question Sl. No. 5 related to efficacy of mine closure plan are detailed in Chapter-8, efficacy of translocated trees in Chapter-9 and sequential mining in Chapter-8 of this report.	



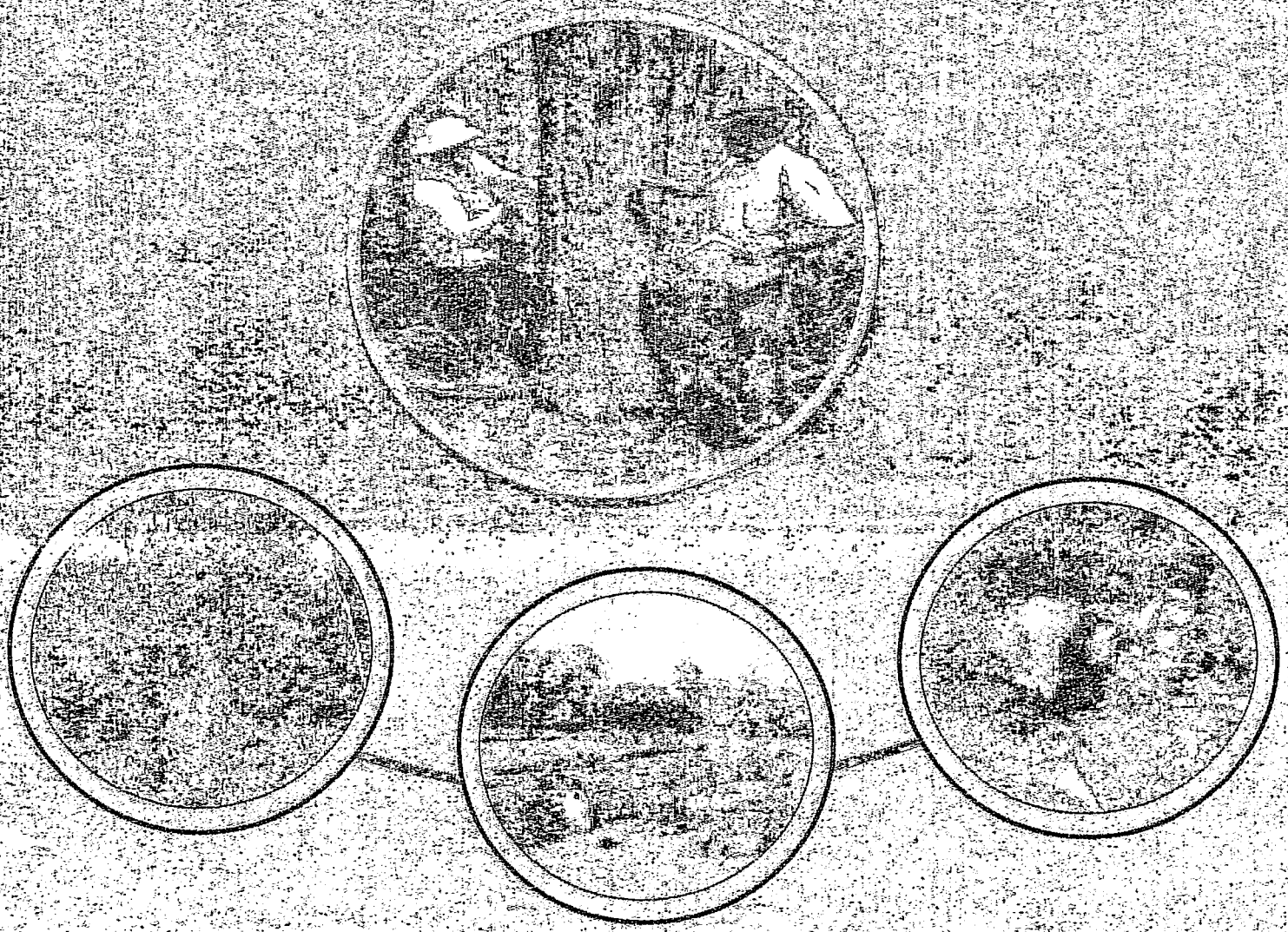
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Biodiversity study in the entire Hasdeo-Arand Coalfield comprising of Tara, Parsa, Parsa East & Kanta Basan and Kente Extension coal blocks in Chhattisgarh

Chhattisgarh Forest Department

For

State Forest Department
Government of
Chhattisgarh



By

Indian Council of Forestry Research and Education (ICFRE) Dehradun

In association with

Wildlife Institute of India (WII) Dehradun

12
No

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Foreword

Mining poses serious and highly specific threats to biodiversity and therefore biodiversity conservation and mining is under increasing scrutiny due to growing awareness of the importance of biodiversity conservation. The mining often operates in remote and environmentally sensitive areas therefore to effectively manage biodiversity in mining regions the extent and distribution of biodiversity is essential for better understanding to incorporate into conservation plans and decision-making.

Central India is one of the biggest phytogeographical provinces of the country, having diversified tropical deciduous forests dominated with Sal (*Shorea robusta*) which is home for indigenous tribal and large mammals. The Hasdeo-Arand Coalfield (HAC) of Chhattisgarh is the largest un-fragmented moderately dense moist-dry deciduous Sal and teak forests, outside the protected area network, in central India also third largest coal bearing area in Chhattisgarh. Following the appeal before the National Green Tribunal (NGT) Principal Bench Delhi, the NGT remanded the MoEF&CC to seek advice of the Forest Advisory Committee and conduct Biodiversity assessment for the whole Hasdeo-Arand Coalfield comprising of Tara, Parsa, Parsa East & Kanta Basan (PEKB) and Kente Extension Coal Blocks through [illegible] and Education (ICFRE) Dehradun in association with Wildlife Institute of India, Dehradun.

Accordingly, this study report based on the comprehensive data collected during 2019-2021 for the interdisciplinary aspect has contributed to arrive at significant findings. I applaud Dr. Sudhir Kumar, DDG (Extension) and the team including the Director IFGTB, ADG of ML Scientists, Human Experts partner institutes-Wildlife Institute of India and the Project staff for the significant contribution.

I believe that this report will provide policy and decision makers with valuable information pertaining to HAC and the coal blocks to inform action and commitment towards achieving sustainable development of mining. Also, this report will provide base to establish road map for integrating pathways for conservation of biodiversity in Hasdeo-Arand Coalfield, Chhattisgarh.

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Acknowledgement

I express my pleasure on successful completion and submission of the draft final report on ***'Biodiversity study in the entire Hasdeo-Arand Coalfield comprising of Tara, Parsa, Parsa East & Kanta Basan and Kente Extension coal blocks in Chhattisgarh'*** to the State Forest Department, Government of Chhattisgarh, as per the assignment.

The successful completion of study was made possible because of continued encouragement and constructive guidance from Shri A.S. Rawat, IFS, Director General, ICFRE. I sincerely thank DG for all the support. Also, I take this opportunity to thank Dr. S.C. Gairola, IFS, Former Director General, ICFRE and Shri Vipin Chaudhary, IFS, Former Deputy Director General (Extension), ICFRE for their cordial support and valuable inputs during the course of the study.

The commendable support extended by the State Forest Department, Govt. of Chhattisgarh is immensely acknowledged. I personally thank the PCCF (HoF), SFD, Shri Sunil Kumar Mishra, IFS, APCCF (Land Management/Forest Conservation Act) & Nodal Officer; Shri S.S. Bajaj, IFS, APCCF and Shri Atul Kumar Shukla, IFS, Former APPCF, (Land Management/Forest Conservation Act) for sparing their valuable time and support provided during the study. The timely support provided by Shri A.B. Minz, IFS, CCF Surguja; Shri Naveed Shujauddin, IFS, In-charge CCF, Bilaspur Circle; Shri Anurag Shrivastava, IFS, CF, Surguja Circle (Additional Charge); Mrs. Priyanka Pandey, IFS, DFO Surguja (now DFO, Korba Division); Shri Pankaj Kumar Kamal, IFS, DFO, South Surguja Division; Smt. Shama Faruque, IFS, DFO, Katghora Division and Shri J.R. Bhagat, IFS, DFO Surajpur Division is worth mentioning. Without their timely involvement in providing appropriate details and mobilizing the forest workforce in the field, the study would not have been possible.

The cooperation extended by Smt. Sapna Mukherjee, FRO, Udaipur Forest Range and Shri A. K. Chaubey, FRO, Kendai Forest Range and their respective team of workforces during the field survey was commendable and without their support, field work would not have been completed.

I am thankful to the timely help rendered by the office of DMG, Raipur and M/s. CMPDIL, Ranchi for providing the information related coal blocks in the Hasdeo-Arand Coalfield.

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My sincere thanks are also due to the officials of Forest Survey of India, Dehradun for providing the needful information in time to facilitate the study.

I am also thankful to mine lessees for their prompt response and providing required information during the team visit to their mine and especially M/s. Rajasthan Rajya Vidyut Utpadan Nigam Ltd. (RVUNL) for their cooperation.

I also extend my sincere thanks to the Director, WII and Expert team of WII, Dehradun for timely coordination during conducting study and preparing the study report.

I take this opportunity to thank Dr. A.N. Singh, ADG (EM), Scientists and staff of the EM Division, ICFRE for their contribution and timely involvement in completion of the study.

I sincerely thank the Domain Experts Sh. S.S. Agrawal, Former CMD, M/s. NMDC Ltd., Hyderabad; Dr. N. Ramanna, Scientist-G (Retd.), ICFRE; Shri R. Nanmathi Selvan, Former DGM, Indian Bureau of Mines, Bengaluru and Dr. Sumer Chandra, Scientist-D (Retd.), ICFRE for their expert services in successful completion of the study and report.

My special thanks to Dr. N. Rama Rao, Dr. V. Jeeva and Shri Anish V. Pacha for their contribution in analyzing data, compilation and finalization of the draft study report.

I thank Dr. Anita Chauhan, Ms. Kumbhesri Kamal Rana and other project staff of EM Division, Directorate of Research, ICFRE, for their untiring and commendable assistance during the preparation of this report.

(Dr. Sudhir Kumar)

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4	Dr. (Mrs.) V. Jeeva, Scientist-F & Senior Consultant, ICFRE	Forest Ecology and Environment, Natural Resource Management, Overall Synthesis & Finalization of Report
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12	Dr. N. Ramarao, Scientist-G (Retd.), ICFRE	Forest Ecology and Biodiversity, Reclamation & Rehabilitation of Mining Environment
13	Shri. R. NanmathiSelvan, DGM (Retd.), Indian Bureau of Mines (IBM)	Review and Drafting of Report on Mining and Geology
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15	Shri. Avinash Kumar	AutoCAD and GIS - Preparation of Thematic Maps
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19	Shri. Arvind Kumar, Project Associate	Assistance in Preparation of Thematic Maps

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2	Dr. Abijit Das, Co-Investigator	Overall project management, review of the draft report and finalization
3	Dr. G.V.Gopi, Scientist E and Nodal Officer, EIA	Review of the draft report and finalization
4	Dr. S.F. Wesley Sunderraj, Senior Subject Matter Specialist	Inputs in mitigation plan, biodiversity conservation plan , review of mine closure plan and finalization of the report
5	Mr. Lakshminarayanan	Field supervision, review of the draft report and finalization of the report
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ABBREVIATIONS

µS/cm	Micro simens per centimeter
ACUs	Adult Cattle Units
AEL	Adani Enterprises Limited
AM	Arbuscular Mycorrhizal
amsl	Above Mean Sea level
APCCF	Additional Principal Chief Conservator of Forests
ASHA	Accredited Social Healthcare Activist
ASPT	Average Score Per Taxon
BALCO	Bharat Aluminium Company Limited
BCA	Biodiversity Conservation Area
BCMP	Biodiversity Conservation Management Plan
BH	Bore Hole
BIS	Bureau of Indian Standard
BMI	Benthic Multimetric Index
BOD	Biochemical Oxygen Demand
CBA	Coal Bearing Act
CCF	Chief Conservator of Forest
CD	Community Development
CECB	Chhattisgarh Environment Conservation Board
cfu g^{-1}	Colony forming unit per gram
CHP	Coal Handling Plant
CISZ	Central Indian Shear Zone
CMPDI	Central Mine Planning and Design Institute
CMR	Coal Mines Regulation
CMSP	Coal Mines (Special Provision) Act
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
CPUE	Catch per Unit Effort
CSPGCL	Chhattisgarh State Power Generation Company Ltd.
CSR	Community Social Responsibility
Cum/T	Cubic meter per Ton
DEM	Digital Elevation Model
DGM	Directorate of Geology & Mining
DGMS	Directorate General of Mines Safety
DMG	Department of Mines and Geology
DO	Dissolved Oxygen
DPR	Detailed Project Report
EAC	Environment Appraisal Committee
EC	Environmental Clearance
ECM	Ectomycorrhiza
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPO	Ephemeroptera Plecoptera Odonata
EPT	Ephemeroptera Plecoptera Trichoptera
ETP	Effluent Treatment Plant
FAC	Forest Appraisal Committee
FBC	Fluidized Bed Combustion
FC	Forest Clearance

FD	Forest Division
FRA	Forest Rights Act
FSI	Forest Survey of India
FY	Financial Year
GA	Geographical Area
GBH	Girth at breast height
GIS & RS	Geographic Information System & Remote sensing
GPS	Global Positioning System
GSI	Geological Survey of India
ha	Hectare
HAC	Hasdeo-Arand Coalfield
HEC	Human Elephant Conflict
HEMM	Heavy Earth-Moving Machinery
ICFRE	Indian Council of Forestry Research and Education
IFGTB	Institute of Forest Genetics and Tree Breeding
IMD	India Meteorological Department
IUCN	International Union for Conservation of Nature
IVI	Importance Value Index
JFM	Joint Forest Management
k.cal/kg	Kilo Calories per Kilogram
KBA	Kanha-Boramdeo-Achanakmar
KECB	Kente Extension Coal Block
kl	Kilo liter
kV	Kilo Volt
kWh	Kilo Watt Hour
LISS-III	Linear Imaging Self-Scanning Sensor 3
LULC	Land Use Land Cover
m	meter
MCM	Million Cubic Meter
Mcum	Million cubic meter
MDO	Mine Developer and Operator
MFPs	Minor Forest Products
ML	Mine Lease
mm	milli meter
MMDR	Mines & Minerals (Development & Regulation) Act
MoC	Ministry of Coal
MoEF&CC	Ministry of Environment and Climate Change
MoRTH	Ministry of Road Transport and Highways
MPCA	Medicinal Plant Conservation Areas
MT	Metric Tonnes
MTPA	Metric Tonne per Annum
MW	Mega Watt
MWQI	Macroinvertebrate Water Quality Index
NBFGR	National Bureau of Fish Genetic Resources
NCP	Northern Crustal Province
NDVI	Normalized Difference Vegetation Index
NFSA	National Food Security Act
NGT	National Green Tribunal
NH	National Highway
NRSC	National Remote Sensing Centre

NTFP	Non Timber Forest Product
OB	Over burden
OBC	Other Backward Caste
OC	Open Cast
OCBIS	Online Coal Block Information System
PA	Protected Areas
PAF	Project Affected Family
PDF	Project Displaced Families
PEKB	Parsa East and Kanta Basan
PESA	Panchyats (Extension to Scheduled Areas), Act
PF	Protected Forest
PGPR	Plant Growth Promoting Rhizobacteria
PMCP	Progressive Mine Closure Plan
PVTGs	Particularly Vulnerable Tribal Groups
R&R	Rehabilitation and Resettlement
RBA	Relative Basal Area
RD	Relative Density
RET	Rare Endangered Threatened
RF	Reserve Forest
RF	Relative Frequency
RVUNL	Rajasthan Rajya Vidyut Utpadan Nigam Limited
SC	Schedule Caste
SCP	Southern Crustal Province
SECC	Socio-Economic Caste Census
SECL	South Eastern Coalfields Limited
SECR	South East Central Railway
SFD	State Forest Department
SH	State Highway
SHG	Self Help Group
SME	Site Mixed Emulsion
SOI	Survey of India
SPCB	State Pollution Control Board
SPSS	Statistical Package for the Social Sciences
sq.km	Square kilometer
SR	Stripping Ratio
ST	Schedule Tribe
SWRP	Sewage Water Reclamation Plant
TDS	Total Dissolve Solid
ToR	Terms of Reference
TR	Tiger Reserve
TTS	Taxa Tolerance Score
UG	Under Ground
WII	Wildlife Institute of India
WMS	Web Map Service
WS	Wildlife Sanctuary

CHAPTER-1

INTRODUCTION

1.1 BACKGROUND

The State Government of Chhattisgarh *vide* letter dated 28.04.2010 submitted a proposal seeking Forest Clearance (FC) under the Forest (Conservation) Act, 1980 for diversion of 1898.328 ha of forest land under Surguja forest division for Parsa East & Kanta Basan (PEKB) coal block. The PEKB is a captive coal block allotted to M/s. Rajasthan Rajya Vidyut Utpadan Nigam Limited (RVUNL). The Forest Advisory Committee (FAC) considered the proposal during the meeting held on 10.03.2011 and a sub-committee was constituted with a direction for a field visit to the PEKB and submit the report. The sub-committee report was considered in the FAC during the meeting held on 20.06.2011 & 21.06.2011 and not recommended for diversion of forest land; however, based on the order of the then Hon'ble Minster of State for Environment & Forests *vide* dated 23.06.2011, permission has been granted for Stage I Forest Clearance (FC) under the FC Act *vide* F.No.8-31/201-FC dated 06.07.2011 for diversion of 1898.328 ha forest land for mining in two phases (Phase-I & II) (Annexure 1.1). Further, the final Stage-II Forest Clearance has been granted by the Ministry *vide* F.No.5-4/2010/10-2 dated 28.03.2012 (Annexure 1.2). Aggrieved by the Stage-II Forest Clearance granted under section 2(ii) of FC Act by the Ministry to M/s. RVUNL, Sri. Sudiep Shrivastava the appellant filed an appeal (No. 73 of 2012) before the National Green Tribunal (NGT) Principal Bench, New Delhi. The NGT pronounced its judgment on 24.03.2014 (Annexure 1.3) and remanded the MoEF&CC with direction to seek advice of the FAC within reasonable time and emphasised for answer to the following questions:

1. *What type of flora and fauna in terms of biodiversity and forest cover existed as on the date of the proposal in PEKB coal blocks*
2. *Is/was the PEKB coal block habitat to endemic or endangered species of flora and fauna*
3. *Whether the migratory route/corridor of any wild animal particularly elephant passes through the area*
4. *Whether the area of PEKB block has that significant conservation/protection value so much so that the area cannot be compromised for coal mining with appropriate conservation/management strategies*
5. *What is their opinion about opening the PEKB coal block for mining as per sequential mining and reclamation methods proposed for regeneration of the flora.*
6. *What is their opinion about the Wildlife Management Plan Finally Prescribed?*
7. *What conditions and restriction do they propose on the mining in question, if they favour such mining?*

Subsequently, the NGT directed the FAC, MoEF&CC to seek advice/opinion/ specialised knowledge from authoritative sources such as Indian Council of Forestry Research and Education (ICFRE) or Wildlife Institute of India (WII).

Aggrieved by the NGT order, M/s. RVUNL approached the Hon'ble Supreme Court and filed Civil Appeal No. 4395 of 2014 and the Supreme Court has stayed the order of the NGT to the extent that all works commenced by the responded/project proponent and the Chhattisgarh State under section 2 of the FC Act, 1980, except the work of conservation of existing flora and fauna, shall stand suspended till further order passed by MoEF&CC in accordance with law for Parsa East & Kanta Basan (PEKB) coal block.

The FAC meeting held on 30.8.2017 directed the Regional Office, MoEF&CC to inspect the PEKB coal block lease area and adjoining area sought for prospecting, in which the user agency is mining in line with the NGT and Hon'ble Supreme Court order (Appeal No 4395 of 2014). Subsequently, the FAC after thorough deliberations and discussion during the meeting held on 26.10.2017 with the user agency, the Nodal officer of the Chhattisgarh State Government and the Regional Office, MoEF&CC Nagpur, recommended in-principal approval for prospecting of coal in Kente Extension Coal Block (KECB) forest area over 1745.883 ha under the section of FC Act 1980 with general and specific conditions that include a biodiversity assessment study to be conducted by the State government through Indian Council of Forestry Research and Education (ICFRE), Dehradun in consultation with Wildlife Institute (WII) for the whole Hasdeo-Arand Coalfield comprising of Tara, Parsa, Parsa East, Kente *vide* F. No 8-46/2017-FC dated 19.12.2017 (Annexure 1.4).

Accordingly, the Additional Principal Chief Conservator of Forests (APCCF) (Land Management) and Nodal Officer, Forest Conservation (FC), State Forest Department, Government of Chhattisgarh, Raipur approached the ICFRE *vide* letter फ.क्र.-भू-प्रबंध/स्वीकृति/331-228/15 dated 02.01.2018 and e-mail dated 03.01.2018 for conducting the above said study in the whole Hasdeo-Arand Coalfield (HAC) comprising of 23 coal blocks that include Tara, Parsa, Parsa East & Kenta Basan and Kente Extension coal blocks. Subsequently, the ICFRF approached WII, Dehradun *vide* letter No 1-23/2006-ADG(EM)LOI/ICFRF-Vol-II dated 23.01.2018 for a proposal to undertake the studies as directed by the NGT and MoEF&CC. In continuation to the above communication, the Dean, Faculty of Wildlife Sciences, WII, Dehradun *vide* letter No.WII/FSM/BP/Chhattisgarh Assessment dated 20.04.2018, submitted the proposal initially followed by a revised proposal *vide* e-mail dated 07.07.2018. Subsequently, ICFRE submitted the consolidated proposal to APCCF (Land Management) and Nodal Officer, Forest Conservation (FC), Chhattisgarh State *vide* letter No.14/1-23/2006-ADG (LM). EoI/ICFRE- Vol-II dated 12.07.2018 based on the Terms of Reference (Annexure 1.5). The Government of Chhattisgarh awarded the study to the ICFRE Dehradun *vide* letter फ. भू-प्रबंध/स्वीकृति/331-228/374 dated 29.01.2019 (Annexure 1.6) and released the

first installment *vide* letter क्र./भू–प्रबंध/खनिज/331-228/890 dated 05.04.2019 (Annexure 1.7) to initiate the study.

1.2 SCOPE OF THE STUDY

The scope of the study is to assess the floral and faunal biodiversity of the entire Hasdeo-Arand Coalfield (1879.6 sq.km) comprising of 23 coal blocks that include Tara, Parsa, Parsa East & Kanta Basan (PEKB) and Kente Extension (as on the study period 2019-2020) as well as to identify the potential impacts of mining on flora and fauna; to prepare outline for Integrated Wildlife Management Plan; suggest Conservation area and mitigation measures for management of the impacts arising out of mining on forest land.

1.2.1 Objective

1. To conduct comprehensive survey for primary baseline data collection on terrestrial flora, avian and aquatic fauna with special reference to endemic/threatened species, habitat description and ecology as well as collection of relevant secondary sources of information. The main focus was on:
    - Study the avifauna, assess the likely impacts due to mining activities and suggest measure for maintaining alternate habitats/home for avifauna including design of artificially made eco-friendly nests.
    - Provide details of Forest cover, migratory routes/corridor of wild animals, particularly, for elephant within the study area, if any;
    - Assess the socio-economic values *vis a vis* biodiversity values of the study area;
2. Assess the potential impacts on biodiversity and suggested mitigation measures to protect/conserve biodiversity due to on-going and proposed mining and allied activities.
3. Delineate conservation area.
4. Prepare outline for Integrated Biodiversity and Wildlife Management Plan with tentative budgetary provision.
5. Study the efficacy of the mine closure plan, transplanted trees, conservation measure and regeneration proposed in the operational (as envisaged in EC/FC and NGT compliance) / upcoming coal blocks and recommendations, if any.
6. Suggest and highlight measure for conservation of important resources to avoid perceived impacts; and modify specific project activities / components/ technologies (if feasible & practical) recommend for modification.

1.3 STUDY PERIOD

The study period is eighteen months that include twelve months for three season comprehensive data collection and six months for report writing. The field survey was initiated during May 2019. The final data collection along with residual data for

floral, aquatic diversity; efficacy of mine closure plan & tree translocation and terrestrial faunal aspects including the camera trap was scheduled to be completed in April 2020. However, due to COVID -19 pandemic and country wide lockdown the field visits could not be made as scheduled and the same was intimated to the APCCF (Land Management) and Nodal Officer, Forest Conservation (FC), State Forest Department, Government of Chhattisgarh, Raipur *vide* letter F.No.1-98/2019-ADG(EM)/BAS/RVUNL/Surguja-CH/ICFRE dated 28.08.2020 for rescheduling the field work once the COVID-19 related travel restrictions cease to exist. The reply to the above communication was received *vide* letter No. क / भू-प्रबंध / खनिज / 331.228/1924 dated 28.10.2020, emphasising the importance of comprehensive and complete baseline data. Also, the ICFRE *vide* letter No 1-98/2019-ADG(EM) BAS/RVUNL/ Surguja-CH/ICFRE dated 02.09.2020 intimated the progress on the study to the MoEF&CC, GoI in response to their letter No. F.No.8-36/2018FC dated 30.08.2020. The survey for final data collection was resumed in the month of October 2020 and continued up to February 2021.

1.4 STUDY AREA

The study area the whole/entire Hasdeo-Arand Coalfield (HAC) comprising of 23 coal blocks that include four allotted coal blocks such as Tara, Parsa, Parsa East & Kanta Basan (PEKB) and Kente Extension (CMPDI, 2012). The area lies between 22°56'37.397" and 22°24'18.359" N latitudes and 82°22'41.579" and 83°8'53.875" E longitudes. The HAC fall partly in Udaipur tehsil of Surguja district; Premnagar tehsil of Surajpur district; and Poudi Uproda and Korba tehsils of Korba district in Chhattisgarh State. The forest area under the coal blocks fall in Udaipur, Laxmanpur and Mainpat Forest Ranges of South Surguja Forest Division; Lemru, Balco, Kudmora, Pasarkhet Forest Ranges of Korba Forest Division; Kendai, Atmanagar Forest Ranges of Katghora Forest Division, and Ramanujganj Nagar Forest Range of Surajpur Forest Division (Figure 1.1 & 1.2).

1.5 APPROACH AND METHODOLOGY

1.5.1 Desk Review

The following documents/reports were desk reviewed by the study team during its visit to the HAC:

1. Forest Working Plans of South Surguja Forest Division (applicable for both Surguja and Surajpur Forest divisions), Katghora Forest Division and Korba Forest Division;
2. Survey of India Toposheets;
3. Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) reports, Detailed Project Reports, Pre-feasibility reports, Mining Plans/Progressive Mine Closure Plans, Environmental Clearance(EC) and Forest Clearance (FC) conditions, and the periodical compliance reports of the

statutory clearances submitted by the operational mines to the concerned Ministries/ Govt. bodies, *etc*.

i) Statutory Approvals like working permissions from the Director General of Mines Safety (DGMS), State Pollution Control Board (SPCB), *etc*., for both the operational coal blocks, *i.e.,* a) PEKB, b) Chotia as well as proposed coal block c) Parsa;
ii) Details on protected areas under respective forest jurisdictions, eco-sensitive areas, sites of religious, socio-cultural and archaeological importance;
iii) Relevant details on proposed/ allocated coal blocks;
iv) Unpublished other relevant reports/documents collected from Chhattisgarh State Forest Department, coal mine project proponents like M/s. Rajasthan Rajya Vidyut Nigam Limited (RVUNL) and M/s. Bharat Aluminium Company Limited (BALCO).
v) Published reports from Journals, related other documents of technical/non-technical reports, books, monographs, *etc*., for project details/intervention, site characteristics and other relevant information about the study area.

1.5.2 Approach

The approach adopted include desk review of relevant documents to generate project related information in detail; series of working group meetings with partner institution to work out the modality such as selection of sampling sites in the study area, methods of sampling, standardization of methodology to undertake comprehensive field survey, sharing of project related data /document- study area shape files (AUTOCAD), *etc*., and report preparation and finalization. Consultative meetings with State Forest Department (SFD) and project proponents were conducted to collect relevant information related to forest area, forest compartments, shape files of the area, location maps, assistance to conduct the field survey and project intervention information.

The study was initiated with a working group meeting held on 15.04.2019 at ICFRE Dehradun involving ICFRE and WII for biodiversity data collection consisting of terrestrial flora and fauna, avian and aquatic fauna; social and environment experts to finalize the approach and methodology to conduct the socio-economic survey and assessment on physical environmental conditions (Annexure 1.8). Followed by this, the entire team carried out reconnaissance surveys under different domains of the study during the period from 28.05.2019 to 05.06.2019 in the Hasdeo-Arand Coalfield area comprising of 23 coal blocks including Tara, Parsa, PEKB and Kente Extension (as on 2019-2020 study period) to work out the modality for generation of primary baseline data collection for the respective domains.

Consultative meetings with Chief Conservator of Forest (CCF), Surguja Forest Circle along with SFD officials from Udaipur Forest Range under Surguja Forest Division

and officials from M/s. RVUNL was held at Gumgaon 28.05.2019 to facilitate and gather information/data/maps/shapefiles/documents requirement from various stakeholders and establish networking/cooperation to facilitate and conduct the comprehensive field survey/study (Plate 1.1 - 1.3).

The baseline data collection on biodiversity study was undertaken for three seasons viz pre-monsoon (during 29.05.2019 to 04.06.2019); monsoon (from 15.09.2019 to 28.09.2019) and winter (from 15.02.2020 to 28.02.2020). Further data collection proposed to be conducted during April 2020 could not be made possible due to nation-wide lockdown on account of COVID-19 pandemic situation.

Thereafter, the surveys/studies resumed from 25.10.2020 to 01.11.2020 and from 31.01.2021 to 04.02.2021 after the unlock. During this period, the team collected residual baseline data on environmental components under different domains as well as assessment of efficacy of translocated trees, progressive mine closure plan and conservation measures (as outlined in the EIA/EMP and mine closure plan and EC/FC conditions), *etc.* (Plate 1.4 - 1.5).

1.5.3 Methodology

Comprehensive real time exhaustive field surveys were conducted for collection of primary baseline data on respective environmental components such as terrestrial flora, aquatic biodiversity, socioeconomic, mining, efficacy of mining plan, translocated tress, conservation measures, *etc.*, using standard methodologies. Thematic maps were generated using Remote Sensing (RS) and Geographical Information Systems (GIS) with the spatial data.

The detailed methodologies adopted for different components of the study are provided under the respective Chapters (Chapter 4, 5, 6 and 7). Suitable statistical tools were employed for analysis of data, interpretation and preparation of report.

1.5.4 Working Group Meetings and its outcomes

A series of working group meetings were organised by ICFRE with the partner institutes and making involved all the stakeholders as well as domain experts throughout the study period. After the inception working group meeting, second of its kind with WII was held on 18.12.2019 at ICFRE Dehradun to review the progress of the study, identify gaps in collection of baseline data and workout the modalities of moving ahead with the collection of information (Annexure 1.9). The, third working group meeting with WII and domain experts was held at ICFRE on 27.11.2020 to finalise the draft report (Annexure 1.10, Plate 1.6).

Subsequently, the ICFRE received the draft report from WII through e-mail from Dr. Bivash Pandav on 22.12.2020 and suggestions/comments on the same were intimated to WII *vide* letter No 1-98/209-ADG (EM)/BAS/RVUNL/ Surguja-CH/ICFRE dated

24.12.2020 through email on 24.12.2020. As requested by WII, the fourth working group meeting with them was held on 13.01.2021 at ICFRE on the draft report submitted by their team of experts (Annexure 1.11). Further, WII requested for extension of the study period up to 31.03.2021 *vide* letter dated 20.01.2021 (Annexure 1.12). Finally, the WII submitted draft final report of their part to the ICFRE *vide* email dated 12.04.2021

1.6 COAL BLOCKS

The Hon'ble Supreme Court of India through its judgment dated 25.08.2014, read with its order dated 24.09.2014 cancelled allotment of 204 coal blocks including all the blocks allotted in the Hasdeo-Arand Coalfield in the past. Subsequent to the Supreme Court Judgment, the Coal Mines (Special Provision) Ordinance 2014; (i) the Coal Mines (Special Provision) Second ordinance, 2014 and (ii) the Coal Mines (Special Provision) Rules, 2014 were promulgated. Under this Ordinance read with the Special provisions to four coal blocks allotted in Hasdeo-Arand Coalfield that are:

(i) Parsa East & Kanta Basan (PEKB) Coal Block No.14 to M/s. Rajasthan Rajya Vidyut Utpadan Nigam Limited (RVUNL).
(ii) Parsa-Coal Block No.13 to M/s. RVUNL.
(iii) Kente Extension Coal Block No. 12 - allotted to M/s. RVUNL and
(iv) Chotia Coal Block No.2 (sub-blocks 2A & 2B) allotted to M/s. BALCO (Vedanta Group).

Table 1.1: Details on the communication between ICFRE and other relevant stakeholders primarily the State Forest Department, Govt. of Chhattisgarh in respect of finalising the list of coal blocks in Hasdeo-Arand Coalfield falls under Surguja, Surajpur and Korba districts of Chhattisgarh

Letter No	Date	Source: to & fro	Subject
F.No1-98/2019-ADG(FM)/BAS/RVNL/Surguja-CF/ICFRI	23.10.2020	APCCF	HAC
F.No1-98/2019-ADG(FM)/BAS/RVNL/Surguja-CF/ICFRI	01.10.2020	APCCF	HAC
F.No1-98/2019-ADG(FM)/BAS/RVNL/Surguja-CF/ICFRI	22.08.2020	APCCF	HAC
F.No1-98/2019-ADG(FM)/BAS/RVNL/Surguja-CF/ICFRI	11.10.2019	APCCF	HAC
F.No1-98/2019-ADG(FM)/BAS/RVNL/Surguja-CF/ICFRI	05.09.2019	APCCF	HAC
F.No1-98/2019-ADG(FM)/BAS/RVNL/Surguja-CF/ICFRI	18.07.2019	Mineral Resources Dept	Geological reports of 18 coal blocks
F.No1-98/2019-ADG(FM)/BAS/RVNL/Surguja-CF/ICFRI	18.07.2019	APCCF	Geological reports of 18 coal blocks
S.No(FM/Min/331-228/1506	11.05.2018	Received letter form PCCF	Hasdeo-Arand coal blocks

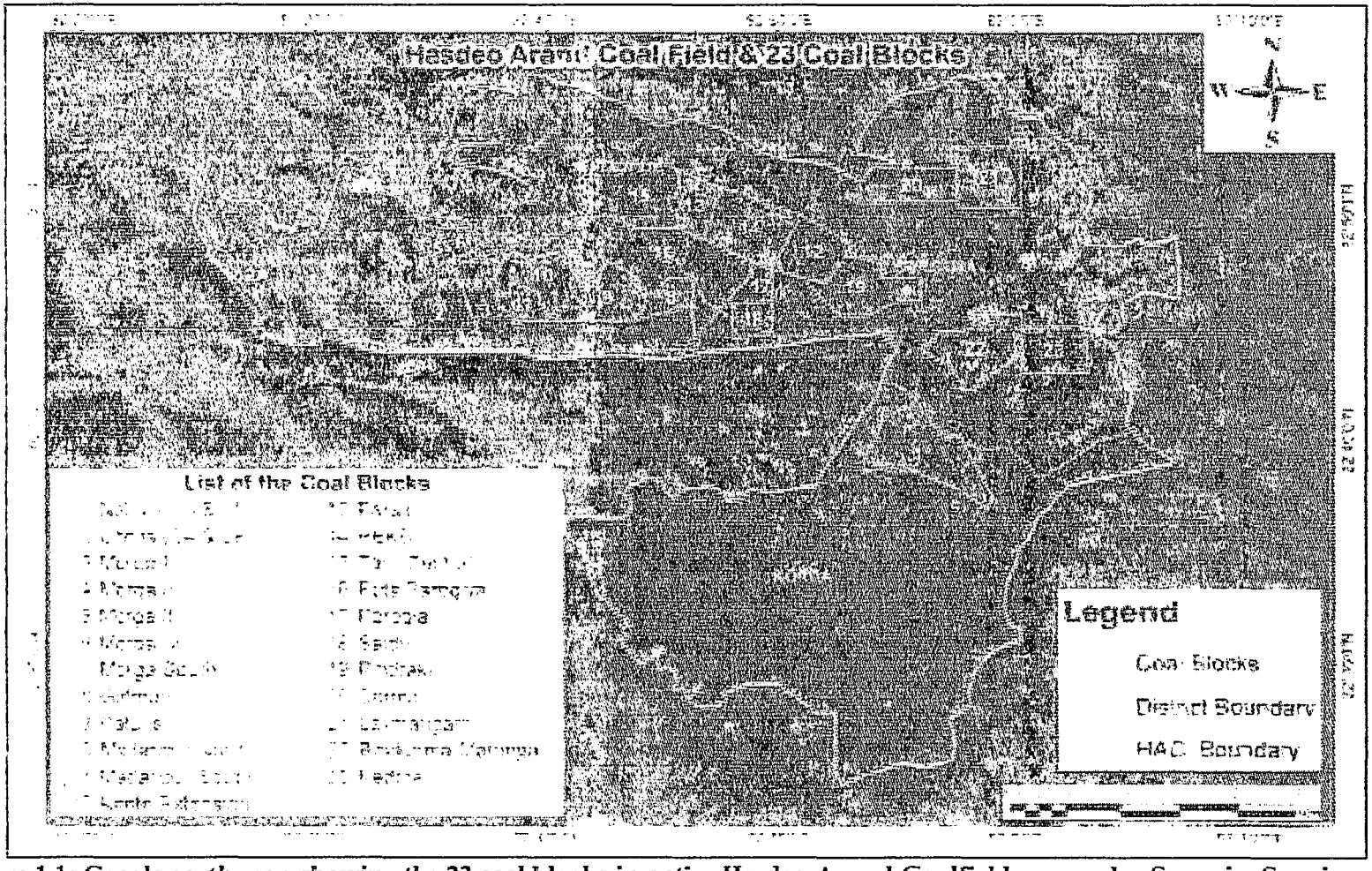


Figure 1.1: Google earth map showing the 23 coal blocks in entire Hasdeo-Arand Coalfield area under Surguja, Surajpur and Korba districts of Chhattisgarh

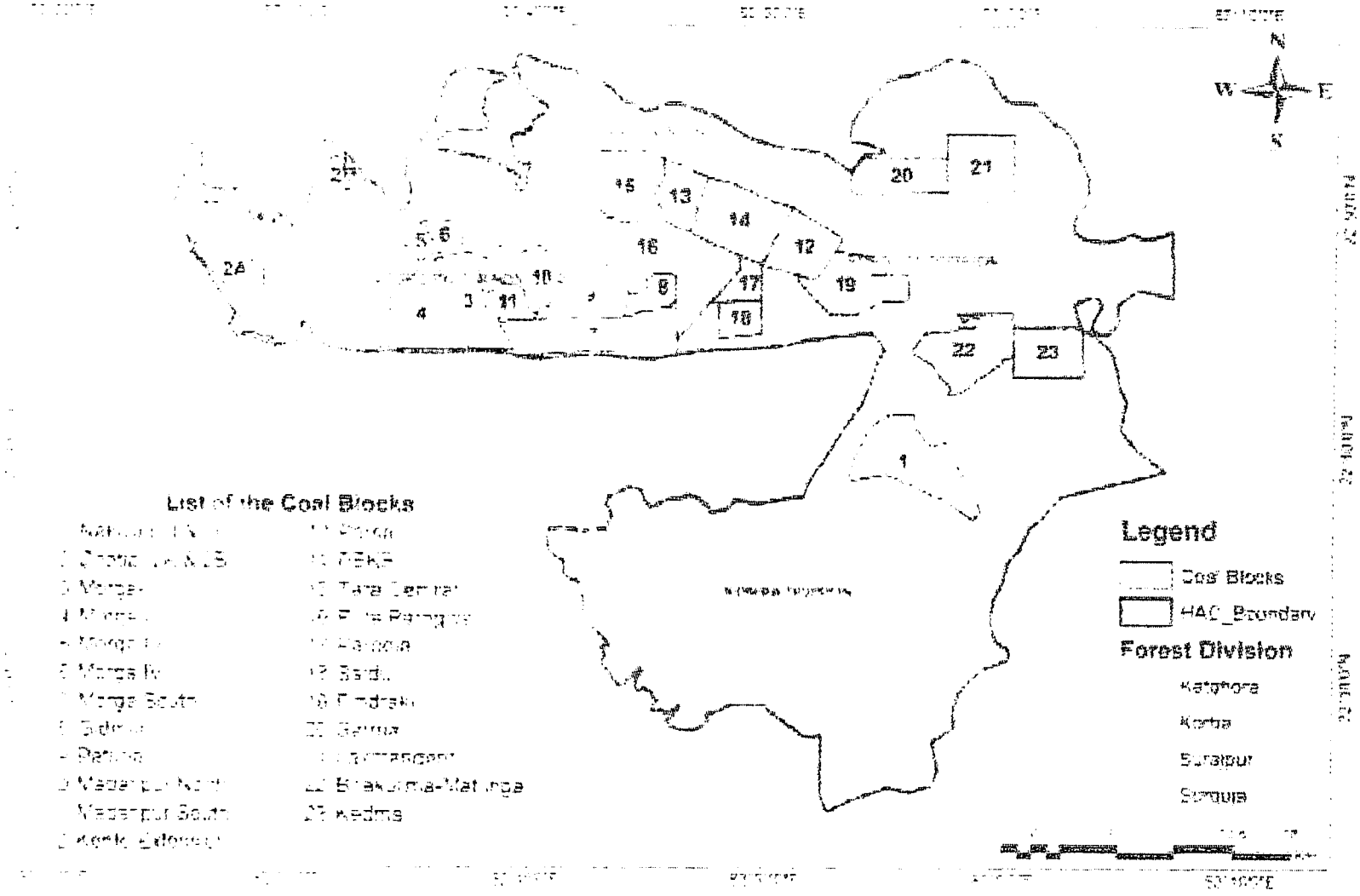


Figure 1.2: Demarcation of the 23 Coal blocks in the entire Hasdeo-Arand Coalfield area under Surguja, Katghora, Korba and Surajpur Forest Divisions of Chhattisgarh

Table 1.2: Profile of the coal blocks and status of mining plans in the entire Hasdeo- Arand Coalfield area of Surguja, Surajpur and Korba districts of Chhattisgarh

Sl. No.	Name of Coal Block as per coal block allocation rule	Block No.	District	Latitude	Longitude	Allotment status	Extent sq.km.	Geological Reserves in MT	Remarks/Status
Allotted									
1	Parsa East KantaBasan-CMSP (OC)	14	Surguja	22°47'38.62"N to 22°51'16.65"N	82°49'39.01"E to 82°47'23.51"E	Allotted to M/s. Rajasthan RajyaVidyut Utpadan Nigam Limited	26.83	532.86	Mine is in operation in the Ist Phase
2	Parsa-CMSP (OC)	13	Surguja & Surajpur	22°48'56.76"N to 22°52'0.66"N	82°46'41.68"E to 82°45'35.84"E		12.52	256.40	EC awaited
3	Kente Extension-MMDR (OC)	12	Surguja	22°47'00.72"N to 22°50'01.14"N	82°51'59.32"E to 82°50'58.41"E		17.60	369.22	TOR accorded
4	Chotia-Sub block-2A-CMSP (OC, UG)	02	Korba	22°50'08.23"N to 22°44'24.40"N	82°26'10.87"E to 82°29'10.75"E	Allotted to M/s. Bharat Aluminium Company Ltd. (BALCO) (Vedanta Group).	8.63	29.187	The ML has 2 sub blocks. Sub block 2A is under Fly ash dumping & backfilling; Sub block 2B is in operation
	Chotia-Sub block-2B			22°52'08.70"N to 22°50'55.42"N	82°51'37.96"E to 82°52'47.17"E		3.17	10.832	
Identified									
5	Tara-CMSP (OC)	15	Surajpur	22°49'25.44"N to 22°52'23.87"N	82°45'21.34"E to 82°42'48.95"E	Identified	24.00	317.33	Block initially allotted to CMDC
6	Madanpur North-CMSP (OC, UG)	10	Surajpur & Korba	22°45'34.81"N to 22°48'23.62"N	82°40'16.79"E to 82°38'36.67"E	Identified	21.39	215.46	Unallocated
7	Madanpur South-CMSP (OC)	11	Korba	22°45'11.15"N to 22°40'55.97"N	82°58'48.11"E to 82°38'32.10"E	Identified	7.14	169.83	APMDC Ltd.
8	Gidmuri-CMSP (OC, UG)	08	Korba	22°45'29.56"N to 22°47'[illegible]3.87"N	82°44'16.63"E to 82°45'10.66"E	Identified	7.33	80.27	Chhattisgarh State Power generation Co. Ltd
9	Panura-CMSP (OC, UG)	09	Korba	22°45'21.64"N to 22°48'[illegible]0.56"N	82°43'50.93"E to 82°42'37.53"E	Identified	16.14	269.25	NA
10	Morga II-CMSP	04	Korba	22°47'48.78"N to 22°42'05.68"N	82°35'52.05"E to 82°37'19.42"E	Identified	26.64	350.70	NA
11	Morga III-CMSP	05	Korba	22°47'42.56"N to 22°49'21.71"N	82°35'10.69"E to 82°35'22.65"E	Identified	6.00	36.00	M.P state Mining Corp. Ltd.,
12	Morga IV-CMSP	06	Korba	22°48'05.67"N to 22°49'[illegible]3.05"N	82°36'04.17"E to 82°35'53.02"E	Identified	6.87	34.78	M.P state Mining Corp. Ltd.,
13	Morga South-MMDR	07	Korba	22°43'48.13"N to 22°46'17.89"N	82°39'21.49"E to 82°46'10.17"E	Identified	21.92	432.54	Unallocated
14	Sarhi-MMDR	18	Surguja & Korba	22°44'33.17"N to 22°46'10.26"N	82°47'54.65"E to 82°49'38.68"E	Identified	6.72	27.49	Identified Geological Report
15	PunaParogiya-MMDR	16	Surguja, Surajpur & Korba	22°44'30.66"N to 22°49'56.74"N	82°46'12.32"E to 82°42'58.64"E	Identified	48.04*	NA	Identified
16	Parogia-	17	Surguja	22°46'03.96"N to 22°48'02.08"N	82°47'56.01"E to 82°48'40.46"E	Regionally promotionally explored block	7.16*	NA	Regionally promotionally explored block
17	Pindrakhi-MMDR	19	Surguja	22°45'21.36"N to 22°48'[illegible]1.95"N	82°53'44.75"E to 82°52'50.52"E	Identified	23.94*	NA	Identified
18	Sarma-	20	Surguja	22°50'38.86"N to 22°52'05.64"N	82°57'28.97"E to 82°53'55.90"E	Regionally promotionally explored	18.18*	NA	Regionally promotionally explored block

Sl. No.	Name of Coal Block as per coal block allocation rule	Block No.	District	Latitude	Longitude	Allotment status	Extent sq.km.	Geological Reserves in MT	Remarks/Status
						block			
19	Lakhanpur	2	Surguja	22°56'20.31"N to 22°57'[illegible]4"N	83°00'10.39"E to 82°57'27.55"E	Regionally promotionally explored block	23.64*	NA	Regionally promotionally explored block
20	Bhalumuda-Marringa-MMDP	22	Surguja	22°42'15.26"N to 22°45'[illegible]89"N	82°57'55.95"E to 82°57'53.66"E	Identified	26.00*	NA	Identified
21	Kusmunda	27	Surguja	22°45'01.00"N to 22°45'[illegible]19"N	82°03'12.53"E to 82°00'12.07"E	Regionally promotionally explored block	18.95*	NA	Regionally promotionally explored block
22	Morga-I-CMDP	1	Korba	22°48'[illegible]6.4"N to 22°44'[illegible]4.24"N	82°57'21.87"E to 82°54'[illegible]5.02"E	Identified	21.62*	NA	Identified
23	Nakoya-I, II & III -MMDP	31	Korba	22°56'57.57"N to 22°54'[illegible]2.39"N	82°59'39.69"E to 82°55'[illegible]0.75"E	Identified	34.29*	NA	Identified
Total							**434.72**		

Sources: The shape files provided by RVUNL, extent of area worked out using GIS Sy[illegible] FRI

– CMPDI- OCBIS [illegible] regionally promotionally explored blocks, will be include[illegible] in HAC only after finalization of block boundary

*No documents available and therefore the area of extent was estimated using GIS & R[illegible]

The Central Mine Planning and Design Institute (CMPDI) have identified the coal blocks in Hasdeo-Arand Coalfield (https://www.cmpdi.co.in/OCBIS/dashboard.php). In order to finalize exact number of coal blocks for the study, requests and reminders were made to APCCF with a copy to Mineral Resources Department and CMPDI for providing the details of the additional coal blocks, if any (Table 1.1). Further, the CMPDI has intimated that the coal blocks- Parogia, Sarma, Laxmangarh and Kedma are only regionally promotionally explored and are yet to be identified once the boundary area finalized after detailed exploration (*vide* letter No. DG/CMPDI/Forests/ 714(A)/2021 dated 05.03.2021). However, the shape files received from M/s. RVUNL for the 23 coal blocks were considered for the study. Efforts were made to collect baseline data on the allotted coal blocks from the respective project proponents and for the other identified coal blocks from secondary sources.

The status on the coal blocks based on the information received is presented in Table 1.2. The 23 coal blocks considered for the study fall in the Udaipur, Lakhanpur and Mainpat forest ranges of South Surguja Forest Division; Lemru, Balco, Kudmora, Pasarkhet forest ranges of Korba Forest Division; Kendai, Pasan, Atmanagar forest ranges of Katghora Forest Division, and Ramanuj Nagar forest range of Surajpur Forest Division (Figure 1.3).

1.7 REPORT FORMAT

This report consists of ten chapters (Volume-I) as per the details furnished below as well as its attachment as annexures.

Chapter-1	Introduction
Chapter-2	Profile of the Hasdeo-Arand Coalfield Area
Chapter-3	Profile of the Coal Blocks
Chapter-4	Status of Terrestrial Floral Diversity
Chapter-5	Status of Terrestrial and Avian Faunal Diversity
Chapter-6	Status of Aquatic Biodiversity
Chapter-7	Social- Economic *vis-a vis* Biodiversity Values of HAC
Chapter-8	Efficacy of Mine Closure Plan & Conservation Measures Proposed in Operational/Upcoming Coal Blocks
Chapter-9	Efficacy of Translocated Trees
Chapter-10	Findings and Recommendations

1.8 LIMITATIONS OF THE STUDY

Based on the available information, the study considered for baseline data generation only 23 coal blocks (total extent of 472.21 sq.km) that consists of on-going, allotted, identified and yet to be regionally explored coal blocks in the study area of Hasdeo-

Arand Coalfield comprising of 1879.57 sq.km as on the study period of 18 months (2019-2020). Lack of required documents/reports like mining and mine closure plans, EIA/EMP reports (except for PEKB, Parsa, Kente extension and Chotia coal blocks); non-availability of documents/ reports/information for Morga-I, Nakiya-I, II & III, Kedma, Bhakurma-Matringa, Laxmangarh, Sarma, Pindraki, Parogia, Puta Parogia coal blocks, for which only the provisional coal block boundaries are available, were the major constraints to outline specific impacts. Available secondary sources of information were considered wherever applicable. In addition, the shape files provided by the M/s. RVUNL for the 23 coal blocks in HAC were used. Therefore, there may be slight variation with the actual coal block boundary details posted by the CMPDI site. The same may be considered carefully in future.

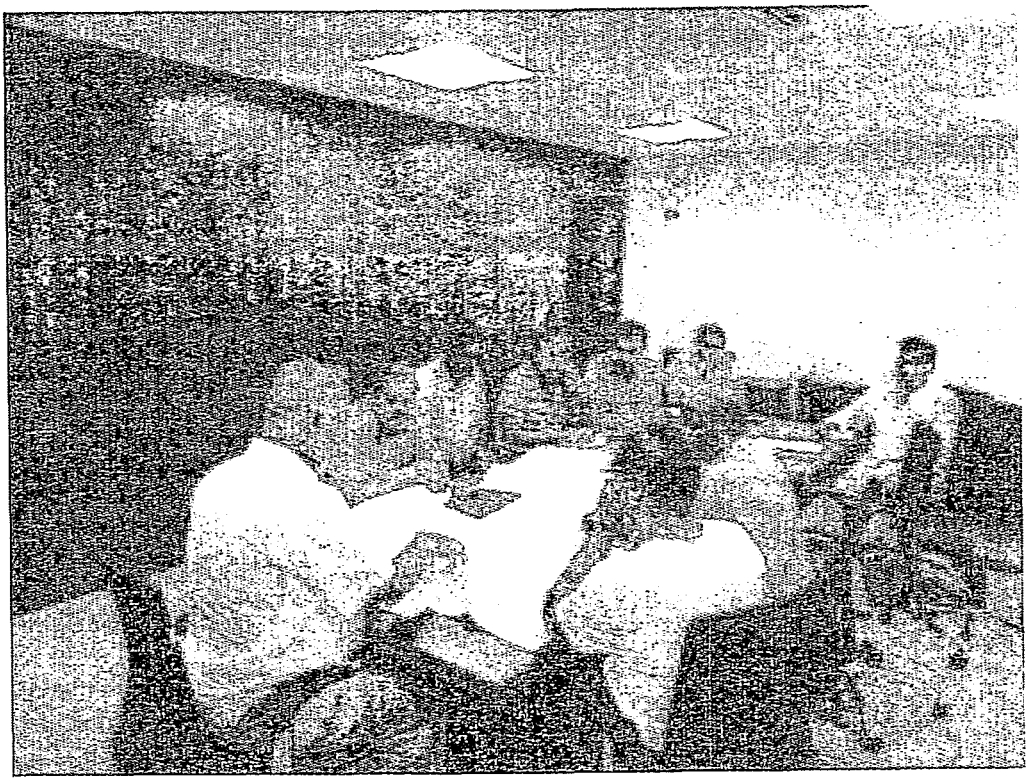
The draft report expected to be submitted was delayed due to the gaps in the data collection for various components including camera trap established by WII, which was planned during April 2020, could not be made because of COVID-19 pandemic related country-wide lockdown (first lock down commenced from 24.03.2020). However, ICFRE requested the Chhattisgarh Forest Department for rescheduling of the work period (time frame for submission of the final report) *vide* ADG (EM) office letter F.No.1-98/2019-ADG(EM)BAS/RVUNL/Surguja-CH/ICFRE dated 28.08.2020 and the request has been agreed by the Chhattisgarh Forest Department *vide* letter No. क्र/भू-प्रबंध/खनिज/331-228/1924 dated 28.10.2020 keeping in view the importance of the baseline data essentially required for the study.

Wildlife part

The wildlife study mainly concentrated in the area of Tara, Parsa, Parsa East & Kanta Basan (PEKB) and Kente Extension coal blocks in the HAC. The study area for inventory of mammals and pattern of habitat use for selected mammalian faunal study considered in HAC is 630 sq.km and 10 km buffer that include the extent of mine lease coal blocks of Tara, Parsa, Parsa East & Kanta Basan (PEKB) and Kente Extension (87 sq.km). In addition, probability of tiger presence in the entire Hasdeo-Arand Coalfield (HAC) landscape (1518 sq.km) using forest cover, ungulate prey and minimal habitat disturbance have also been made. The findings are outlined in Chapter -5 of this report; however, the detailed report submitted by WII is enclosed as Volume-II for reference.



Plate 1.1: Inception meeting of the study held on 28.01.2019 with team of experts from ICFRE, WII, Domain experts, SFD and Parsa East & Kanta Basan (PEKB) mine officials



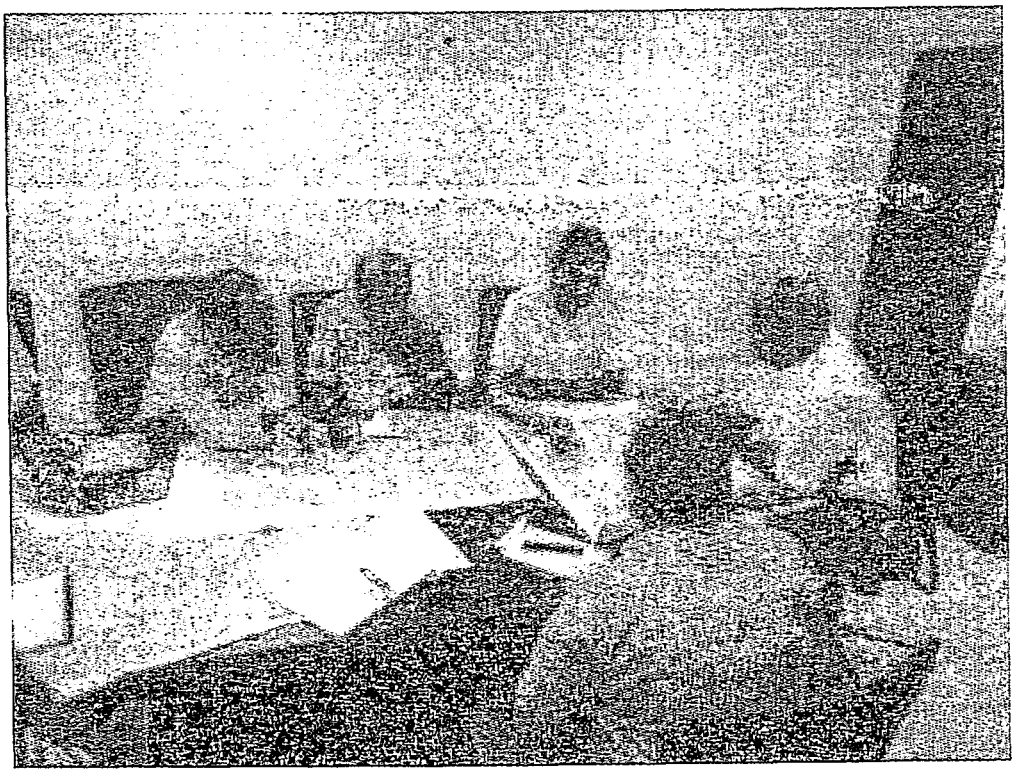


Plate 1.2: Working group interactive meeting to decide the methodology and sample design held on 29.01.2019



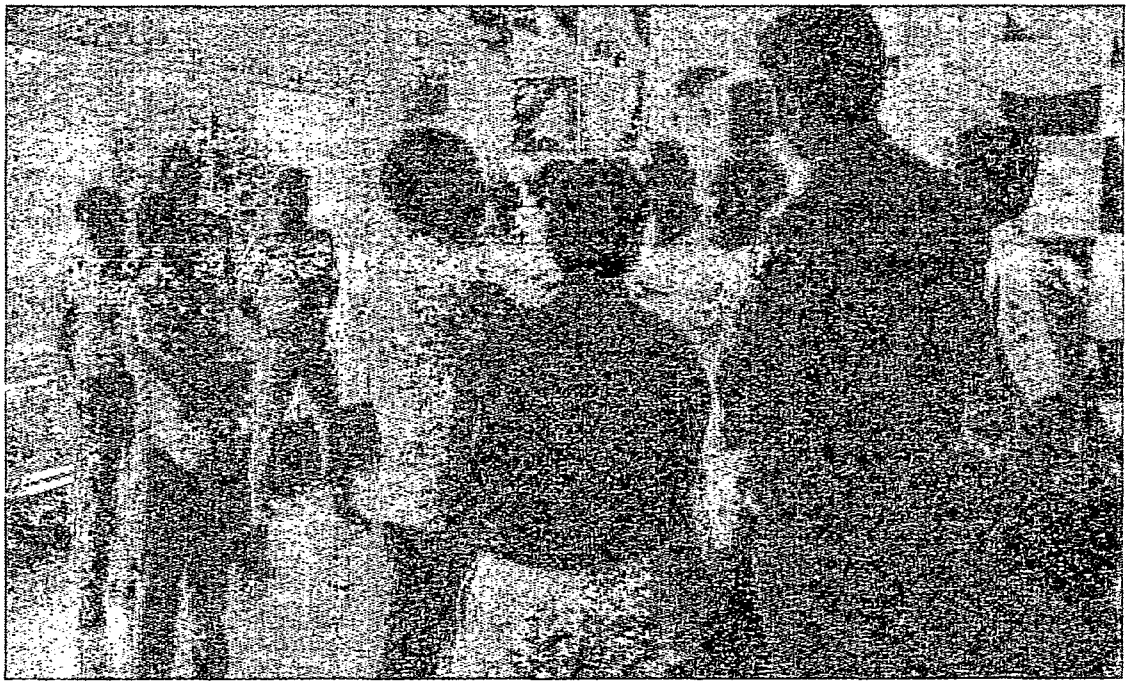


Plate 1.3: Expert team interacting with the SFD officials of the respective forest divisions/ranges in Chhattisgarh for field survey in HAC

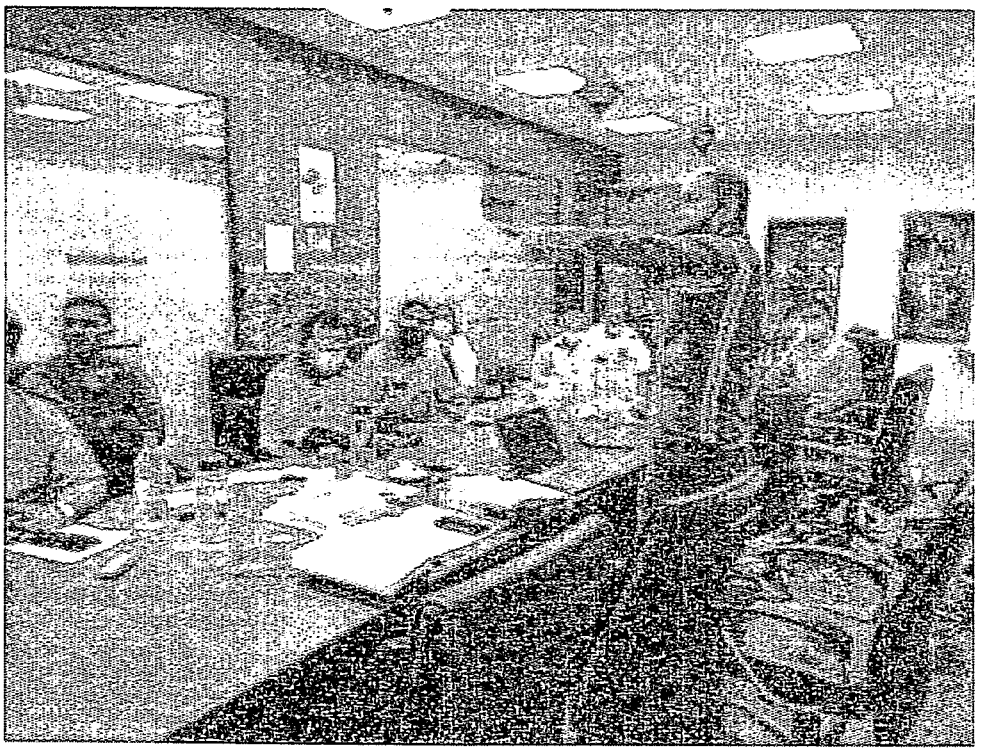


Plate 1.4: Expert team having discussion with PEKB for baseline data collection on mining and mine closure plan during October 2020

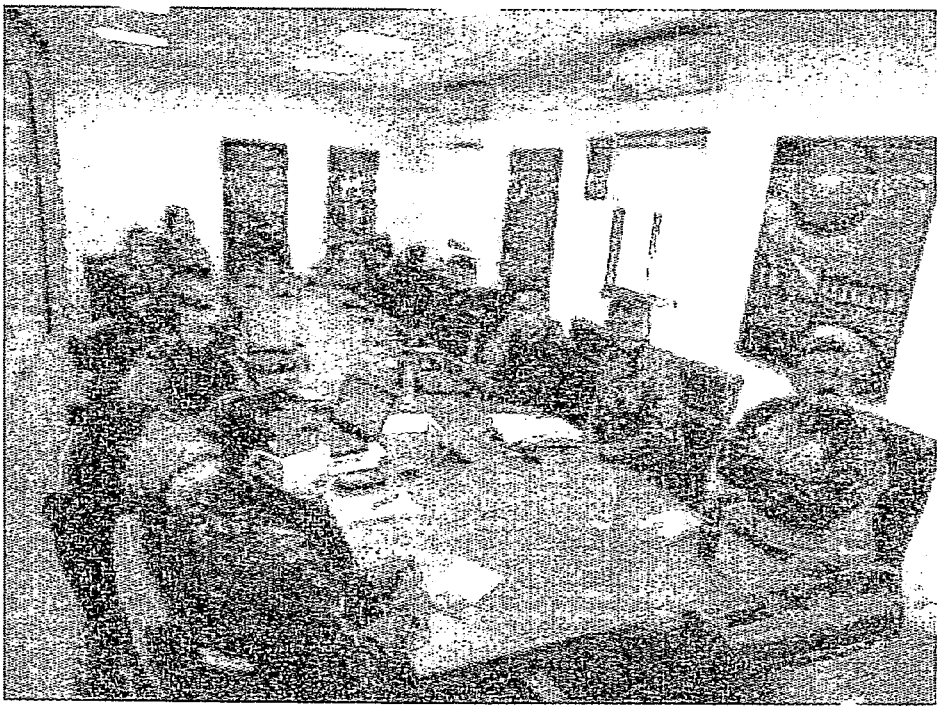


Plate 1.5: Expert team having discussion with PEKB for baseline data collection on mining and mine closure plan during February 2021



Plate 1.6: Working group meeting with WII and Domain expert at ICFRE, Dehradun during November 2020

CHAPTER-2

PROFILE OF THE HASDEO-ARAND COALFIELD

2.1 INTRODUCTION

The study area *i.e.*, the Hasdeo-Arand Coalfield is the third largest in terms of coal reserves (17%) in the country with an area of 1879.8 sq.km spread over from north Korba to south Surguja and Surajpur districts of Chhattisgarh (Figure 2.1 and 2.2). The next-largest is Korba Coalfield that lies over an area of 530 km^2. About 80% of the coal resources are reported to be under forest land use and the total estimated coal reserves is 5.179 billion tonnes out of which 1.369 billion tonnes are proven reserve. Out of the total coal bearing area, 1502 sq.km falls in the forest, which is reported to be the largest un-fragmented forests in Central India consisting of pristine Sal (*Shorea robusta*) and teak forests outside the official protected area system, which is an important corridor for movement of flagship species like elephants and tigers in Chhattisgarh.

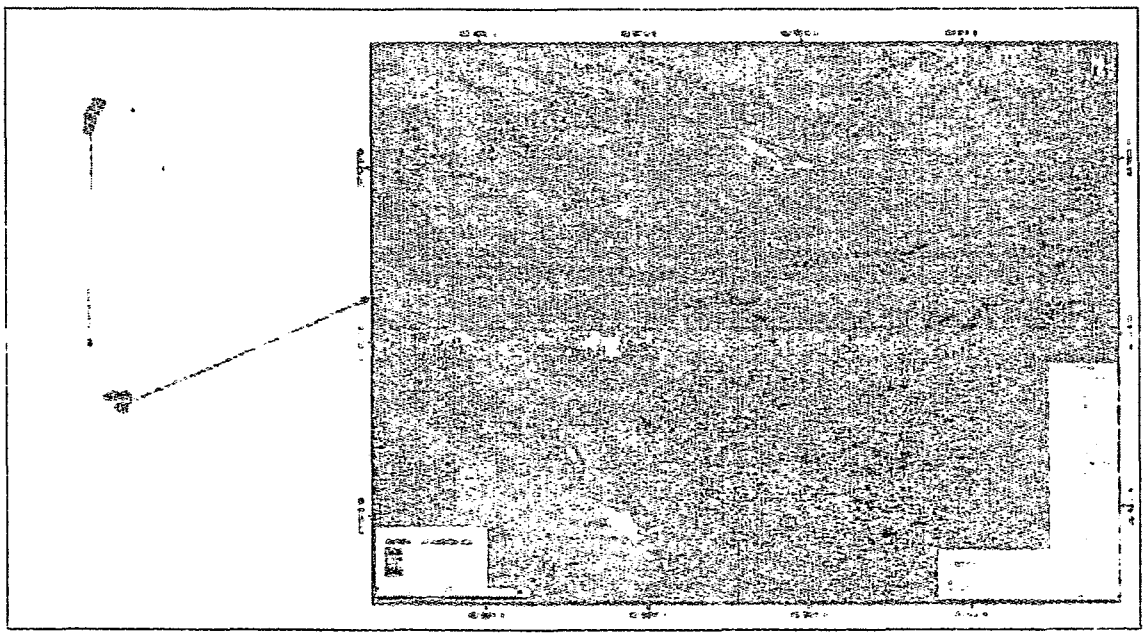


Figure 2.1: Location map of Hasdeo-Arand Coalfield in Chhattisgarh, India

National Highway NH 130 that passes through the HAC provides easy accessibility. The district headquarters *i.e.*, Ambikapur (Surguja) and Surajpur (Surajpur) are located towards north at about 100 km and 120 km respectively, whereas Korba district is situated at about 50 km south of the coalfields. The nearest Railway station is at Ambikapur, which is also the nearest city, while the nearest airport is Swami Vivekananda airport at Raipur, the State Capital, situated at about 280-300 km away from the coalfield. The nearest larger water body is Hasdeo Bango Reservoir.

A total of 23 coal blocks have been identified by Ministry of Coal in the Hasdeo-Arand Coalfield, of which, two *i.e.*, Parsa East & Kanta Basan (PEKB) and Chotia-2A coal blocks are in operation as on today, the remaining coal blocks are either allocated

or ar[illegible] under various process/ stages for development, however, many are identified and few are regionally promotionally explored (CMPDI, 2021).

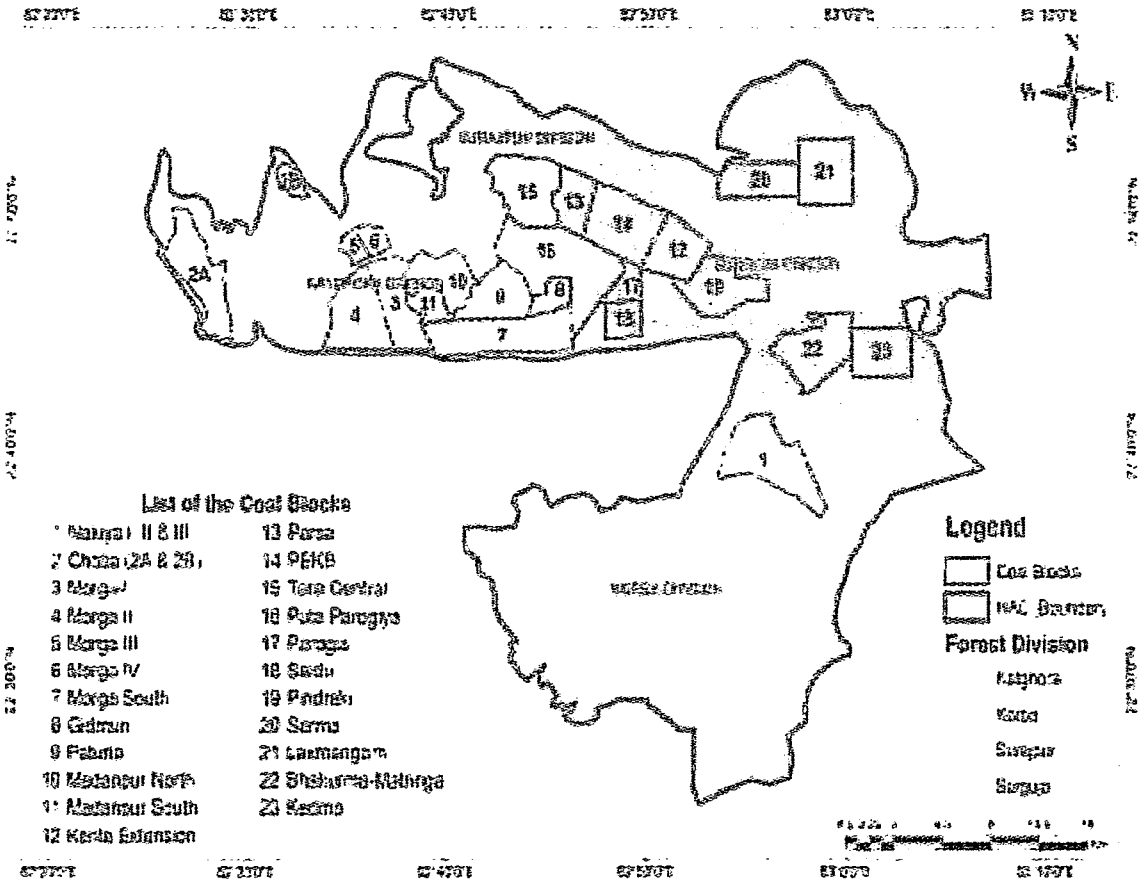


Figure 2.2: Location of coal blocks within the study area of Hasdeo-Arand Coalfield that falls within the Forest Divisions of Surguja, Surajpur and Korba & Katghora in Chhattisgarh

2.2 CLIMATE

The study area experiences tropical to semi-tropical climate with three well defined seasons *i.e.,* summer (March to mid-June), monsoon (from mid-June to mid-September) and winter (mid-September to February). The temperature varies with the change in the topography and land use. The upstream reaches of Hasdeo have good forest cover and therefore the temperature is lower than that in the downstream reaches. Summers are hot with day temperature ranging between 35°C to 46°C and the night temperature between 18°C to 24°C. Winters are mild with day temperature ranging from 26°C to 31°C and the minimum temperature at night varies from 6°C to 19°C. The average maximum and minimum temperature recorded in the area is 41.5°C in June and 19.8°C in September respectively. December is the coolest month with the average daily maximum temperature of 26.5°C and the mean daily minimum temperature of 5.5°C. The normal annual rainfall reported to occur is 1192.3 mm with 73 normal rainy days and the average rainfall is about 1400 mm. South-West (SW) monsoon account for 80% of the rainfall that occur between June and September (1056 mm) with 57 normal rainy days. The NE monsoon occur during October-

December (48.4 mm) with 6 normal rainy days; winter (Jan- March) with 37 mm normal rainfall and 6 normal rainy days and summer (April to May) with 50.1 mm normal rainfall with 4 normal rainy days. Winds are generally light to moderate and prevail throughout the year. Winds from N direction are predominant (27.4%) followed by W direction winds (8.7%) and S direction winds (6.3%) of the total time. Calm conditions prevailed for over 30.9% of the time.

2.3 SOILS

Soils of Surguja district can be broadly classified into four major classes: Red and Yellow, Alluvial, Laterite and Medium blue Soils. Red and Yellow soil are derived from the parent rocks of Gondwana System including sedimentary rocks. *Alluvial soils* are yellow to grey in color and found along the sides of Rihand and Hasdeo Rivers and their major tributaries with alternative layers of sand and silt. These soils contain adequate amounts of potash and lime but are deficient in nitrogen, phosphoric acid and humus. *Lateritic soils* are red in color and rich in oxides of iron and aluminium formed due to leaching of soil. These are generally poor in nitrogen, potash, and organic matter. On the basis of colour lateritic soils can be divided as dark red laterite and white laterite. *Black soils* are formed by weathering of basaltic and trap rocks. These are highly retentive of moisture and extremely compact and tenacious when wet. Soil of alluvium are residual in nature, cover most of the Tara, Parsa, Parsa East & Kanta Basan, Kente Extension, Gidmuri, Paturia, Madanpur, Chotia coal blocks. Soils in PEKB coal block is predominantly of clay type and sandy in Gidmuri and Paturia coal blocks, yellowish to reddish brown colour and yellow to brownish soils in Tara block. The soil depth varies between 0.5 m to 11 m in Gidmuri and Paturia blocks and upto 6 m in Tara block. Soils of PEKB block is slightly alkaline (pH 6.2 to 7.5), low (0.14% to 0.21%) in organic matter and nutrient status.

2.3.1 Soil Microorganism in the Study Area

The soils in the HAC area are generally of clayey loam type with sandy loam soil in some areas. The soils developed on moderately steep slopes are marked by severe erosion. The soils have been classified as Ustocherpts/ Ustorthents/ Rhodustalfs/ Haplustalfs/ Haplusterts as per pedological taxonomy. The area is more prone to soil erosion and gully erosion is a prominent feature of the physiography in most of the areas (Singh, 2013). Soil microorganism composition is closely related to soil fertility and the plant community (Tripathi *et. al.,* 2009; Maiti, 2013). Soil microbial community structure, diversity and soil enzyme activity, are highly sensitive to soil environmental changes (Bell *et. al.,* 2001; Wong, 2003; Soni and Rawat 2005; Borpujari, 2008; Hossain *et. al.,* 2015; Upadhyay *et. al,* 2016). They can be used as evaluation indexes of the sensitivity of the soil ecosystem to offset the short comings of soil physicochemical indexes (Singh *et. al.,* 1989; Srivastava and Singh, 1991; Jha and Singh, 1991 Singh *et. al.,* 2004). Considering the importance of soil microorganism community in maintaining the sustainability of the soil ecosystem, which plays a key role in nutrient cycling, litter decomposition and ecosystem

functional maintenance, the ICFRE undertook the study of the status of different microbial populations (*viz.*, Bacteria, Fungi, Actinobacteria and symbiotic group of fungi (Mycorrhizal fungi) within the HAC area (Plate 2.1) .

2.3.1.1 Enumeration of soil microbial population

Soil samples with smaller roots were collected during three seasons viz., June, 2019, September, 2019 and February, 2020 from various representative locations within the study area of Hasdeo-Arand Coalfield (HAC), which is mostly Sal (Shorea robusta) dominated forest landscapes. Fungal fruit bodies of Ectomycorrhizal (ECM) fungi belong to Basidiomycetes were collected during rainy season (September, 2019). The samples collected and preserved were brought to laboratory at Institute of Forest Genetics and Tree Breeding (IFGTB), Coimbatore for processing and estimation of soil microbial population and identification of respective organisms by adopting standard techniques.

2.3.1.2 Status of spore population of Arbuscular Mycorrhizal (AM) Fungi and Ectomycorrhizal (ECM) Fungi

The investigation of the association of symbiotic group of fungi like Arbuscular Mycorrhizal (AM) and Ectomycorrhizal (ECM) fungi with the roots and soils collected from the study area during different seasons revealed both AM fungal root colonization in the form of vesicular and hyphal structures and arbuscular structures; and ECM colonized root samples had prominent basidiomycete characteristic hyphal structures like clamp connections.

In the present investigation, a total of 24 AM fungi belonging to four genera *viz.*, *Acaulospora* (02 species), *Gigaspora* (03 species), *Glomus* (18 species) and *Scutellospora* (01 species) were recorded. The genus *Glomus* spp., were noted to be most abundant AM fungus in different study sites during rainy season. This has important implications for plant ecology, as the vegetation with they are associated is unlikely to survive where these fungi are absent.

In the present study, a total of 14 different ECM fungi belong to 9 genera such as *Amanita, Astraeus, Boletus, Boletellus, Lycoperdon, Russula, Scleroderma, Suillus* and *Tuber* were recorded from the Sal forests of Hasdeo-Arand Coalfield during rainy season. These findings are in consonance with studies of earlier researchers (Soni *et. al.*, 2011; Verma *et. al.*, 2019).

2.3.1.3 Other beneficial PGPR (Plant Growth Promoting Rhizosphere) microbes

The soil samples collected were also analyzed and estimated for population density of PGPR microorganisms. The results of the analysis of microbial populations represented as colony forming units (cfu) x dilution factor per gram of the soil samples collected are discussed in the table below:

Sl. No.	PGPR Microbes	Population Density (cfu. g^{-1})					
		June, 2019		September, 2019		February, 2020	
1	Actinobacteria	0.3×10^2	20.0×10^2	0.3×10^2	16.3×10^2	0.3×10^2	2.0×10^2
2	*Azospirillum*	0.17×10^5	22.7×10^5	0.17×10^5	16.7×10^5	7.3×10^5	18.0×10^5
3	*Azotobacter*	0.17×10^5	44.7×10^5	0.3×10^5	39.2×10^5	7.6×10^5	17.3×10^5
4	Phosphate Solubilizing Bacteria (PSB)	0.17×10^5	1.67×10^5	0.17×10^5	3.8×10^5	6.5×10^5	19.3×10^5
5	Fungi	6.0×10^2	49.0×10^2	4.0×10^2	40.0×10^2	1.3×10^2	9.7×10^2

2.4 LAND USE COVER CHANGE DETECTION

ICFRE undertook the assessment of land use changes using standard methodologies described as below:

2.4.1 Methodology

The Land use land cover (LULC) maps for the year 2011-12 and 2015-16 were generated on 1:50,000 scales using on screen visual interpretation/digitization method in GIS domain and with help of Web Map Service (WMS) of Bhuvan Geoportal of NRSC, ISRO data using post analysis of vector layer. LULC layer prepared for the study area is consisting of five major classes *viz.* Built-up, Agriculture, Forest, Wastelands and Water Bodies and 14 sub classes of NRSC classification (Figure 2.3 - 2.5). The steps followed for analysis are digitization of land use map, and editing as given in Table 2.1.

Area statistics of land use categories have been calculated in sq. km as well as in percentage. The change in the extent of different land use categories during the period from 2011-12 to 2015-16 was analyzed and computed. The input data for this study is used from data of Resourcesat-2 LISS-III terrain corrected data from LISS-III sensor of 3 seasons viz. i) Monsoon season - Kharif crop (August - October); ii) Post-Monsoon – Rabi crop (December - March) and iii) Pre-Monsoon - Zaid crop (April - May) for the years 2011-12 and 2015-16.

The data was classified using a hybrid approach (Decision Tree – See 5 or Supervised MXL or both). The overall classification accuracy of different LULC classes vary from 79% (like agro-horticulture) to 97% (like water bodies).

Table 2.1: Methodology adopted in preparation of data sheets

Input data	Software	Process	Output layers
Resourcesat-2 LISS-III	Arc GIS 10.1	Visual interpretation/digitization	Land use/land cover
Carto-DEM		Drainage network extraction	Drainage
		Aspects extraction	Aspects
Geological Map (1:50000)		Visual interpretation/ digitization	Geo-rectification of coal blocks
Digital Processes data of Forest Cover		Visual interpretation	Forest cover

Input data	Software	Process	Output layers
Digital Processes data of Forest type		Visual interpretation	Forest type
SOI Toposheets		Visual interpretation	Base map
Forest Division, Range, Compartment		Visual interpretation	Forest Division, Range, Compartment
Administrative data		Visual interpretation	District, tehsil village

2.4.2 Land Use and Land Cover Change (LULC) Detection

The LULC maps of study area for the years 2011-12 and 2015-16 were generated to assess the changes in land use pattern (Figure 2.3- 2.4). The major land use comprises of forests (81.20%) followed by agriculture (9.55%), water bodies (1.59%) and wastelands (6.89%). The built up area is 0.76% of the total coalfield area (Table 2.2).

2.5 GEOLOGY

Geologically, Chhattisgarh constitutes rock formations ranging in age from Archaean to Recent. East-West trending Central Indian Shear Zone (CISZ) separating the Northern Crustal Province (NCP) and the Southern Crustal Province (SCP) is an important and major tectonic feature of the Region. Regionally, the area comprises predominantly the rocks of Precambrian and Gondwana Super group (Pareek, 1988; Dutta, 2001). The Meta sedimentary rocks (Sausar Group) are characterized by pilots, quartzite, chlorite schist, quartz chlorite schist, quartz sericite schist and intra-formational conglomerate, etc. Major portion of the study area is covered by Chota Nagpur Gneissic Complex and thereafter by Gondwana super group of rocks.

The Hasdeo river basin falls in the south-eastern region of the Chotanagpur plateau. Hasdeo-Arand Coalfield (HAC) is surrounded all sides by Gondwana litho-units comprise of Talchirs, Barakars, and Kamthi Formations except in the east by Archean rocks. HAC is a part of Son-Mahanadi master Gondwana basin and has a prominent fault along the major part of its southern periphery bringing Talchir formation and Precambrian rocks in juxtaposition with Barakars, while towards north the coal measures rest conformably on the Talchir sediments. The Barakar formation is a principal coal bearing unit often thick and extensive (GSI, 1983)

In general the sedimentary in Hasdeo-Arand basin exhibiting a half-garben configuration, show a more or less E-W to NW-SE strike with 3°-6° dip towards south. However, the change due to altitude, particularly the magnitude of dip, is conspicuous near fault planes. The coalfield is traverses by several faults, generally trending NW-SE and NE-SW directions of varying magnitudes with a lateral extend of about 2-8 km. The available surface and sub-surface data of HAC have established the existence of six co-relatable coal seams *viz.*, VI/Ketam; V/Morga; IV/Dhajag; II/Bisrar; II/Paturia and I/Sagbari in descending orders. Besides, at least six thin coal seams are locally persistent.

Table 2.2: Land use/land cover of Hasdeo-Arand Coalfield that falls within the districts of Surguja, Surajpur and Korba in Chhattisgarh

SN	LULC Class	LULC Sub Class	2011-12		2015-16		Change (%)
			Area (sq. km)	Area (%)	Area (sq. km)	Area (%)	
1	Agriculture	Agriculture, Crop land	169.56	9.02	166.64	8.86	-0.16
		Agriculture, Fallow	14.05	0.75	12.86	0.68	-0.07
		Agriculture, Plantation	0.19	0.01	0.03	0.00	-0.01
		Sub-Total	**183.88**	**9.78**	**179.53**	**9.55**	**-0.23**
2	Wastelands	Barren/Unculturable/ Wastelands, Gullied/Ravinous Lands	38.62	2.05	13.94	0.74	-1.31
		Barren/ unculturable/wastelands, Barren rocky	0.25	0.01	115.29	6.13	6.12
		Barren/unculturable/ Wastelands, Sandy Area	-	-	0.23	0.01	-
		Sub-Total	**38.88**	**2.07**	**129.45**	**6.89**	**4.82**
3	Built up	Builtup ,Mining	2.45	0.13	5.25	0.28	0.15
		Builtup, Rural	7.35	0.39	8.30	0.44	0.05
		Builtup, Urban	-	-	0.78	0.04	-
		Sub-Total	**9.73**	**0.52**	**14.33**	**0.76**	**0.24**
4	Forests	Forest, Deciduous	1504.52	80.0	1417.46	75.41	-4.63
		Forest, Scrub Forest	110.51	5.88	106.92	5.69	0.19
		Forest, Forest Plantation	-	-	2.10	0.11	-
		Sub-Total	**1615.02**	**85.92**	**1526.49**	**81.21**	**-4.71**
5	Water bodies	Water Bodies, Reservoir/Lakes/Ponds	13.76	0.73	13.70	0.73	0
		Water Bodies, River/Stream /Canals	18.50	0.98	16.27	0.87	-0.11
		Sub-Total	**32.26**	**1.72**	**29.97**	**1.59**	**-0.12**
		Total	**1879.77**	**100**	**1879.77**	**100**	

Source: Estimated using NRSC-ISRO, 2011-12 & 2015-16 digital data

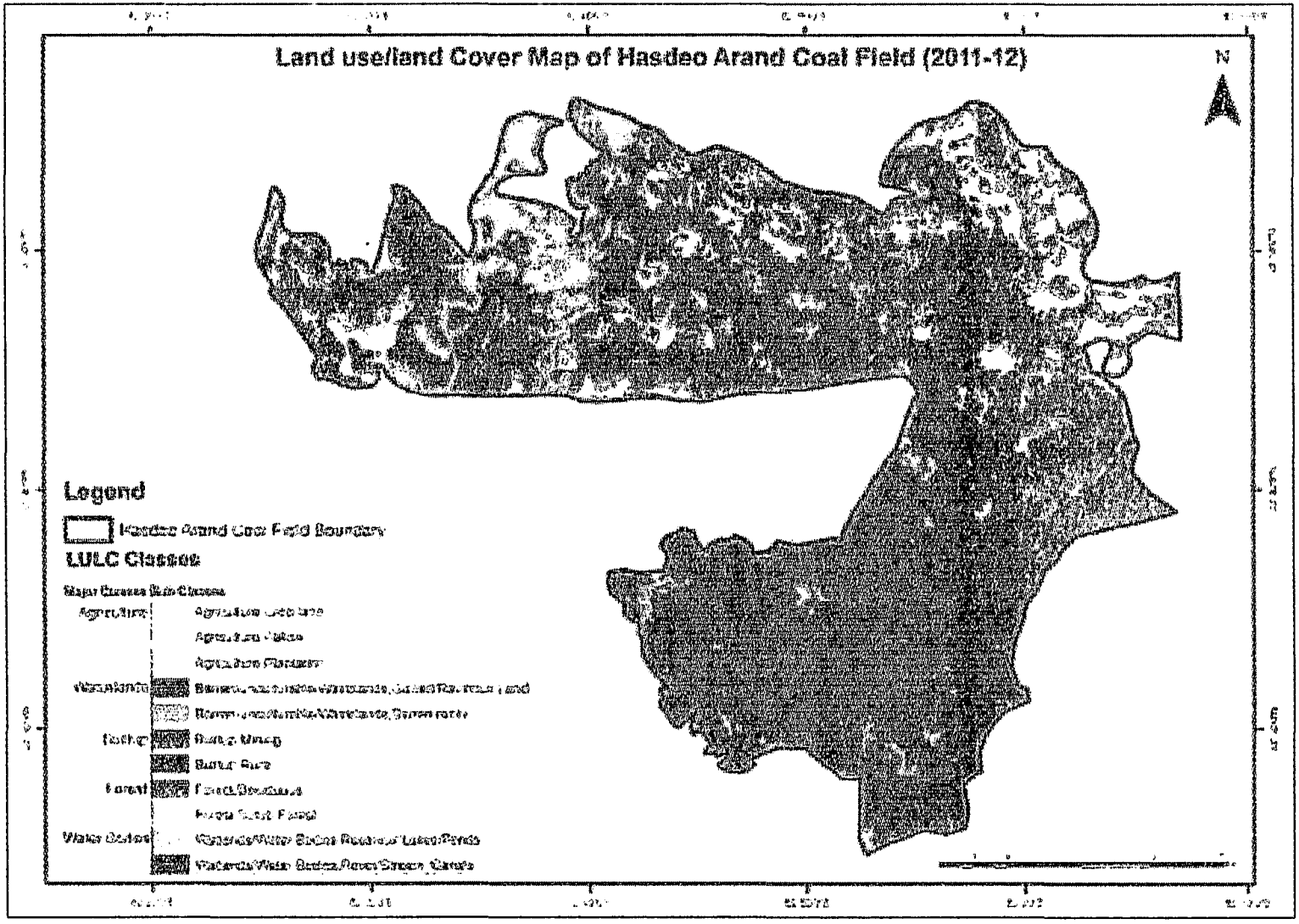


Figure 2.3: Land Use Land Cover map (2011-12) of Hasdeo-Arand Coalfield that falls within the districts of Surguja, Surajpur and Korba in Chhattisgarh

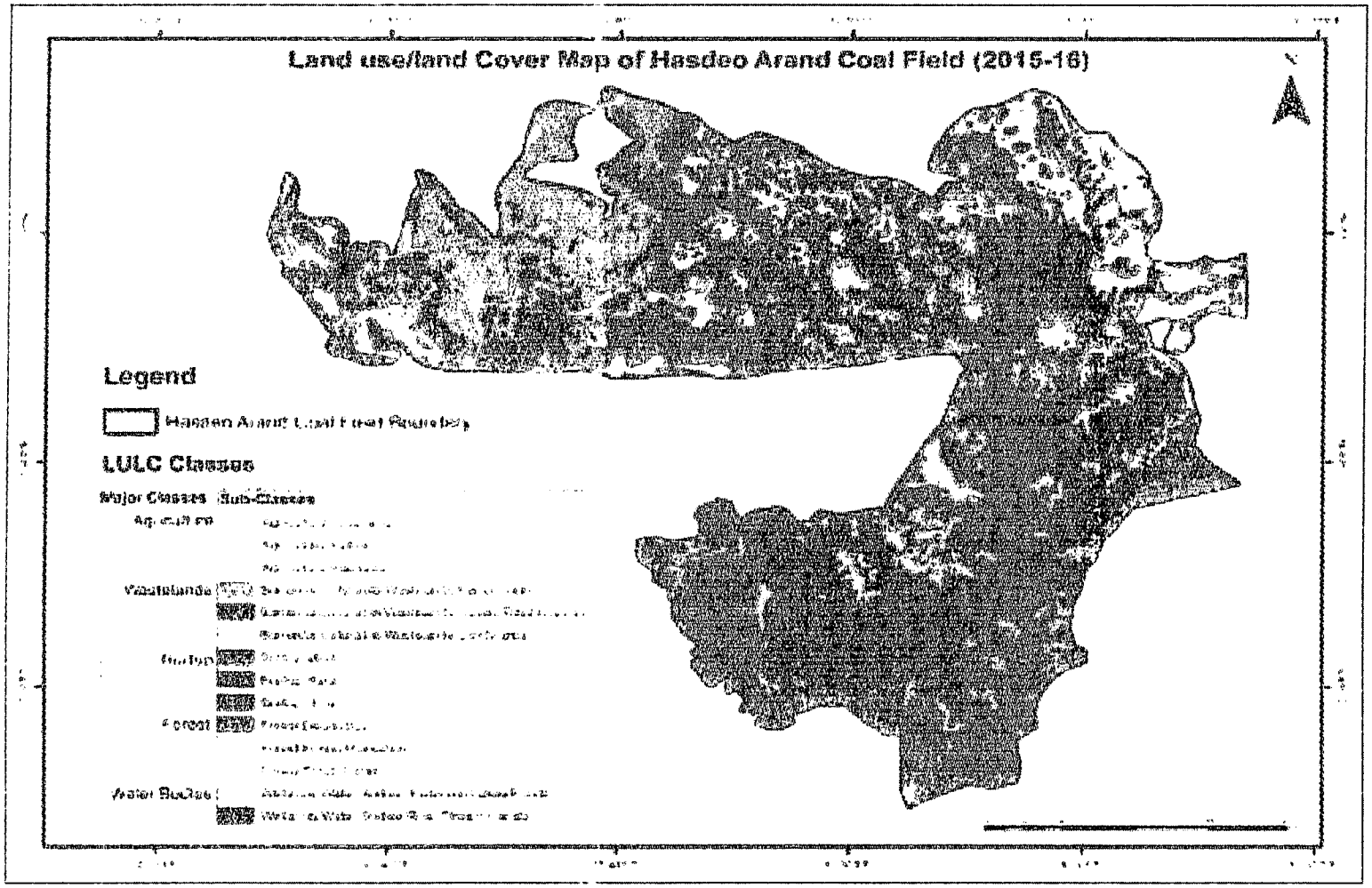


Figure 2.4: Land Use Land Cover (2015-16) of Hasdeo-Arand Coalfield that falls within the districts of Surguja, Surajpur and Korba in Chhattisgarh

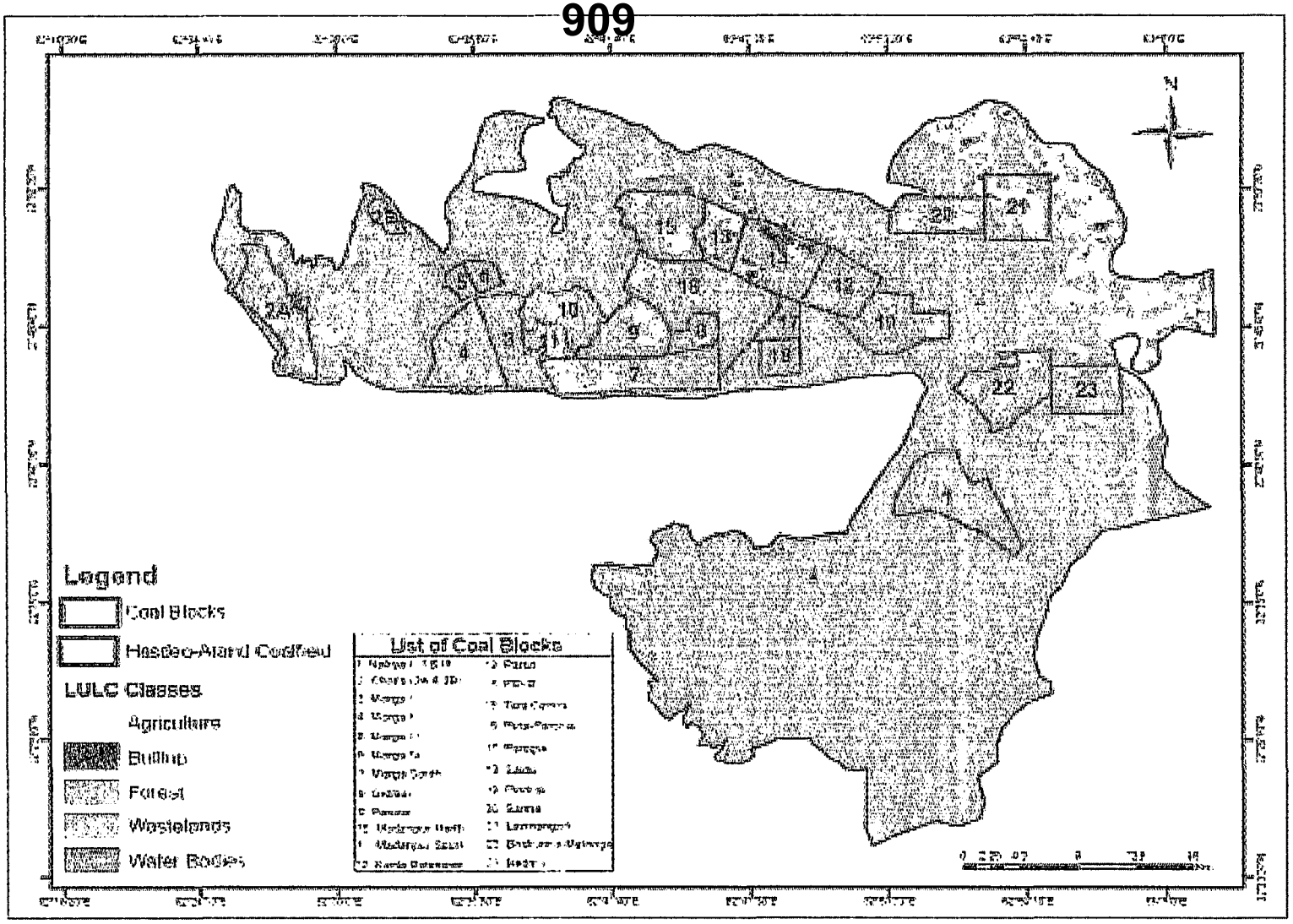


Figure 2.5: Land Use Land Cover Map during 2015-16 and coal blocks of Hasdeo-Arand Coalfield that falls within the districts of Surguja, Surajpur and Korba in Chhattisgarh

2.6 TOPOGRAPHY

The elevation maps of the study area were prepared using Carto DEM of NRSC (ISRO). The Hasdeo-Arand Coalfield is highly rugged in the southern part and dissected by deep gorges (Figure 2.6). Physio-graphically /Geographically, Chhattisgarh state is divided into three distinct land areas/three distinct zones viz., Chhattisgarh Plains, Bastar Plateau and Northern Hill Zones. The study area falls under northern region of hill that occupies parts of Surguja, Surajpur and northern part of Korba districts. It represents structural plains of Gondwana rocks, pediment/pediplains, structural and denudational plateaus, structural and denudational hills and valleys. HAC has rugged undulating topography with elevation ranging from 450 m to 550 m a msl.

Western parts of the coalfield sandwiched between Mahespahar on the north and Lam Pahar on the south having maximum elevation of 939 m and 593 m amsl respectively. Eastern parts of the coalfield have moderately rolling topography. The elevation in the entire study area varied between 200 - 1059 m and there are eight aspect features like flat, N, NE, S, SE, E, W, SW and NW. The elevation zone from 418 - 410 m amsl has highest area of 597.60 km^2 (31.01%) and a maximum coal blocks lies in this zone.

2.7 DRAINAGE

The river basin and drainage map of the study area was generated through geo-rectification of Survey of India (SOI) Topographic sheets as base map using Arch GIS software (version 10.1) and using Carto DEM of NRSC (ISRO). The major part of the study area is drained by Hasdeo River, a tributary of Mahanadi River running south of the Hasdeo-Arand Coalfield. Sub-dendritic to sub parallel drainage system drains the water into Hasdeo-Bango reservoir which lies south-western part of the coalfield extending its back water northerly. The pristine forest is the watershed for the Hasdeo-Bango reservoir and the Hasdeo River, which is a tributary of the Mahanadi River. Hasdeo River and its tributaries originate from the high elevation zones and flow in small drainage channels. Most of the water in the smaller tributaries comes from the natural springs originating in the forests.

The Rihand is another major river-body, rise in the south of Surguja and flows towards north roughly through the central part of Surguja district for 160 km and has three sub-basins namely Moran, Mahan and Ghunghutta and its principal tributaries in Surguja district are the Mahan, Morana (Morni), Geur, Gagar, Gobri, Piparkachar, Ramdia and Galphulla. Thereafter, it flows north and finally joins the Sone sub basin that is an eastern part of the River Ganga Basin (Figure 2.7). The Rihand River Basin comprises of dendritic drainage pattern indicating that there are many contributing streams. The stream order of the basin varies from 1st to 3rd order streams with maximum stream-order frequency in case of first-order streams and then for second order. The entire river basin drainage within the study area has stream order of five (Figure 2.8).

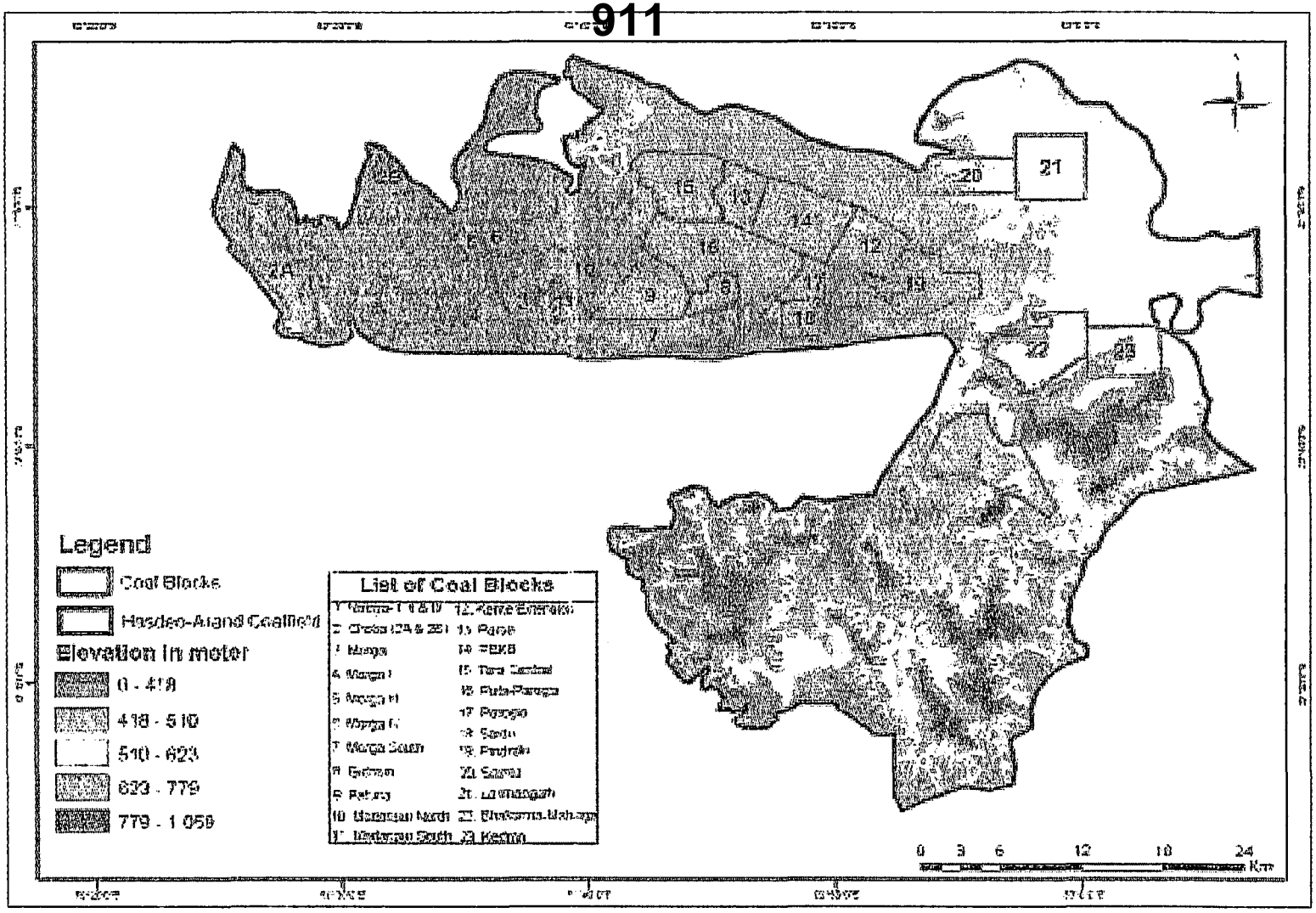


Figure 2.6: Elevation map of Hasdeo-Arand Coalfield that falls within the districts of Surguja, Surajpur and Korba in Chhattisgarh

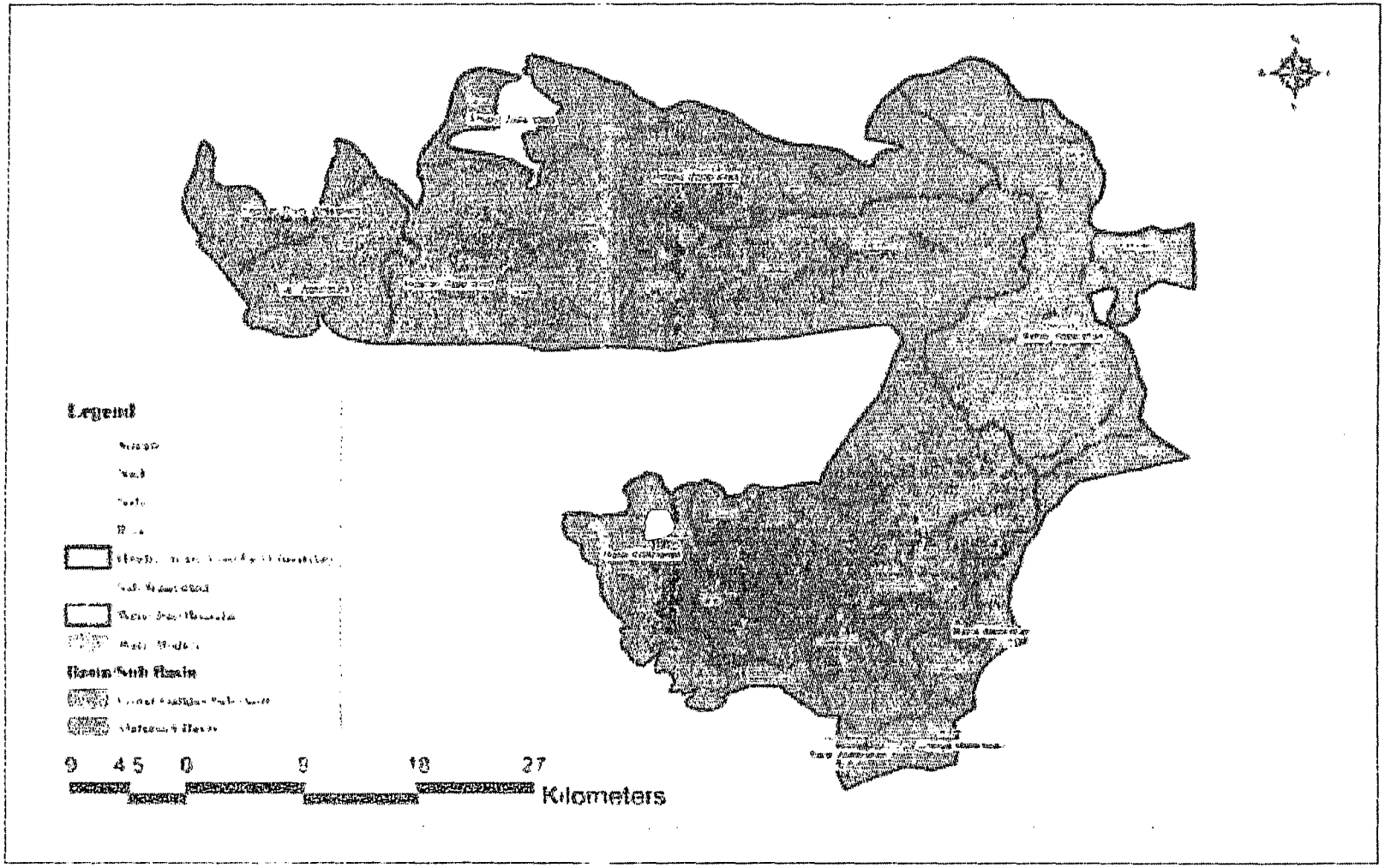


Figure 2.7: Watershed map of Hasdeo-Arand Coalfield that falls within the districts of Surguja, Surajpur and Korba in Chhattisgarh

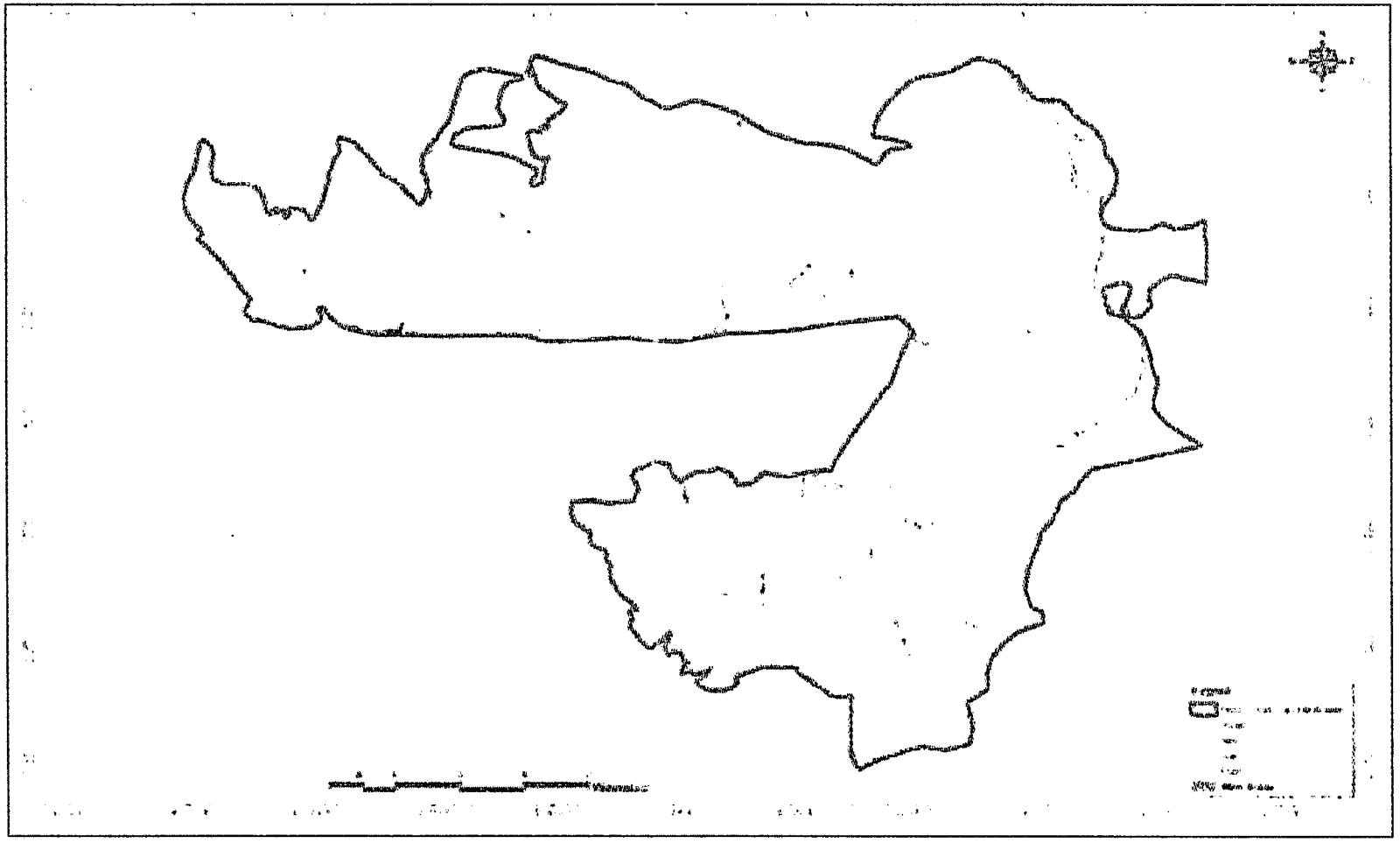


Figure 2.8: Drainage map of the whole Hasdeo-Arand Coalfield that falls within the districts of Surguja, Surajpur and Korba in Chhattisgarh

2.8 FOREST

Forty four per cent of the state is covered with the forests. People of Chhattisgarh have symbiotic relationship with the forests. The economy, culture, tradition and livelihood of people are all inextricably linked to the forests. The entire Hasdeo-Arand Coalfield area (1879.8 sq.km) comprises part of Korba, Surguja and Surajpur districts in Mahanadi and lower Ganga basins that falls in Zone-7 Eastern plateau and hills region agro climatic zone. The coalfield covers a total area of 1879.8 sq.km of which 1502 sq.km. has forest cover; around 80% of this is covered by good quality forest (ATREE, 2012). The forest area falls under the jurisdiction of Udaipur, Lakhanpur and Mainpat forest ranges of South Surguja Forest Division; Lemru, Balco, Pasarkhet and Kudmura forest ranges under Korba Forest Division; Atmanagar, Kendai and Pasan forest ranges under Katghora Forest Division and Ramanuj Nagar forest range under Surajpur Forest Division (Figure 2.9)

Five forest types were observed within the study area (Figure 2.10), prepared by using FSI (2011) digital data. Based on the Champion & Seth classification (1968) of forest types of India, the forests in the study area broadly belong to Tropical dry deciduous /Tropical Moist deciduous forest type groups with the following five forest types:

i) 3C/2e (ii) Moist Peninsular Low Level Sal Forests
ii) 5B/C1 c Dry Peninsular Sal Forest
iii) 3B/C2 Southern Moist Mixed Deciduous Forest
iv) 5B/C2 Northern Dry Mixed Deciduous Forest
v) 5/E9 Dry Bamboo Brake

2.9 BIODIVERSITY AND SOCIOECONOMIC

HAC area is celebrated as the largest un-fragmented forests in central India outside the official protected area system. This unbroken forest stretch is an important corridor for movement of flagship species like elephants and tigers and spread across Korba, Surguja and Surajpur districts of Chhattisgarh, and these are also one of the most pristine Sal (*Shorea robusta*) and teak forests in the country. Many other recorded species including officially recorded by the forest department confirms that the area extremely rich in biodiversity.

The State has around 20,000 villages of which 9,500 villages are adjacent to forests, which have more than half of the population belonging to tribal groups. Gonds form the largest proportion (55%) of the tribal population. The tribal and other backward classes are concentrated in the hilly parts of southern and northern districts where the hillocks are covered with forests. Hasdeo-Arand forests are home to the large vulnerable forest dwelling adivasi community of Gonds, 90% of whom are deeply dependent on the forests for forest produce, agriculture and for their livelihoods.

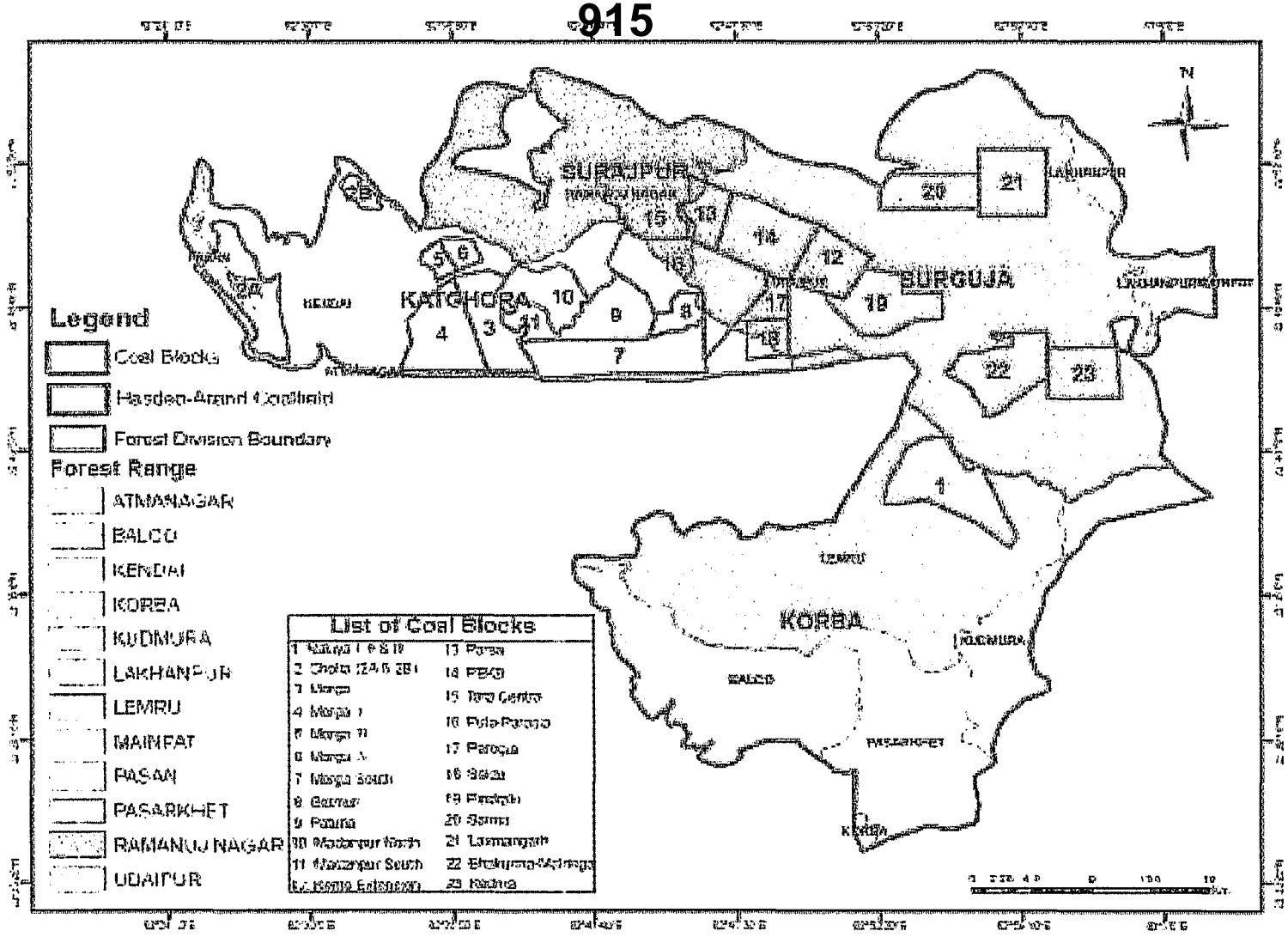


Figure 2.9: Forest Range map of Hasdeo-Arand Coalfield with the 23 coal blocks depicted in the respective ranges within the districts of Surguja, Surajpur and Korba in Chhattisgarh

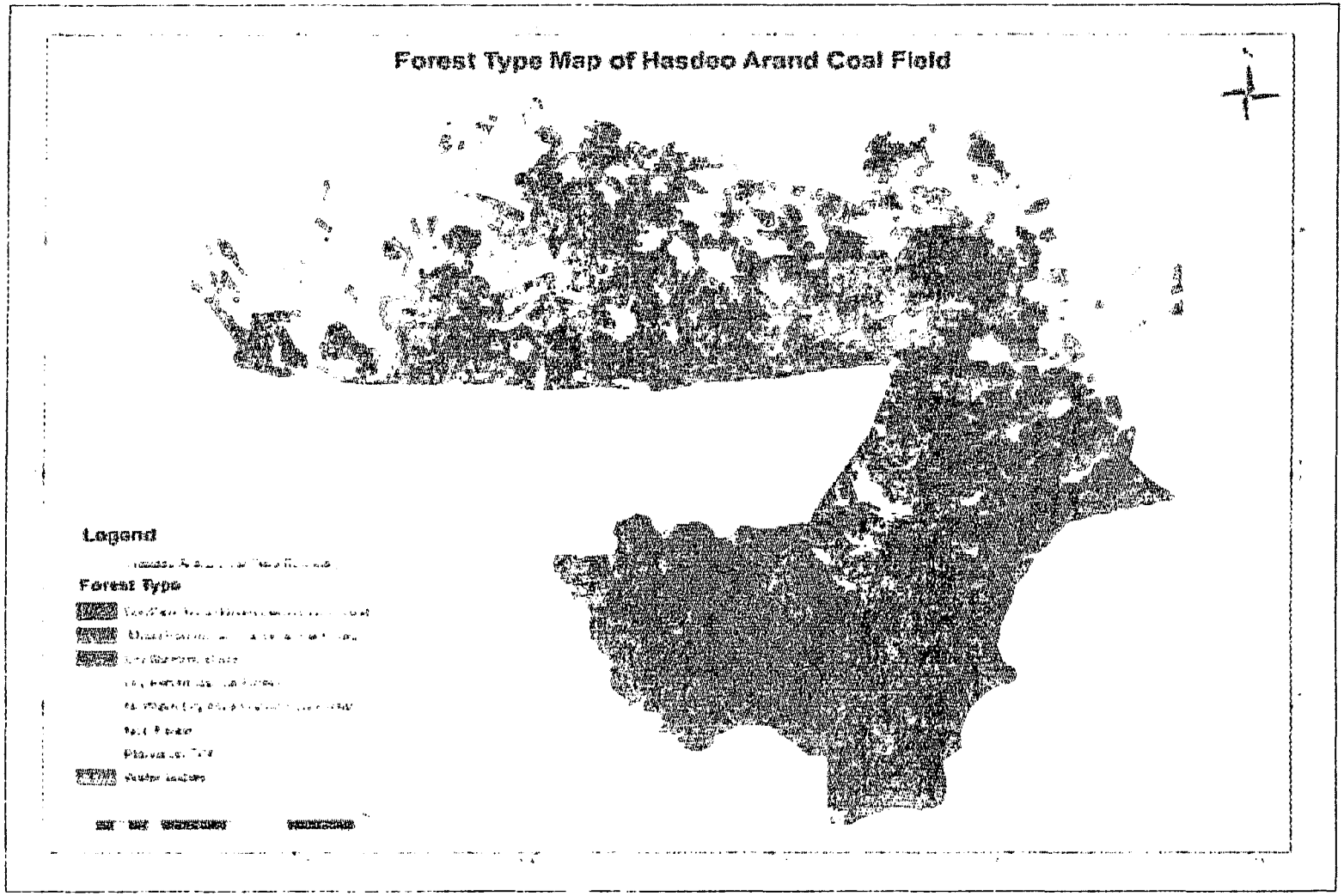


Figure 2.10: Forest Type map of Hasdeo-Arand Coalfield that falls within the districts of Surguja, Surajpur and Korba in Chhattisgarh

M⁻t villages in the Hasdeo area are dependent on agriculture and forest produce for their livelihoods. The forest also the watershed of the Hasdeo-Bango reservoir on the Hasdeo River is the lifeline to the adjoining villages. A detailed study on the terrestrial/aquatic biodiversity, avifauna and the socio-economic biodiversity value in terms of local people dependency along with the detailed methodology used to collect the baseline data are provided in the Chapter 4 to 8 under respective component heading.

2.10 COAL RESOURCES

Coal is an essential resource for meeting the challenges facing the modern world; United States has the largest coal reserves with about 24% share of the total world reserves, followed by Russian Federation (15%), Australia (14%), China (13%) and India (9.6%). In terms of production China continued to be the largest producer of coal & lignite in 2018 with about 46% share in total world production (WCA, 2020), followed by India (9.3%), USA (8.6%) and Australia (6.3%).

2.11 COAL UTILIZATION AND RESOURCES IN INDIA

India has a long history of commercial coal mining since 1774 and Nationalization of coal mines was put to effect on 01.05.1973. Government of India Planning Commission (2006) have emphasised that coal will remain India's most important energy source till 2031-32 and possibly beyond. In India, during the year 2018-19, 87% of the coal was dispatched to the Power Sector; and other industries like cement, i rtilizer, chemical, paper and thousands of medium and small-scale industries are also dependent on coal for the energy requirements. The production of coal was 642 million tonnes in 2017-18 that increased to 695 million tonnes in 2018-19 and the increase is about 8.3% (Table 2.7).

The coal deposits in India primarily are concentrated in the Gondwana sediments occurring mainly in the eastern and central parts of Peninsular India, although Gondwana coal deposits also are found in the north eastern part of the country mainly in Assam and Sikkim. The tertiary coal-bearing sediments are found in Assam, Arunachal Pradesh, Nagaland and Meghalaya. Exploration carried out by GSI, CMPDI and other agencies have established 326.496 billion tonnes (including that estimated in Sikkim) of geological coal resources upto 1200 m depth in the country as on 01.04.2019. Out of these resources, 155.614 billion tonnes (48%) are Proved Reserves and remaining 170.88 billion tonnes are classified under resources category. State-wise geological resources of coal as on 01.04.2019 are furnished in Table 2.3.

The total coal resources of India is reported to be 326495 million tonnes as on 1st April 2019; of which about 59908 million tonnes (18%) of coal resources are reported to occur in the state of Chhattisgarh, which has third highest resources base of coal in India next to Jharkhand and Odisha (Table 2.3). In Chhattisgarh state, the Hasdeo-Arand Coalfield (1879 sq.km) has third highest coal resources of 5529 million tonnes, which is about 9% of coal reserves of the state next to Mand-Raigarh and Korba

Coalfield and both coalfields occur adjacent each other (Table 2.4). Korba Coalfield consists of 530 sq.km area of which 51.25% (271.67 sq.km) has been leased in Korba Coalfield that include 62% of coal bearing area (168 sq.km) for underground mining.

Table 2.3: State wise geological resources of coal as on 1.04.2019

State	Proved	Indicated	Inferred	Total
				In Million Tonnes
All India	**155614.41**	**140500.53**	**30380.69**	**326495.63**
Andhra Pradesh	97.12	1078.44	431.65	1607.21
Arunachal Pradesh	31.23	40.11	18.89	90.23
Assam	464.78	57.21	3.02	525.01
Bihar	309.53	1513.01	11.30	1833.84
Chhattisgarh	21446.29	36259.57	2201.90	59907.76
Jharkhand	48031.93	30400.13	6073.90	84505.96
Madhya Pradesh	12182.45	12735.98	3874.67	28793.10
Maharashtra	7573.20	3257.37	1846.59	12677.16
Meghalaya	89.04	16.51	470.93	576.48
Nagaland	8.76	21.83	415.83	446.42
Odisha	39654.47	33472.75	7713.12	80840.34
Sikkim	-	58.25	42.98	101.23
Telangana	10622.00	8564.74	2651.80	21838.94
Uttar Pradesh	884.04	177.76	-	1061.80
West Bengal	14219.25	12846.87	4624.03	31690.15

Source: Indian Coal & Lignite Resources-2019, Natural Energy Resources, Mission-IIB, 2019 (GSI).

Table 2.4: Coalfield wise geological resources of coal in the state of Chhattisgarh including Hasdeo-Arand Coalfield as on 1.04.2019

State	Proved	Indicated	Inferred	Total
				In Million Tonnes
Chhattisgarh	**21446.29**	**36259.57**	**2201.90**	**59907.76**
Sohagpur	94.30	10.08	-	104.38
Sonhant	364.83	2303.81	1.89	2670.53
Jhilimili	228.20	38.90	-	267.10
Chirimiri	320.33	10.83	31.00	362.16
Bisrampur	1549.71	613.02	5.15	2167.88
East Bisrampur	-	164.82	-	164.82
Lakhanpur	455.88	3.35	-	459.23
Panchbahini	-	11.00	-	11.00
Hasdeo-Arand	**2032.28**	**3273.42**	**223.12**	**5528.82**
Sendurgarh	152.89	126.32	-	279.21
Korba	**5877.26**	**5783.70**	**168.02**	**11828.98**
Mand-Raigarh	10003.78	20803.93	1563.04	32370.75
Tatapani	366.83	3116.39	209.68	3692.90

Source: Indian Coal & Lignite Resources-2019, Natural Energy Resources, Mission-IIB, 2019 (GSI).

Table 2.5: Details of coal blocks in Hasdeo-Arand Coalfield in Korba, Surguja and Surajpur Districts in Chhattisgarh

Sl.No.	Name of Coal Block as per coal block allocation rule	Block No.	District	Area (in sq.km)	Geological Reserve (in MT)	Mineable Reserve (in MT)
1	Parsa East & Kanta Basan-CMSP (OC)	14	Surguja	26.83	532.86	452.46
2	Parsa-CMSP (OC)	13	Surguja & Surajpur	12.52	256.40	200.41
3	Kente Extension-MMDR (OC)	12	Surguja	17.60	369.22	323.70
4	Chotia - CMSP (OC/UG)	02	Korba			
	Choita-2A			8.63	29.186	25.45
	Chotia-2B			3.17	10.832	10.40
5	Tara-CMSP (OC)	15	Surajpur	24.00	317.33	166.92 (OC)
6	Madanpur North-CMSP (OC/UG)	10	Korba & Surajpur	21.39	213.46	94.96 (OC) 38.34 (UG)
7	Madanpur South-CMSP (OC)	11	Korba	7.14	169.83	158.921 (OC)
8	Gidmuri-CMSP (OC/UG)	08	Korba	7.33	80.27	16.05 (OC) 64.22 (UG)
9	Paturia-CMSP (OC/UG)	09	Korba	16.14	269.25	30.85 (OC) 238.41 (UG)
10	Morga– II-CMSP	04	Korba	26.64	350.70	NA
11	Morga– III-CMSP	05	Korba	6.00	36.00	NA
12	Morga– IV-CMSP	06	Korba	6.87	34.78	NA
13	Morga South-MMDR	07	Korba	21.92	432.54	NA
14	Saidu-MMDR	18	Korba & Surguja	6.72	27.49	22
15	Puta Parogiya-MMDR	16	Surguja, Korba & Surajpur	48.04*	**No information is available** #Parogia, Sarma, Laxmangarh and Kedma coal blocks are only regionally promotionally explored will be identified once the boundaries are finalised as per CMPDI. * No documents available and there for the area of extent was estimated using GIS & RS	
16	Parogia#	17	Surguja	7.16*		
17	Pindraki -MMDR	19	Surguja	23.94*		
18	Sarma#	20	Surguja	18.18*		
19	Laxmangarh#	21	Surguja	23.64*		
20	Bhakurma-Matringa- MMDR	22	Surguja	26.00*		
21	Kedma#	23	Surguja	18.95*		
22	Morga-I-CMSP	03	Korba	21.62*		
23	Nakiya-I, II &III -MMDR	01	Korba	34.29*		

Table 2.6: List of coal mine leases in Korba Coalfield, Korba districts, Chhattisgarh state as on 1.04.2015

S.No.	Name of mining area	Name of coal Block	Total area of mining Lease in Hectare	Mining Method	Date of Starting of mining activity
1	S.E.C.L. Korba	Banki Surakachar Block	50.40	Underground	01.03.1976
2	S.E.C.L. Korba			Underground	16.01.1963
3	S.E.C.L. Korba			Underground	03.12.1983
4	S.E.C.L. Korba	Rajgamar	57.05	Underground	01.02.1974
5	S.E.C.L. Korba	Korba manikpur block	19.44	Open Cast	01.02.1966
6	S.E.C.L. Korba	Dhelwadih block	8.31	Underground	24.01.1991
7	S.E.C.L. Korba	Dhelwadih block	8.62	Underground	31.05.1993
8	S.E.C.L. Korba	Amarpur block	10.26	Underground	26.01.1997
9	S.E.C.L. Korba	Jatraj block,	26.59	Open Cast	19.01.1979
10	S.E.C.L. Korba	Kusmunda II block	4.20	Open Cast	01.09.1988
11	S.E.C.L. Korba	Kusmunda II block, Pondi block &Hardi block	29.46	Open Cast	09.01.1981
12	S.E.C.L. Korba	Kusmunda B block Hardı block	24.37	Open Cast	27.12.1991
13	S.E.C.L. Korba	Vijay Khand Sendurgarh block	32.96	Underground	01.09.1996
14	S.E.C.L. Korba	Vijay Khand Sendurgarh block			01.09.1996
Total lease area			**271.66**		

**1*2*3 IBM - Indian Mineral Year Book 2019, Part III – Mineral; Review, 53rd Edition; *4 https://www.globalmethane.org/Data/Coal_IN_Korba_flyer.pdf ; *5 to *14 District Survey Report, Directorate of Geology and Mining, Govt. of Chhattisgarh 2016.*

In HAC area two mining leases have been allotted and two more mining leases are in the process of obtaining statutory clearances, and these four mining leases put together covers an area of 68.75 sq.km area *i.e.* about 4% of HAC coal bearing area having 1198 million tonnes of coal resources.

It is pertinent to mention that coal mineralization in Korba Coalfield exists up to 600 m depth from the surface, therefore mining for such deep deposits underground mining methods also adopted; whereas coal mineralization in HAC persist up to a depth of maximum 250 m from surface and partings between two coal seems do not exceed 25 m. Coalfield wise coal resources of Chhattisgarh state and the details of coal blocks of HAC and mining leases of Korba Coalfield are given in Table 2.5 & 2.6.

2.12 COAL PRODUCTION AND CONSUMPTION PATTERN IN INDIA

2.12.1 Coal Production Pattern

Chhattisgarh is the largest coal producing State with a share of about 22.2% followed by Odisha with contribution of 19.8% to the national output (Figure 2.12) and the production has substantially increased from 2014 to 2019 (Figure 2.11). Coal mining was confined mainly to the Public Sector which contributed 95% to the national production. State wise and sector wise coal production is given in Table 2.7.

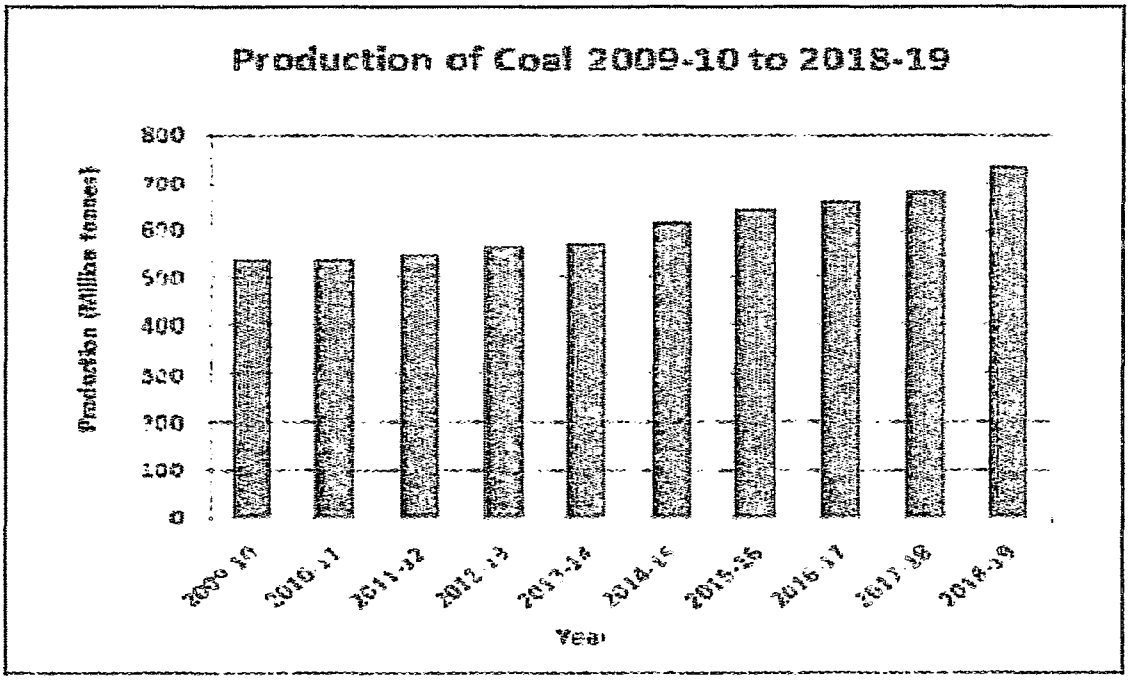


Figure 2.11: Coal production for last 10 years from 2009-10 to 2018-19 from coal producing states in India

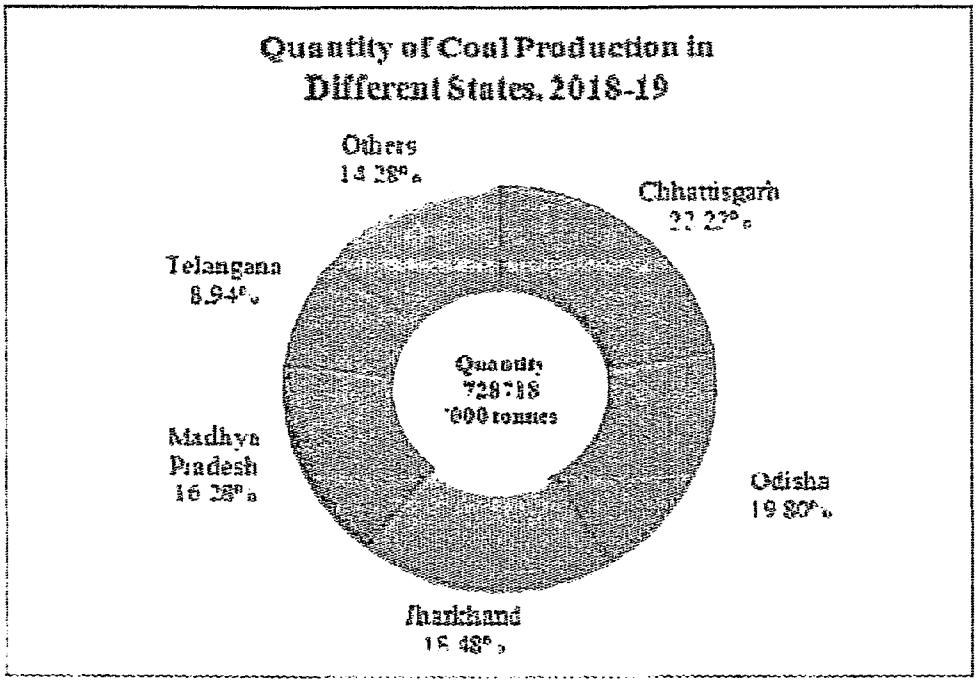


Figure 2.12: Major share of coal producing states in India

Table 2.7: Sector wise and State wise production of Coal for the year 2016-17 to 2018-19

State	2016-17	2017-18	2018-19
			In, 000 Tonnes
India	**657868**	**641774**	**694983**
Public Sector	625196	641774	694983
Private Sector	32672	33626	33735
Assam	600	781	784
Chhattisgarh	138525	142546	161893
Jammu & Kashmir	10	14	13
Jharkhand	126435	123297	134666
Madhya Pradesh	105013	112127	118661
Maharashtra	40559	42219	49818
Meghalaya	2308	1529	-
Odisha	139359	143328	144312
Telangana	61336	62010	65160
Uttar Pradesh	16056	18309	20275
West Bengal	27667	29240	33136

Source: 1-Coal Directory of India 2017-18. 2- Provisional Coal Statistics, 2018-19.

2.12.2 Coal Consumption Pattern

Thermal power plants, iron & steel, sponge iron and cement are continued to be the major consuming industries of coal in India. Sizeable quantities are also consumed by the railways, collieries and as domestic fuel. Data regarding consumption in these sectors are not available; however, industry-wise dispatches of coal during 2016-17, 2017-18 and 2018-19 are depicted in the Table 2.8.

Table 2.8: Industry wise coal consumption pattern in India (in Million tonnes)

Industry	2016-17	2017-18	2018-19
Total	**645.98**	**690.00**	**732.79**
Electricity	535.04	585.49	637.95
Iron and Steel	10.34	11.45	17.66
Sponge iron	5.56	8.53	12.23
Fertilizer	2.13	1.88	1.79
Cement	6.36	7.71	8.82
Others (chemical, other base metals, paper &pulp, textile & rayon, brikes, others, etc)	86.55	74.94	54.34

*Source: Coal Directory, 2016-17, 2017-18 and Provisional Coal Statistics, 2018-19. *Data on consumption is not available. Includes direct feed, coking washery and steel (boilers).*

2.13 DEMAND & SUPPLY OF COAL

As per Ministry of Coal, Govt. of India, demand for coal for the year 2017-18 and 2018-19 is 908.40 and 991.35 million tonnes respectively. Indian Mineral Year Book published by IBM adopts the practice of apparent supply of coal considering Dispatch from Mines + Import (-) Export. Accordingly, data for the year 2017-18 and 2018-19 are given in Table 2.9.

Table 2.9: Demand and supply of coal in India

Year	Demand	Apparent supply (In million tonnes)			
		Dispatch	Import	Export	Total
2017-18	908.40	690.003	208.253	1.504	896.752
2018-19	991.35	732.794	235.354	1.306	966.842

It is evident from the above table that coal production in the country is about 24% shortage for the year 2017-18 and about 26% shortage for the year 2018-19 against the internal demand. Import of coal during the same period substitute about 23% and 24% for the years 2017-18 and 2018-19 respectively.

As such coal production need to be accelerated to fill the gap between demand and supply, which will promote over all sustainable development as coal being major energy source in India. Yearly coal consumption pattern of the world indicate that India is second highest coal consuming country in the world and consuming about 11% of world production, however per capita consumption of coal is lowest among top 10 coal consuming countries. Coal and electricity consumption pattern of top 10 highest coal producing countries are tabulated in Table 2.10.

Table 2.10: Coal based consumption pattern of top 10 highest coal producing countries

Sl No.	Country	Coal*			Electricity**	
		Yearly consumption of coal (MMcf)	World Share in %	per capita consumption in Cubic feet	Electricity consumption kWh/per year	Consumption per capita kWh/per year
1	China	4319921 826000	50.0	3055.00	6310000000000	4475
2	India	966288 692000	11.3	729.54	1547000000000	1181
3	USA	731071 000000	8.5	2263.27	3911000000000	12071
4	Germany	357488 592000	3.0	3132.70	533000000000	6602
5	Russia	230392 143100	2.7	1585.90	106500000000	7481
6	Japan	210599 949300	2.5	1648.05	934000000000	7371
7	South Africa	202298 474200	2.4	3599.13	212000000000	3904
8	South Korea	157124 158500	1.8	3081.87	495000000000	9720
9	Poland	148799 901400	1.7	3916.90	142000000000	3686
10	Australia	129642 679100	1.5	5343.29	69750000000	9742

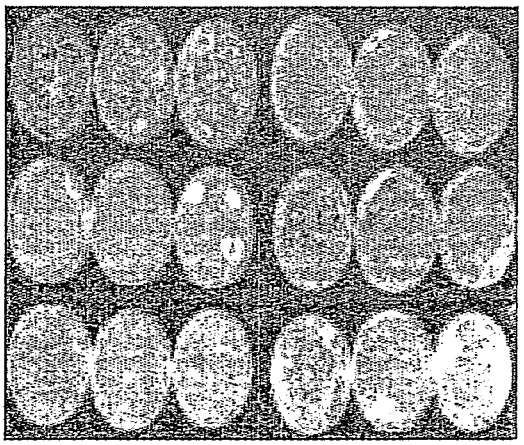
Source: *Worldometer **Wikipedia

Coal is considered energy mineral in India and thermal power plants are the highest consumer of coal. The electricity consumption is compared with that of coal consumption and it was found that electricity consumption of the world is not directly proportional to coal consumption. USA produces coal about 25% lesser than India but consumes electricity about 40% higher than India. Similarly, Japan is 6th highest coal producer and third highest consumer of electricity. Coal production levels and electricity consumption pattern indicate that worldwide coal alone is not considered as energy mineral, alternately other source of energy like shale gas, green energy (solar and wind energy) and atomic energy are tapped to meet energy requirement.

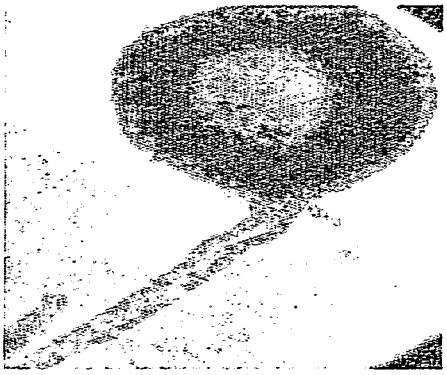
India may also move on this direction to conserve non-renewable energy minerals and tap atomic, solar and wind energy to meet country's energy requirement in an environment friendly manner which will drastically reduce emission and contribute to minimize global warming.



Rhizosphere soil samples collection



Pure culture colonies of Actinomycetes, soil Fungi and PGPR

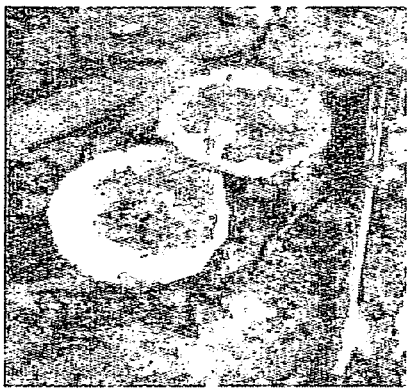


Glomus intraradices

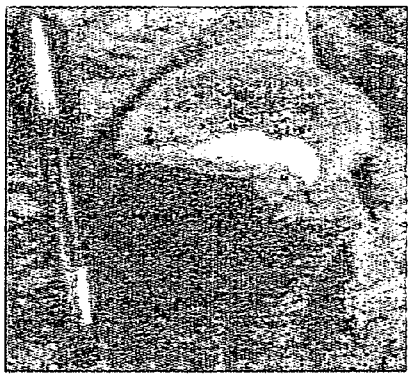


Acaulospora scrobiculata

Arbuscular Mycorrhizal (AM) fungal spores recorded from rhizosphere soil samples



Russula cinerella



Boletus sp.

Ectomycorrhizal (ECM) fungal recorded from Sal forests in Hasdeo-Arand Coalfield

Plate 2.1: Microflora recorded from study area of Hasdeo-Arand Coalfield that falls within the districts of Surguja, Surajpur and Korba in Chhattisgarh

CHAPTER-3

PROFILE OF THE COAL BLOCKS

This chapter provides comprehensive baseline information on 23 coal blocks identified by CMPDI and considered for the biodiversity assessment study.

3.1 DETAILS OF COAL BLOCKS IN HASDEO-ARAND COALFIELD

The Central Mine Planning and Design Institute (CMPDI) have identified 23 coal blocks in Hasdeo-Arand Coalfield (HAC) of which some of the blocks were allotted in the past for captive use. The Hon'ble Supreme Court of India through its judgment dated 25.08.2014, read with its order dated 24.09.2014 cancelled allotment of 204 coal blocks including all the blocks allotted in the HAC. Subsequent to the Supreme Court Judgment, the Coal Mines (Special Provision) Ordinance 2014; (i) the Coal Mines (Special Provision) Second ordinance, 2014 and (ii) the Coal Mines (Special Provision) Rules, 2014 were promulgated. Under this Ordinance, read with the Special provisions, four coal blocks allotted in HAC are as follows:

(i) Parsa East and Kanta Basan (PEKB) – Coal Block No. 14 to M/s. Rajasthan Rajya Vidyut Utpadan Nigam Limited (RVUNL).
(ii) Parsa – Coal Block No. 13 to M/s. RVUNL.
(iii) Kente Extension - Coal Block No. 12 - allotted to M/s. RVUNL
(iv) Chotia – Coal Block No. 2 (sub block 2A & 2B) is allotted to M/s. BALCO (Vedanta Group).

Of the four coal blocks allotted, two blocks *i.e.*, PEKB (block No. 14) and Chotia (block No. 2) are in operation and are producing coal. Processes of obtaining necessary clearances are in progress for the remaining two blocks *i.e.*, Parsa (block No. 13) and Kente Extension (block No. 12). Detailed information on exploration, mining and mine closure activities envisaged are available for re-allotted 4 blocks. For 5 coal blocks such as Tara, Madanpur (North), Madanpur (South), Paturia and Gidmuri, information on geological, mining and mine closure proposals are available. However, relatively meagre technical information is available for another 05 coal blocks and no information is available for the remaining 9 coal blocks. Based on the status of allotment and availability of the information, the coal blocks were classified in to four groups for the purpose of convenience to present the profiles of the 23 coal blocks:

1. **Group I:** Four coal blocks (previously allotted) for which geological, mining and mine closure proposals are available.
2. **Group II:** Five coal blocks for which only technical information are available.
3. **Group III:** Five coal blocks for which limited information available.
4. **Group IV:** Nine coal blocks for which no information is available.

Table 3.1: Profile of the coal blocks in the entire Hasdeo-Arand Coalfield area of Surguja, Surajpur and Korba districts of Chhattisgarh

Sl. No.	Name of Coal Block	Block No	District	Allotment status	Extent Area in sq.km*	Geological Reserves in MT	Mineable Reserves in MT	Remarks
				GROUP –I				
1	Parsa East Kanta Basan	14	Surguja	Allotted to M/s. Rajasthan Rajya Vidyut Utpadan Nigam Limited	26.83	532.86	452.46	Detailed information on exploration, mining, mine closure are available
2	Parsa	13	Surguja & Surajpur		12.52	256.40	200.41	
3	Kente Extension	12	Surguja		17.60	369.22	323.70	
4	Chotia	02	Korba	Allotted to M/s. BALCO (Vedanta Group).	11.80	40.018	35.85	
				GROUP –II				
5	Tara	15	Surajpur	Not Allotted	24.00	317.33	166.92	Initially allotted and subsequently cancelled coal blocks - geological, mining and mine closure proposals are available
6	Madanpur North	10	Surajpur & Korba	Not Allotted	21.39	213.46	133.30	
7	Madanpur South	11	Korba	Not Allotted	7.14	169.83	158.921	
8	Gidmuri	08	Korba	Not Allotted	7.33	80.27	80.27	
9	Paturia	09	Korba	Not Allotted	16.14	269.25	269.26	
				GROUP –III				
10	Morga – II	04	Korba	Not Allotted	26.64	350.70		Only technical information is available
11	Morga – III	05	Korba	Not Allotted	6.00	36.00		
12	Morga – IV	06	Korba	Not Allotted	6.87	34.78		
13	Morga South	07	Korba	Not Allotted	21.92	432.54		
14	Saidu	18	Surguja & Korba	Not Allotted	6.72	27.49		
				GROUP –IV				
15	Puta Parogia	16	Surguja, Surajpur & Korba	Not Allotted	48.04*	NA		No information available except for the GPS location provided by RVUNL. As per CMPDI # coal blocks are regionally promotionally explored and will be identified after detailed exploration (#Parogia, Sarma, Laxmangarh and Kedma). * No documents available and there for the area of extent was estimated using GIS & RS
16	Parogia#	17	Surguja	Not Allotted	7.16*	NA		
17	Pindraki	19	Surguja	Not Allotted	23.94*	NA		
18	Sarma#	20	Surguja	Not Allotted	18.18*	NA		
19	Laxmangarh#	21	Surguja	Not Allotted	23.64*	NA		
20	Bhakurma-Matringa	22	Surguja	Not Allotted	26.00*	NA		
21	Kedma#	23	Surguja	Not Allotted	18.95*	NA		
22	Mogra-I	03	Korba	Not Allotted	21.62*	NA		
23	Nakiya I, II & III	01	Korba	Not Allotted	34.29*	NA		

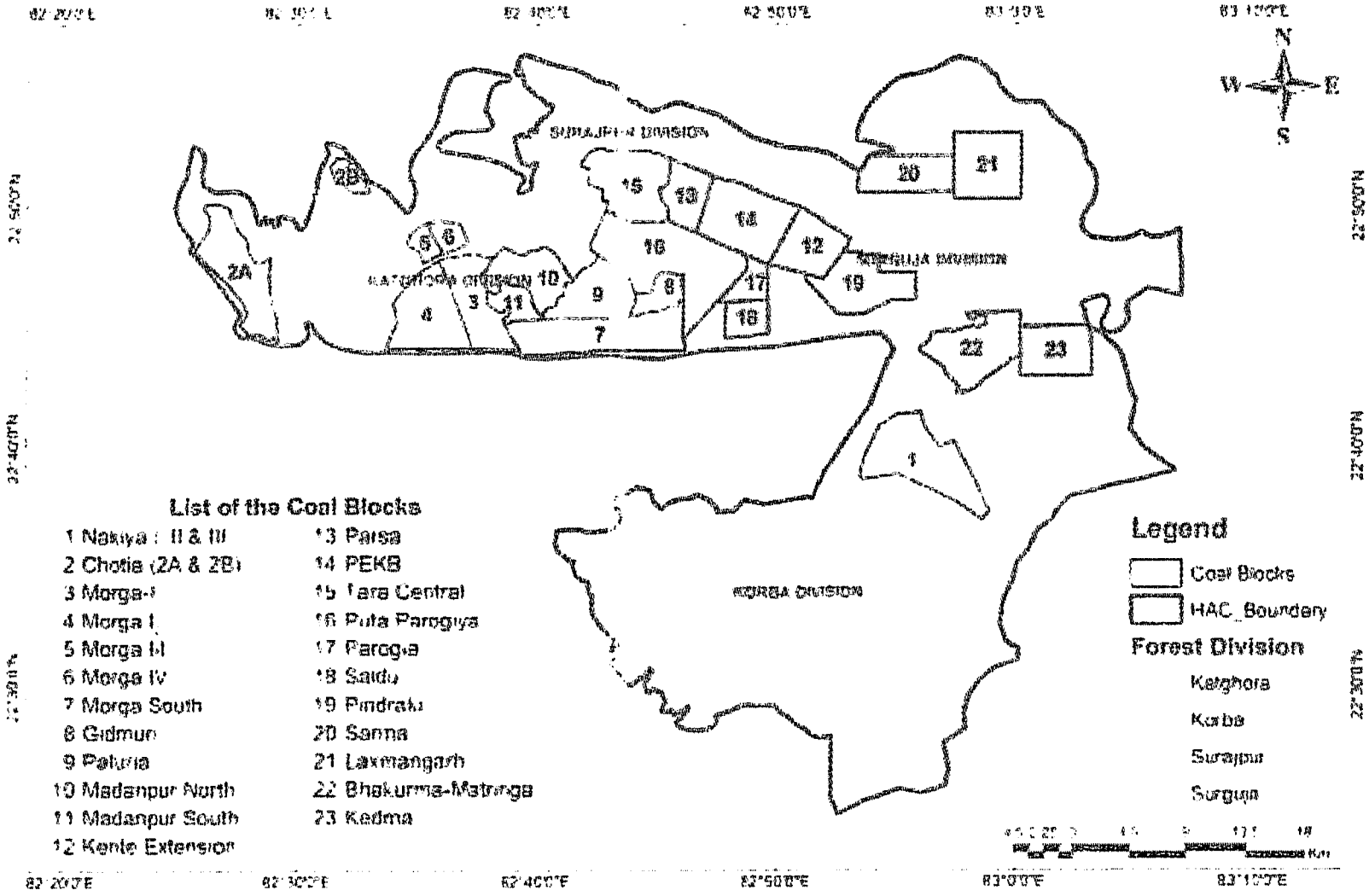


Figure 3.1: Distribution of coal blocks in the Forest Divisions of Surguja, Surajpur, Katghora and Korba in Hasdeo-Arand Coalfield of Chhattisgarh

Details of coal blocks are given in Table 3.1 and locations of coal blocks (GPS location provided by RVUNL) are depicted in Figure 3.1. Out of these 23 coal blocks, Parogia, Sarma, Laxmangarh and Kedma are only regionally promotionally explored and are yet to be identified after detailed exploration by CMPDI.

3.2 PROFILE OF THE COAL BLOCKS:

GROUP – I: PARSA EAST AND KANTA BASAN (PEKB) COAL BLOCK NO.14, OPEN CAST - 15 MTPA OF M/S. RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD. (RVUNL) (RAJASTHAN GOVT. UNDERTAKING) VIDYUT BHAWAN, JANPATH, JYOTI NAGAR, JAIPUR-302005.

3.2.1 Location

Coal block Parsa East & Kanta Basan (PEKB) is located in northern fringe of HAC area in Surguja District, Chhattisgarh State at about 290 km away from Raipur and 150 km away from Bilaspur on NH-130. The nearest rail head i.e., Bisrampur on Bijuri-Ambikapur section of the South East Central Railway (SECR) is located about 60 km from mine. A Railway siding has been commissioned in April 2018 connecting Surajpur Railway Station (75 km) on Bilaspur-Ambikapur route of SECR to pit head of PEKB Mine. The coal block is depicted in Survey of India Toposheet 64J/13 and bounded by North latitude $22^0 47'39"$ to $22^0 51'12"$ and East longitude $82^0 46'38"$ to $82^0 50'51"$.

3.2.2 Status of Mining Lease

Mining lease agreement was signed between the Govt. of Chhattisgarh and M/s. RVUNL initially on 30.05.2012 and again on 19.04.2017, after re-allotment of coal block on 31.03.2015. The PEKB coal block is valid for a period of 30 years *w.e.f.* 01.04.2015. Total area of the project has been revised to 2682.856 ha as per revised Mining Plan for 15 MT (Table 3.2).

Table 3.2: Land use for mining and allied activities: Parsa East & Kanta Basan (PEKB) coal block in Surguja District, Chhattisgarh State

Sl. No.	Particulars	Area (ha)
A	**Mining**	
1	Excavation area & barrier	**2388.247**
B	**Infrastructure & OB dump area**	
1	External dump	112.655
2	Infrastructure	36.224
3	Coal evacuation route	30.260
4	CHP & washery	28.381
5	Reject based thermal power project	42.570
6	Colony & Plantation area	3.990
7	Rationalization area	40.532
	Total (B)	**294.609**
	GRAND TOTAL (A + B)	**2682.856**

The total area of 2682.856 ha includes 1871.118 ha of forest land, 109.952 ha of Government land and 701.786 ha of tenancy land. There are 7 villages falling within PEKB coal block (Table 3.3).

Table 3.3: Village wise land acquired for Parsa East & Kanta Basan opencast coal block in Surguja district, Chhattisgarh

Land Use	Ownership	Within Excavation Area (ha)	Outside Excavation Area (ha)	Total (ha)
Agricultural Land	Private land	579.241	122.545	701.786
Settlements				
Forest Land		1704.744	166.374	1871.118
Waste Land	Government land	104.262	5.690	109.952
Grazing Land				
Surface Water Bodies				
Others (Specify)	-	-	-	-
Total		**2388.247**	**294.609**	**2682.856**

All lands have been acquired, except tenancy land of 334.725 ha of Ghatbarra village in dip side of the mine. Village wise land use pattern are given in Table 3.4.

Table 3.4: Village wise land use pattern in Parsa East & Kanta Basan opencast coal block, Surguja District, Chhattisgarh State

Name of the Village	Total Area (ha)	Land use pattern (ha)						Total Land (in ha)
		Forest Land			Govt. Land	Tenancy Land		
		Revenue Forest		Protected Forests		Adiwasi	Non Adiwasi	
		Chhote Jhharka Jungle	Bade Jhharka Jungle					
Salhi	1171.00	14.165	-	34.820	14.288	23.973	1.092	88.338
Hariharpur	441.00	2.768	19.321	110.156	10.187	34.815	0.735	177.942
Parsa	1266.00	50.378	8.542	138.036	18.320	100.398	12.533	328.207
Kente	1284.00	83.380	0.782	505.928	14.890	194.387	0.089	799.456
Ghatbarra	2447.00	61.660	0.611	706.783	52.256	212.217	121.547	1155.085
Parogia	3956.00	-	-	128.130	-	-	-	128.130
Basan	1519.00	-	-	5.698	-	-	-	5.698
Total		212.351	29.256	1629.551	109.941	565.79	135.996	2682.856

3.2. Project Status & Regulatory Clearances

Particulars/ Milestones	Date
Block allotted to RVUNL by the Ministry of Coal	25.06.2007
Mining Plan for 10 MTPA approved by MoC	16.07.2009
Stage-1 FC granted *vide* letter no. F.No. 8-31/2010-FC	**06.07.2011**
EC of 10 MTPA OC mine & Coal washery granted *vide* Letter No. J-11015/03/2008-IA.II(M)	21.12.2011
Stage-2 FC granted *vide* letter No. F.No. 8-31/2010-FC	**15.03.2012**
ML deed agreement	**30.05.2012**
DGMS permission u/s. 98(1&3) of CMR 1957	26.09.2012
CTO for 2MTPA OC Mine & Washery granted *vide* letter No. 5137/TS/CECB/2012 & 5139/TS/CECB/2012	31.12.2012
Mine operation commenced	As on February 2013
MoC accorded in principle approval for revision of mining plan from 10 MTPA to 15 MTPA	03.02.2012
Expansion Mine Plan (15 MTPA)- 1st revision of approval by MoC	19.11.2013
CTO for 10 MTPA OC Mine & Washery granted *vide* letter no. 1330/TS/CECB/2014 & 1328/TS/CECB/2014	03.06.2014
Cancellation of 204 coal blocks including PEKB by Supreme Court of India	**24.09.2014**
Re allotment of Coal Block Revalidation of stage-I, FC by MoEF&CC	31.03.2015
MoEF&CC revalidated the Forest Clearance (stage-I) after reallocation of coal block with conditions that mining shall be done in two phases.	**19.06.2015**
Authorization to handle hazardous waste *vide* letter No. 5254/HO/HSMD/CECB/ 2012 valid for 301/1/2021	30.01.2016
Expansion Mine Plan (15 MTPA)- 2nd revision to accommodate Fluidized bed combustion (FBC) plant within ML area approval by MoC (power plant based on washery rejects)	12.08.2016
ML deed agreement signed after re-allotment	**19.04.2017**
EC for 15 MTPA OC Mine &Washery *vide* letter No. J-11015/03/2008-IA.II(M)	10.08.2018
CTO for 15 MTPA OC Mine & Washery *vide* letter No. 6507/75CECB/2018 valid upto 31st Dec. 2019	10.12.2018
DGMS permission renewal u/s 98(1) of CMR 1957	10.04.2015
Explosive Magazine License renewal valid upto 31/03/2022	07.03.2018
DGMS permission u/s 196(3) of CMR 2017	As on January 2019

3.2.4 Explosive License and Magazine Capacity

Explosive magazine is located within mining lease boundary at Survey No. Kh No. 218/10 and 218/22 of Kente village, Udaipur Tehsil, Surguja District. Permitted capacity of magazine is given in Table 3.5.

Table 3.5: Permitted capacity of magazine for Parsa East & Kanta Basan opencast coal block, Surguja District, Chhattisgarh State

Sl. No	Type	Capacity	Date of license expiry
1	Nitrate mixture-slurry and emulsion explosives	100 Kg	31.03.2022
2	Cast booster	300 Kg	
3	Detonating fuse	3000 m	
4	Electric/Non Electric (NONEL) Detonators	20000 nos	

3.2.5 Approval of Mining Plan

Mining plan of PEKB Opencast Coal Mine (10 MTPA) was approved by Ministry of Coal *vide* letter No. 13016/74/2006-CA-I dated 16.07.2009 with project area of 2711.034 ha including forest land 1898.328 ha. Stage-1 forest clearance was granted for 1898.328 ha on 06.07.2011. Environment clearance for the project was granted on 21.12.2011 with project area of 2711.04 ha. In the Mining Plan (10 MTPA) approval letter dated 16.07.2009, the Standing Committee of Ministry of Coal observed that the coal block has the potential for producing 15 MTPA and directed M/s. RVUNL to prepare the revised mining plan. Mining plan was revised to 15 MTPA and approved by Ministry of Coal *vide* letter No. 34011/18/2016-CPAM dated 12.08.2016 with project area of 2682.856 ha including 1871.118 ha of forest land.

As per guidelines issued by Ministry of Coal *vide* letter No. 34011(48)/2009-CPAM dated 15.07.2015, CMPDI certified that the boundary of PEKB (area as per the approved mining plan of10 MTPA) encroaches over 27.90 ha on the North Western side and 0.278 ha on the South Eastern side as the area is beyond the boundary of vesting order co-ordinates as per "Certified Map of Geological Co-ordinates duly approved by CMPDI with respect to vesting order Co-ordinates". Accordingly, the total area reduced by 28.178 ha from original approved project area of 2711.034 ha (area as per 10 MTPA Mining Plan) to 2682.856 ha (area as per 15 MTPA Mining Plan).

As per approved Mining Plan (15 MTPA), the total forest land requirement for the project is 1871.118 ha, which is part of the already approved Stage-II Forest Clearance (MoEF&CC *vide* letter dated 15.03.2012) for an area of 1898.328 ha. The EIA/EMP was prepared on the basis of approved mining plan of 15 MTPA with the reduced project area of 2682.856 ha only.

~2.6 Geology, Exploration and Reserve

Exploration undertaken in the PEKB coal bock established the existence of 3 persistent and potential coal seams *viz.*, Seam IV, V and VI in ascending order. Besides, one or two thin impersistent coal seams without significant economic value occur below the seam IV. All 3 coal seams incrop within the coal block. The coal seams and coal bearing rocks trending along NW-SE direction and dipping 2° to 4° towards south. Potential coal seams occur within Barakar column and exploration boreholes drilled encountered Talchir Formation below coal seam IV (Table 3.6)

Table 3.6: Summary of exploration in PEKB opencast coal block, Surguja District, Chhattisgarh State

Drilling Agency	Period	No. of bore holes	Meterage
1st Phase of drilling area(13.27 sq.km)			
GSI	1980-85	10	3229.35
GSI	1996-98	3	671.85
Sub Total		**13**	**3901.20**
Adani Mining Private Ltd.	Sept. 2008- Dec '08	42	6044.00
CDA		58	2139.60
Shriram-Gemicon		12	1015.00
Sub Total		**112**	**9198.60**
Grand Total		**125**	**13099.80**
2nd Phase of drilling area (14.4 sq.km)			
Adani Mining Private Ltd.	Sep. 2008-June 09	71	11799.50
Grand Total		**196**	**24899.30**
Bore-hole Density: 8.11 BH/sq.km			
Total block area: 27.67 sq.km			

Seam wise Geological Reserves of the Block (as on August 2016)

Seam	Batter	Barrier	Quarry	Total	%
					in Million tonnes
VI	3.34	0.28	38.49	42.11	7.90
V	15.85	1.18	159.25	166.28	31.20
IV	24.45	2.11	287.91	314.47	59.01
Total	**43.64**	**3.57**	**485.65**	**532.86**	**100.00**
Remarks: Batter: Benching from earth face or earth cutting edge to coal top in rise side as well as dip side. Barrier: Space of 7.5 m from block boundary to earth face or earth cutting edge.					

Summary of Minable Reserves (as on August 2016)		(in Million Tonnes)
1	Gross Geological Reserves	532.86
2	Gross Geological Reserves blocked in 7.5 m barrier and batter and not considered for mining	47.21
3	Gross Geological Reserves considered for mining	485.65

Summary of Minable Reserves (as on August 2016)		(in Million Tonnes)
4	Geological loss @5%	24.28
5	Net Geological Reserves considered for Mining	461.37
6	Mining loss @5%	23.07
7	Minable Reserves	438.30
8	30% reserves blocked in batter and barrier may be recovered by High wall mining	14.16
9	Total Minable Reserves	**452.46**

3.2.7 Sequence of coal seams and overburden/parting

Sl. No.	Particulars	UNITS	QUARRY		
			Min.	Max.	Usual
I	Thickness of coal seam (avg)				
	VI	m	0.66	2.27	1.2-2.0
	V	m	1.41	8.37	2.0-7.0
	IV	m	5.20	9.72	7.0-8.5
II	Thickness of Top OB & Parting (Avg)				
	Hard OB	m	10.00	169.00	60.00
	Part bet VI & V	m	9.71	23.10	15.0-20.0
	Part bet V & IV	m	5.00	35.00	16.79
	Quarry Parameters				
III	Dip of Seams	Degree	4° (1 in 20)		

Total mineable reserve estimated· 452.46 MT. Corresponding OB estimated: 2362.72 M.cum, Avg. Stripping ratio envisaged: 5.16 cum/tonne

3.2.8 Quality of coal

Seam	Proximate Analysis on 60% RH & 40°C						Gross CV in Kcal / kg		Grade		Avg. Grade
	M%		Ash%		VM%						
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
VI	1.5	5.2	38.1	53.7	17.8	25.9	2658	4637	G16	G9	F-G as per GR
V	1.8	5.9	43.4	57.5	16.9	21.5	2465	3815	G17	G12	G-17
IV	1.5	5.2	24.4	41.9	19.7	28.4	3686	5526	G13	G6	G-11

3.2.9 Mining

Special Conditions

MoEF&CC revalidated the Forest Clearance on 19.06.2015 (stage-I) after reallocation of coal block. As per condition No. 9 of Stage-I Forest Clearance, which is reproduced below, "*The Mining shall be done in two phases –*

During Phase-I, covering 15 years, the mining shall be restricted to 762.00 ha of Forest land

- *During Phase-II, the mining permission over remaining 1136.00 ha will be linked to the reforestation and biodiversity management in phase-I. The Project Proponent will submit the application for permission in mining phase-II along with compliance report of phase-I."*

The mining activities of the PEKB Open Cast coal mine is being done in compliance with the phase-wise mining as mentioned in condition No. 9 of Stage-I Forest Clearance issued *vide* letter F. No. 8-31/2010-FC dated 6th July, 2011 *i.e.*, Phase-I within 762 ha of forest land. The objective of imposing condition of phase wise mining is to ensure that second stage of mining will be undertaken only after verifying the efficacy of biological reclamation in the first phase of mining.

Phase-I: Mine boundary has been restricted within 762 ha of forest land. A mine safety zone has been created along phase –I boundary coordinates by pillaring on the ground with two line barbed-wire fencing under the supervision of local forest officials, considering phase-I land as boundary of the mine.. The phasing of forest land for the mine is being monitored by State Forest Department and permission of tree felling and use of forest land for mining is being given accordingly. Total area of the Phase-I mine is 1300.50 ha including 762.00 ha of forest land & 538.50 ha of non-forest land. However, the mine management informed to the ICFRE team that the total mining lease area of Phase-I is 1188.675 ha. As per envisaged proposal for the Phase-I over an area of 1188.675 ha, which includes mining area is 866.166 ha, Infrastructure area is 183.819 ha and External OB dump area is 138.69 ha. Till December 2020, total broken area is 731.50 ha out of 866.166 ha of mining area.

Moreover, Centre of Mining Environment, Indian Institute of Technology (Indian School of Mines), Dhanbad, which is an approved third-party organization as per notification issued by the Coal Controller, Ministry of Coal, Government of India *vide* letter No. CC/MCPS/CIL/(Crores)/2011-12 dated 01.08.2016, was engaged for Assessment of PEKB Coal Mine working as per Mining Plan & Mine Closure Plan. Assessment of the Mining Plan & Mine Closure Plan for FY 2017-18 for PEKB open cast coal mine has been completed by IIT, Dhanbad. The assessment report has been submitted to the Coal Controller, Ministry of Coal, Government of India. The Page No. 3 of the Report states that-

"The mining plan of the PEKB Open Cast Mine is being worked in consonance with the sequential mining as mentioned above in the Forest Clearance condition No. 9. Present mining is restricted in phase-I area of forest land i.e. of 762 ha. A mine safety zone has been created through pillaring on the ground and two-line fencing along phase-I boundary coordinates has been erected considering phase-I land as boundary of the mine."

3.2.10 Salient Features of the PEKB Opencast Mine

Opencast fully mechanized mining operations are being carried out. The mine has already encountered seam IV & seams V. Coal winning is being done using Surface Miner as well as Loader and Dumper combination, while OB removal with shovel and dumper combination. The ROM coal production is being washed at integrated coal washing arrangement with 15 MTPA capacities. An *in-pit* conveyor is being commissioned for transportation of coal from pit to washery with a view to significantly reduce the movement of surface transportation and the completion of its construction works have been delayed due to COVID-19 related lockdown restrictions (Table 3.7). Total OB removal is presently being backfilled. The mine commenced production from Feb 2013 and production data is given below:

Year wise coal extraction and OB removal

Year	Coal (MT)	OB (Mcum)	SR (Cum/T)
2012-13	0.292	3.907	13.38
2013-14	1.196	4.924	4.12
2014-15	3.442	3.835	1.11
2015-16	6.209	11.965	1.93
2016-17	8.266	16.189	1.96
2017-18	8.328	19.493	2.34
2018-19	15.000	32.813	2.19
Note: Reason for low production till 2017-18 was due to unavailability of rail route upto mine site and constrained for road transportation.			
Ensuing Five-year Production Plan			
Year	**Coal (MT)**	**OB (Mcum)**	**SR (Cum/T)**
2019-20	15	41.75	2.78
2020-21	15	50.32	3.35
2021-22	15	51.60	3.44
2022-23	15	49.07	3.27
2023-24	15	51.91	3.46

Table 3.7: Salient features of the PEKB opencast mine

Particulars	Original capacity (10 MTPA)	Expanded Capacity (15 MTPA)	Remarks
Geological Reserves	532.86 MT	516.40 MT	Reserve arrived after detailed exploration
Mineable Reserve	452.46	452.46	
Method of Mining	OB by Shovel Dumper with drilling and blasting and coal by surface miner.	OB by Shovel Dumper with drilling and blasting and coal by surface miner.	
Year of targeted production	3rd year since 2012-13	5th year since 2012-13	
Expected Life of	50 years	31 years	Reduced by 19

Particulars	Original capacity (10 MTPA)	Expanded Capacity (15 MTPA)	Remarks
Mine			yr.
Coal Bearing Area (ha)	2388.525	2388.247	
No. of seams	3	3	
Average seam gradient	4^0	4^0	
Average Grade	F	F	
Average SR	5.16	5.24	
Maximum Strike length (km) - Along Surface.	6.12	6.12	
Maximum Depth of the Mine	225 m	225 m	
Manpower (to achieving targeted production)	1707	1805	
Water requirement for Mine operation	9000 m^3/day (3600 m^3/day for mine + 5400 m^3/day for Washery).	12580 m^3/day (6880 m^3/day for mine + 5700 m^3/day for Washery).	Additional water requirement. (Mine 3280 m^3/day and Washery 300 m^3/ day) 3580 m^3/day will be sourced from mine dewatering.
Potable water requirement	615 m^3/day	615 m^3/day	
Coal evacuation	Railway siding of 75 km taking off from Surajpur Railway Station to Mine head has been completed in April 2018 with 4000 tonnes SILO with Rapid Loading System. The average rake dispatch is 10/12 rakes/day. Each rake has carrying capacity of 4000 tonnes (approx.)		

3.2.11 Land Use Plan

Land use for life of mine (post mining)

Sl.No.	Particular	Total (in ha) (10 MTPA)	Total (in ha) (15 MTPA)
A	Mining		
	Excavation area & barrier	2388.525	2388.247
B	Infrastructure & OB dump area		
1	External dump	164.259	112.655
2	Infrastructure	22.438	36.224

Sl.No.	Particular	Total (in ha) (10 MTPA)	Total (in ha) (15 MTPA)
3	Coal evacuation route	-	30.260
4	CHP & Washery	47.340	28.381
5	Reject based thermal power project	-	42.570
6	Colony & Plantation area	49.054	3.990
	Rationalization area	39.418	40.532
	Total (B)	**322.509**	**294.609**
GRAND TOTAL (A + B)		**2711.034**	**2682.856**
Note: The total project area is reduced to 2682.856 ha in Mining plan of 15 MTPA approved by MoC from 2711.034 ha in Mining plan of 10 MTPA earlier approved by MoC.			

Land Status as on 31/03/2019 (Phase-I)

Broken Area Details in Forest or Non - Forest land				Remaining balance in forest and Non forest			Total Land in Phase -1		
Area	Forest	Non-Forest	Total	Forest	Non-Forest	Total	Forest	Non-Forest	Total
Infrastructure & Dumping Area	137.183	147.297	284.48	38.029	0	38.029	175.212	147.297	322.509
Mining Area	373.538	248.3	621.838	213.25	142.903	356.153	586.788	391.203	977.991
Total	**510.721**	**395.597**	**906.318**	**251.279**	**142.903**	**394.182**	**762**	**538.5**	**1300.5***
*As per the information furnished by the mine management the total mining lease area of Phase-I is 1188.675 ha. As per envisaged proposal for the Phase-I over an area of 1188.675 ha, which includes mining area is 866.166 ha, Infrastructure area is 183.819 ha and External OB dump area is 138.69 ha. As on 30th September 2020, total broken area is 731.50 ha out of 866.166 ha of mining area.									

3.2.12 Mine Planning & Design

It is fully computerized using MINEX software and has been used for surveying, reserve updating and production scheduling.

i. Geo-mining conditions

The selection of mining method was done considering geo-mining conditions such as

a. Favourable coal bearing area for dip and strike length making it amenable for deployment of HEMM and surface miner.
b. Favorable thickness of coal seams
c. Coal bearing area being free from major geological disturbances
d. Relatively flat gradient of coal seams (1 in 20)
e. A very large mineable coal reserve.

Targeted production of 15 MT was already achieved in 2018-19 due to favourable geo-mining conditions.

ii. Design criteria

The design criteria adopted in this Mine plan is as follows:

- Number of annual working days --- 330

- Number of daily shifts /day --- 3
- Duration of each shift (hours) --- 8

The opencast mine is being worked on the 3-shifts/day and seven days/week round the year for coal extraction and overburden removal.

Based on the above factors, mining system has been worked out for achievement of rated capacity in shorter period *i.e.*, low gestation period as well as reduction of Inter-mixing of coal with stone bands and starting of internal dumping as soon as sufficient de-coaled area is created. The OB benches above coal seams are being extracted in horizontal slicing method.

3.2.13 Mine Pits

i. Pit dimension: PEKB coal mine has only one pit having a strike length of 6.2 km (approx.) in E-W direction with dip towards south. Present mine pit dimensions are given below:

Sl. No.	Parameters	Dimension
1	Length of quarry	6.2 km (approx.)
2	Width of quarry	800 m (approx.)
3	Depth of quarry	45 m (approx.)
4	Area of quarry	731.5 ha (approx.)
5	Coal seams exposed	Two (seam no. IV &V)

ii. Mine pit boundaries

The proposed boundaries of the mine are as follows:

- **North**- One-meter thickness line on the base Seam IV as the floor boundary, in the incrop region
- **East**- The surface limit of the mine is 7.50 m away from the block boundary and then the resultant floor boundary has been envisaged.
- **South**- The surface limit of the mine is 7.50 m away from the block boundary and then the resultant floor boundary has been envisaged.
- **West**- The surface limit of the mine is 7.50 m away from the block boundary and then the resultant floor boundary has been envisaged.
  Common boundary with Parsa coal block on the west and Kente Extension on the east.

iii. Mine Parameters

Total three seams *i.e.*, seam-IV to VI are considered for open cast mining. In general, the coal bearing formation exhibits a more or less NW-SE strike with southerly dip. The minimum and maximum dip ranges from 2° to 5°. The beds are almost flat/sub-horizontal near Seam-IV incrop in the west and east.

iv. Scheme of Operation

All the mining operations of drilling in OB benches, loading and transportation of overburden, cutting coal by surface miner, loading and transportation of coal are outsourced to three agencies. However, blasting is being done departmentally. MDO for this purpose is Adani Enterprises Limited. PEKB mine has only one pit and the mine is being operated for three shifts/day, each shift of 8 hrs and all the days in a year. OB, mineable reserves and stripping ratio is as under:

Sl. No.	Particulars	As on 01.04.2012	Extracted till 31.03.2019	Balance quantity as on 01.04.2019
1	O.B (M.cum)	2368.72	93.126	2275.594
2	Coal (M.T)	452.46	42.733	409.727
3	Stripping ratio (cum/t)	5.24	2.18	5.55
Balance life of mine is envisaged as 29 years.				

3.2.14 Drilling & Blasting

a. Drilling

Drilling and blasting is done for OB removal as coal extraction is by surface miners. 5 Nos. of 160 mm BHDs of Hitatchi make are deployed in the mine for drilling in OB. Bench height in OB is maintained 5.5 m to 6.0 m, since OB mostly sandy-sandstone & fractured sandstone. Sub-grade drilling upto 0.3 m is done, where ever required. Spacing & burden is maintained as 6m x 4m. Blasted OB is excavated by deploying backhoe excavators in two slices each of 2.5 m to 3 m loaded in 35 tonne dumpers and transported to decoaled area for backfilling.

b. Blasting

Blasting is being carried out departmentally as per DGMS permission under the supervision of Blasting officer and overman. Blasting is carried out in day time between 1 pm to 2 pm, although charging of blast holes with explosives commences from 10:00 am onwards. No secondary blasting is required. Blasting accessories are drawn from explosive magazines; while site mixed emulsion (SME) is supplied by explosive manufactures at blasting site in their pump trucks. Explosive column in blast holes is nearly one third and stemming column is two third of blast depth. Controlled blasting is done through Nonels of different delays. SME with cast boosters are charged optimally to control fly rock and ground vibrations. Some parameters are placed below:

Sl. No.	Particulars	Hydraulic Excavator
1	Bench height	5.7 m
2	Dia of Blast hole	160 mm
3	Depth of blast hole	6 m

Sl. No.	Particulars	Hydraulic Excavator
4	Spacing & Burden	6 m x 4 m
5	No. of rows	3-4
6	No. of holes	80
7	No. of rounds/day	15-20
8	Charge /hole	25 kg
9	Powder factor	4.5 cu.m/kg

The ground vibration due to blasting are controlled by

i. Reducing the amount of explosive charge per delay
ii. Reducing spacing & burden of blast hole per blast
iii. Reducing the amount of explosives charged per blast
iv. Proper controlled rock movement during blast by using suitable initiating sequence and delay.
v. Proper strata movement during blasting by using suitable firing sequence.

3.2.15 Pit Operation

PEKB coal block is allotted to RVUNL which in turn has outsourced all its mining, beneficiation and rail transport operations to M/s. Adani Enterprises Limited (AEL) by appointing them as MDO. M/s. Adani Enterprises Limited have in turn engaged three contractors for carrying out all mining operations in the pit *viz.* drilling, excavation of OB by shovel dumper combination and it's transportation to internal dump and coal extraction by surface miners and it's transportation to receiving bunkers of coal handling plants (CHP). Blasting is done departmentally. Since the pit has a strike length of 6.12 km (approx.), all the three contractors are working independently in the areas as under:

Name of contractor	Area of operation(between X-sections)
M/s. Karam Jeet Singh and Company Ltd.	83 ha from chainage W900-W2900
M/s. Sierra Infrastructure Private Ltd.	13.22 ha from chainage W500-W900 & E900-E1600
M/s. Avatar Singh and Company	22.4 ha from chainage E1600-E2300

Bench height and width in OB is planned as 6 m and 20 m respectively. A 6 m bench is excavated in two slices of 3 m each and benches are worked along strike direction (E-W) from top to bottom and advance in dip direction. OB is transported from the pit to internal dump for backfilling, while coal is transported to receiving hopper of coal handling plant for crushing it to (-)50 mm size and conveying to receiving hopper of coal washeries. Presently, only two coal seams viz. seam IV & seam V are exposed in the pit. Coal extracted from seam IV is of superior quality (G-11) having 36-38% ash content. It is fed to 10 MTPA coal washery (with Jigging technology), where quality is upgraded to 30-31% ash content with reject as 10-11%. Coal from seam No.V is inferior in quality (G -17) having 48-52% ash content is fed to 5.0 MTPA dense

media cyclone washery where quality is upgraded to 31-32% ash content with reje... as 36-37%. Presently 70% coal production is from seam IV and 30% from seam V.

3.2.16 Waste Dumps

The opencast mine is planned upto 225 m depth with overall average stripping ratio of 5.24. The total volume of OB has been estimated as 2368.72 Mcum. The total volume of external dump has been estimated as 43.52 Mcum solid. Rest of the OB quantity is planned as internal dumps. By adopting the proposed sequence of mining, as the quarry advances, the amount of internal dump will increase as more space for the internal dumping is created. For external dumps no additional land will be required outside the block boundary. External dump is accommodated inside the block boundary. Two external dumps *i.e.* external dump west and external dump east have been placed on the north western and north eastern side of the block boundary respectively. Two internal dumps *i.e.* internal dump west and internal dump east have also been proposed & under progress.

As the gradient of the seam is flat, during working of the quarry substantial amount of OB will be accommodated in internal dump. Further no external dumping will be required. Hence, OB will be accommodated in internal dump for rest of the mine life. Dumping has been planned assuming 15 % swelling factor. Height of west external dump and east external dump will be 30 m and 60 m respectively. During closure of mine, overburden dumped above ground level will be used to fill void up to 30 m below ground level. It is proposed to maintain water body in the final void that is 30 m below ground level. The land reclamation is being done progressively after exhaustion of coal and completion of internal dumping (backfilling) and flushing (merger) with external dumps. The top soil is being used with minimum time lag for spreading over the external & internal dumps. External overburden dumps have been merged with internal dump & reclamation of the same has been started with indigenous plantation, etc., after dumping/spreading top soil over the external and internal dumps. Out of 2368.72 Mcum of OB, about 43.52 Mcum have been accommodated in external dumps, which constitutes about 1.84 % of total dumping.

3.2.17 Coal Washery & Coal Handling Plant (CHP) & Inpit conveying system

A 15 MTPA Coal Handling Plant (CHP) with 10 MTPA Jig Washery and 5 MTPA DMC Washery plant at PEKB mine has been established and in operation. For handling, washing, stacking and loading the thermal coal, all necessary infrastructures have been built at PEKB mine and some of them are under final stage of execution. Following sections are briefing the overall system configuration.

3.2.17.1 In Pit Conveying System

There are 2 Paths for In-pit conveyors and detailed descriptions of both the paths are described below:

i. **P.TH-I (For seam IV)**: Rated 1870 TPH/Design 2050 TPH: PATH-I is dedicated for feeding coal to existing 10 MTPA CHP plant. Mined raw coal at (-)100 mm (max 250 mm) will be received through 20T or 40T dumper trucks at 2 nos. of Chain feeders of 1100/1210 TPH each, and will convey the coal on PKIC-01. Suitable grizzly (300 mm x 300 mm) will be fixed at appropriate location at tail end in order to restrict oversized material transporting up to dump station. This conveyor will convey the coal to Belt feeder BF-1 at PKTT-1. BF-1 is to be installed on the top of the existing hoppers (2 x 273 T). BF-1 will feed to the either of hoppers through prism type diverter gate depending on coal level in the hopper. The level Transmitters in the Hoppers will be properly installed and protected from the coal flow.

ii. **PATH-II (For coal of seam V & VI)**: Rated 1100 TPH/Design 1210 TPH: PATH-II: Mined raw coal (-) 100 mm (Max 250 mm) will be received through 20T or 40T dumper trucks at a Chain feeder of 1100/1210 TPH and will be conveyed on conveyor PKIC-02. Suitable grizzly will be fixed at appropriate location at tail end in order to restrict oversized material transporting up to dump station. This conveyor will convey the coal to Belt feeder BF-2 at PKTT-1. BF-2 is to be installed to convey material from PKTT-1 to new 5 MTPA CHPP Dump hoppers (DS-03). Belt feeder BF-2 will feed to the hopper through diverter gate depending on coal level in the hopper. The level Transmitters in the Hoppers will be properly installed and protected from the coal flow. However, provision of feeding the coal to existing 2 Nos. Hoppers will also be kept in the system. This can be achieved with Belt plough for intermediate discharge in existing 2 Nos. hoppers.

3.2.17.2 Future Expansion

As mine progresses additional In-pit conveyors of 500 m length will be installed after every 5 years of operation up to 30 years of mine life, which is under construction. Chain feeders will be shifted at new conveyors tail ends after every 5 years and previous dump station will be converted into Transfer tower.

3.2.18 Coal Handling and Washery Plant

3.2.18.1 Coal Handling Plant

Two (2) hoppers (2 x 300 T capacities) at CHP dump station are provided to take the feed from ROM coal dumpers from mine. Both CHP dump hoppers are equipped with belt feeders along with rod gates. Raw coal from CHP dump station, transfer coal to crusher/screening house (TT-1 via two conveyor C-1 & C-2, at TT-1 two sets of screen and crusher are provided for both the conveyors, material from both the conveyors feed to screens, oversize material (+) 50 mm further feed to crushers to crush down to (-50) mm, crushed material feeds to conveyor C-4, under size material feed to C-4 conveyor for further dispatching. C-4 conveyor feed to either YC-1-yard

conveyor to stack crushed coal at yard or C-5 washery feed conveyor at TT-2 via diverter gate. C-5 conveyor conveys the material to Jig washery from TT-2.

3.2.18.2 Dense Media Cyclone Washery (For seam V & VI)

CHP For DMC Washery

In-pit conveying system will feed the ROM coal of (-) 100 mm (Max. (-) 250 mm) lump size, to ROM hopper of total 150 T capacity at dump station. The entire ROM Stream is designed for 1000 TPH rated. The necessary extraction system below dump hopper at the rate of 1000 TPH (avg.) by two number of vibrating feeders are installed. Conveyor CV-301 will convey the (-) 100 mm (Max. (-) 250 mm) lump size material to screening cum crusher building (TP-1). CV-301 will feed the material to scalping screen. Scalping screen separate (-) 50 mm and (+) 50 mm material. (-) 50 mm material will be feed to conveyor CV-302 and (+) 50 mm material feed to double roll crusher. Double roll crusher crushed (+) 50 mm material to (-) 50 mm and feed to the same conveyor CV-302. (-) 50 mm material will be conveyed to transfer tower TP-2 through CV-302. CV-302 & 303 series of conveyor feeds (-) 50 mm crushed coal to 5 MTPA DMC Washery plant. Washery product will be conveyed to yard conveyors through series of conveyors CV 305, 306 & 307. Diverter gate provided at the discharge end of CV-307. Rejects from washery will be conveyed by CV-304 to generate the rejects stockpile by telescopic chute.

3.2.19 Coal Dispatch System

There is no dispatch of processed (washed) coal and rejects by road to the consumers.

From the 15 MTPA of raw coal, yield of washed coal is 12 MTPA (approx.), while reject is 3 MTPA (approx.) which are dispatched as under:

i. Rapid loading system

a. (Stacking of washed coal, reclamation and rapid loading through silo)-12 MTPA capacity.

b. Dedicated railway line from silo to Surajpur- 75 km built by MDO.

ii. Dispatch of rejects by railway wagons

a. Present arrangement-Dispatch of rejects by railway wagons.

b. Future Plan- To set up a power plant.

3.2.20 Electrical Power Distribution

PEKB is powered from the double circuit 132 kV transmission line from Bishrampur-Tarkeshwar to PEKB site. The 132/33 kV substation has two nos. of 15/22 MVA, 132/33 kV transformers with 3 nos. of outgoing in 33 kV switch board and the same is fed the power to following major infrastructures.

- ✓ 2 nos. of outgoing breaker panels are tapped to supply to existing PEKB 33/6.6 kV Switch yard,
- ✓ 1 no. of outgoing breaker panel is tapped to supply to 5MTPA PEKB Coal Washery and
- ✓ The other outgoing feeders shall be utilized to feed the power supply to proposed PARSA and KENTE coal blocks.

Power distribution in PEKB is at 6.6 kV and 415 V level.

Existing PEKB 33/6.6 kV switchyard is equipped with following major component. This substation received power from 132/33 kV substation. This substation is fed the power to SS-01 CHP related load for Jig washery, Jig washery, Mini washery and other mining related load.

- ✓ 33 kV gantry structure with isolators and metering arrangements
- ✓ 33/6.6 kV oil type transformers – 7.5 MVA - 2 Nos.
- ✓ 6.6 kV indoor switchboard (VCB) – The same is received power from 7.5 MVA transformer
- ✓ 33/6.6 kV oil type transformers – 2 MVA - 2 Nos.
- ✓ 6.6 kV indoor switchboard (VCB) – The same is received power from 2 MVA transformer

Capacitor Bank to compensate the power factor

Substation-01 (SS-01) PEKB is equipped with following major component. This substation received power from Existing PEKB 33/6.6 kV switchyard. This substation is fed the power to CHP related load for jig Washery and in-motion wagon loading system.

- ✓ 6.6k V indoor switchboard (VCB) – The same is received power from 7.5 MVA transformer of existing PEKB 33/6.6 kV switchyard.
- ✓ 6.6/0.415 kV oil type transformers – 2 MVA - 2 Nos.
- ✓ DG set
- ✓ 415 V indoor switchboard
- ✓ PLC room
- ✓ Capacitor Bank to compensate the power factor

Jig Washery substation PEKB is equipped with following major component. This substation received power from existing PEKB 33/6.6kV switchyard. This substation is fed the power to jig washery equipment.

- ✓ 6.6 kV indoor CICO Panel (VCB) – The same is received power from 7.5 MVA transformer of existing PEKB 33/6.6 kV switchyard.
- ✓ 6.6/0.415 kV oil type transformers – 2 MVA - 2 Nos.
- ✓ 415 V indoor switchboard
- ✓ PLC room
- ✓ Control room

MTPA DMC Washery substation PEKB is equipped with following major component. This substation received power at 33 kV from 132/33 kV switchyard through cable. This substation is fed the power to DMC washery and its CHP related equipment.

- ✓ 33 kV Switchboard
- ✓ 33/6.6 kV oil type transformers – 6.3 MVA - 2 Nos
- ✓ 6.6 kV indoor switchboard (VCB) – The same is received power from 7.5 MVA transformer of existing PEKB 33/6.6 kV switchyard.
- ✓ 6.6/0.415 kV oil type transformers – 2 MVA - 3 Nos. / 1.6 MVA – 1 no
- ✓ DG set
- ✓ 415 V indoor switchboard
- ✓ PLC room
- ✓ Control Room
- ✓ Capacitor Bank to compensate the power factor

3.2.21 Intrumentation and Control

For Operations and monitoring of CHP and Electricals Hot Redundant envisaged at 10 MTPA Control room and 5 MTPA Control room.

For PEKB, Control room having PLC panels and required Operation & Engineering workstations envisaged at substations, RIO panel are connected to PLC panel via FO Cables.

Control Systems of CPP, Wagon Loadings systems are connected to respective Plant PLC via FO Cables for plant integration.

UPS envisaged for all PLC system power supply backup at required level.

Required safety switches and cabling for interlock and protection considered for CHP conveyors.

For plant Communication PA system at CHPP are considered having Master Control station at respective control room.

For Surveillance and plant monitoring CCTV system having cameras at Dump stations, Stock yard, etc., envisaged. Monitoring of CCTV is being done through workstation at respective plant control rooms.

Fire Detection system required at substation with connectivity to detectors, MCP and Hooters shall be considered.

3.2.22 Utility System

3.2.22.1 Water supply arrangement

Mi Seepage water after preliminary treatment at Mine sump is pumped to surface reservoir and stored for industrial water usage. Industrial water is used for different application which includes CHP Dust suppression, Road Dust suppression, Coal Washery plant, general wash down. Water treatment plant is installed for treatment of water for specific purpose like gland sealing, dust suppression, Ventilation system.

Plain water dust suppression system is installed for entire coal handling plant to minimize dust generation while material transfer from one point to another. Coal Stockpile is equipped with fixed sprinkler system for dust suppression system.

Crusher house is equipped with High efficiency bag filter system which includes dust extraction suction hoods, conveying ducts from different material transfer points like conveyor discharge points, screens, crushers, *etc.* Dust is captured by negative pressure through ID fan and allows passing through Bag filter. Clean air is discharged via 30 m stack as per environment norms.

Fixed hydrant/water monitor system is installed to mitigate fire in plant. Electric main & jockey fire pumps with diesel back up pumps are installed at site. 2 Hours of water storage is provided to meet water demand as per statutory norms.

Remark: Coal Washery and Coal Handling operations are reproduced from write up received from mine management.

3.2.22.2 Surface water management

During dry season, Surface/Sub-surface water accumulated in the void is used for industrial purpose in the mine. During rainy season, inrush of outside water is prevented by having peripheral (garland) drain along the lease boundary. Water of catchment area is guided into mine sump (in void area) through various sides & cross drains. No excess water is pumped from the void (sump) to outside the Coal Block area.

3.2.22.3 Dust suppression system

The emissions of particulate matter from the OB excavation, coal mining and washery are controlled by effective dust extraction/dust suppression system. Dusty air from various material transfer points is being controlled with dry fog system, which will allow through vent only clean air to the surrounding environment.

3.2.22.4 Air pollution control measures at mining activities (dust suppression system)

A number of practices have been adopted to control air pollution, which includes:

- Continuous haul road sprinkling is being done.
- Wet Drilling is done to minimize dust generation during drilling operation.

- Surface miner coal cutting is being done with water spraying system, which is built in cutting drum with interlocking system.
- Dust suppression is done through pressurized water tanker sprinkling system at haul road, Overburden and coal faces, Dump yard, loading and unloading points of OB and coal with the help of 8 to 9 out of 11 numbers of 18000 litre capacity tankers.
- Dust generation is also minimized by regulating speed of coal and OB dumpers.
- Overloading of coal and OB dumpers is prohibited to reduce dust generation through spillage,
- Only Mines Seepage water is used in Dust suppression and Water Tanker filling stations have been established at different places near working areas with High capacity pumps to reduce the water filling timing.
- Installed 04 Nos. of Online Ambient Air Quality Monitoring Systems for continuous observation of air quality.

Dust suppression system is provided for control of dust during loading and discharging of coal into conveyors/wagons. Dust suppression system has also been put in place for suppressing the dust at surface including CHP, Stacker yard, coal stock and roads.

3.2.23 Coal Handling Plant (CHP)

A pump house has been constructed in CHP area of total storage capacity of 2580 CUM which receives clean mine water. High pressure pumps have been installed to supply water at high pressure to dust suppression system. Adequate numbers of spraying nozzles have been provided at Dump hoppers and each transfer point of CHP to take care of dust suppression at these points. All around stacker yard rain guns and monitors have been installed for dust suppression. The rain guns can be operated from the control room and Mist spraying System in crusher and screening area in CHP.

- All transfer points are being provided with dust suppression system.
- Coal transportation from CHP to Washery by covered belt conveyors are regularly operated for the purpose.
- Bag filters Installed in CHP for control of Dust emission

3.2.23.1 Reject coal stock

Water monitors have been installed all around the coal stock for dust suppression. It receives water at high pressure from the pumps installed at CHP.

3.2.23.2 Wharf wall coal stock

Rain guns have been provided along the complete length of the siding for dust suppression.

3.2.24 Surface Roads

Three water tankers of 18 kl have been deployed for sprinkling water on all the roads for dust suppression. These tankers have been fitted with pumps for spraying water at high pressure. These tankers are filled from different reservoirs. Further fixed sprinklers have also been installed along the road in front of washery for dust suppression.

3.2.25 Mining Lease Boundary (Phase-I)

It was noticed that entire phase-I mining lease boundary and safety zone area properly demarcated by concrete (permanent) boundary pillars.

3.2.26 Production Constraints

It was informed that there are no production constraints as geo-mining conditions are quite favourable and coal production target of 15 MT was achieved in 2018-19.

3.2.27 Statutory Violations

It was observed that there were no major violations pointed out by statutory authorities (DGMS, SPCB, State Forest Dept., MoEF&CC regional office, DMG, *etc.*) during last 2 years.

3.2.28 Spontaneous Heating

Spontaneous heating (burning of coal) was not observed during site visit. It was informed by mine management that spontaneous heating takes place occasionally at coal stockyard, especially rejects from washeries and it is quenched by pressurized water spraying. Since wining of coal is done by deployment of surface miner and no coal is left at the edge of coal bench, no case of spontaneous heating was observed in the pit.

3.2.29 Coal Stockyard

There is no stockyard for raw coal. Two washed coal stockyards having a gross capacity of 2.20 lakh tonnes are provided, where coal is handled (stacking & reclaiming) by Stacker Reclaimer (2 Nos.) for loading into wagons through 4000 tonne capacity silo under rapid loading system. Rejects (failings) from coal washeries are stacked at the railway siding (adjacent to rapid loading system) for loading into railway wagons under dump and load system.

3.2.30 Mine Closure Plan

3.2.30.1 Waste management

Open cast mining is planned up to 225 m depth with overall stripping ratio of 5.24 Cum/T. Total volume of over burden estimated is 2368.72 Mcum. The OB removed during initial years will be placed beyond the in crop of the seam IV. The total volume of external dump has been estimated as 43.52 Mcum solid. Rest of the OB proposed to be dumped in internal dumps/ backfilling (2325.20 Mcum). It is proposed to start internal dumping/backfilling when about 100 m space is available on the quarry floor. For external dumping no additional land is envisaged. Two internal dumps/backfilling are proposed (i) Internal dump/backfilling west and (ii) internal dump/backfilling east. It is envisaged internal dumping from 3rd year of the mining operations and during 5^{th} and 6^{th} year of mining operation, overburden material will be accommodated both in internal and external dumps. From 6th year of mining operation onwards, no external dumping will be required. Hence, OB will be accommodated in internal dump for the rest of the mine life.

3.2.30.2 Water quality management

The daily water requirement for mine and coal washery operation is approximately 2650 m^3/day. Water for mine area will be sourced from mine sump and colony will be sourced from bore well. Generation of waste water expected from mine is approximately 20 m^3/day which will be treated from Effluent Treatment Plant (ETP). Generation of domestic waste water from colony located outside the mine area will be approximately 492 m^3/day, which will be treated in the Sewage Water Reclamation Plant (SWRP) provided near colony.

3.2.30.3 Surface water control measures

Retaining wall at toe of dumps and unstable benches are provided, water channels/drains to settling ponds are provided to drain water to settling ponds. Seepage water and rain water collected in open pit are pumped to natural water course. Septic tanks and soak pits are provided for domestic and waste water from colony. Regular monitoring of surface water and ground water quality is being undertaken.

3.2.30.4 Air quality and noise level management

Ambient Air Quality data form 12 monitoring stations around 10 km radius of the project has been generated and analyzed. Results indicate air quality is fairly good and devoid of any industrial pollution. Proper mixing of oil and ammonium nitrate ensures complete detonation and reduce fumes and noxious gases. Water spraying at drilling site and haulage roads reduces dust during drilling and transportation. Regular maintenance of vehicles and mining machineries reduce emission. Monitoring data

noise level is within permissible limits. (Source: Six monthly compliance reports submitted to MoEF&CC for period ending 30.09.2019).

3.3 PARSA COAL BLOCK (BLOCK NO.13) OF M/S. RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD. (RVUNL) (RAJASTHAN GOVT. UNDERTAKING) VIDYUT BHAWAN, JANPATH, JYOTI NAGAR, JAIPUR-302005

3.3.1 Background of the Project

- Parsa coal block was allotted to Chhattisgarh State Power Generation Company Ltd. (CSPGCL) (Erstwhile Chhattisgarh State Electricity Board) by the Ministry of Coal *vide* F.No-13016/23/2006-CA-I dated 02.08.2006 for coal mining.
- Mine Plan and Mine Closure Plan (5 MTPA) was approved by Ministry of Coal *vide* letter no. 13016/90/2006-CA-I (Part) on dated 19.05.2014.
- The Hon'ble Supreme Court of India through its Judgment dated 25.08.2014 & 24.09.2014 had cancelled the allotment of 204 coal blocks including Parsa Coal block.
- Subsequently, coal block was allotted to RVUNL *vide* vesting order No. 103/24/2015/NA, dated 08.09.2015 to meet the coal requirement of it's three thermal power projects.
- MoC transferred approval of Mine Plan (5 MTPA) and Mine Closure Plan earlier issued to CSPGCL to RVUNL from the date of allotment.
- Proposal for diversion of 841.538 ha of forest land in Surguja & Surajpur Forest Divisions submitted *vide* letter dated 04.08.2016 (Part-I of Form-A of FC Act) (State Serial No. FP/CG/MIN/20742/2016).
- Mine Plan & Mine Closure Plan (1st Revision for inclusion of pit top washery) was approved by Ministry of Coal *vide* letter File No. 34011/24/2016-CPAM, dated 10.11.2016 for 5 MTPA of mine & coal washery.
- The ToR for EIA/EMP was issued by MoEF&CC *vide* letter No.J-11015/76/2016-IA.II (M) dated 23.03.2017.
- Subsequently, district-wise Public Hearing was organized by CECB at Basan village, Surguja district, Chhattisgarh on 29.10.2017 and at Tara Village, Surajpur district, Chhattisgarh on 12.11.2017.
- Stage-I granted by MoEF *vide* letter F. No. 8-36/2018-FCdated 13.02.2019 for diversion of 841.538 ha of forest land.
- EC recommended by EAC in it's meeting held on 21.02.2019. Final Clearance is under approval for 5 MTPA coal mine and 5 MTPA coal washery.

3.3.2 Status of Mine Lease

Mining lease application submitted for over an area of 1252.447 ha to Director, Directorate of Geology & Mining (DGM), Raipur on 08.12.2015. Govt of India *vide*

letter dated 13.07.2017 issued Gazette Notification under section 4(1) of CBA Act, which is deemed as grant of previous approval. As per Coal Bearing Act (A&D) 1957, Gazette Notification u/s 11(1) of CBA Act issued by Chhattisgarh Government on 20.09.2018 which is deemed Mining Lease and granted for a period of 30 years. Mining lease area comprises with

- Forest Land: 841.538 ha
- Agricultural / Tenancy Land: 365.366 ha
- Govt. Revenue Land: 45.543 ha

3.3.3 Location of Mining Area

The Parsa coal block is located in the north central part of the HAC in Surguja and Surajpur districts, Chhattisgarh. The block is located at towards northwest of PEKB coal block of M/s. RVUNL and sharing eastern boundary of the block with PEKB.

The taluk headquarters at Udaipur and the district headquarters at Ambikapur are located at a distance of 26 km and 70 km respectively northeast of the block on SH-2A. Lakhanpur, another small township is located about 43 km northeast of the block on SH-2A. The SH-2A aligned in a NE–SW direction passes very close to the north western corner of the block. The block can be approached from Tara village, located on SH-2A at a distance of about 152 km from Bilaspur, through a fair-weather forest road that leads to Ghatbarra village through Fatehpur village located in the southern part of the block. The accessibility within the block is through kuccha/unmetalled roads and is difficult during monsoon. Morrum and mud road connect the villages within the block.

3.3.4 Geology

The Parsa coal block is in the north central part of HAC. However, it is covered with coal bearing Barakar formation with underlying Talchir formation which has been intersected in boreholes at depth. The detailed exploration in Parsa block has proved the existence of Barakar and Talchir formations under thick blanket of soil and alluvium of residual nature. The detailed exploration in Parsa coal block of HAC has established the existence of 3 persistent and potential coal seams *viz.*, Seam-IV, V and VI in ascending order. Besides, at least 1 to 2 thin and impersistent coal seams without any significant economic potential also occur below Seam-IV as revealed from a few boreholes drilled upto the Talchir Formation. All these seams occur within Barakar column.

3.3.5 Exploratory Drilling

The total area of the block is 12.52 sq.km. Detailed exploratory drilling in the entire area was completed by March 2012 end and geological report in April end. The quantum of drilling carried out in Parsa block is given below:

Quantum of drilling completed as on March, 2012.

Agency	Period	No. of Boreholes	Meterage
Geological Survey of India (GSI)	1981-85	7	2, 457.50
Adani Mining Private Limited (AMPL)	Nov.2011 – March 2012	107	13, 062.00
Total		**114**	**15, 519.50**

Source: Mining Plan

Thus, a total of 114 boreholes involving 15519.50 m have been drilled till March 2012 in Parsa coal block with a borehole density of 9 per sq.km. The depth of the boreholes in the block including those drilled up to Talchir formation ranges from 19.00 m (PCL-102) to 481.00 m (PCL-46).

The density of boreholes is adequate to ascertain precisely the geometry, quality and quantity of coal resources. Application of geophysical logging was also considered as a tool to enhance the confidence level of interpretation further.

3.3.5.1 Seam wise coal reserves

The sequence of coal seams occurred within the Parsa coal block is detailed as under:

Seam / Parting	Thickness Range (m)		Generalized Thickness Range (m)
	Min.	Max.	
Top OB	12	200	90.00
Seam - VI	0.95	2.70	1.2-2.0
Parting	11.33	17.61	14-16
Seam - V	2.26	7.97	3.5-6.5
Parting	21.38	33.27	26-32
Seam - IV	6.79	9.67	8.0-9.0

Geological Coal Reserves(in Million Tonnes)

Seam name	Gross Proved Reserves	Net Proved Reserves	Minable Reserves
Seam-VI	25.48	22.93	20.29
Seam -V	80.35	72.31	63.27
Seam -IV	150.57	135.51	116.84
Total	**256.40**	**230.76**	**200.41**

3.3.5.2 Summary of coal seam VI

Seam VI is the youngest seam occurring in the block. The incrop of the seam extends throughout the strike length. The depth of occurrence of the seam is from 14.50 to 206.55 metres. The thickness of the full seam varies from 0.95 to 2.70 metres and the general thickness ranges between 1.2 and 2.0 metres. The seam is free of >1 metre in-seam dirt bands. However, it contains 1-5 dirt bands ranging in thickness from 0.05 to 0.52 meters. The proximate analysis on 60% RH and 40% C of the seam on 1100 sample for >1 metre seam thickness shows moisture %, ash % and volatile matter % vary from 4.80 to 8.71, from 32.63 to 51.63 and from 18.23 to 23.85 respectively.

Determined Gross CV on 1100 samples of the seam are 2658 to 2859 K cal/kg and unit GCV for 1100 samples varies from 7693 to 9136 K cal/kg. The unit VM% varies from 33.18 to 38.66. The UHV on 1100 samples of the seam varies from 1187 to 3213 K cal/kg and the corresponding grade is UG to F. The ultimate analysis of the seam indicates the DMMF carbon% and hydrogen% as 80.13 to 86.40 and 5.44 to 6.16 respectively. The HGI of the seam varies from 70-74.

3.3.5.3 Summary of coal seam V

The depth of occurrence of the seam is from 6.0 to 224.75 metres. The thickness of the full seam varies from 2.26 to 7.97 metres and the general thickness ranges between 3.5-6.5 metres. The seam has in general developed significant dirt bands having thickness less than 1 meter. However, the seam has encountered dirt band thickness over 1 meter in 19 boreholes generally spread over the entire area. This has resulted into the seam occurring in two sections in these boreholes. In such cases the sectional as well as seam overall analysis has been conducted by combining both sections. It has been observed that the quality variation is not significant as the grade varies from UG to F and therefore these sections are considered together for reserve estimation. The proximate analysis on 60% RH and 40% C of the seam on 1100 samples for >1 metre seam thickness shows moisture %, ash % and volatile matter % vary from 4.36 to 8.64, from 30.59 to 60.30 and from 14.99 to 25.90 respectively. Determined Gross CV on 1100 samples of the seam are 2000 to 4770 k.cal/kg and unit GCV for 1100 samples varies from 7168 to 8386 kcal/kg. The GCV on ADB varies from 1986 to 4791 kcal/kg. The unit VM % varies from 30.76 to 38.89. The UHV on 1100 samples of the seam varies from 61 to 3487 kcal/kg and the corresponding grade is Ungraded to E. The ultimate analysis of the seam indicates the DMMF carbon % and hydrogen % as 81.20 to 85.24 and 5.21 to 6.27 respectively. The HGI of the seam varies from 69-79.

3.3.5.4 Summary of coal seam IV

Seam IV is the lowermost and most potential seam occurring in the block. The incrop of the seam extends throughout the strike length. It is dissected by one low magnitude strike fault in the western part of the block. The depth of occurrence of the seam is from 7.05 m to 270.42 metres. The thickness of the full seam varies from 6.79 to 9.67 metres and the general thickness ranges between 8.0 and 9.0 metres. The seam is generally free of >1 metre in-seam dirt bands except in 1 borehole where the seam occurs in 2 sections. The proximate analysis on 60% RH and 40% C of the seam on 1100 samples for >1 metre seam thickness shows moisture %, ash % and volatile matter % vary from 5.11 to 8.05, from 24.57 to 41.77 and from 20.64 to 31.41 respectively. Determined Gross CV on 1100 samples of the seam varies from 3454 to 5899 k.cal/kg and unit GCV for 1100 samples varies from 7748 to 8386 k.cal/kg. The GCV on ADB varies from 3446 to 5901 k cal/kg. The unit VM % varies from 33.14 to 40.17. The UHV on 1100 samples of the seam varies from 2430 to 4398 k.cal/kg and the corresponding grade is F to D. The ultimate analysis of the seam indicates the

DM"F carbon % and hydrogen % as 81.42 to 88.02 and 4.89 to 5.87 respectively. The HGI of the seam varies from 59 to 64.

The Parsa coal block contains three workable coal seams having average cumulative thickness of 15 m. The coal seams have shallow gradient of 2 to 6^0 and incrop in the block over the strike length of 3.10 km and 4.3 km in the dip direction. The deposit is generally free from major faults except one fault having throw of about 80-160m in the extreme southwest corner. Since the deposit is shallow and has multi seam incrops, it is felt that the block has good opencast prospects.

Quality of Coal

Seam	Proximate Analysis on 60% RH & 40°C						Gross CV in Kcal / kg		Grade	
	M%		Ash%		VM%					
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
VI	4.8	8.7	33.5	51.1	18.2	23.8	2658	2859	G16	G15
V	4.3	8.6	30.6	60.3	14.9	25.9	2000	4770	UG*	G9
IV	5.1	8.0	24.5	41.7	20.6	31.4	3454	5879	G13	G5
*UG (Unspecified Grade)										

Geo-Mining Parameters

Sl. No.	Features	Details
1	Geological Reserve	256.40 MT
2	Mineable reserves	200.41 MT
3	Average Grade	F
4	Total overburden generation External dump Internal dump	1227.19 million m^3 21.02 million m^3 1206.17 million m^3
5	Average stripping ratio (Cum/Tonnes)	6.12
6	Ultimate depth	275 m
7	Quarry Floor Area	936.20 ha
8	Quarry Surface Area	1114.69 ha
9	No. of Seams and Seam Gradient	Three, 2° to 6°
10	Strike Length (along the floor)	2.95 km
11	Power requirement	Power requirement (5-7 MVA).
12	Manpower requirement (Peak)	768
13	Life of Mine	45 years including three years of construction period.
14	Project cost	Rs. 1960 Crores

Therefore, the quality parameters have been assessed on 1100 samples for each of potential seam VI, V and IV separately as well as combining these seams together. In the major part of the property, either there is a combination of seams IV and V or seams IV, V and VI. It was, therefore, felt necessary to have an overall assessment of the coal quality combining seams IV+V as well as IV+V+VI. The combined seam analysis in the laboratory was conducted on samples drawn from boreholes evenly spread over the property. It is noted that combined seams which will be mined

together will offer overall Grade F for IV+V as well as IV+V+VI. Considering Seam IV as the bottom most quarriable seam a total of 256.40 Mt. of gross reserves will be amenable to opencast mining. The maximum floor depth will be about 275 m.

Post Mining Land Detail

Particular	Forest Land (ha)	Non Forest Land (ha)	Total (ha)
Quarry	804.362	318.94	1123.302
Safety Zone	6.073		6.073
External Dump	10.174	53.91	64.084
Roads	0.09	2.28	2.37
Nallah diversion	9.213	5.588	14.801
CHP, belt conveyor & washery	3.716	9.87	13.586
Infrastructure including pit head rail siding& electric route	5.043	8.185	13.228
Settling pond	0.010	2.25	2.26
Top soil	1.798	0.802	2.6
Rationalization area	1.059	9.084	10.143
Total	**841.538**	**410.909**	**1252.447**

Land Type Details Village wise (in ha)

Sl. No.	Village	District	Pvt. Land	Govt. Land	Forest Land		Total
					Revenue Forest	PF/ RF	
1	Tara	Surajpur	61.59	3.39	29.51	556.00	
2	Janardanpur		53.26	2.15	12.26		
Total (A)			114.85	5.54	41.77		
3	Fatehpur	Surguja	99.66	18.29	78.61		
4	Ghatbarra		3.64	0.52	4.82		
5	Hariharpur		65.87	7.06	74.90		
6	Salhi		81.35	14.13	85.44		
Total (B)			250.52	40.01	243.76	556.00	
Total (A+B)			**365.37**	**45.54**	**841.54**		**1252.45**

R & R Details

Sl.No	Name of Village/ Hamlet	Tehsil /District	No of PAFs		
			Land Oustees	Home & Land Oustees (PDFs)	Grand Total (PAFs)
1	Salhi	Udaipur/ Surguja	255	39	294
2	Ghatbara		9	0	9
3	Hariharpur		27	110	137
4	Fatehpur		55	160	215
a) Total Surguja district			346	309	655
5	Tara	Premnagar/ Surajpur	144	75	219
6	Janardanpur		94	27	121
b) Total Surajpur district			**238**	**102**	**340**
Total Surguja & Surajpur districts (a+b)			**584**	**411**	**995**

3.3 Mining Strategy

3.3.6.1 Mining process

Three years have been considered as construction period. During this period, following construction activities will be taken up:

- Making approach road;
- Land acquisition;
- Bringing power line to the project and construction of electrical sub-station, power supply;
- Infrastructure like office, store, workshop, coal handling plant etc.;
- Statutory clearance;
- Colony (essential residential buildings); and
- Railway siding and construction of MGR for coal dispatch.

3.3.6.2 Opening of mine field

The Parsa opencast mine is proposed to be developed in the 1st year of mine operation by grading properly the access trench of 40 m width with the help of hydraulic backhoe and 35 T dumpers and other auxiliary HEMM. The access trench is to be graded from 515 m RL at 1 in 16 to the mine floor of about 500 m RL. The box cut is developed in such a manner so as to facilitate the proper drainage of water towards the sump. This would also facilitate extension of coal and OB bench for full development of mine. The mine will advance towards dip direction exposing the floor of Seam-IV. After creation of sufficient decoaled area, internal backfilling of OB will be started. The coal production will start from the 1st year of mine operation and the target coal production of 5.00 MTPA will be achieved in the 3rd year of mine operation.

The alignment of the face has been so planned as to facilitate the drainage of water. The quarry has been divided into two parts *i.e.* east and west for optimum accommodation of internal dump. Both eastern and western part will be worked simultaneously. During working of the quarry, haul road will be developed at 1 in 16 gradient along centre of the quarry. This has been done in order to maximize the volume of the internal dump.

As gradient of coal seam is flat, haul road in quarry will be designed along center of the quarry. This central haul road will serve both eastern as well as western quarry. A belt conveyor will be installed along one side of haul road for in-pit transportation of coal to surface. 40 m width haul road has been proposed. Out of which, 10 m will be used for installation of belt conveyor. Coal is proposed to be transported from in pit to surface by belt conveyor to reduce fleet size of dumper as well as noise and dust pollution.

3.3.6.3 Coal washery process

5 MTPA coal washery with wet separation technology has been envisaged. The raw coal produced from mines will be conveyed /brought to the CHP hopper through pit head conveyor and after crushing it in CHP, -50 mm raw coal will be conveyed to the coal washery for further processing. The washed product from the washing plant shall be fed to the dispatch system of the coal handling plant. The quality of the dispatch coal shall meet the requirement of the RRVUNL *i.e.* 30% ash, 10% moisture and overall GCV shall not be less than 4500 kcal/kg (ADB); Sufficient water will be available from mine seepage to cater water requirement of various mining & washery activities. Hence, no ground water is required. The washery will produce approximate 3.8 MTPA of clean coal with an ash content of 30% and 1.2 MTPA of rejects with an ash content of about 60% approx. The clean coal will be transported by rail to RVUNL's power plants whereas the rejects are envisaged to generate Power by setting up a Fluidized Bed Combustion (FBC) Power Plant within the ML area of adjacent coal block. The yield of washery shall be around 77.5%.

The washery will be planned with the state-of-the-art technology with due consideration to environment in and around washery. The washery plant will be operating with a carefully designed closed loop water circuit with zero discharge outside and also deploys suitable measures to keep noise and air pollution under control as per statutory norms. Also afforestation surrounding the plant has been considered to work as barrier for dust and noise. Metal/pucca roads and avenue plantation will be suitably done. Emergency settling pond of adequate size will be provided to facilitate emergency draining of thickener. A suitable size pond will be made in the vicinity to accommodate storm water discharge which will be recovered for further use or if required treated before discharging into rivers/stream/water bodies.

3.3.7 Evacuation of Coal

It is similar to PEKB mine. It has been planned to construct a CHP with Washery of 5 MTPA capacity. Washed coal shall be loaded into railway wagon connecting through spur line with railway siding connecting Surajpur railway station. The coal shall be loaded into wagon through rapid loading system. Washery rejects shall be disposed as per guidelines of MoC.

Progress on statutory clearances and Pre-Commencement Report of Parsa Coal Mine for the month ending- April, 2019

Milestone	Remarks (If any)
Mining Plan Approval	Mining Plan with peak rated capacity of 5 MTPA was earlier submitted to MoC on 20.07.2012 and subsequently approved on 19.05.2014. CMPDI *vide* letter dated 08.06.2016 revised the geological co-ordinates of the Parsa coal block due to which RVUNL submitted revised Mining Plan. Revised Mining Plan with integrated washery of 5 MTPA is approved by MoC on 10.11.2016.
Date of	Govt. of India *vide* letter dated 13.07.2017 issued Gazette Notification under

Milestone	Remarks (If any)
Previous Approval	section 4(1) of CBA Act, which is deemed as grant of previous approval.
Forest Clearance	Nodal Officer sought Essential details (EDS) against Forest Diversion Proposal (FDP) on 13.08.2016, which are submitted on 03.09.2016. Forest Diversion Proposal (FDP) accepted by Nodal Officer on 16.09.2016. Nodal Officer recommended the proposal to Secretary State (Forest) on 16.04.2018. Secretary State (Forest) forwarded the proposal to MoEF&CC on 02.05.2018. FAC meeting is completed on 26.07.2018. FAC *vide* MoM of meeting dated 26.07.2018 recommended that expert legal opinion may be obtained from ASG, whether in principal approval can be considered for this coal block pending final disposal of the case in the Apex Court. Again FAC meeting is completed on 19.12.2018. FAC Sub-Committee site visit completed on 8-9, Jan, 2019. FAC meeting is successfully completed on 15.01.2019. FAC *vide* MOM of FAC meeting held on 15.01.2019, decided to recommend for grant of *In-principle* approval, with general standard and following specific condition *i.e.* The State Government shall reconfirm the presence / absence of VDF in the north-eastern part of the proposed forest land under diversion and scope of excluding the same from the proposal. **FC-I Clearance granted by MoEF *vide* letter dated 13.02.2019.**
Status of Environment Clearance	ToR Application made on 27.09.2016 and hard copy of the same submitted to MoEF on 30.09.2016. ToR granted by MoEF&CC on 23.03.2017. Baseline study, for the period from 1st March 2017 to 31st May 2017 for preparation of EIA/EMP is completed on 30.05.2017 RVUNL submitted the Draft EIA/EMP report to the Member Secretary, CECB, Raipur on 19.07.2017, for conduct of public hearing. Public hearing is completed on 29.10.2017 for Surguja district. CECB issued notification to conduct public hearing for Surajpur District on 12.11.2017. Public Hearing at Surajpur is successfully completed on 12.11.2017. Member Secretary, CECB Raipur recommended proceedings of Public Hearing to Secretary MoEF on 28.12.2017. Revised EIA/EMP uploaded on the portal of MoEF on 10.01.2018. Hard copy submitted to MoEF on 23.01.2018. Proposal for Environment Clearance considered by Expert Appraisal Committee in its meetings held on 15.02.2018, 24.07.2018, 27.09.2018 and 21.02.2019. ***EC recommended by EAC in it's meeting held on 21.02.2019. Final Clearance is under approval.***
Date of Grant of Mining Lease	As per Coal Bearing Act (A&D) 1957, Gazette Notification u/s 11(1) of CBA Act issued by Chhattisgarh Government on 20.09.2018 which is deemed Mining Lease.
Date of Land Acquisition	**Application under CBA (A&D) Act, 1957** RVUNL *vide* letter dated 15.03.2017, Applied under Sec 3 of CBA (A&D) Act 1957 for appointment of Competent Authority. Govt. Of India *vide* letter dated 24.04.2017, appointed competent authority under Sec 3 of CBA Act 1957 in respect of the areas falling within the jurisdiction of RVUNL. Application for Sec (4) under CBA Act for notice of intention of Central Govt. to prospect the coal in the land is submitted to MoC, GoI on

Milestone	Remarks (If any)
	15.06.2017 Govt. of India *vide* letter dated 13.07.2017 issued gazette notification under section 4(1) of CBA Act to be published in Gazette. Application for Sec 7(I) under CBA Act for notice of intention to acquire whole land & all rights in respect of Parsa coal block is submitted to MoC, GoI on 04.10.2017. GoI *vide* letter dated 27.12.2017 issued gazette notification under Sec 7(I) under CBA Act. Application for sec 8(2) under CBA Act submitted to the Coal Controller, Ministry of Coal, Kolkata *vide* letter dated 19.01.2018 on 25.01.2018. Coal Controller under Section 8(2) of CBA Act issued "No Objection Certificate" *vide* letter dated 23.02.2018 stating that No objection is received to acquisition of whole or any part of the land or of any right in or over such land as scheduled in the notification. Application for Sec 9(1) under CBA Act to declare acquisition of whole land & all rights in respect of Parsa coal block is submitted to MoC, GoI on 21.03.2018. Gazette Notification by GoI is published for Section 9(1) under CBA Act declaring acquisition of whole land & all rights are acquired in respect of 'Parsa' coal block on 14.06.2018. Application for Sec 11(1) under CBA Act to vest acquisition of whole land & all rights in respect of Parsa coal block is submitted to MoC, GoI on 04.07.2018. Gazette Notification by GoI is published for Sec 11(1) under CBA Act to vest acquisition of whole land & all rights in respect of 'Parsa' coal lock in favour of RVUNL on 02.08.2018. Gazette Notification under section 11 (1) of CBA Act issued by Chhattisgarh Govt. on 20.09.2018. R&R plan has been submitted to SDMs of Surguja & Surajpur *vide* letter dated 20.06.2018. Sub Division Officer, Udaipur has forwarded the application to Collector, Surguja on 24.08.2018. Approval of R&R plan & finalization of Land rate is pending at Collector, Surajpur.

3.3.8 Salient Features of Coal Block

Particulars	Details
Location	North central part of HAC and on north western continuity of PEKB mine/coal block
Coordinates (Coal Mine Block)	Latitude 22^0 48'57.07" 22^0 51'56.85" Longitude $82^0$45'10.50" $82^0$47'22.86" Toposheet 64J/13
Villages	Core Zone covers Tara, Janardanpur, Fatehpur, Ghatbarra, Hariharpur & Salhi villages.
Tehsil	Udaipur and Premnagar
Districts	Surguja and Surajpur
State	Chhattisgarh
Elevation above MSL	Varies from 505 m to 559 m
Toposheet no.	64 J/9, J/10, J/13 and J/14
Land Use for the Mine	The total area of mine is 1252.447 ha Forest area: 841.538 ha (67.0%) Agricultural/Tenancy Land: 365.366 ha (29%) Govt. land: 45.543 ha (4%)

Particulars	Details
Coal washery land use within the ML area	13.586 ha
Climatic conditions As per IMD-Ambikapur	Annual Maximum Temperature: 42.7^0 C Annual Minimum Temperature: 4.4^0 C Annual Rainfall: 1526.9 mm
Nearest highway	SH-2A (0.5 km, NW)
Nearest railway station	Bisrampur (62 km, NW)
Nearest airport	Raipur (290 km, SW)
Nearest Town/City	Udaipur (26 km, NE)/Ambikapur (70 km, NE)
Nearest water bodies	Atem nadi (1.9 km, NE) Chhoti Chornai nadi (9.5 km, SE) Chornai Nadi (13.2 km S)
Reserve/Protected forest	**Reserve Forest (RF):** 1. Pidiya RF (within ML area) **Protected Forest (PF):** 1. Janardanpur PF (within ML area) 2. Ghatbarra PF (within ML area) 3. Fatehpur PF(within ML area) 4. Tara East PF (within ML area) 5. Gumga PF – adjacent 6. Shivnagar PF (2.7 km, NNE) 7. Matringa PF (4.5 km, E) 8. Murgaon PF (5.9 km, NE) 9. Paturiya PF (6.2 km, SW) 10. Chandan nagar PF (6.4 km, N) 11. Chirwan PF (8.1 km, NNE) 12. Dhajag PF (8.8 km, SW) 13. Putta PF (9.3 km, E) 14. Kotmi PF (9.5 km, NE)
Other historical and archaeological places	None within 10 km radius
Ecology sensitive/ Protected areas as per Wild Life Protection Act 1972 (National Park/ Wild life Sanctuary/ Bio sphere reserves)	None within 10 km radius
Defence installations	None within 10 km radius from ML boundary
Industries	Nil, within 10 km radius
Other Industries/Mines	Parsa East & Kanta Basan coal block under operation by RVUNL and Tara coal block (adjacent) Other mines of HAC
Coal user locations	Motipura Choki, Chhabra, Baran district (Rajasthan)
	Village-Undal, Jhalraptan tehsil, distt-Jhalawar district (Rajasthan)
	Thukrana, Suratgarh tehsil, Shriganganagar district (Rajasthan)
Socio-economic factors	Resettlement and Rehabilitation is involved
Seismic zone	Zone-II as per IS-1893 (Part-1)-2002

3.4 KENTE EXTENSION COAL MINE (9 MTPA) OF RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LTD (RVUNL), (RAJASTHAN GOVT. UNDERTAKING), VIDYUT BHAWAN, JANPATH, JYOTI NAGAR, JAIPUR-302005.

3.4.1 Status of Mine Lease Details

The Kente Extension coal block in HAC area, Kente Village, Tehsil Udaipur, district Surguja Chhattisgarh over an area of 1760 ha has been allotted to M/s. Rajasthan Rajya Vidyut Utpadan Nigam Limited (RVUNL) *vide* order No - 13016/26/2004-CA-I/CA-III(Pt) (Vol. II), dated 31.03.2015 to meet the coal requirement of their two thermal power projects. PI. deed has been executed between RVUNL and DM, Surguja on 23.08.2018. This coal block has a common boundary on west side with Parsa East and Kanta Basan (PEKB) coal block of RVUNL. This coal block is fresh allotment for captive use of coal for RVUNL. MoEF&CC has accorded ToR *vide* letter no. J-11015/48/2019-IA.II(M) dated 08.01.2020 for preparation of EIA/ EMP.

3.4.2 Location of Mining Lease Area

The Kente coal block is located in the north central part of the HAC in Surguja district, Chhattisgarh. The block is located towards east of Parsa East and Kanta Basan coal block of Rajasthan Rajya Vidyut Utpadan Nigam Ltd., Jaipur. The tehsil headquarters at Udaypur and the district headquarters at Ambikapur are located at a distance of 26 km and 70 km respectively. The coal block depicted in the Survey of India toposheet 64J/13 and bounded by latitudes $22^0$47'0.802''N - $22^0$49'58.536''N and longitudes $82^0$49'21.991 $82^0$52'48.833''.

3.4.3 Geology and Exploration

The coal block is quadrilateral in shape and extends about 4.2 km along strike direction (NW-SE) and about 4.8-3.8 km along dip direction (SW). Geological Survey of India (GSI) did preliminary exploration. Topography Survey was done for ML area of 17.60 sq.km with contouring of 1 m interval. Coal bearing area in this block belongs to Barakar formation and has strike in NW-SE direction & dip at 2^0 to 5^0 towards south. The block is traversed by two faults *viz* F1-F1 & F2 –F2. Generally, throw of the fault is less than 8m. Detailed exploration of the area was undertaken by Mineral Resource Division, Adani Enterprises Ltd. (AEL). Exploration details summarized and given below:

Drilling Agency	Period	No. of bore holes	Meterage
GSI	2002-03	4	1153.40
AEL	Sept 2018	133	13235.50
	Total	**137**	**14388.80**
Borehole Density: 8 boreholes/sq.km			

Thr persistent workable coal seams *viz.*, IV, V & VI with cumulative thickness of 15 m have been established. In addition one more seam *i.e.*, Seam IV A having average thickness of 1 m locally developed on the northern part of the block below the coal seam IV with a parting vary from 6 to 8 m.

3.4.4 Geological and Mineable Reserves

Three mineable coal seams occur in this coal block namely seam no. VI, V & IV the top most seam No. is VI.

Seam/Parting	Thickness (M)		
	Min	Max	Mean
VI	1.02	1.85	1.10
Parting	9.11	18.59	
V	2.51	8.22	6.70
Parting	19.49	30.69	
IV	5.35	8.91	7.90

Lower seams (I, II, III) are thin & impersistent and do not offer any mining potential.

Resources: Seam wise geological coal resources in MT are estimated as follows:

Seam	Proved (MT)(111)	Indicated (MT)(121)	Total (MT)	Resource %
VI	16.758	4.624	21.381	5.79
V	133.536	26.502	160.038	43.34
IV	158.968	28.835	187.804	50.86
Total	**309.262**	**59.961**	**369.223**	**100**

Net geological reserves of coal as per Geological Report (GR) are 369.22 MT, break-up of these reserves as envisaged, is tabulated below:

3.4.5 Summary of Coal Reserves

1.	Gross Geological Reserves (MT)	410.25
2.	Net Geological Reserves (MT)	369.22
3.	Net Geological Reserves blocked in barrier, batter, Road diversion-not considered for mining (MT)	35.51
4.	Net Geological Reserves considered for mining (MT)	333.71
5.	Mining loss @ 3% (MT)	10.01
6.	Mineable reserves (MT)	323.70
	Total Recovery of Coal (MT)	**323.70**

For the rated output of 9.0 MTP, the life of the mine has been estimated as 49 years including built up period & reducing trend of coal production in start and finishing years of the mine. Total volume of OB estimated 1182.22 M.cum. Stripping ratio envisaged 3.65 cum/te.

3.4.6 Quality of coal

Based on more than 100 samples analysed, coal quality in three seams is envisaged as under:

Coal Seam	Proximate analysis on 80% RH & 40 ^{0}C							
	Moisture%		Ash%		VM%		FC %	
	Min	Max	Min	Max	Min	Max	Min	Max
VI	4.8	9.4	36.4	54.9	17.70	27.7	21.26	33.83
V	3.9	8.6	38.4	63.5	15.4	23.6	11.45	31.30
IV	4.2	9.5	26.9	44.0	20.0	27.3	29.33	40.42

The coal block is in the process of obtaining statutory clearance and hence there is no mining activity within the block.

3.4.7 Pre –Feasibility Summary

Description	Details
Production/Estimated Reserves	Capacity: 9 MTPA Net Geological Reserve : Total: 369.22 Million Tonnes
Total area reserved for Mining	1647.54 ha
Total Water requirement & Source	Total water requirement for the project is 4100 m^3/day including mining activities, washery & potable water. Water required for the mining activities will be sourced from tube wells in the first year and afterwards water will be sourced from mine reservoir after treatment in water treatment plant.
Working hours	Three shifts operation with 8 hour shift has been planned.
Manpower (Operation)	800 (approx.)
Estimated Cost of the Project	2144.00 Crore. Considering coal extraction and OB removal to be outsourced activity to be performed by Outsourcing Agency. *Above CAPEX (Capital Expenditure) is tentative.* *Detailed Estimate will be worked out during DPR Stage.*
Nearest Railway station, Airport	Nearest railway station-Bisrampur (72 km, NW) on the Bijuri-Ambikapur section of South East Central Railway (New Railway line from Surajpur R.S. to Pit Head is already constructed. Nearest Airport Raipur (290 km, SW).
Existence of Public Road, Railway Track nearby	The Block is connected to the NH 130 and passing at a distance of about 10 km from its N-W corner.

3.4.8 Brief Description of nature of the project

The proposed project involves the mining of coal in an extent of 17.64 sq.km and falls in schedule 1(a) (i) Mining of Minerals of Category 'A'.

Need for the project

The coal produced in the Kente extension coal mine will be transported to the following Power plants of RVUNL in Rajasthan:

Name of specified end use plant	Address	Configuration	Capacity
Chhabra TPP Unit -5 to 6	Motipura Choki, Chhabra, District- Baran, Rajasthan	2 x 250 MW 2 x 660 MW	1820 MW
Suratgarh Supercritical TPP, Unit- 7 & 8	Thukrana, Tehsil – Suratgarh, District-Shriganganagar, Rajasthan	2 x 660 MW	

3.4.9 Mining Parameters

Sl.No.	Parameters	Value	Unit
1	Maximum depth	195	M
2	Maximum strike length: along the Mine Floor along the Mine Surface	 4.1 4.2	 km km
3	Minimum strike length: along the Mine Floor along the Mine Surface	 3.7 4.0	 km km
4	Maximum dip rise length: On the Mine Floor On the Mine Surface	 4.0 4.1	 km km
5	Minimum dip rise length: On the Mine Floor On the Mine Surface	 2.8 2.9	 km km
6	Area: On the Mine Floor On the Mine Surface	 1499.0 1647.54	 ha ha

Proposed Land Use Plan (Post Mining)

Sl. No.	Particular	Extent in ha
A	**Mining**	
	Excavation area	**1647.54**
B	**Infrastructure & OB Dump Area**	
1	External dump	**48.368**
2	Top soil dump	-
3	Infrastructure area (power supply, CHP, washery setting pond approach road *etc*).	**26.943**
4	Diversion of road	**6.537**
5	Safety zone	**30.919**
	Total (b)	**112.767**
	Grand Total (a + b)	**1760.000**

3.4.10 Quantity of Waste Generated and Scheme for its Management /Disposal

The opencast mine is proposed upto 195 m depth with overall average stripping ratio of 3.65. The total volume of Over Burden (OB) has been estimated as 1182.22 Mcum.

The OB removed during initial years will be placed beyond the incrop of the seam-IV. The total volume of external dump has been estimated as 27.67 Mcum. Rest of the OB will be placed in internal dumps. The total volume of internal OB, *i.e.* the volume which will be accommodated internally by backfilling has been estimated as 1154.54 Mcum. The internal dumping will start when about 100 m space is available on quarry floor. By adopting the proposed sequence of mining, as the quarry advances, the amount of internal dump will increase as more space for the internal dumping is created. For external dumps no additional land will be required outside the block boundary. External dump will be accommodated inside the block boundary. One external dump *i.e.* external dump east has been proposed on the north eastern side of the block boundary. Two internal dumps *i.e.* internal dump west and internal dump east has been also proposed. Overburden will be dumped in external as well as internal dumps. Height of eastern external dump will be 60 m above ground level at the end of mine operation. The top soil is to be used with minimum time lag for spreading over the external & internal dumps. It is proposed to reclaim dumps with plantation *etc.*, after dumping/spreading top soil over the external and internal dumps.

3.4.11 Top soil management

Efforts will be made to excavate and segregate top soil separately. Dozer (before the ground preparation for drilling and blasting) will scrap top soil. Scrapped top soil will be transported to the top soil storage area. During initial period of mining the top soil shall be directly utilized for plantation of saplings along the proposed roads and barren land. As and when the external waste dump gets stabilized the stored top soil will be spread over the area of dump to facilitate plantation. Top soil is proposed to be removed separately and stacked inside the ML area in a manner so as not to lose its fertility. The top soil would be spread over the reclaimed land, afterward. Top soil is proposed to be stored for initial four years and also during subsequent years; it will be directly spread over the reclaimed area.

3.4.12 Energy/Power Source

The proposed mining block is virgin. Based on rated capacity of 9.0 MTY ROM coal for Kente extension coal block and assuming certain parameters for coal transportation and loading, washery & pumping, *etc.* The tentative requirement of power shall be in the range of 5 7 MVA at 33 kV. The power supply for Kente extension coal block shall be taken from existing 132/33 KV substation to Kente coal block (allotted to M/s. RVUNL), which is about 5 KM from PEKB coal block. Restricted earthing has been envisaged for Electrical System. All electrical system will have protection from lightning and high voltage surge. Switching station and substation shall be equipped with all safety features of firefighting system.

3.4.1 Evacuation of Coal

It is similar to Parsa East and Kanta Basan mine. It has been planned to construct a CHP with Washery of 9 MTPA capacity. Washed coal shall be loaded into railway wagon connecting through spur line with railway siding connecting Surajpur railway station. The coal shall be loaded into wagon through rapid loading system to be constructed. Washery rejects shall be disposed as per guidelines of MoC.

3.5 CHOTIA OPEN CAST COAL MINE OF M/S. BALCO

3.5.1 Introduction

Chotia coal mine is located in HAC in the state of Chhattisgarh, was originally allocated to M/s. Prakash Industries Limited (PIL) in the year 2003. M/s. PIL started the coal production from the Chotia coal mine in the year 2006 and operated the mine till 31.03.2015. The Supreme Court of India through its judgment dated 25.08.2014 read with its order dated 24.09.2014 had cancelled allotment of 204 coal blocks, including Chotia Coal Mine. Subsequent to the Supreme Court Judgment, the Coal Mines (Special Provision) Ordinance, 2014 read with the Coal Mines (Special Provision) Second ordinance, 2014 were promulgated and the Coal Mines (Special Provision) rules, 2014 were framed for auction and allotment of all blocks which were subject to cancellation pursuant to the Supreme Court Judgment. Bharat Aluminium Company Limited (BALCO) participated in the e-auction conducted by Ministry of Coal and on winning the bid, Chotia coal mine has been vested with BALCO *w.e.f.* 01.04.2015. Mining lease area is 1,179.826 ha for which lease has been granted to BALCO. Coal produced from this mine has to be used for Captive purpose in 600 MW power plant already set up by the Mine Operator (Lessee) at Korba.

3.5.2 Location

- The Chotia coal mine is located on the western side of Hasdeo river in HAC in Korba district of Chhattisgarh State.
- This coal mine is connected to SH 2A which in turn is connected to NH 130. SH 2A is about 3 km from Chotia-sub block 2A and 13 km from Chotia-sub block 2B.
- Chotia- sub block 2A and Chotia- sub block 2B are connected by 10 km forest tar road constructed by the Lessee.
- Nearest Railway station is at Korba which is 70 km on Bilaspur section of SECR and nearest airport is at Raipur (248 km)
- The mine is covered by a part of Survey of India Toposheet No. 64J/05 and 09 and is bounded by Longitudes 82°25'49" & 82°33'31" E and Latitudes 22°46'55" & 22°52'05" N.

3.5.3 Status of the coal block

Mining lease has been transferred to M/s. Bharat Aluminium Company Limited *vide* letter No.F 3-13/2015/12 dated – 09/07/2015. Mining Lease comprises of two sub blocks *viz.*, Chotia- sub block 2A having an area of 863 ha and Chotia- sub block 2B having an area of 316.826 ha which are almost 10 km apart and mining lease for these two sub blocks are not contiguous. The Total area of Chotia coal mine is 1179.826 ha. Mining Lease deed was executed on 16.10.2015 *vide* certificate number IN-CG01841675482369 N for a period of 20 years from 16.10.2015 and is valid upto 15.10.2035.

3.5.4 Statutory Clearances

3.5.4.1 Mining Plan and Mine Closure Plan

Mining Plan and Mine closure Plan 3rd revision for Chotia coal block (Chotia-sub blocks 2A & 2B) was approved by Ministry of Coal *vide* its letter no. 34011/08/2015-CPAM dated 11.03.2016. Details of previous revisions of mine plan are as under:

Mine Plan (Original)	13016/22/2003-CA dated 04.08.2004	By Prakash Industries Ltd.
Mine Plan (1st Revision)	13016/22/2003-CA dated 20.08.2007	By Prakash Industries Ltd.
Mine Plan (2nd Revision)	13016/22/2003-CA dated 02.02.2010	By Prakash Industries Ltd.
Mine Plan (3rd Revision)	14011/08/2015-CPAM dated 11.03.2016	By BALCO

3.5.4.2 Environment Clearance

- EC of Chotia-sub block 2A has been transferred to M/s. Bharat Aluminium Company Limited from M/s. Prakash industries Limited by MoEF&CC *vide* its letter no J-11015/96/2004-IA II (M) dated 04.06.2015 and is valid for 20 years or life of mine, whichever is earlier.
- **Capacity for Chotia- sub block 2A is: 0.75 MTPA**
- **Environment clearance** for Chotia-sub block 2B was granted from MoEF&CC to M/s. Bharat Aluminium Company Limited *vide* letter No. J-11015/96/2004-IA-II(M) dated 18.07.2018 and is valid for 20 years or life of mine, whichever is earlier.
- **Capacity for Chotia sub block 2B is 1.0 MTPA.**

3.5.4.3 Forest Clearance

- Forest Clearance (Stage-2) has been transferred to M/s. Bharat Aluminium Company Limited by MoEF&CC *vide* its letter F.No 8-64/2005 dated 18.05.2015.

- Total Forest area is 960.286 ha. Out of which, FC has been approved for 914.675 ha (Both Stage-I and Stage-II). FC (Stage-I) has been approved for remaining 45.611 ha *.
  (* **However, lessee is not proposing any mining activity in Chotia - sub block 2A area as per approved Mine Plan 3rd Revision)**

3.5.4.4 CTE

- CTE for Chotia- sub block 2A has been transferred to M/s. Bharat Aluminium Company Limited from CECB *vide* letter No. 1631/TS/CECB/2015 dated 10.07.2015 for a capacity of 0.75 MT.
- CTE for Chotia- sub block 2B coal mine has been granted to M/s. Bharat Aluminium Company Limited from CECB *vide* letter No.- 4412/TS/CECB/2018 dated 23.08.2018 for a capacity of 1.0 MT.

3.5.4.5 CTO

- CTO for Chotia- sub block 2A has been renewed by CECB for period of 1.04.2019 to 31.03.2020 *vide* letter No. 6302/TS/CECB/2018 dated 27.11.2018 for a capacity of 0.75 MT.
- CTO for Chotia- sub block 2B has been granted to M/s. Bharat Aluminium Company limited by CECB on 06.10.2018 and is valid upto 17.07.2019 for a capacity of 1.0 MT.

3.5.4.6 CGWA approval

The renewal of NOC for ground water withdrawal was granted to M/s. Bharat Aluminium Company limited *vide* letter No.-CGWA/NOC/MIN/REN/1/2018/5555 dated 20.12.2018 and is valid upto 11.06.2021. The permissible quantity is 1370 cum/day (350 cum/day from Ground water and 1020 cum/day by dewatering mine seepage).

3.5.4.7 Seam opening permission of Chotia sub block 2B

Under Rule 9 (1) of the colliery Control Rules, 2004 and in exercise of power conferred by Gazette notification G.S.R 816 (E) dated 15.11.2011, mine opening permission for Chotia- sub block 2B is given *vide* letter No-CC/Tech/op-perm/Chotia-II OC Coal Mine/BACL/2018-19 dated 24.08.2018 for OC mine only.

3.5.4.8 Seam Opening permission for Chotia- sub block 2A

Under Rule 9 (1) of the colliery Control Rules, 2004 and in exercise of power conferred by Gazette notification G.S.R 816 (E) dated 15.11. 2011, mine opening permission for Chotia- sub block 2A is given *vide* letter No-CC/Op-perm/Chotia-I OC Coal mine/2015-16 dated 20.11.2015 for OC mine only.

3.5.4.9 Explosive license

Magazine 1-License no: E/HQ/CG/22/185(E64754)

Explosive magazine is located at survey No: 169/4, village Chotia about 10 km from Chotia- sub block 2B coal mine. The Capacity of magazine is given below:

Sl. No.	Type	Capacity	Date of license expiry
1	Nitrate mixture- slurry and Emulsion Explosive	1800 Kg	31.03.2021
2	Cast booster	350 kg	
3	Detonating Cord	20000 Mtrs	
4	electric and/or ordinary Detonators	10000 Nos.	

Magazine 2 – License no: E/HQ/CG/22/184(E64750)

Explosive magazine is located at survey No: 169/1, village Chotia about 10 km from Chotia- sub block 2B coal mine. The Capacity of magazine is given below:

Sl.No	Type	Capacity	Date of license expiry
1	Nitrate mixture- slurry and Emulsion Explosive	1800 Kg	31.03.2021
2	Cast booster	350 kg	
3	Detonating Cord	20000 Mtrs	
4	electric and/or ordinary Detonators	10000 Nos	

In addition, there are 5 Portable magazines located within the same premises (Survey No. 169/1) and all have valid license

3.5.4.10 DGMS approvals

Chotia- sub block 2A: Under Regulation 98(1) & (3) of Coal Mines Regulation, 1957 in respect of height and width of benches in overburden and coal being worked by deployment of HEMM in combination of shovel and dumpers with a system of deep hole blasting in Seam 2 at Chotia- sub block 2A opencast mine was permitted *vide* letter No. BSP/3347 dated 13/07/2015.

Chotia- sub block 2B: Under Section 16 (1) of Mines Act, 1952 and regulation No. 6 (1) of Coal Mines Regulation 2017, Notice in Form I was submitted to DGMS *vide* ref. No. BALCO/CHT/NOTICE/2018/589, dated 11.10.2018, informing the actual date of reopening of Chotia- sub block 2B OC coal mine as no permission is required now under modified rules.

3.5.4.11 Authorization to handle hazardous waste

Authorization to handle hazardous waste has been granted by CECB to M/s. Bharat Aluminium Company Limited *vide* letter No 442/HSMD 1725/HSMD/HO/CECB/2016 dated 17.06.2016 and is valid for 5 years up to 10.01.2021.

3.5 Geology

Regional exploration for coal in Morga, Tara and Chotia areas was carried out in 1976-85 and a report was published by GSI in 1988. Total 19 Boreholes of HAC series were drilled and two potential Blocks, Chotia- sub block 2A and Chotia- sub block 2B were identified based on 9 boreholes out of 19 boreholes and estimates of reserves were made (Geological Report titled "Regional Exploration for Coal in Morga, Tara and Chotia areas of HAC, Bilaspur and Surguja districts M.P", 1988). Detailed exploratory drilling has been done on these sub-blocks of Chotia, *i.e.* Chotia- sub block 2A and Chotia- sub block 2B.

Chotia- sub block 2A: Initial exploration by GSI established the occurrence of 3 coal horizons locally numbered as Seam 2, 3 and 4 in ascending order. Only Seams 2 & 4 is developed as potential coal deposits.

Chotia- sub block 2B: Initial exploration by GSI included 3 boreholes. Subsequent exploration was carried out and 3 coal horizons, Seam 1, 2 and 3 in ascending order have been proved in this block.

Agency	Period of Drilling	Chotia- sub block 2A		Chotia- sub block 2B	
		No of boreholes	Meterage (m)	No of boreholes	Meterage (m)
GSI	Jul 1977- Nov1981	06	1,359.95	03	646.35
GEMICON (Phase 1)	Jul 2000- Nov 2001	52	3,176.40	11	639.20
Prakash Industries Ltd (PIL) (Phase 2)	Mar 2005- Dec 2005	11	1,781.50	10	501.00
PIL (Phase 3)	Aug 2007- Oct 2007		-	18	773.00
	Total	**69**	**6,317.85**	**42**	**2,559.55**

3.5.5.1 Exploration in Chotia- sub block 2A

- Initial exploration by GSI established the occurrence of 3 coal horizons locally numbered as Seam 2, 3 and 4 in ascending order. Only seams 2 & 4 are developed as potential coal deposits, as Seam-3 occurs in patches. It is being mined in Chotia sub block 2A opencast.
- While approving the Mining Plan (Original), MoC directed that details in respect of thickness, quality and potential of Seam 4 are to be proved in western area. In first, second and third phases (No third phase drilling in Chotia- sub block 2A), 69 boreholes have been drilled in the Chotia- sub block 2A. The second phase of exploration was designed to confine the drilling up to seam 4 horizons only.

- Total mining area had been covered under detailed topographical survey, covering surface features and a plan on 1:4000 RF with 3m contour interval been prepared by previous allottee.
- There are altogether 11 faults all along the Chotia- sub block 2A interpreted on the basis of difference in floor levels of the coal seams. The western part of Chotia- sub block 2A, in the area of development of Seam 4, is traversed by 7 no. of faults. The general trend of the fault is N-S to NW-SE and throws ranges from 5 m to 140 m.
- Geological disturbances related to faulting in Chotia- sub block 2A will be taken care of when the mine is operational. As of now, no mining activity is being carried out.

3.5.5.2 Exploration in Chotia- sub block 2B

- Initial exploration by GSI included 3 boreholes. However, details in respect of thickness, quality and potentiality in respect of 3 coal horizons as established by GSI were to be proved.
- All subsequent explorations were designed to confine the drilling up to these horizons only. In all 3 coal horizons, Seam-1, 2 & 3 in ascending order, have been proved in this block.
- All 42 boreholes drilled in different phases have been considered for the preparation of Mining Plan (2nd revision). Total area of 8 sq km was covered under detailed topographical survey covering all the surface features and a plan on 1:4000 RF with 3 m contour interval has been prepared.
- There are altogether 5 faults interpreted on the basis of difference in floor levels of the seams in Chotia- sub block 2B
- Most faults have a throw ranging from 1 5 m and hence will not largely affect mine working. However, one fault with throw of 35 m runs parallel to block boundary, and this area is not being mined at present.

3.5.5.3 Revision of Mining Plan (4th Revision)

Mining in Chotia coal block is in combination of open cast and underground mining. To increase extractable coal from Chotia sub block 2A, techno-economic study was undertaken, based on which open cast mining area extended increasing stripping ratio to 1:13 and limiting to a depth of 150 m. In the approved mining plan of 3rd revision, it was envisaged for UG mining for entire C sector and Sector D to H of Chotia sub block 2A. In the 4th revision of mining plan, some part of C sector and Sector D to H, open cast mining is proposed and remaining parts by UG mining, which increase about 3 million tonnes of extractable coal while comparing mining plan of 3rd revision. Therefore, it is proposed to mine open cast method in coal seam 2 in sector C of Chotia sub block 2A followed by open cast method for Sector D to H.

3.5.4 Balance Geological Reserves

The following are the considerations to arrive balance reserves in the 4th revision of the mining plan:

- Reserves minable by opencast method from sector A and B are considered exhausted and deleted from the reserve base.
- Fresh reserves minable by opencast method are added in Chotia sub block 2A estimated from sector C and sector D to H opencast and underground parts.
- 7.5 m is left all along the boundary. Additionally, 4 m left along the eastern boundary of sector D to H pit for accommodating road.
- Geological loss of 10% considered while arriving extractable reserves.
- Minimum thickness of 0.5 m considered for estimation of reserves for open cast method and 1.2 m is considered as minimum workable thickness for underground method of mining.

Balance Reserves as on 01.04.2019 (Million tonnes)

Name of the Mine	Seam	Geological Reserves	Minable Reserves	Extractable as per revised assessment	Balance extractable as on 01.04.2019
Chotia sub block 2A	4	13.787	13.28	8.65	8.65
	3	0.140	0	0	0
	2	14.379	12.17	10.23	4.00
	1	0.880	0	0	0
Subtotal		**29.186**	**25.45**	**18.88**	**12.65**
Chotia sub block 2B	3	0.558	0.54	0.54	0.54
	2	2.339	2.25	2.25	1.61
	1	7.935	7.61	5.12	4.86
Subtotal		**10.832**	**10.40**	**7.91**	**7.01**
Grand Total		**40.018**	**35.85**	**26.79**	**19.66**

- Since, more than 50-51% recovery is not possible in UG coal mining, the differences in mineable and extractable reserves are maintained accordingly for seams where UG mining has been planned as per approved mine plan.

Remark

Reserves of sector A and B of Chotia- sub block 2A is exhausted and part of C sector is proposed tobe mined open cast and UG Method. In sector D to H by open cast and UG. G & H are not mineable.

- In respect of Chotia sub block 2B sector A is minable by open cast and sector B is proposed to be mine by underground method.

3.5.6 Mining

Exploitation of coal could be carried out basically by two methods, one by opencast

IN THE HON'BLE NATIONAL GREEN TRIBUNAL

PRINCIPAL BENCH

AT NEW DELHI

ORIGINAL APPLICATION NO. 59 OF 2024

IN THE MATTER OF: -

HASDEO ARRAND BACHAO SANGHRSH SAMITI ... INTERVENOR

Versus

In the Suo motu matter of-

NEWS ITEM TITLED "DEFORESTATION FOR MINING RESUMES IN HASDEO LOCALS ACTIVISTS ALLEGE DETETION''APPEARING IN THE HINDU DATED 22.12.2023

Next Date 03.07.2024

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1.	**ANNEXURE A– 2** Copy Of the Bio- Diversity Assessments Study Executive Report prepared by ICFRE in Consultation With Wildlife Institute of India along with main Report.	201- 400

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Date : 12.06.2024

Place: Delhi

mining and the other by underground mining. Open cast mining is preferred where the extractable coal reserve is in economical stripping limits. This economic stripping ratio may vary as per the cost of mineral to be mined. While feasibility of opencast mines will mainly depend on the economic stripping ratio, land availability for mining and external dump/infrastructure, sensitivity of surface features, etc., feasibility of UG mining is based on many parameters, few of which are given below:

- Depth of the seam
- Seam thickness and other properties of the seam like grade, uniformity etc.
- Physico-mechanical properties of immediate roof
- Hard cover over the seam
- Geological disturbances

Assessment of open cast and economic cut-off as per landed coal price at end use power plant is worked out by BALCO and it is decided to work the coal seams in Chotia sub block 2A with cut off stripping ratio of 1: 13. Pit boundaries with the economic cut of ratio were demarcated in Minex software in Sector C and Sector D to H. In Sector D to H pit the cut off is extended to 1: 15.

3.5.6.1 Approved method of mining

Approved *vs.* present method of mining

Block	Sector	Approved method of mining as per 3rd revision	Method of mining proposed in 4th revision
Chotia sub block 2A	**Sector A&B**	Opencast mining	Reserves are exhausted
	Sector C	UG mining	Part opencast and part UG
	Sector D to H	UG mining (G and H are not mineable	Part opencast and part UG. D is opencast and G & H is not minable
Chotia sub block 2B	**Sector A**	Opencast mining	Opencast mining
	Sector B	UG mining	UG mining

- Thus, this Mining Plan proposes change in the approved method of mining and part of area proposed for UG mining is now proposed to be mined by opencast method in Sector C and Sector D to H of Chotia sub block 2A.

- Methodology and parameters remain the same in Chotia sub block 2A.

3.5.6.2 Seam structure

Chotia sub block 2A exhibit relatively simple structure with the beds showing broadly NW SE strike and dipping towards south west of the property with rolling dip varying from 3° to 5°. The strike and dip over the lease are as given below:

Seam structure Chotia sub block 2A

Seam 2	Strike	Amount of dip	Direction
North	E-W	5°	S
North East	NNW-SSE	3°	WSW
East	NW-SE	2° - 3°	SW
South East	N-S to WNW – ESE	Sub horizontal	W to NNE
South West	NE-SW	4°	NW
West	N-S	3° - 4°	E
Seam 4	**Strike**	**Amount of dip**	**Direction**
North West	NW-SE	5°	SW
South East	E-W	5°	S

Chotia sub block 2A is traversed by 11 faults and based on the faults and incrop, it has been divided into various sectors.

Chotia sub block 2B is traversed by 5 faults with beds showing NE-SW, E-W and N-S strike and the dip of seam varies from 3° to 6°, the direction varying from SW, S and to E. The description of strike and dip of the coal seams is as below:

Seam structure Chotia sub block 2B

Seam 1	Strike	Amount of dip	Direction
North	E-W	2°_3°	S
North East	NW-SE	6°	SW
South East	E-W	3°	Rolling dips
West	N-S	3°-4°	E

3.5.6.3 Surface features

- Chotia sub block 2A consist mainly of forest land, private land and Govt. land.
- Entire area of Chotia lies within protected forest.
- There is no major water body within coal bearing area except drainage channel of sub-dendrite nature for monsoon rains.
- Hasdeo river is located in the south east of Chotia sub block 2B and ha - HFL of 376.5 m, whereas, ground elevation of the coal block varies from 380 m to 438m.

3.5.6.4 Gradient of coal seams

The coal seams in Chotia deposit are having flat dip varying from 3° to 5° in sub block 2A and 2° to 6° in sub block 2B. However, the direction of dip changes due to basinal structure in both Chotia sub block 2A & Chotia sub block 2B.

3.5.7 Mining Operation

3.5.7.1 Open cast mining - Chotia sub block 2A

Opencast mining was proposed in Sectors A and B of Chotia sub block 2A in Seam 2

in the Approved Mining Plan (3rd Revision). Opencast mining in these sectors commenced in the year 2006 by the prior allottee and continued till March 2015, wherein ~ 8.22 Mt coal has reportedly been mined out (against ~ 6.22 Mt of extractable reserve assessed in the Approved Mining Plan 2nd Revision). BALCO continued mining in the balance mineable area of 0.126 sq.km with an estimated mineable reserve of 0.5 Mt and extractable reserve of 0.3 Mt, extraction of coal in this sector is completed in the year 2016-17. Additional open castable areas are identified in Sector C and Sector D to F of Chotia sub block 2A with stripping ratio 1: 13 and 1: 15 respectively. The areas identified are proposed to be mined by opencast method and the remaining area is proposed to be mined by UG method.

Geo - mining characteristics of Chotia sub block 2A

Parameters	Unit	Seam 2	Seam 4 top &bottom
Coal			
Min thickness	m	0.3	0.3
Max thickness	m	2.3	5.18
Category of excavation		III	III
Quality (GCV)	kcal/kg	4,675-6,476	3,785-6,118
Wt Avg GCV of ROM	kcal/kg	G 10	G 11
Volume weight	tlm^3	1.51	1.6
Dip	deg	2 to 5	5
Overburden			
Thickness of top OB	m	8m to 53m	4m to 115m
Category of excavation		50% category III + 50% category IV	
Volume weight	tlm^3	*2.2 2.4* tlm^3	

Opencast mine parameters

The basic parameters of the opencast mine are tabulated as below:

Parameter	Sector C	Sector D, E, F
	Unit(m)	Unit (m)
Maximum length of the quarry along the dip at surface	771	1,137
Maximum length of the quarry along the dip at floor	678	910
Minimum length of the quarry along dip at surface	546	790
Minimum length of the quarry along dip at floor	473	551
Maximum width of the quarry along strike at surface	1,483	1,442
Maximum width of the quarry along strike at floor	1,407	1,078
Minimum width of the quarry along strike at surface	1,246	853
Minimum width of the quarry along strike at floor	1,127	677
Minimum depth of quarry	21	20
Maximum depth of quarry	64	150
Area of excavation (ha)	92.4	102.0

3.5.8 Bench geometry

Shovel dumper combination has been proposed in the Approved Mining Plan (3rd Revision) and the same will be followed. The geometry of the mine is proposed as below:

Working bench - OB:

- Height – 6 m
- Width – 28 m
- Bench slope - 70 degree

Non-working bench - OB:

- Height – 6 m
- Width – 10 m
- Bench slope - 70 degree

In case of coal, the bench height will be same as the thickness of coal seam. Ultimate pit slope will be 44° for Sector C open cast mine. For Sector D to H open cast mine the ultimate pit slope is planned to be 36°. The bench slope proposed is with reference to the slope scientific study conducted for Chotia sub block 2B by NIT Raipur. Further before commencement of opencast operation in Chotia sub block 2A, Scientific study will be carried out for the proposed pit and internal and external dump design as per the provision of Reg 106 CMR 2017. As per approved mine plan, Chotia- sub block 2A is designed to extract coal by both OC and UG methods. The reserves are revised based on additional opencast OC mining proposal.

Seam wise coal reserve as per present plan (Million tonnes)

Block	Seam	Geological	Mineable	Extractable as per revised assessment	Balance Extractable as on 01.04.2019
Chotia sub block 2A	4 (Top & Bottom)	13.787	13.280	8.650	8.650
	3	0.140	-	-	
	2	14.380	12.170	10.230	4.000
	1	0.880	-	-	
	Sub-Total	**29.187**	**25.450**	**18.880**	**12.650**
Chotia sub block 2B	3	0.558	0.540	0.540	0.54
	2	2.339	2.250	2.250	1.61
	1	7.935	7.610	5.120	4.86
	Sub Total	**10.832**	**10.400**	**7.910**	**7.01**
	Grand Total	**40.019**	**35.850**	**26.790**	**19.66**

Reserves (Million. Tonnes) of Chotia sub block 2A as per present proposal

#	Sector	Seam	Geological	Mineable		Extractable
				UG	OC	
1	A&B	1	0.88			
2	A&B	2	6.73	-	6.23	Exhausted
3	A&B	3	0.14			
4	C	2	2.30		2.10	2.07
5	D to F	4	6.80	-	6.35	5.70
6	F&H	4	7.00	6.93	-	2.95
7	C	2	5.34	3.84	-	1.93
		Total	**29.19**	**10.77**	**14.68**	**12.65**

Calendar plan of excavation and stripping ratio

The calendar plan for Sector C and Sector D to F opencast mine proposed is presented below:

Calendar plan of excavation and stripping ratio for Chotia sub block 2A Sector C open cast mine

Year	Coal tonnage	Coal volume	OB	SR
	Tonne	cum	cum	
2024-25	2,50,000	1,66,667	16,20,300	6.48
2025-26	2,50,000	1,66.667	34.90,140	13.96
2026-27	2,50,000	1.66,667	34.90.140	13.96
2027-28	2,50,000	1,66.667	34.90.140	13.96
2028-29	2,50,000	1,66,667	34.90.140	13.96
2029-30	2.50,000	1,66.667	34.90,140	13.96
2030-31	2,50,000	1.66,667	34,90.140	13.96
2031-32	2.50.000	1.66.667	34.90.140	13.96
2032-33	70.000	46.667	9,10.000	13.00
Total	**20,70,000**	**13,80,000**	**2,69,61,280**	**13.02**

Calendar plan of excavation and stripping ratio for Chotia sub block 2A Sector D to F opencast mine

Year	Coal tonnage Tonne	Coal volume cum	OB Bank cum	SR
2023-24	4,70,000	2,93,750	35,43,160	7.54
2024-25	5,00,000	3,12,500	76,00,000	15.2
2025-26	5,00,000	3,12,500	76,00,000	15.2
2026-27	5,00,000	3,12,500	76,00,000	15.2
2027-28	5,00,000	3,12,500	76,00,000	15.2
2028-29	5,00,000	3,12,500	16,00,000	15.2
2029-30	5,00,000	3,12,500	76,00,000	15.2
2030-31	5,00,000	3,12,500	76,00,000	15.2
2031-32	5,00,000	3,12,500	76,00,000	15.2
2032-33	4,20,000	2,62,500	75,10,000	17.88
2033-34	4,20,000	2,62,500	74,16,000	17.66
2034-35	3,90,000	2,43,750	69,51,874	17.83
Total	57,00,000.0	35,62,500.0	8,62,21,034	15.13

3.5.9 Opencast working

3.5.9.1 Schedule of working

The following schedule of working is considered for operation of opencast mine. For UG mine the working days will be 330 days per annum and the other schedules would remain same.

3.5.9.2 Working Schedule

Parameter	Value
Working days per annum	330
Working hours per shift	8
Working shift per day	3

3.5.9.3 Schedule of working

The following schedule of working is considered for operation of opencast mine.

Volume handled per day for Chotia sub block 2A

Detail	Unit	Sector C	Sector D to F
Average OB to be handled per day	Cum	10,600	23,100
Average coal to be handled per day	Cum	500	950
Tonnage of coal per day	tonne	760	1,550

The peak coal tonnage to be handled per day from Chotia sub block 2A pit will be 2,500 tpd while the peak OB handling will be 38,500 cum/day.

3.5.10 Initial Operation

Land clearance will be carried out as per prevalent procedures followed by demarcation of area for access and box cut. Development of infrastructure will progress parallel to land clearance and preparation of access road for both the mines of Chotia. The access road exists for these pits for a width of 8m and need to be strengthened and widened to 12m. The over burden comprises of top soil and weathered mantle which will be excavated without blasting. The top soil cover varies in thickness in the entire area of Chotia sub block 2A and Chotia sub block 2B. While the average thickness varies from 2.00m to 2.40m in Sector C, it varies from 1.5 to 1.65 in Sector D to H of Chotia sub block 2A. In Chotia sub block 2A the top soil thickness varies from 1.00 m to 1.20 m. The top soil is proposed to be mined and stored separately.

3.5.11 Drilling and Blasting

The harder OB and coal needs blasting for loosening. The prepared material then will be loaded and transported to designated site. Drilling is proposed by 115 mm drills in Chotia sub block 2B and for Chotia sub block 2A RBH drill of 160 mm is proposed.

Working width of 30 m is to be maintained in benches for deployment of drills and other equipment. Drilling is proposed with a burden and spacing of 5.0 x 5.85m for OB benches and 5.5 x 6m for coal benches. Considering a powder factor of 0.35 kg/cum in OB and 0.20 kg/cum in coal, the average per day explosive consumption would be 10 tonnes for OB and 0.3 tonne for coal.

Bulk emulsion explosives are proposed with initiation by nonels and cast boosters.

Blasting will be avoided during rainy days, at night hours and during stormy conditions. Precautions for safe blasting will be followed.

Scientific study for arriving at the blasting pattern will be conducted in the first year of operation in Chotia sub block 2A D to H sector. The proposed design will be revised, if required.

Presently 2X2.5 tonne magazine exist. Two more 2.5 tonne magazine is proposed, out of which one magazine will be used exclusively to store nonels.

3.5.12 Transportation of OB and Coal

Coal is proposed to be transported to the coal stock maintained in south eastern part of the lease. From the stock coal will be directly moved to end use plant. No crushing or screening is proposed within the lease hold. OB will initially be dumped in decoaled void of Sector A & B and further in the identified dumping area proposed in Sector A&B

3.5.13 System of Mining

Conventional shovel dumper combination is proposed for mining wherein the diesel hydraulic excavator will load the coal/OB loosened by blasting on to mine trucks for transportation to designated site.

3.5.14 Design of Opencast Mine Stages

As has been explained earlier geological model has been prepared with Minex incorporating the borehole database from the exploration and the topography data generated by Balco post vesting of the block. Ultimate pit is designed leaving 7.5m from the lease boundary and following the design geometry detailed earlier. Stage pits are designed for 1st year, 3rd year, 5th year, and every consecutive 5 years till the life of the mine. The year wise volumes are derived from the stage volumes. Roads are designed with minimum 12 m width and 1 in 14 gradients. Switch backs are provided wherever required and as far as possible in pit roads are designed without curves. The stages are described below:

3.5.14.1 Chotia sub block 2A Sector C OC

The sector C has a total area of 2.42 sq.km and is bound by the following:

Boundaries of sector C

Direction	Bound by
East	Fault F2 F2 I
West	Fault F1-F1'
North	Incrop of Seam 2
South	Incrop of Seam 2 and Fault F1- F1

Ultimate pit

From the total area of sector C, an area of 0.92 sq.km is identified to be open castable. The ultimate pit plan is provided below:

Ultimate pit parameters

Parameters	Unit	Values
Maximum depth of Quarry	m	64
Minimum depth	m	21
Area of excavation	ha	92.36
Ultimate pit slope	deg	44
Bench height	m	6
Berm width at ultimate pit	m	6
Road width	m	12

Approach road is planned at the northern flank as pit is proposed to commence with a box cut in the northern part of the identified open pit. In the initial stages, the road will be shifted from the north eastern flank to the north western flank. Road length at the flank in from stage 2 to the final stage 7 will be 550 m. After touching the seam floor, road will move along the floor of the quarry till the completion of the pit. Road width proposed is 10 m with 1 in 14 gradients.

Year 1

The initial pit commences from north eastern part of the proposed pit area. Mining is proposed to commence in the year 2024-25, after obtaining required permissions. This part has minimum waste and lesser depth. Production of coal commences from the first year after stripping the top OB. Initial ramp is of 200 m length at 1 in 16 gradients. The initial OB is proposed to be transported to Sector A & B excavated void area and dumped. Top soil will be stored separately in the top soil dump in the Sector A & B area. Coal will be transported directly to the coal stock area. The coal will be reloaded to trucks for transportation to the end use plants by road. Weigh bridge of 100 ton capacity, which is in operation in southern eastern part of lease area. Existing road which connects Sector D to H to the main entry of the lease will be strengthened which will be used for coal transportation.

The entire OB quantity is proposed to be dumped in decoaled pit void of Sector A & E. The configuration of the pit is presented below:

Parameters of initial pit Sector C

Parameters	Unit	Value
Area	sq.km	0.13
Depth	m	24
Length at bottom	m	200
Length of face	m	50~
Coal	Mt	250,000
OB	Mcum	1,620,300

Year 2

In the second year Pit will expand in the dip side with the same width. The OB will be transported to Sector A & B for external dumping in the initial part of the year and internal dumping will start in mid-year 2. Coal will be continued to be handled to the coal stock yard. The OB to be handled in the second year is 2.625 Mcum and coal production will reach the peak rated capacity of Chotia sub block 2A sector C opencast mine. Total OB volume 50% is planned to be dumped internally.

Parameters of pit in Second year

Parameters	Unit	Value
Area	sq.km	0.21
Depth	m	40
Length at bottom	m	380
Length of face	m	800
Benches	No	6
Coal	Mt	250,000
OB	Mcum	3,490,140

Year 3

The pit will continue to expand towards dip along the eastern boundary. After reaching the dip most part, the pit face is planned to be advanced along the western side, almost along strike. Road will remain with the same length as in first year of operation. Entire OB generated to be internally backfilled.

Parameters of pit in third year

Parameters	Unit	Value
Area	sq.km	0.30
Depth	m	48
Length at bottom	m	549
Length of face	m	1014
Coal	Mt	250,000
OB	Mcum	3,490,140

Year 4

Pit will continue to progress towards western side. Both southern and western flank will be expanded. As the backfilling progresses along the northern flank, road is proposed to be shifted further towards western side along the northern flank. From this year the internal dumping will be raised further 15 m from the original ground level. The parameters of 1th year pit are provided below

Parameters of pit in fourth year

Parameters	Unit	Value
Area	sq.km	0.39
Depth	m	52
Length at bottom	m	612

Parameters	Unit	Value
Length of face	m	1180
Benches	No	9
Coal	Mt	250,000
OB	Mcum	3,490,140

Year 5

As explained above, the pit will progress towards western side and the road is proposed to be shifted towards further westwards in the northern flank. Road length would increase to 550 m.

Parameters of fifth year pit Sector C

Parameters	Unit	Value
Area	sq.km	0.65
Depth	m	60
Length at bottom	m	633
Length of face	m	1,363
Benches	No	11
Coal	Mt	250 000
OB	Mcum	3,490,140

Final stage - Year 9

The pit will attain the final stage in the year 9 *i.e.* in the year 2032-33. The final pit configuration is as shown below:

The final internal dumping will reach up to a distance of 100 m from the final pit wall in the southern side of the pit. After completion of extraction, the pit void is proposed to be backfilled completely with fly ash and waste

Parameters of final stage Sector C

Parameters	Unit	Value
Area	sq.km	0.92
Depth	m	64
Length at bottom	m	633
Length of face	m	1,363
Benches	No	11
Coal	Mt	8,20,000
OB	Mcum	11,380,140

3.5.14.2 Stage plans - Chotia sub block 2A Sector D to H

As mentioned earlier, assessment was made to identify open castable part in Sector D to H as well. A part with over all stripping ratio 1: 13 is identified. The resultant pit had some parts left out in the east and west along the lease boundary in patches. After due consideration, these patches were also annexed to the open castable area parts could not be mined effectively by UG methods and for conservation of coal reserves.

This has resulted in increase of overall stripping ratio to 1:15.

Maximum depth of the pit is around 120 m. Pit is designed with benches of 6 m height and berm/bench width of 4 m at the ultimate pit. The total pit area is 1.05 sq.km.

Year 1

The initial excavation is proposed in the area with lesser depth. Road is proposed to be drawn in the north eastern flank. The stage pit is shown below:

Both F6 and F9 fault will be encountered in the pit. The pit is worked to a depth of 100m to achieve the requisite production. OB from the pit is planned to be transported to Sector A & B void for dumping.

Parameters of first year pit Seam 4

Parameters	Unit	Value
Area	sq.km	0.25
Depth	m	110
Length at bottom	m	470
Length of face	m	860
Benches	No	11
Coal	Mt	470,000
OB	Mcum	3,543,160

Year 2

In the year 2, pit will further expand in both dip and the strike direction. F6 fault will be crossed. Road will be extended into the pit with a switch back. Pit depth will extend and reach 360 m RL. In the initial years additional 4 Mcum will have to be excavated and pre stripping is proposed with deployment of contractual agency.

Parameters of second year pit Seam 4

Parameters	Unit	Value
Area	sq.km	0.19
Depth	m	115
Length at bottom	m	570
Length of face	m	1010
Benches	No	19
Coal	Mt	500,000
OB	Mcum	7,600,000

Year 3

In year 3, the pit extends all along the south and west wards as the flank extends along the eastern side. More area in the fault get exposed, which down towards the seam to 35 m. Also, F9 fault gets further opens up.

Parameters of year 3 pit Seam 4

Parameters	Unit	Value
Area	sq.km	0.35
Depth	m	121
Length at bottom	m	656
Length of face	m	1,100
Benches		22
Coal	Mt	500,000
OB	Mcum	7,600,000

The face encounters F10 fault which forms a basinal structure with F9 fault. Road extends along the eastern flank. Coal is hauled through road in coal floor with two switch backs in the fault zone. The peak production remains at 0.50 MTPA. Internal dumping of OB commences at this stage. While 70% of the OB is dumped in mined out area of Sector A & B remaining will be internally backfilled.

Year 4

For fourth year the pit will further extend and reach the ultimate pit limit in the southern side. After touching the ultimate pit limit, the pit will further progress in the western direction along the ultimate pit boundary. There is no remarkable increase in depth and no. of benches in this year. Entire OB generated is dumped in to the pit.

Parameters of year 4 pit Seam 4

Parameters	Unit	Value
Area	Sq.km	0.46
Depth	m	126
Length at bottom	m	700
Length of face	m	1,150
Benches	No	22
Coal	Mt	500,000
OB	Mcum	7,600,000

Year 5

In this stage, the pit extends further to the south along the strike between faults F9 and F6, while the faces in the west of fault F9 will almost remain unmoved. The face length almost remains constant. Most of the workings in this stage are in lower depth area, during this period the peak production is 0.5 MTPA. Internal dumping continues and the entire waste generated is dumped into the pit

Parameters of stage 3 pit Seam 4

Parameters	Unit	Value
Area	Sq.km	0,51
Depth	m	121
Length at bottom	m	830
Length of face	m	1,170

Parameters	Unit	Value
Benches	No	24
Coal	Mt	500,000
OB	Mcum	7,600,000

Year 10

The pit further extends south-south western side. Face length remains constant and most of the working is concentrated between faults F6 and F9. The internal OB dump will be raised 15 m above the OGL leaving a berm of 15 m. The parameters of the pit are provided below:

Parameters of year 10 pit Seam 4

Parameters	Unit	Value
Area	Sq.km	1.01
Depth	M	125
Length at bottom	M	1,100
Length of face	M	1,200
Benches	No	24
Coal produced from 6th year to 10th year	Mt	24,20,000
Corresponding OB	Meum	37,910,000

Year 12

The faces in the western side are pushed to the pit boundary at this stage at a reduced strip ratio of 1:13. In this stage entire OB will be backfilled in the internal dump with the height of 15 m over the OGL.

Parameters of year 12 pit Seam 4

Parameters	Unit	Value
Area	Sq.km	1.01
Depth	M	150
Length at bottom	M	1,100
Length of face	M	1,200
Benches	No	24
Coal produced from 6th year to 10th year	Mt	810,000
Corresponding OB	Meum	14,367,874

Heavy Earth Moving Machineries

The equipment strength is calculated with 18 hours of operation per day and 75% efficiency factor (product of availability and utilization). Population of coal tipper and rear dumper are calculated with a lead of 3 km. requirements assessed for both the opencast mines in Chotia sub block 2A is provided as follows:

Equipment	Capacity Mcum/year	No of equipment for Peak Production
HEMM Equipment		
RBH Drills /160 mm	3.35	6
Diesel Hydraulic Shovel /3.1 cum, Back hoe	0.7	2
Diesel Hydraulic Shovel /5.5 cum,	1.35	9
Coal tippers/ 20t with 3 km lead	0.12	5
Rear Dumpers /35 t with 3 km lead	0.45	25
Track Dozer /320 hp	-	7
Ancillary Equipment		
Front End Loader / 5.74 cum		3
Wheel Dozer / 300hp		1
Motor Grader /280 hP		2
Crane /50 t		1
Crane /10 t	-	2
Vibratory Compactor /167 cm roller width		3
Water Sprinkler /28 kl	-	3
Fire Tender	-	1
Fork Lift	-	1
Boom Truck	-	1
Fuel Truck/ 12 kl	-	1
Tyre Handler		2
Maintenance van		2
Explosive van	-	3

3.5.15 OB Dump

3.5.15.1 Dumping schedule

In Sector C opencast mine, OB is proposed to be dumped in mined out area in Sector A&B in the first year. Sufficient space could be generated for partial internal dumping in the second year. From third year all the OB generated are proposed to be internally dumped. OB generated from Sector D to F pit will be transported to the decoaled void in Sector A&B for dumping for three years from commencement of mining operation. In the third year sufficient space is generated for partial internal jumping of OB. The OB dumping programme for Chotia sub block 2A is presented below:

OB dumping schedule for Chotia sub block 2A

Year	Excavation (Bcum)		Total	External (Bcum)		Internal (Bcum)	
	OB	Top soil		OB	Top soil	OB	Top soil
Sector C Opencast mine							
24-25	13,82,700	2,37,600	16,20,300	13,82,700	2,37,600		
25-26	32,65,740	2,24,400	34,90,140	16,32,870	2,24,400	16,32,870	
26-27	32,74,540	2,15,600	34,90,140		2,15,600	32,74,540	
27-28	32,94,340	1,95,800	34,90,140		97,900	32,94,340	97,900

Year	Excavation (Bcum)		Total	External (Bcum)		Internal (Bcum)	
	OB	Top soil		OB	Top soil	OB	Top soil
28-29	32,70,140	2,20,000	34,90,140	-	-	32,70,140	2,20,000
29-30	32,48,140	2,42,000	34,90,140	-	-	32,48,140	2,42,000
30-31	32,74,140	2,16,000	34,90,140	-	-	32,74,140	2,16,000
31-32	32,74,140	2,16,000	34,90,140			32,74,140	2,16,000
32-33	7,76,800	1,33,200	9,10,000			7,76,800	1,33,200
Total	**2,50,60,680**	**19,00,600**	**2,69,61,280**	**30,15,570**	**7,75,500**	**2,20,45,110**	**11,25,100**
			Sector D to F opencast mine				
23-24	34,95,160	8,000	35,43,160	34,95,160	48,000		
24-25	73,60,000	2,40,000	76,00,000	73,60,000	2,40,000		
25-26	73,90,000	2,10,000	76,00,000	59,12,000	2,10,000	14,78,000	
26-27	74,57,500	1,42,500	76,00,000		1,42,500	74,57,500	
27-28	74,92,750	1,07,250	76,00,000		1,07,250	74,92,750	
28-29	74,61,400	1,38,600	76,00,000		1,38,600	74,61,400	
29-30	74,74,600	1,25,400	76,00,000			74,74,600	1,25,400
30-31	74,87,800	1,12,200	76,00,000			74,87,800	1,12,200
31-32	74,99,350	1,00,650	76,00,000			74,99,350	1,00,650
32-33	74,08,690	1,01,310	75,10,000			74,08,690	1,01,310
33-34	73,08,750	1,07,250	74,16,000			73,08,750	1,07,250
34-35	68,16,574	1,35,300	69,51,874			68,16,574	1,35,300
Total	**8,46,52,574**	**15,68,460**	**8,62,21,034**	**1,67,67,160**	**8,86,350**	**6,78,85,414**	**6,82,110**

It is proposed to backfill the pit voids by OB/fly ash from Balco's power plant at Korba after completion of UG mine and abandoning the entries

3.5.15.2 Dump design for Chotia sub block 2A

The dumps are proposed in a deck of 30 m till OGL. All the dumps both internal and external dumps are designed with an overall slope angle of 28°. Each deck will have a berm width equal to the vertical height of the deck in both the internal and external dump of Chotia sub block 2A. The independent slopes are envisaged to be 36° or the angle of repose of the material to be dumped. External dumping is also planned with 30 m decks and 30 m berm width. For external dump proposed in Sector A & B, one deck of 30m is proposed over OGL. For internal dumping one deck of 15m height above original ground level is proposed in all the two open cast mines after leaving 20 m berm width. This deck will be handled back to the pit to the extent possible after closure of the mine.

Initially, OB will be moved to Sector A & B decoaled pit from the opencast mine planned in Chotia sub block 2A. Existing road between sector D to H and Sector A will be strengthened and will be utilised for movement of dumpers carrying waste to the decoaled area of Sector 'A'. A road will be prepared for movement of OB from Sector C to Sector A. Scientific Study for slope stability analysis for pit, internal and external dumps is conducted for Chotia sub block 2B (results are discussed in later part of the report) by NIT Raipur in the month of January 2018. In the same lines investigation will be carried out for Chotia sub block 2A before the commencement of

th~OC mining in Sector D to F pit. Top soil spreading will be done for technical reclamation after raising the dump by 15 m in the pits and 30 m in the sector A pit from original ground level. Top soil is planned to be stored in designated top soil stacks which will have a height of 3 m. Two such stacks in Chotia sub block 2A are proposed, one in Sector D to H (in the northern part of the pit) and another in Sector A, where a top soil dump exist are proposed. Provision of slope monitoring radar will be explored during actual operation of the mine.

Chotia sub block 2B OC - Geo-mining characteristics

S.N.	Particular	Thickness	
		Min (m)	Max (m)
A.	Coal		
1	Seam 3	0.06	2.7
2	Seam 2	0.12	3.5
3	Seam 1	0.08	4.08
4	Category of Excavation	Category III	
5	Quality	Seam 1- (ROM Grade G-8)	
		Seam 2- (ROM Grade G-11)	
		Seam 3- (ROM Grade G-13)	
6	Volume weight	1.57 t/m^3	
7	Dip of the seam	Dipping towards centre 3 to 6 deg	
B.	Overburden	Thickness (m)	
1	Top O.B.	8-12	
2	Parting between seam 3 & seam 2	5.5-30.7	
3	Parting between seam 2 & seam 1	14.4-22.6	
4	Category of excavation	50% category III + 50% category IV	
5	Volume weight	2.2-2.4 t/m^3	

3.5.16 Opencast Mine Parameters

The basic parameters of the opencast mine are given below:

Parameters	Unit (m)
Maximum length of the quarry along the dip at surface	1,125
Maximum length of the quarry along the dip at floor	1,046
Minimum length of the quarry along dip at surface	911
Minimum length of the quarry alone dip at floor	936
Maximum width of the quarry along strike at surface	870
Maximum width of the quarry along strike at floor	757
Minimum width of the quarry along strike at surface	589
Minimum width of the quarry along strike at floor	463
Minimum depth of quarry	20
Maximum depth of quarry	60
Area of excavation (ha)	79.4

3.5.17 Mineable Reserve and Stripping Ratio

The balance reserve in Chotia sub block 2B as per 3rd Revision of mining plan is as below:

Balance reserves Chotia sub block 2B as per 3rd revision

S. No	Seam	Reserve in Mt				Mine Capacity/ Technology		Years of operation	
		Geological	Mineable		Extractable			From	To
			U/G	OC					
1	3,2 &1	5.41	Nil	4.98	4.98	1	OC	2	6
2	1	5.41	5.19	Nil	2.70	0.3	UG	6	16
Total		**10.82**	**5.19**	**4.98**	**7.68**				

As mentioned earlier, out of the balance reserves of 4.98 Mt, a quantity of 0.67 Million Tonnes of coal is mined out in the month of October 2018. So, a balance reserve as on 1st April 2019 is 4.31 Million tonnes which is proposed to be mined by opencast method. There is no change in the UG reserves. Revised table as per the present proposal is provided below:

Balance reserves Chotia sub block 2B as per 4th revision

S. No.	Seam	Reserve in Mt				Mine Capacity/ Technology		Years of operation	
		Geological	Mineable		Extractable			From	To
			U/G	OC					
1	3,2 &1	5.41	Nil	4.31*	4.31	1	OC	1	6
2	1	5.41	5.19	Nil	2.70	0.3	UG	7	15
Total		**10.82**	**5.19**	**4.76**	**7.01**				

*0.67 MT extracted from the reserves provided in approved mining plan as per 3rd revision till 31.03.2019.

- The mineable reserves are initially estimated to be 5.21 Mt with corresponding OB volume of 26.18 Mcum and the stripping ratio of 5.02 cum/t.
- Mining activity had commenced in sector A prior to re-allocation in the year 2014 and reportedly 0.23 Mt of coal (area 0.07 sqkm) was mined out by prior allottee M/s. Prakash Industries Limited (PIL) resulting in a balance mineable reserve of ~4.98 Mt. Mining activity has commenced by M/s. BALCO in the month of October 2018 after obtaining environmental clearance for the production capacity of 1 MTPA from Sector A opencast mine and 0.67 million tonne has been mined till 31st March 2019.

3.5.18 Opening the Deposit and Sequence of Mining Operations:

As the mine is under operation, further mining would extend from the present working faces. The haul road at 1 in 23 gradient exists around 20 m west of CSG 18 bore hole from 411 RL to 399 RL. The mine face is proposed to be advanced from the present position along the south-southwest direction.

3.5.18.1 Calendar programme of excavation

Presently the workings are in Seam 1 floor. Extraction of coal commenced from October 2018 and in the year 2018-19 and 0.67 Million tonnes of coal has been extracted. From the consecutive years coal production of 1 Mt is planned.

Production Schedule as per 4th Revision of Mining Plan for Chotia sub block 2A & 2B

Mine	Chotia – sub block 2A			Chotia - sub block 2B			Total
Method	OC	UG	Sub total	OC	UG	Sub Total	
Reserves (Mt)	**7.77**	4.88	**12.65**	**4.31**	**2.70**	**7.01**	**19.66**
2019-20	-	-	-	1.00	-	1.00	1.00
20-21	-	-	-	1.00	-	1.00	1.00
21-22	-	-	-	1.00	-	1.00	1.00
22-23	-	-	-	1.00	-	1.00	1.00
23-24	0.47	-	0.47	-	0.22	**0.53**	1.00
24-25	0.75	-	0.75	-	0.25	0.25	1.00
25-26	0.75	-	0.75	-	0.25	0.25	1.00
26-27	0.75	-	0.75	-	0.25	0.25	1.00
27-28	0.75	-	0.75	-	0.25	0.25	1.00
28-29	0.75	-	0.75	-	0.25	0.25	1.00
29-30	0.75	-	0.75	-	0.25	0.25	1.00
30-31	0.75	-	0.75	-	0.25	0.25	1.00
31-32	0.75	-	0.75	-	0.25	0.25	1.00
32-33	0.49	0.26	0.75	-	0.25	0.25	**1.00**
33-34	0.42	0.33	0.75	-	0.23	0.23	**0.98**
34-35	0.39	0.36	0.75	-	-	-	0.75
35-36	-	0.75	0.75	-	-	-	0.75
36-37	-	0.75	0.75	-	-	-	0.75
37-38	-	0.75	0.75	-	-	-	0.75
38-39	-	0.75	0.75	-	-	-	0.75
39-40	-	0.31	0.31	-	-	-	0.31
40-41	-	0.31	0.31	-	-	-	0.31
41-42	-	0.31	0.31	-	-	-	0.31

3.5.19 Scientific Study for Stability Analysis

Scientific study for stability analysis for the working benches, ultimate pit wall, external and internal dumps is conducted by NIT, Raipur in the month of January 2018 and the results are presented below:

Results of slope stability analysis for the opencast pit in Sector A are provided below:

Description	Pit depth (m)	Slope angle (deg)	FoS	Remark
First year in dry season	37	24	2.41	Highly stable
First year in monsoon season	37	24	2.42	Highly stable
Third year in dry season	48	24	2.71	Highly stable
Third year in monsoon season	48	24	2.60	Highly stable
Fifth year in dry season	60	24	1.65	Highly stable
Fifth year in monsoon season	60	24	1.68	Highly stable
Ultimate pit in dry season	60	45	1.21	Safe
Ultimate pit in monsoon season	60	45	1.21	Safe

The results of dump slope stability analysis are as below:

Results of pit slope stability analysis

Type of dump, year of operation and season	Pit depth (m)	Slope angle (deg)	FoS	Remark
External dump in dry season	15	37	2.41	Highly stable
External dump in monsoon season	15	37	2.42	Highly stable

Schedule of mine operations is as under

OC mine of Chotia- sub block 2B will get exhausted in 2023-24.

After this, UG mining at Chotia- sub block 2A will commence simultaneously in both it's sub blocks (sectors). In the mine planned it is proposed to leave a barrier (horizontally) of 400 m between OC and UG workings, being the barrier zone. Underground mining operations in Chotia- sub block 2B are planned only after UG operations at Chotia- sub block 2A have stabilized. However, as per 4th revised mining plan OC mining will be continued in Chotia sub block 2A till 2034-35.

3.5.20 Mine Design

Mine is operated for 3 shifts in a day; each shift is of 8 hours and all the days in a year. Effective no. of working days in a year is 330.

Shovel dumper combination has been proposed in the Approved Mining Plan and the same is being followed. The geometry of the mine is proposed as below:

Working bench - OB

- Height – 6 m
- Width – 20 m
- Bench slope - 70 degree

Non-working bench – OB:

- Height – 6 m
- Width – 10 m
- Bench slope - 70 degree

In case of coal, the bench height will be same as the thickness of coal seam.

Ultimate pit slope will be 45^0.

Chotia- sub block 2A exhibits relatively simple structure with the beds showing broadly NW-SE strike and dipping towards south west of the property with rolling dip varying from 3^0 to 5^0. Only seam 2 is exposed in this pit. The strike and dip over the lease is as given below:

Geo Mining Characteristics for Chotia- sub block 2A (Opencast Mine)

S. No	Particulars	Thickness	
		Min (m)	Max (m)
A.	**Coal**		
1	Seam 2	0.3	3.50
2	Quality	Seam 2, G-9	
3	In-situ Bulk density	1.5 t/m^3	
4	Dip of the seam	Dipping towards South-West with rolling dip of 5^0 to 6^0	
B.	**Overburden**	**Thickness (m)**	
1	Top OB	8-53 m	
2	In-situ Bulk density	2.2-2.4 t/m^3	

Geo Mining Characteristics for Chotia- sub block 2B

S. No	Particular	Thickness	
		Min (m)	Max (m)
A.	**Coal**		
1	Seam 3	0.06	2.7
2	Seam 2	0.12	3.5
3	Seam 1	0.08	4.08
4	Quality	Seam 1, G-8 Seam 2, G-11 Seam 3, G-13	
5	In situ Bulk density	1.57 t/m^3	
6	Dip of the seam	Dipping towards center 3 to 6 deg	
B.	**Overburden**	**Thickness (m)**	
1	Top OB	8-12 m	
2	Parting between seam 3 & seam 2	5.5-30.7 m	
3	Parting between seam 2 & seam 1	14.4-22.6 m	
4	In situ bulk density	2.2-2.4 t/m^3	

In Chotia- sub block 2B, Seam 1 and Seam 2 are exposed and being mined through OC only.

Mine Pit - Opencast mine parameter of Chotia- sub block 2A

Parameters	Unit (m)
Maximum length of the quarry along the dip at surface	2,056.77
Maximum length of the quarry along the dip at floor	2,044.15
Minimum length of the quarry along dip at surface	763.83
Minimum length of the quarry along dip at floor	707.93
Maximum width of the quarry along strike at surface	2,962.63
Maximum width of the quarry along strike at floor	2,955.44
Minimum width of the quarry along strike at surface	789.07
Minimum width of the quarry along strike at floor	750.01
Minimum depth of quarry	10
Maximum depth of quarry	55

Remark: Coal reserves designated for OC working in Chotia- sub block 2A have already exhausted after extracting 3.0 MT coal.

Opencast parameters of Chotia- sub block 2B

Parameters	Unit (m)
Maximum length of the quarry along the dip at surface	1125
Maximum length of the quarry along the dip at floor	1046
Minimum length of the quarry along dip at surface	911
Minimum length of the quarry along dip at floor	936
Maximum width of the quarry along strike at surface	870
Maximum width of the quarry along strike at floor	757
Minimum width of the quarry along strike at surface	589
Minimum width of the quarry along strike at floor	463
Minimum depth of quarry	20
Maximum depth of quarry	60

Remark: Presently, sub block 2B is in operation and mine benches are advancing towards dip in N-S direction. Present dimension of Chotia- sub block 2B pit(quarry) are as under:
Width of the quarry rise to dip = 450 m
Length of the quarry along strike = 550 m
Depth of quarry from surface to coal seam = 32 m
Surface area of the quarry = 24.75 ha
Coal bench floor area of the quarry

Typical Latitudinal X-Section of Chotia- sub block 2B OCM (E658450)

a. South to North: Dip to Rise direction

Topmost RL of Pit 432.65

Sl. No.	Top RL (m)	Bottom RL(m)	Strata	Bench height (m)	Bench Width (m)	Agency
1	432.65	430.38	Top soil	2.27	12.88	Contractor
2	430.38	428.46	Sand stone	1.92	7.54	
3	428.46	423.21	Sand stone	5.25	48.05	
4	423.21	417.61	Coal	5.6	28.79	
5	417.61	416.5	Sand stone	1.11	34.81	
6	416.5	411.93	Sand stone	4.57	23.71	
7	411.93	405.04	Sand stone	6.89	33.68	
8	405.04	399.19	Coal	5.85	28.35	
9	399.19	394.8	Decoaled	4.39	161.4	
10	394.8	415.5	Waste dump	20.7	24.73	
11	415.5	431.85	Waste dump	16.35	77.75	
12	431.85	422.05	Waste dump	9.8	27.49	
13	422.05	409.82	OGL	12.23		

b. West to East: Strike direction

Topmost RL of Pit 432.65

Sl. No.	Top RL (m)	Bottom RL (m)	Strata	Bench height (m)	Bench Width (m)	Agency
1	418.07	412.12	Sand stone	5.95	11.3	Contractor
2	412.12	406.3	Sand stone	5.82	12.6	
3	406.3	399.87	Coal	6.43	15.8	
4	399.87	395.9	Sand stone	3.97	55.38	
5	395.9	398.91	Sand stone	3.01	26.04	
6	398.91	408.3	Sand stone	9.39	32.67	
7	408.3	413.6	Sand stone	5.3	220	
8	413.6	408.3	Sand stone	5.3	45	
9	408.3	405.6	Sand stone	2.7	83.84	
10	405.6	408.95	Sand stone	3.35	21.3	
11	408.95	415.32	Sand stone	6.37	43.65	
12	415.32	416.9	Sand stone	1.58	32.87	
13	416.9	420.3	OGL	3.4		

Waste Dump

OB excavated from the mine is being back-filled in the decoaled area created by ongoing excavation.

Coal Stockyard

Coal from mine is transported to the coal stock yard from where coal is loaded into tarpaulin covered trucks/trailer for dispatch to Balco Plant, located at a distance of 75 km at Korba.

3.5.21 Drilling and Basting

3.5.21.1 Drilling

- Drilling in OB and coal is done by 150 mm blast hole drill (EX200Lc and EX210Lc). The hole is drilled for a maximum of 6 m depth in OB and equal to the seam thickness in case of coal. Bench height in OB is maintained at 6 m and for coal it is maintained equal to the coal seam thickness. The OB after blasting is excavated by 3.1 m^3 shovel (EC480 DL) and is loaded in 18 m^3 dumper (Bharat-Benz 3128) which transports the OB to the internal Overburden dump. Sub grade drilling of 60 cm is done in Overburden. Drilling in OB and coal is done in staggered pattern for proper utilization of explosive energy through uniform distribution of charge in the blasting area.
- Coal after blasting is loaded by 1.8 m^3 shovel (EC300 DL) and is transported to coal stock yard by 23 m^3 dumper (Bharat-Benz 3128). No sub grade drilling is done in the coal bench.

3.5.21.2 Blasting

- Blasting is done in OB to develop the cracks and fractures in it so that it could be easily loaded by shovel. Blasting is done as per the guidelines of DGMS under the supervision of Blasting officer (First class manager of competency in coal) and is supported by shot firers (overmen) and helpers. Supply of explosive and blasting accessories in Chotia-sub block 2B mine is outsourced to Special Blast company. Blasting is generally carried out during the day time between 1 p.m. to 2 p.m.
- Transaction of explosive and accessories from the magazine is done by the magazine in-charge through online PESO SETT system. SME (Site mixed emulsion) is supplied by the Special Blast Company (SBC) at the blasting site in their pump trucks.
- Controlled blasting technique is adopted in the mine by doing blasting using NONEL/ shock tubes of different delay, which helps in controlling the ground vibration, air-blast, and fly-rock. For each round of blasting, ground vibrations levels are monitored through seismograph.
- Secondary blasting is done to reduce the size of big boulders generated during the primary blasting and it is carried out by primer cartridges and detonating fuse.
- Pop shooting method by drilling short hole is used for carrying out secondary blasting as this provides proper utilization of explosive energy resulting in reducing the chances of air-blast.

Details of drilling and blasting pattern for OB and coal

Sl. No.	Particulars	OB	Coal
1	Bench Height	6 m	Equal to Coal Seam Thickness around (2.4 m to 3.5 m)
2	Diameter of Hole	150 mm	150 mm
3	Depth of Hole	6 m	Equal to Coal Seam Thickness around (2.4 m to 3.5 m)
4	Spacing & Burden	5 m x 4 m	7 m x 6 m
5	No. of Rows	5	5
6	Max Charge per hole	42 kg	15 kg
7	Powder factor	2.9 cum/kg	12 tonnes/kg

3.5.22 Extent of Mechanization

Chotia coal mine is fully mechanized, having deployment of mining machineries by Contractor. At present, only Chotia- sub block 2B is operational and extent of mechanization for it is mentioned below:

Equipment	Peak
HEMM Equipment	
RBH Drills /115 mm	5
Diesel Hydraulic Shovel /3.1 cum, Back hoe	6

Equipment	Peak
Rear Dumpers /35 t Bharat Benz make	18
Track Dozer /320 hp	4
Ancillary Equipment	
Front End Loader / 5.74 cum	1
Wheel Dozer / 300hp	1
Motor Grader /280 hP	1
Crane /50 t	1
Crane /10 t	1
Vibratory Compactor /167 cm roller width	1
Water Sprinkler /28 kl	2
Fire Tender	1
Fork Lift	1
Boom Truck	2
Fuel Truck/ 12 kl	1
Tyre Handler	1
Maintenance van	1
Explosive van	1

Stripping Ratio

Combined geological coal reserve of all three seams - Seam 3, 2 & 1 in Sector A (OC area) of Chotia- sub block 2B coal mine is 5.424 Mt and mineable reserves of 4.98 Mt with total overburden of 26.18 mcum was estimated as per approved mining plan 3rd Revision. The overall stripping ratio is 5.02 cum/t.

Dust suppression system

Usage of mine seepage water for dust suppression is done through water tankers which regularly sprinkle water along the haul road within mines. Water tankers are also deployed for the 10 km stretch road connecting Chotia- sub block 2B and Chotia- sub block 2A for water sprinkling to suppress the dust as it a service road connecting to NH 130 via SH 2A and used for coal transportation from Chotia- sub block 2B to Korba.

3.5.23 Coal Processing (CHP)

Not set up in the mine. Only raw coal (ROM) is dispatched to power plant.

3.5.23.1 Stocking, Loading and Dispatch

- Coal from Mine face is loaded on 24t (for Seam 1) and 28t (For seam 2) capacity dumpers and weighed in 50t weighbridge. They are stocked seam wise separately at coal stockyard. Heaps are separate for Production and Dispatch at a time for both seams.
- Dispatch trucks of 35t capacity are loaded at Stockyard and weighed on 50t weighbridge and then covered by Tarpaulin before transportation to the end use to

BALCO thermal power plant for captive consumption which is about 75 km from the mine site.

- For 2018-19, the Dispatch Breakup was 80% Seam 1 and 20% Seam 2.
- For 2019-20, the % dispatch plan is 50% seam 1 and 50% seam 2.

Quality of Coal

Chotia- sub block 2A	GCV	Moisture %	FC%	VM%	Ash content%
Seam 4 (Top & Bottom)	G9 - G12	1.12-1.45	45.6-47.2	22.6-27.7	23.66-40.20
Seam 2	G9	3.14–4.80	-	23.0-25.7	14.86-36.38
Chotia-II					
Seam 3	G13	6.45-9.57	34.80	27.60	21.6-39.56
Seam 2	G11	5.08-9.94	-	-	28.16-40.96
Seam 1	G8	7.48-11.48	49.0-51.20	25.60-27.80	12.7-32.89
* Currently lessee is operating at Chotia- sub block 2B Mine by opencast method as per approved mine plan					

3.5.24 Land use pattern

The details of land use pattern of Chotia coal mine (as per latest requirement) are as given below:

Pre-mining land use of Chotia coal mine

S.No	Type of Land	Chotia- sub block 2A (ha)	Chotia- sub block 2B (ha)	Total(ha)
1	Forest Land	643.46	316.826	960.286
2	Government Land	20.88	-	20.88
3	Private Land	198.66	-	198.66
	Total	**863.00**	**316.826**	**1,179.826**

During Mining land useof Chotia Coal Mine (for life of mine)

Description	Area in ha
OC Operation	420.53
Undisturbed	45.906
UG Infrastructure	15.3
UG Mining Operation (Marginally Disturbed Area & Pond)	698.09
Total land	**1,179.826**

Post Closure land Use Plan

Description	Area in ha
Backfilled & Biologically reclaimed	420.53
Undisturbed	45.906
UG Infrastructure- Dismantled and Plantation	15.3
UG Mining Operation	698.09
Total land	**1,179.826**

3.5.25 Infrastructure

(i) Road – National Highway 130 is very near to Mine Site (Chotia- sub block 2A). A 10 km black topping road connecting Chotia- sub block 2B with Chotia- sub block 2A mine has been constructed by BALCO itself to facilitate day to day mine visit by team and also for Dispatch by truck from Chotia- sub block 2B mine.

(ii) Rail – Not applicable for Chotia Mines as coal is transported by road to its Korba Thermal Power Plant.

(iii) Power supply – Power is drawn from nearest CSEB main substation and three substations will be built to supply power to underground mines when operational. At present, all illumination, pumping and other electrical setup at Chotia-II are powered through DG set.

(iv) Water Supply – Drinking water supply is by bore wells drilled in the project area, which will be continued. Mine water is used for dust suppression and watering plantation. The average daily water consumption quantity due to sprinkling and plantation is 110 cum/day for Chotia- sub block 2A and 350 cum/day for Chotia- sub block 2B.

(v) Maintenance facilities – Maintenance facilities and Workshops are set up separately within Chotia- sub block 2A premises by the Contractor.

(vi) Others – Central Store for material storage, Diesel Storage, Project Office, rest shelters, Canteen at mines, first aid centre, Vocational Training Centre, Explosive Magazine and Residential Facilities at Township have already been set up.

3.5.26 Manpower

Total manpower is 537 person employed as under:
Departmental = 156
Contractual = 381

3.5.27 Statutory Violations

It is informed by the Mine management that no major violation has been pointed out by any Statutory Authorities during last 2 years.

3.5.28 Constraints in Mining Operations

It is informed by the Mine management that presently there are no constraints in mining operation and achieving targeted production.

Past production for 10 yrs (OB and coal) planned *vs* actual + stripping ratio

After allotment of Chotia coal block through E-auction, mine has come in operation in 2015-16.

FY	Coal (in tonnes)		OB (in CUM)		Stripping Ratio	Remark
	Planned	Actual	Planned	Actual		
2015-16	1,20,000	1,19,999	18,00,000	18,00,000	15.00	Production from Chotia-sub block 2A
2016-17	1,80,000	1,79,999	9,00,000	9,00,000	5.00	
2017-18	0	0	0	0		
2018-19	666667	666667	27,20,378	27,20,378	4.08	Production from Chotia-sub block 2B

Remark: Chotia- sub block 2A has exhausted in September 2016 for mining by OC Method as par Mining Plan 3rd revision. There was no production from October 2016 to October 2018 as permission from Coal Controller for Mine Operation at Chotia-sub block 2B was received on 24.08.2018. Presently OC mining planned in Chotia sub block 2A *w.e.f.* 2023-24.

3.5.29 Planned Production for 2019-20

Planned coal production for FY 2019-20 is 1 MTPA for which 6.7 Million cum of OB will be removed resulting into stripping ratio of 6.7 cum/te.

Long term production schedule as per mine plan is as under:

Mine	Method	Seam	Capacity (MTPA)	Reserve (Mt)	Y1 15-16	Y2 16-17	Y3 17-18	Y4 18-19	Y5 19-20
Chotia-sub block 2A	OC	Seam 2	1.0	0.30	0.3				
	UG	Seam 4	0.5	6.88					
	UG	Seam 2	0.2	2.93					
Chotia-sub block 2B	OC	Seam 3,2,&1	1.0	4.98		1.0	1.0	1.0	1.0
	UG	Seam 1	0.3	2.70					
Total				**17.79**	**0.3**	**1.0**	**1.0**	**1.0**	**1.0**
					Y6 20-21	**Y7 21-22**	**Y8 22-23**	**Y9 23-24**	**Y10 24-25**
Chotia-sub block 2A	OC	Seam 2	1.0	Nil	----	----	----	----	---
	UG	Seam 4	0.5	6.88	0.1	0.5	0.5	0.5	0.5
	UG	Seam 2	0.2	2.93	0.13	0.2	0.2	0.2	0.2
Chotia-sub block 2B	OC	Seam 3,2,&1	1.0	4.47	0.8	0.18	---	---	---
	UG	Seam 1	0.3	2.536	---	0.1	0.3	0.3	0.3
Total				**16.816**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**
Presently, Chotia- sub block 2B is in operation for OC Mining which is likely to be exhausted in 2022-23. *(Note: Y1 indicates 2015-16 , Y2 indicates 2016-17 and so on)									

3.5.30 Computerized Mine Planning

Minex and AutoCAD are used by Survey department on daily basis for calculating volume of OB removed and actual coal top and floor RL.

Minex and AutoCAD are also used by Geology Dept. for coal seam modelling and revalidation of borehole data earlier provided in GR.

3.⌒ GROUP – II: TARA, MADANPUR NORTH, MADANPUR SOUTH, GIDMURI AND PATURIA

Five coal blocks such as Tara, Madanpur (North), Madanpur (South), Paturia and Gidmuri coal blocks are explored in detail and reserves & resources were estimated and classified. Mining plan and mine closure plans were prepared envisaging production proposals and mine closure activities and environmental protection measures. Statutory approvals were in the process of obtaining by the previous allottee. These five coal blocks include 23 coal blocks cancelled in the HAC by the Hon'ble Supreme Court of India through its Judgment dated 25th August 2014 & 24th September 2014. Subsequently the blocks were not re-allotted. Based available data salient features of these coal blocks were summarized and tabulated below in Table 3.8:

- On reviewing features of these blocks, it is found that more than 90% of the extent of the coal blocks are in forest land in respect of Madanpur (North) and Madanpur (South); Tara coal block possess more than 80% of forest land while Paturia and Gidmuri coal blocks having about 61% forest land.
- The coal blocks are situated in undulating topography marked by isolated hillocks separated by valleys. The blocks are very sparsely populated, in and around the blocks are densely forested with Sal, Mahua, Palas, Dhowda, Tednu trees *etc.* Timber, Tendu leaves, Gum, Mahua flowers and fruits (Gulli), *etc.*, are obtained from the forest.
- These blocks are explored in detail. About 76 sq.km area has been explored by drilling 567 bore holes for cumulative meterage of 58363m. Density of the bore hole varies from 6.2 to 9 per square kilometre for different coal blocks.
- Exploration revealed presence of four coal seams in Tara, Madanpur (North) and Madanpur (South) coal blocks, whereas five coal seams encountered in Paturia coal block and 3 coal seams in Gidmuri coal block.
- As per the earlier approved mining plan total resources of 1050.14 million tonnes were estimated from these blocks.
- Mining proposals are made to exploit 4.1 MTY for Madanpur (North) coal block by opencast as well as underground mining method. Paturia and Gidmuri coal blocks also proposed in combination of open cast and underground mining method to exploit 5.6 million tonnes of coal per annum. Open cast mining method proposed for Tara and Madanpur (South) coal blocks to exploit 6 million tonnes and 5.4 million tonnes per annum respectively.
- Madanpur (South) coal block of APMDC has not proposed any beneficiation facilities at mine head and proposed to dispatch ROM to consumers.

Mine Closure proposals includes simultaneous backfilling of open pit, reclamation and afforestation waste dumps and other pollution control measures with proper budgeting.

Table 3.8: Salient features of the coal blocks of Group II based on the information

Name of the Coal Block &No.	Extent of Lease Area in sq.km		Exploration				Reserves in MT		Mining Plan	Remarks/ Previous allottee
	Total	Forest	BH drilled	Total m drilled	BH Ratio	Coal seams	Geological	Minable		
Tara (15)	24.00	19.23 (80.13%)	192	16296	8.0	4	317.33	166.92 OC	MP/ 6 MTY	CMDC Ltd.
Madanpur North (10)	21.387	19.320 (90.34%)	155	12181	7.24	4	213.46	94.96 OC 38.34 UG	MP/ MCP 4.1MTY	Consortium of companies*
Madanpur South (11)	7.140	6.603 (92.47%)	44	9062	6.18	4	169.83	158.921 OC	MP/MCP 5.4MTY	ML applied APMDC. No beneficiation plant envisaged
Paturia (8)	16.14	9.04 (56%)	176	20824	9	5	269.25	30.85OC 238.41UG	MP/ 5.6 MTY	Chhattisgarh State Electricity Board
Gidmuri (7)	7.33	5.18 (70.7 %)				3	80.27	16.05OC 64.22UG		

*Note: * Ultratech Ltd., Singhal Enterprise Ltd., Nav Bharat Coalfields Ltd., Prakash Industries, Anjani Steel Pvt. Ltd., Chhattisgarh Captive Coal Mining Ltd.*

3. GROUP – III MORGA-II, MORGA-III, MORGA-IV, MORGA SOUTH AND SAIDU

SUMMARY OF COAL BLOCKS FOR WHICH LIMITED DATA IS AVAILABLE

Five coal blocks such as Saidu (18), Morga II (4), Morga III (5), Morga IV (6) and Morga South (9) are explored and resources were estimated based on Regional Geological study and exploration. Detailed geological report is available for Saidu coal block. However, mining and mine closure proposals are not available for these blocks. These five coal blocks includes 23 coal blocks cancelled in the HAC by the Hon'ble Supreme Court of India through its Judgment dated 25.08.2014 & 24.09.2014. Subsequently the blocks were not allotted. Based on available data salient features of these coal blocks were summarized and tabulated in Table 3.9:

- Saidu coal block is situated about 4 km from south of PEKB coal block in Korba and Surguja districts. Morga II, III & IV and Morga South coal blocks are located in Korba district and southeast of Chotia coal block and Morga South is southern side of Paturia and Gidmuri coal blocks.
- More than 85% coal block areas are in forest land and back waters of Bango Reservoir extends within the coal blocks of Morga II & III and north-western boundary of Morga IV coal block is along the bank of Bango reservoir back water channel.

  The coal blocks Saidu, Morga II, III & IV are regionally explored. Bore hole density of these blocks vary from 0.33 to 1.2 borehole per square kilometre, whereas Morga South coal block is explored in detail with borehole density of 11 boreholes per square kilometre.
- Exploration reveals five coal seams incroped in Saidu and Morga South coal blocks and established 27.5 million tonnes and 432.5 million tonnes of geological resources respectively. In coal block Morga II seven coal seams are established and 350 million tonnes of geological resources estimated. In coal block of Morga III six coal seams contribute 36 million tonnes of geological resources. Coal block of Morga IV is regionally explored and 7 million tonnes of geological resources estimated.
- Mining proposals and mine closure proposals for these coal blocks are not prepared. However, minable reserves of Saidu coal block are estimated to the tune of 22 million tonnes out of 27.5 million tonnes of geological reserves.

Table 3.9: Salient features of the coal blocks of Group III based on the information

Name of the Coal Block & No.	Extent of Lease Area in sq.km		Exploration				Reserves in MT		Mining Plan	Remarks/ Previous allottee
	Total	Forest	BH Drilled	Total m drilled	BH Ratio	Coal seams	Geological	Minable		
Saidu (18), Surguja & Korba Districts	6.72	NA	8	1948	1.2	5	27.490	22.00	NA	
Morga II (4), Korba District	26.64	85%	Regional exploration			7	350.70	NA	NA	Gujarat Mineral Development Corp.
Morga III (5), Korba District	6.00	5.89 98.2%	2	475	0.33	6	36.00	NA	NA	M.P state Mining Corp. Ltd.,
Morga IV (6), Korba District	6.87	80%	2 BH. Regionally explored				7	NA	NA	M.P state Mining Corp. Ltd.,
Morga South (9), Korba District	21.92	21.33 97.3%	245	53413	11	5	432.54	NA	NA	

3⁀ GROUP IV – NINE COAL BLOCKS FOR WHICH NO INFORMATION IS AVAILABLE

Remaining 9 coal blocks no information is available and these blocks also not re-allotted. The details of the same are as follows:

Sl. No.	Name of Coal Block	Block No
1.	Nakiya- I II & III	1
2.	Morga – I	3
3.	Puta Parogia	16
4.	Parogia	17
5.	Pindraki	19
6.	Sarma	20
7.	Laxmangarh	21
8.	Bhakurma- Matringa	22
9.	Kedma	23

Geographic location of 4 blocks such as Morga I, Puta Parogia, Parogia, Pindraki coal blocks are situated within the major clusters of coal blocks sharing block boundaries with other blocks. Nakiya- I II & III coal block is situated away from the cluster in Korba forest division. Sarma and Laxmangarh coal blocks are situated northeast of coal block cluster in Surguja forest division and Bhakurma-Matringa and Kedma coal blocks are situated southeast of coal block cluster. In the absence of technical inputs in the field of exploration, mining and mine closure, no comments on these blocks are offered or provided.

CHAPTER-4

STATUS OF FLORAL BIODIVERSITY

4.1 BACKGROUND AND SCOPE OF THE STUDY

This chapter provides details on the forest cover, forest types, extent of forest area in the study area of entire Hasdeo-Arand Coalfield (HAC) comprising of 23 coal blocks that include Tara, Parsa, PEKB and Kente Extension located in Surguja, Surajpur and Korba districts of Chhattisgarh state and a comprehensive three season baseline data on floral biodiversity including vegetation structure and composition of plant communities; Rare, Endangered and Threatened (RET) species; important invasive and medicinal plant species as well as key habitats for conservation in the core/buffer zones of the proposed/active coal blocks and in the entire HAC.

4.2 APPROACH AND METHODOLOGY

4.2.1 Approach

Characterization of forest types, extent of their area, forest cover and relevant thematic maps were prepared from the pre-processed data of India State of Forest Report (ISFR), 2017 and National Forest Type Report 2006 procured from Forest Survey of India, Dehradun using the ERDAS and Arc-GIS software.

A comprehensive qualitative and quantitative assessment of flora for their vegetation composition and structure during three seasons *viz.*, pre-monsoon (April-June), post-monsoon (Sept. Nov.) and winter (Dec.-March) in the whole Hasdeo-Arand Coalfield comprising of four coal blocks (Tara, Parsa, PEKB and Kente Extension) and all other coal blocks having operational, allotted and identified mine leases (Table 4.1). In addition, identification of important habitats with species/communities occurring in the area as well as details regarding the life form wise number of species in the buffer areas up to 10 km was done. The details are summarized in Annexure 4.1 - 4.3.

The baseline data were collected during three seasons from May 2019 to October 2020. The study area includes the entire Hasdeo-Arand Coalfield, comprising of Tara, Parsa, Parsa East & Kanta Basan and Kente Extension coal blocks. Extensive field studies were carried out for collection of relevant data in the core as well as 10 km buffer areas of the entire HAC. Accordingly, the study area has been delineated in the HAC as core and buffer areas *viz.*, core and buffer areas of four coal blocks (as well as core and buffer areas of rest of the coal blocks.

Table 4.1: Details of the coal blocks in Hasdeo-Arand Coalfield in Surguja, Surajpur and Korba districts of Chhattisgarh

Sl. No.	Name of Coal Block	Block No	District	Allotment status	Extent in sq.km	Type of mining
Mine lease under various stages of development						
1	Parsa East Kanta Basan	14	Surguja	Allotted to M/s. RVUNL	26.828	OC
2	Parsa	13	Surguja & Surajpur		12.524	OC
3	Kente Extension	12	Surguja		17.600	OC
4	Chotia	02	Korba	Allotted to M/s. BALCO	11.798	OC/UG
5	Tara	15	Surajpur	Not Allotted	24.00	OC
6	Madanpur South	11	Korba	Not Allotted	7.14	OC
7	Gidmuri	08	Korba	Not Allotted	7.33	OC/UG
8	Paturia	09	Korba	Not Allotted	16.14	OC/UG
9	Madanpur North	10	Korba & Surajpur	Not Allotted	21.387	OC/UG
10	Morga - II	04	Korba	Not Allotted	26.64	NA
11	Morga - III	05	Korba	Not Allotted	6.00	NA
12	Morga - IV	06	Korba	Not Allotted	6.87	NA
13	Morga South	07	Korba	Not Allotted	21.92	NA
14	Saidu	18	Korba & Surguja	Not Allotted	6.72	NA
15	Puta Parogia	16	Surguja, Korba & Surajpur	Not Allotted	48.04	NA
16	Parogia*	17	Surguja	Not Allotted	7.15	NA
17	Pindraki	19	Surguja	Not Allotted	23.94	NA
18	Morga-I	03	Korba	Not Allotted	21.19	NA
19	Sarma*	20	Surguja	Not Allotted	18.15	NA
20	Laxmangarh*	21	Surguja	Not Allotted	23.63	NA
21	Bhakurma-Matringa	22	Surguja	Not Allotted	25.99	NA
22	Kedma*	23	Surguja	Not Allotted	18.93	NA
23	Nakiya I, II & III	01	Korba	Not Allotted	34.29	NA

Extent of area for these coal blocks were estimated using GPS location and GIS
*Kedma, Laxmangarh, Sarma and Parogia are only regionally promotionally explored as per CMPDI, 2021.

The general characteristics of landscapes, vegetation structure, land use and identification of important habitats were documented. The general list of species, including RET species were identified following literature review and expert consultations. The term habitat has been used here in a broad sense for general land cover rather than for a particular species. The habitat assessment using network of

road and trails and characterization of landscapes of the study area was carried out through ground surveys.

4.2.2 Methodology

Enumeration of the plant wealth in the study area having microhabitats, altitudes, aspects and terrain was made through extensive ground surveys by the experts in the ICFRE team. Plant specimens collected were identified with the help of flora by Hooker (1872-97), Haines (1961), Saxena and Brahmam (1994-96). Phytosociological analysis (Braun-Blanquet 1965) were made using quantitative inventories to understand the structure and composition of plant communities as well as to identify the economically useful species and species of special concern, *i.e.* RET or vulnerable species that have enormous implications in the conservation and management (Campbell, 1994).

Phyto-sociological study was carried out by perambulating and laying random sampling plots following quadrat method in all coal blocks consisting of individual mine lease and adjacent forest areas for sampling of tree/crown, shrub/middle storey, and herb/under-storey flora. Random sampling methods by laying quadrats of 10 m x 10 m size primarily for trees and within it 3m x 3m size for shrubs and 1m x 1m size for herbs were followed for phyto-sociological study of flora. Geo-coordinates of all the plots were recorded by employing a hand-held GPS instrument.

During the field survey, all species encountered were recorded and the herbarium specimens were prepared for identification and future use. Number of plants of different species encountered in each quadrat were identified and recorded. The girth at breast height (GBH) of all individuals in each quadrat was measured for all species of trees and woody climbers. All individuals with gbh > 10 cm were considered and recorded as trees (Parthasarathy and Karthikeyan, 1997) and individuals with gbh > 3 cm are considered as lianas. All individuals of shrubs and herbs were also considered and recorded. Based on the quadrat data, frequency, density and basal area of each tree and woody climbers were calculated (Misra, 1968). The Importance Value Index (IVI) for three vegetation habits *viz.*, trees, herbs and shrubs was calculated by summing up the relative density, relative frequency and relative basal area values in case of trees and lianas as well as the former two relative values (relative density and relative frequency) only considered for in case of shrubs and herbs.

Formulae used for vegetation calculations are as follows:

$$\text{Density (D)} = \frac{\text{Total number of individuals of a species}}{\text{Total area of quadrats studied}}$$

$$\text{Frequency (F)} = \frac{\text{Number of quadrats of occurrence}}{\text{Total number of quadrats studied}} \times 100$$

$$\text{Abundance (A)} = \frac{\text{Total number of individuals of a species}}{\text{Number of quadrats of occurrence}}$$

$$\text{Relative Density (RD)} = \frac{\text{Number of individuals of a species}}{\text{Total number of individuals of all species}} \text{X } 100$$

$$\text{Relative Frequency (RF)} = \frac{\text{Number of occurrence of a species}}{\text{Total number of occurrence of all species}} \text{X } 100$$

$$\text{Relative Basal Area (RBA)} = \frac{\text{Total basal area of a species}}{\text{Total basal area of all species}} \text{X } 100$$

Importance Value Index for trees (IVI) = RD + RF + RBA

Importance Value Index for shrubs and herbs (IVI) = RD + RF

4.2.3 Species Diversity

The plant diversity and community structure in the study area was assessed by diversity indices *viz.*, Shannon-Wiener index (H') Simpson's Index (λ) and Buza and Gibson's evenness index (E) calculated as per Magurran (1988), using the following formulae:

Shannon-Wiener Index $(H') = -\sum pi \ln pi$

Simpson's index $(\lambda) = \sum pi^2$

Where, pi is the proportion of individuals of the i^{th} species; $pi = Ni / N$

Ni is the number of individuals in the i^{th} species and

N is the total number of individuals of all species in the stand.

Buza and Gibson's evenness index (E) = H'/ln(S)

Where, H' is Shannon-Wiener Index; S= Species richness of the stand

With the vegetation composition, the RET category species were identified by referring to websites of Botanical Survey of India, FRLHT, IUCN Red list and other available literatures on flora and herbarium pertaining to the rare/ endangered species of Chhattisgarh for the recent updates. The multipurpose and economic plant species, if any, were also identified and listed.

4.2.4 Forest cover

The satellite data of LISS-III (Resolution 23.5m x 23.5m) at 1:50,000 scales procured from Forest Survey of India (FSI), Dehradun in digital format were used for forest cover assessment. Most of the satellite data used in this assessment pertains to the FSI 2011 data for forest type and FSI 2017 data for forest cover of the study area. Forest cover has been classified into five classes on the basis of canopy density.

4.2.5 Forest Type

Forest type maps provide a basis for characterizing forests. FSI (2011) forest type of India, based on Champion & Seth classification (1968) were used for characterizing forests for the study area. The satellite data of LISS-III (Resolution 23.5m x 23.5m) at 1:50,000 scales used for forest type assessment were procured from Forest Survey of India (FSI), Dehradun in digital format and used for classification. Forest type maps for individual coal blocks as well as for the entire HAC were generated using Clip/subtract tool in Arch GIS 10.1v.

4.2.6 Forest Compartment wise forest cover

The entire HAC comprises of 23-coal blocks that fall within 230 forest compartments under 05 forest ranges and four forest division *viz.*, Surguja, Korba, Katghora and Surajpur. The forest compartment wise forest cover map and extent of area under individual coal block were estimated using the shape files provided by the Chhattisgarh SFD. Digital format of FSI (2017) map was used to estimate the extent of area based on the FSI scheme of classification for canopy density using Arc GIS software.

4.3 FOREST COVER, TYPES AND EXTENT OF AREA

4.3.1 Secondary Sources

The study area falls under Deccan bio-geographical area that houses an important part of the rich and unique biological diversity. The forests of the state fall under two major forest groups, *i.e.*, Tropical Moist Deciduous forest and the Tropical Dry Deciduous forest. The state of Chhattisgarh is endowed with about 22 varied forest sub-types. The HAC falls within the three districts namely Surguja, Surajpur and Korba of Chhattisgarh State. The forest cover is 56220.09 km^2 (**55,610.57 km^2** of forest + **609.52 km^2** of Scrub) covering 45.8 % of geographic area (**135192 km^2**) of the state (FSI, 2019). Korba district has forest cover of 51.44 % and Surguja district (including present time Surajpur and Balrampur districts) has forest cover of 45.02% (Table 4.2). Protected Area network constituting of three National Parks and 11 Wildlife Sanctuaries covers 4.93% of its geographical area. Based on the Champion & Seth Classification of Forest Types, there are two major forests types namely, Tropical Moist Deciduous Forests and Tropical Dry Deciduous Forests in Chhattisgarh (Champion and Seth, 1968), with the predominant tree species of Sal

(*S.rea robusta*) and Teak (*Tectona grandis*) followed by Bija (*Pterocarpus marsupium*), Saja (*Terminalia elliptica*), Dhavdha (*Anogeissus latifolia*), Mahua (*Madhuca longifolia* var. *latifolia*), Tendu (*Diospyros melanoxylon*) and bamboo (*Dendrocalamus strictus*) *etc.*, (FSI, 2019). As per Champion and Seth (1968), Sal is one of the dominant tree species in the tropical moist as well as dry deciduous forests in India and it has been considered as a deciduous species (Cooke, 1958; Kirtikar and Basu, 1975; Tiwari, 1995), semi-deciduous species (Bor, 1953), an evergreen species (Krishnaswamy and Mathauda, 1954; Singh and Singh, 1992; Borchert, 2000), and deciduous or brevi-deciduous (Joshi, 1980). Sal generally occurs as gregarious formation and sometimes forms pure stands to mixed forests in the Himalayan foothills and central India (Troup, 1921).

Table 4.2: Comparative account of forest cover and the extent of forest area in Korba, Surajpur and Surguja districts in the study area of Hasdeo-Arand Coalfield, Chhattisgarh

Area (sq.km)	**Chhattisgarh**	**Korba**	**Surguja**	**HAC**
Geographical Area(GA)	1,35,192	6,598	15,732	1879.57
Very Dense Forest	7,067.72	203.00	706.72	126.73
Mod. Dense Forest	32,197.56	2,313.62	3,930.64	1158.05
Open Forest	16,345.29	877.08	2,445.25	197.57
Total	**55,610.57**	**3,393.70**	**7,082.61**	**1482.35**
% of GA	41.14%	51.44	45.02	78.86
Scrub	609.52 (0.45%)	92.03	77.86	33.52
Major forest types in Chhattisgarh				
Forest types			**% of the total**	
5A/C3 Southern Dry Mixed Deciduous Forest			27.37	
3C/C2e (ii) Moist Peninsular Low-Level Sal Forest			16.64	
3B/C2 Southern Moist Mixed Deciduous Forest			15.68	
5B/C1c Dry Peninsular Sal Forest			15.27	
5B/C2 Northern Dry Mixed Deciduous Forest			13.16	
3B/C1c Slightly Moist Teak Forest			6.47	
Relatively lesser forest types in Chhattisgarh				
5/E9 Dry Bamboo Brakes			1.49	
3C/C2e (i) Moist Peninsular High-Level Sal Forest			1.48	
Plantation/ TOF			1.01	
5B/DS1 Dry Deciduous Scrub			0.98	
5A/C1b Dry Teak Forest			0.43	
3/E1 *Terminalia elliptica* Forest			0.02	
			(Source- FSI, 2019)	

To meet the ever-increasing population over the past few decades, large tracts of natural habitats of Sal were converted into agricultural, industrial or urban landscapes and timber markets resulting in habitat fragmentation and loss of biodiversity (Jacquemyn *et al.*, 2003). HAC coal blocks falls within five forest ranges and four Forest Divisions such as Pasan and Kendai forest ranges of Katghora Forest Division; Ramanuj Nagar forest range of Surajpur Forest Division; Udaipur forest range of Surguja Forest Division and Lemru forest range of Korba Forest Division.

4.3.2 Spatial assessment of forest cover class and extent of area in Hasdeo-Arand Coalfield

Geo-rectification of Survey of India (SoI) Topographic sheets were used to develop the base map using Arc GIS software (version 10.1). Generation of various thematic maps showing boundaries of coal blocks, forest divisions, forest ranges, forest compartments, villages, Medicinal Plant Conservation Areas (MPCAs) implemented by Chhattisgarh Forest Department and buffer zone of each coal block for the Hasdeo-Arand Coalfield area were also carried out.

The satellite data of LISS-III (Resolution 23.5m x 23.5m) at 1:50,000 scales procured from Forest Survey of India (FSI), Dehradun in digital format were used for forest cover assessment. Most of the satellite data used in this assessment pertains to the period between October 2015 to December 2015 of the study area. Data from post monsoon period is favoured as it is cloud free in the most part of the country.

The forest area is represented with major two forest type groups *viz.*, Tropical Dry Deciduous /Tropical Moist Deciduous as per Champion & Seth classification (1968) and comprising of five forest types as follows:

(1) 3C/C2e (ii) Moist Peninsular Low-Level Sal Forest;

(2) 3B/C2 Southern Moist Mixed Deciduous Forest;

(3) 5B/C1c Dry Peninsular Sal Forest;

(4) 5/E9 Dry Bamboo Brakes and

(5) 5B/C2 Northern Dry Mixed Deciduous Forest.

The forests cover class and the extent of area in HAC is given in Table 4.3 and shown in Figure 4.1.

Table 4.3: Forest cover estimated in the Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

S. No.	Forest Cover Class	Area (Sq.km)
1	Water body	12.69
2	Scrub	33.52
3	Very Dense Forest	126.72
4	Open Forest	197.57
5	Non-Forest	351.05
6	Moderate Dense Forest	1158.04
	Total	**1879.58**
Source: Estimated using 2015 digital format (FSI, 2017)		

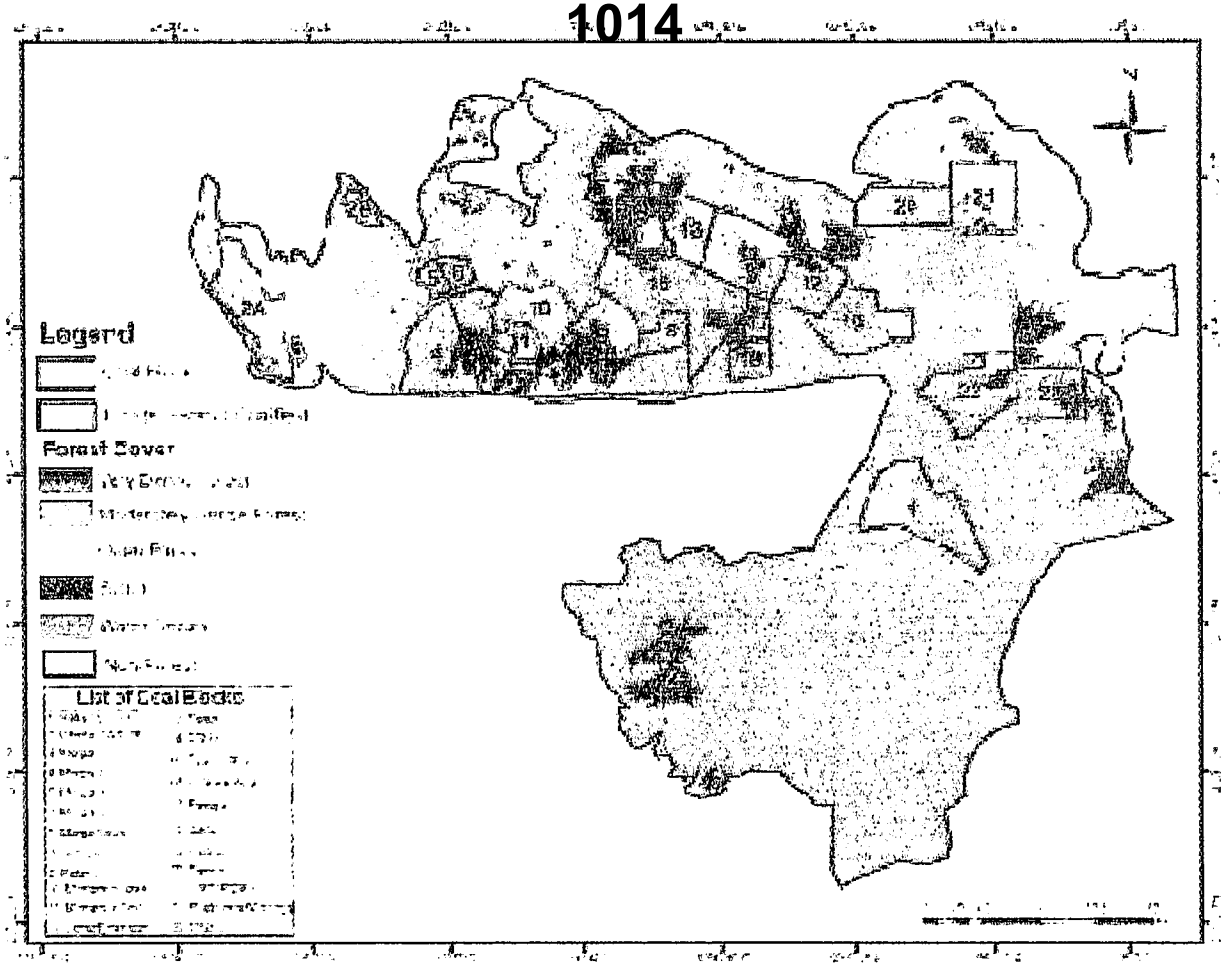


Figure 4.1: Map showing the Forest cover in the study area of Hasdeo-Arand Coalfield within Korba, Surguja and Surajpur districts of Chhattisgarh

4.3.2.1 Extent of forest cover area in 23 coal blocks

The extent of forest cover area in the individual coal block (Table 4.4 - 4.5) was worked out by using GIS and is presented below:

Parsa coal block (13)

Parsa coal block falls within both Surguja and Surajpur districts, Chhattisgarh. It is allotted to M/s. Rajasthan Rajya Vidyut Utpadan Nigam Limited. The EC for the coal block is awaited. The coal block comprises of 4.80 sq.km moderately dense forest cover, 0.33 sq.km very dense forest, and 0.75 sq.km open forest. Out of the total coal block area, 6.94 sq.km *i.e.*, 52.94% falls in non-forest cover class (Figure 4.2a).

Parsa East and Kanta Basan (PEKB) coal block (14)

This coal block falls in Surguja district, Chhattisgarh and is allotted to M/s. Rajasthan Rajya Vidyut Utpadan Nigam Limited. It is one of the operating coal blocks in the HAC. The coal block comprises of 9.10 sq.km moderately dense forest; 2.55 sq.km very dense forest, and 3.77 sq.km open forest. Out of the total coal block area, 12.61 sq.km *i.e.*, 43.86% falls in non-forest cover class (Figure 4.2b).

Kente Extension coal block (12)

This coal block falls in Surguja district, Chhattisgarh and is allotted to M/s. Rajasthan Rajya Vidyut Utpadan Nigam Limited. However, it is not in operation. The coal block comprises of 11.91 sq.km moderately dense forest, 2.63 sq.km very dense forest and 2.10 sq.km open forest. Out of the total coal block area, 1.06 sq.km *i.e.*, 5.76% falls in non-forest cover class (Figure 4.2c).

Chotia coal block (02)

This coal block falls in Korba district, Chhattisgarh and is allotted to M/s. BALCO-(Vedanta group). It is in operation at present. The coal block comprises of 10.09 sq.km moderately dense forest, 0.70 sq.km very dense forest and 7.90 sq.km open forest. Out of the total coal block area, 12.24 sq.km *i.e.*, 39.09% falls in non-forest cover class (Figure 4.2d).

Tara coal block (15)

This coal block falls in Surajpur district, Chhattisgarh and is not allotted. The coal block comprises of 4.29 sq.km moderately dense forest, 16.85 sq.km very dense forest and 0.56 sq.km open forest. Out of the total coal block area, 4.48 sq.km *i.e.*, 16.78% falls in non-forest cover class (Figure 4.2e).

M̃danpur North coal block (10)

This coal block falls in Korba & Surajpur district, Chhattisgarh and is not allotted. The coal block comprises of 11.86 sq.km moderately dense forest, 0.38 sq.km very dense forest and 2.65 sq.km open forest. Out of the total coal block area, 3.52 sq.km *i.e.*, 18.72% falls in non-forest cover class (Figure 4.2f).

Madanpur South coal block (11)

This coal block falls in Korba district, Chhattisgarh and is not allotted. The coal block comprises of 4.29 sq.km moderately dense forest, 0.35 sq.km very dense forest and 0.81 sq.km open forest. Out of the total coal block area, 1.72 sq.km *i.e.*, 23.15% falls in non-forest cover class (Figure 4.2g).

Gidmuri coal block (08)

This coal block falls in Korba district, Chhattisgarh and is not allotted. The coal block comprises of 5.09 sq.km moderately dense forest and 0.79 sq.km open forest. Out of the total coal block area, 1.46 sq.km *i.e.*, 19.13% falls in non-forest cover class (Figure 4.2h).

Paturia coal block (09)

This coal block falls in Korba district, Chhattisgarh and is not allotted. The coal block comprises of 7.60 sq.km moderately dense forest, 7.68 sq.km very dense forest and 1.35 sq.km open forest. Out of the total coal block area, 3.95 sq.km *i.e.*, 18.86% falls in non-forest cover class (Figure 4.2i).

Morga –II coal block (04)

This coal block falls in Korba district, Chhattisgarh and is not allotted. The coal block comprises of 17.51 sq.km moderately dense forest, 3.81 sq.km very dense forest, and 1.52 sq.km open forest. Out of the total coal block area, 2.77 sq.km *i.e.*,10.51% falls in non-forest cover class (Figure 4.2j).

Morga-III coal block (05)

This coal block falls in Korba district, Chhattisgarh and is not allotted. The coal block comprises of 2.06 sq.km moderately dense forest and 0.67 sq.km open forest. Out of the total mine lease area, 1.08 sq.km *i.e.*, 26.87% falls in non-forest cover class (Figure 4.2k).

Morga –IV coal block (06)

This coal block falls in Korba district, Chhattisgarh and is not allotted. The coal block comprises of 2.98 sq.km moderately dense forest and 1.05 sq.km open forest. Out of

the total coal block area, 0.21 sq.km *i.e.*, 4.40% falls in non-forest cover class (Figure 4.2l).

Morga South coal block (07)

This coal block falls in Korba district, Chhattisgarh and is not allotted. The coal block comprises of 15.83 sq.km moderately dense forest, 11.21 sq.km very dense forest and 1.20 sq.km open forest. Out of the total coal block area, 5.12 sq.km *i.e.*, 15.04% falls in non-forest cover class (Figure 4.2m).

Saidu coal block (18)

This coal block falls in Korba & Surguja district, Chhattisgarh and is not allotted. The coal block comprises of 4.46 sq.km moderately dense forest, 1.74 sq.km very dense forest and 1.09 sq.km open forest. Out of the total coal block area, 0.48 sq.km *i.e.*, 5.90% falls in non-forest cover class (Figure 4.2n).

Puta-Parogia coal block (16)

This coal block falls in Surguja, Surajpur & Korba district, Chhattisgarh and is not allotted. The coal block comprises of 33.32 sq.km moderately dense forest, 3.68 sq.km very dense forest and 4.71 sq.km open forest. Out of the total coal block area, 5.14 sq.km *i.e.*, 10.70% falls in non-forest cover class (Figure 4.2o).

Parogia coal block (17)

This coal block falls in Surguja district, Chhattisgarh and is not allotted. The coal block comprises of 3.46 sq.km moderately dense forest, 2.81 sq.km very dense forest and 0.39 sq.km open forest. Out of the total coal block area, 0.41 sq.km *i.e.*, 5.73% falls in non-forest cover class (Figure 4.2p).

Morga-I coal block (03)

This coal block falls in Korba district, Chhattisgarh and is not allotted. The coal block comprises of 8.86 sq.km moderately dense forest, 8.56 sq.km very dense forest, and 1.44 sq.km open forest. Out of the total coal block area, 1.97 sq.km *i.e.*, 9.11% falls in non-forest cover class (Figure 4.2r).

Pindraki coal block (19)

This coal block falls in Surguja district, Chhattisgarh and is not allotted. The coal block comprises of 16.69 sq.km moderately dense forest and 2.92 sq.km open forest. Out of the total coal block area, 3.34 sq.km *i.e.*, 13.95% falls in non-forest cover class (Figure 4.2q).

Sa͡na coal block (20)

This coal block falls in Surguja district, Chhattisgarh and is not allotted. The coal block comprises of 7.15 sq.km moderately dense forest and 3.31 sq.km open forest. Out of the total coal block area, 7.58 sq.km *i.e.*, 41.76% falls in non-forest cover class (Figure 4.2s).

Laxmangarh coal block (21)

This coal block falls in Surguja district, Chhattisgarh and is not allotted. The coal block comprises of 3.39 sq.km moderately dense forest, 0.04 sq.km very dense forest, 3.44 sq.km open forest. Out of the total coal block area, 14.97 sq.km *i.e.*, 63.35% falls in non-forest cover class (Figure 4.2t).

Bhakurma-Matring coal block (22)

This coal block falls in Surguja district, Chhattisgarh and is not allotted. The coal block comprises of 15.21 sq.km moderately dense forest, 2.32 sq.km very dense forest and 1.54 sq.km open forest. Out of the total coal block area, 6.59 sq.km *i.e.*, 25.36% falls in non-forest cover class (Figure 4.2u).

Kedma coal block (23)

This coal block falls in Surguja district, Chhattisgarh and is not allotted. The coal block comprises of 11.92 sq.km moderately dense forest, 3.53 sq.km very dense forest, and 0.80 sq.km open forest. Out of the total coal block area, 2.64 sq.km *i.e.*, 13.95% falls in non-forest cover class (Figure 4.2v).

Nakiya coal block (01)

This coal block falls in Korba district, Chhattisgarh and is not allotted. The coal block comprises of 21.53 sq.km moderately dense forest cover and 8.70 sq.km open forest. Out of the total coal block area, 3.88 sq.km *i.e.*, 11.32% falls in non-forest cover class (Figure 4.2w).

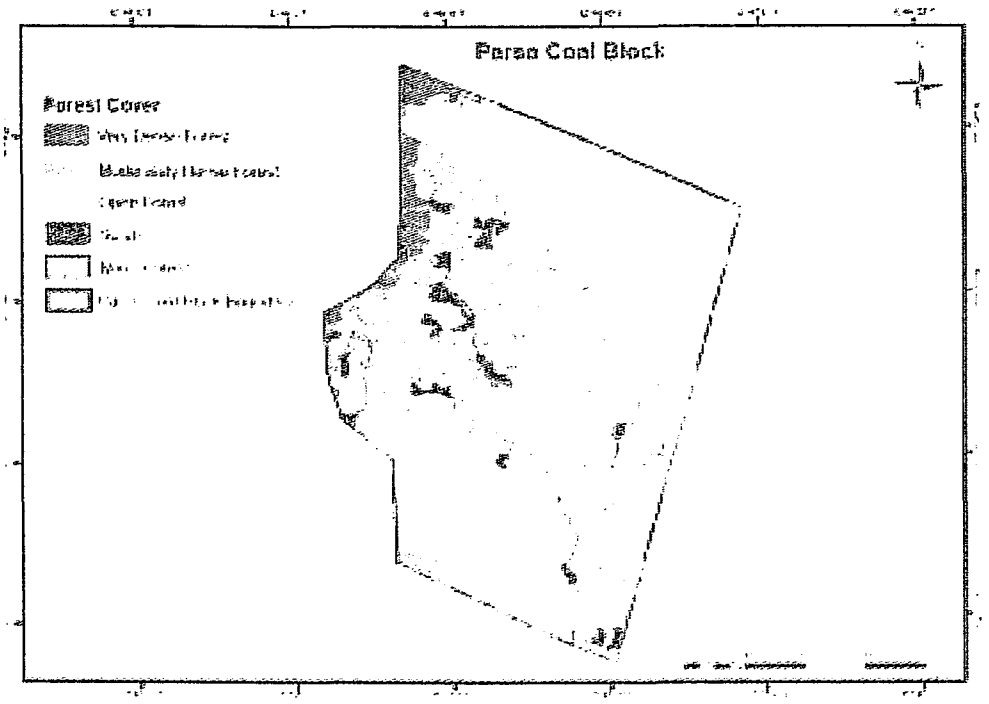


Figure 4.2a: Extent of forest cover in Parsa coal block in Hasdeo-Arand Coalfield within Surguja and Surajpur districts of Chhattisgarh

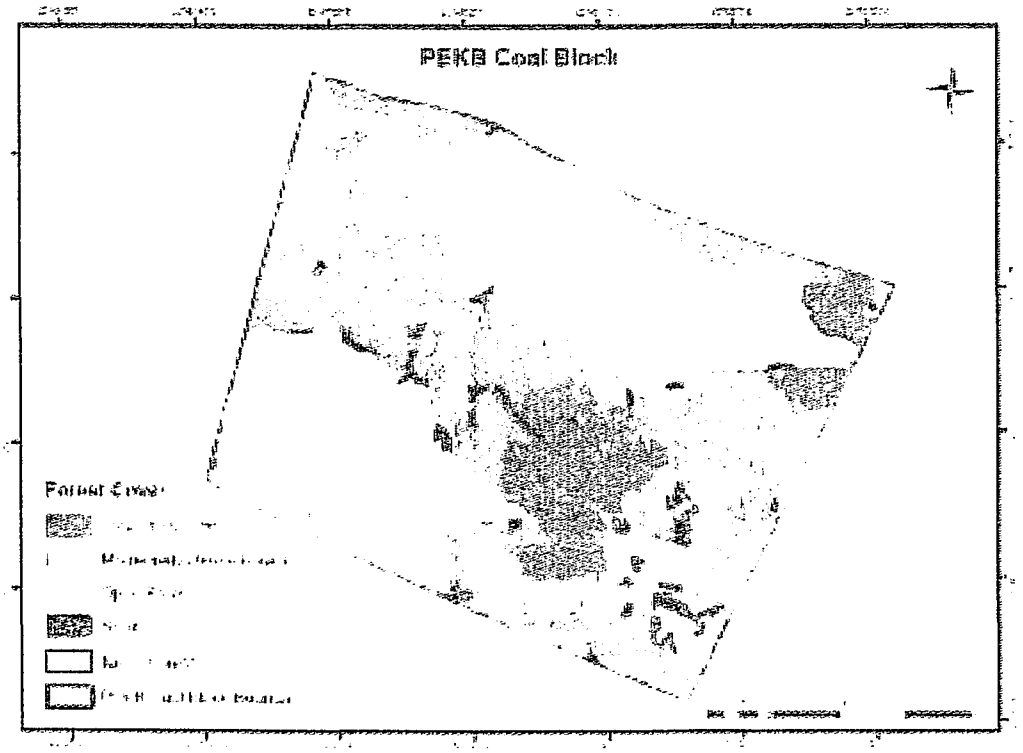


Figure 4.2b: Extent of forest cover in Parsa East and Kanta Basan (PEKB) coal block in Hasdeo-Arand Coalfield within Surguja district of Chhattisgarh

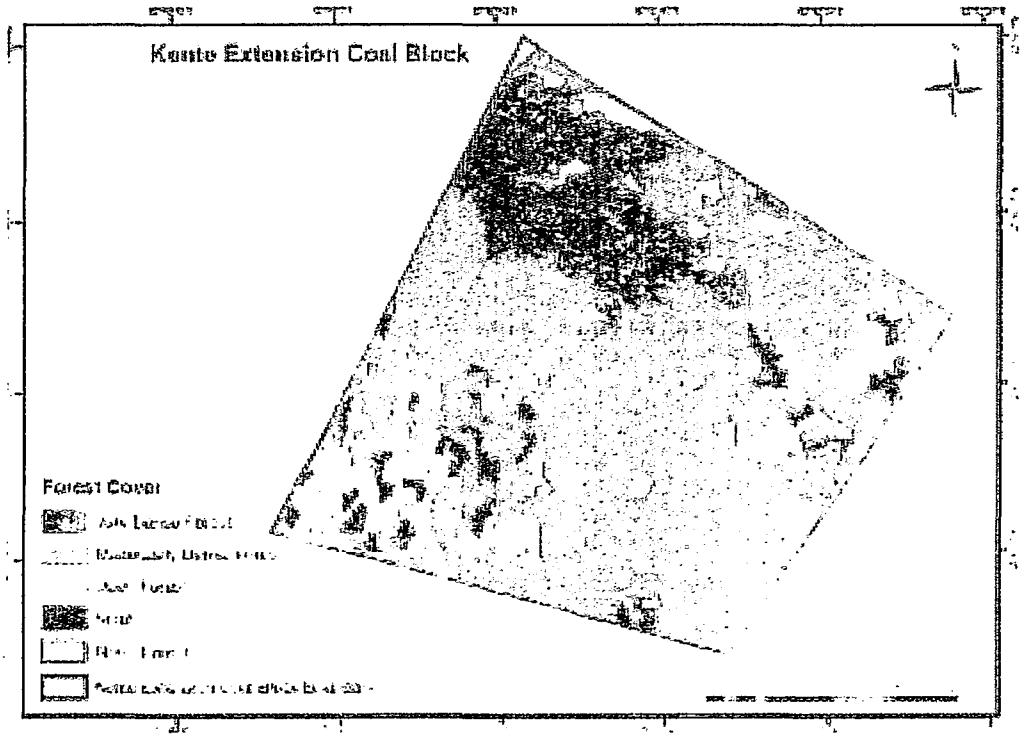


Figure 4.2c: Extent of forest cover in Kente Extension coal block in Hasdeo-Arand Coalfield within Surguja district of Chhattisgarh

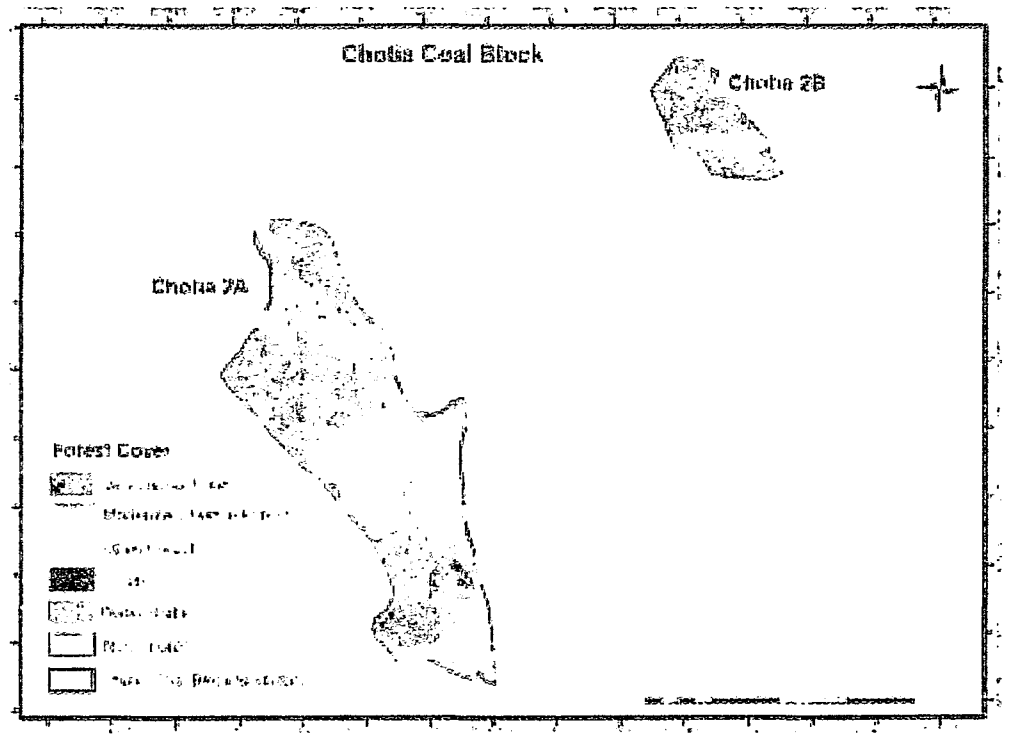


Figure 4.2d: Extent of forest cover in Chotia coal block in Hasdeo-Arand Coalfield within Korba, district of Chhattisgarh

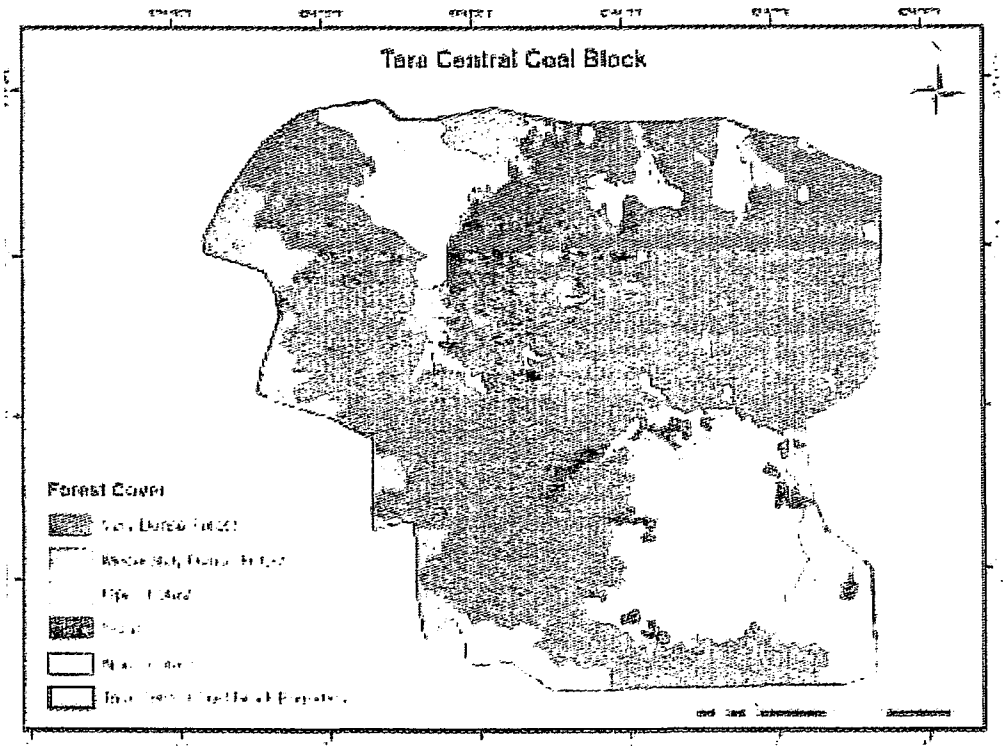


Figure 4.2e: Extent of forest cover in Tara coal block in Hasdeo-Arand Coalfield within Surajpur districts of Chhattisgarh

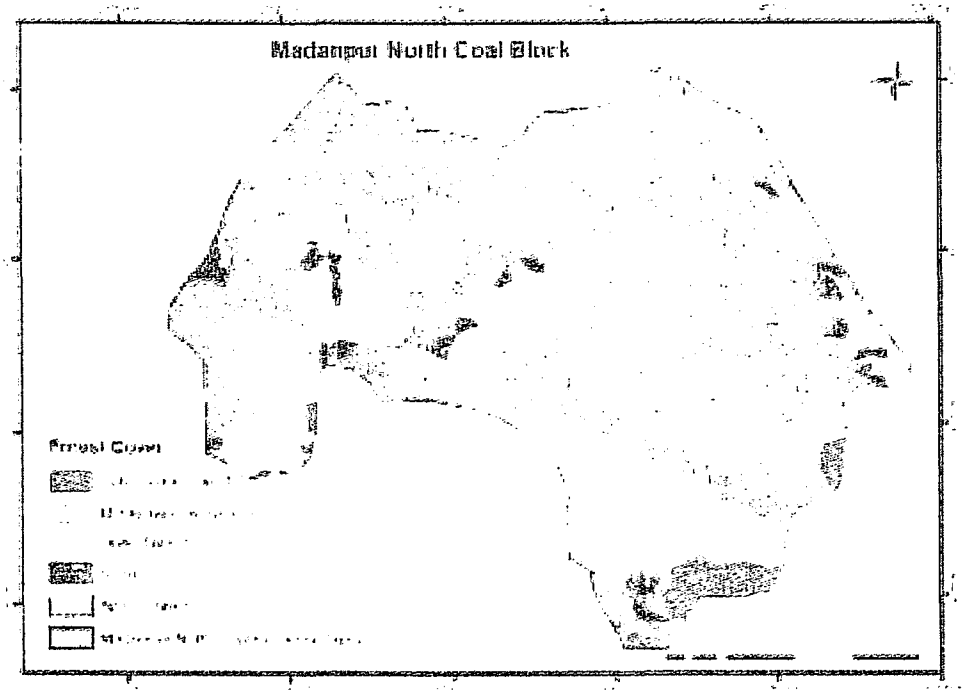


Figure 4.2f: Extent of forest cover in Madanpur North coal block in Hasdeo-Arand Coalfield within Korba and Surguja districts of Chhattisgarh

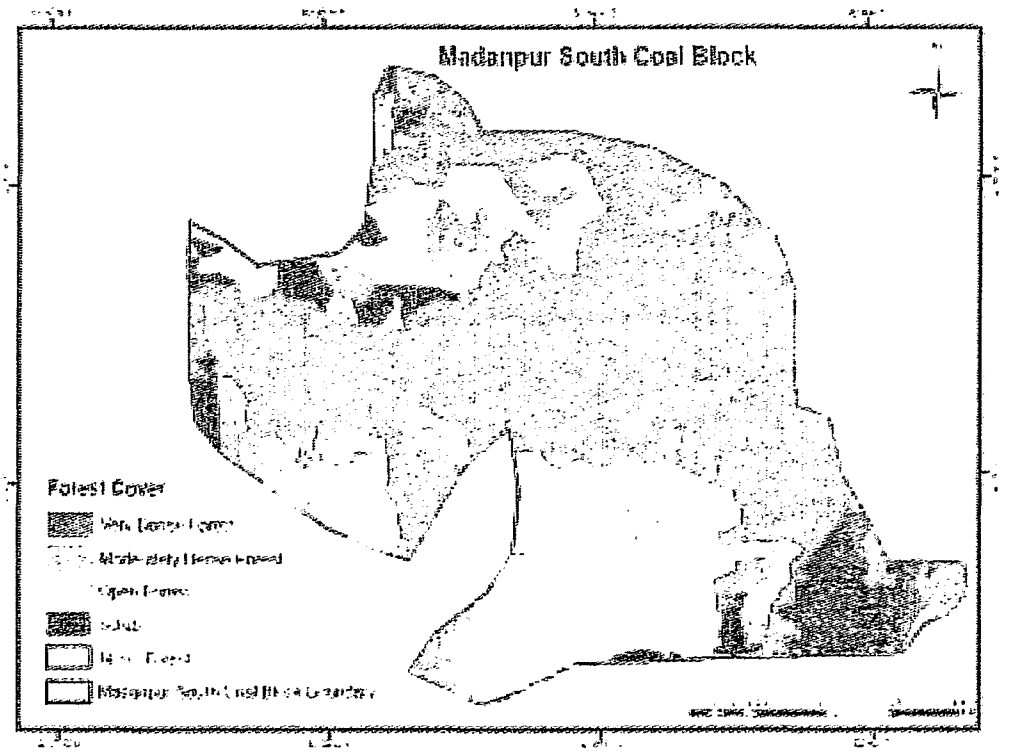


Figure 4.2g: Extent of forest cover in Madanpur South coal block in Hasdeo-Arand Coalfield within Korba district of Chhattisgarh

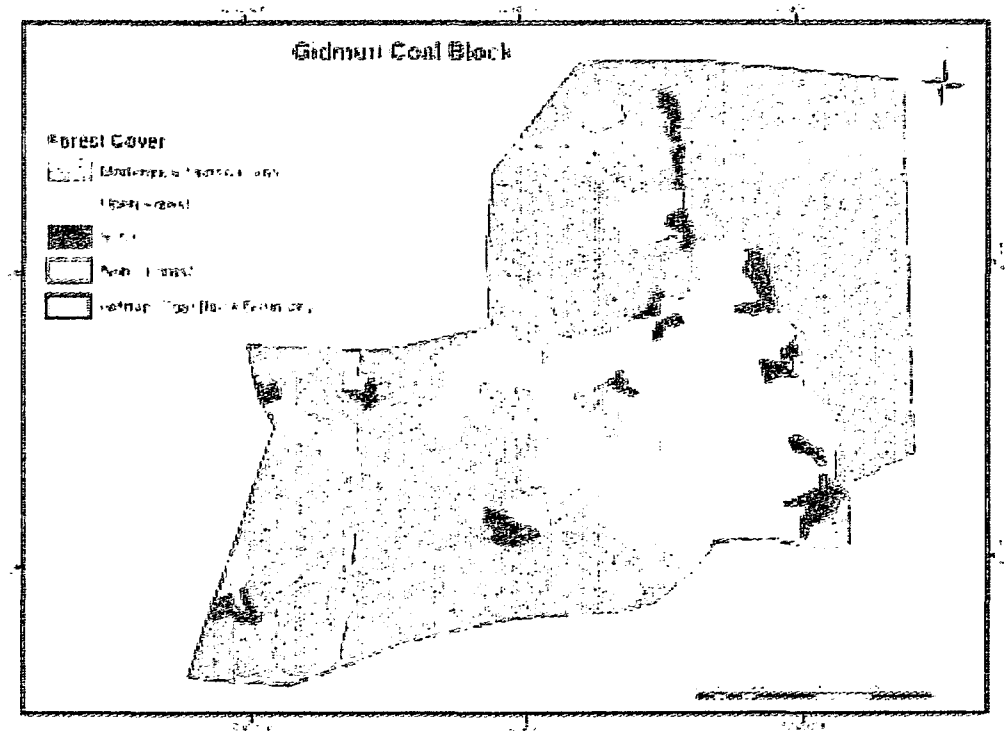


Figure 4.2h: Extent of forest cover in Gidmuri coal block in Hasdeo-Arand Coalfield within Korba district of Chhattisgarh

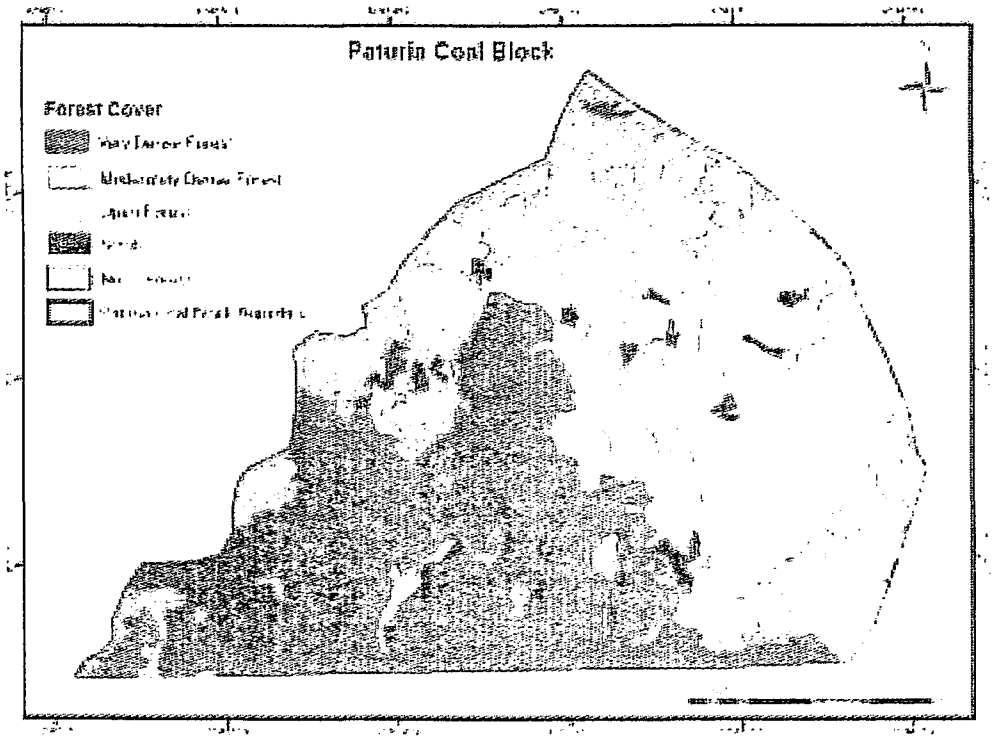


Figure 4.2i: Extent of forest cover in Paturia coal block in Hasdeo-Arand Coalfield within Korba district of Chhattisgarh

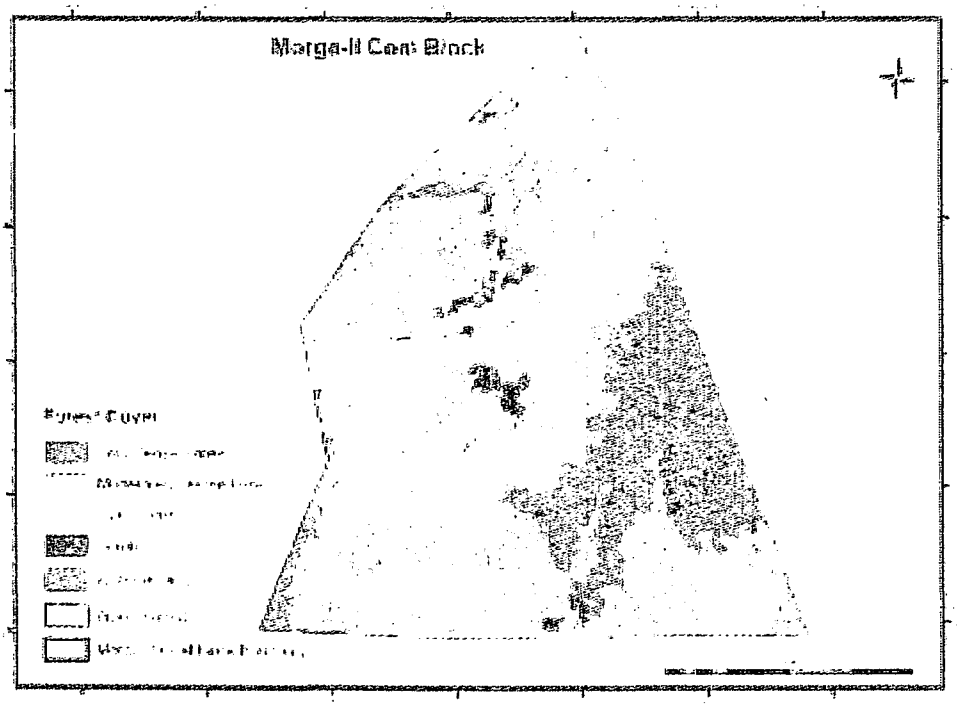


Figure 4.2j: Extent of forest cover in Morga –II coal block in Hasdeo-Arand Coalfield within Korba district of Chhattisgarh

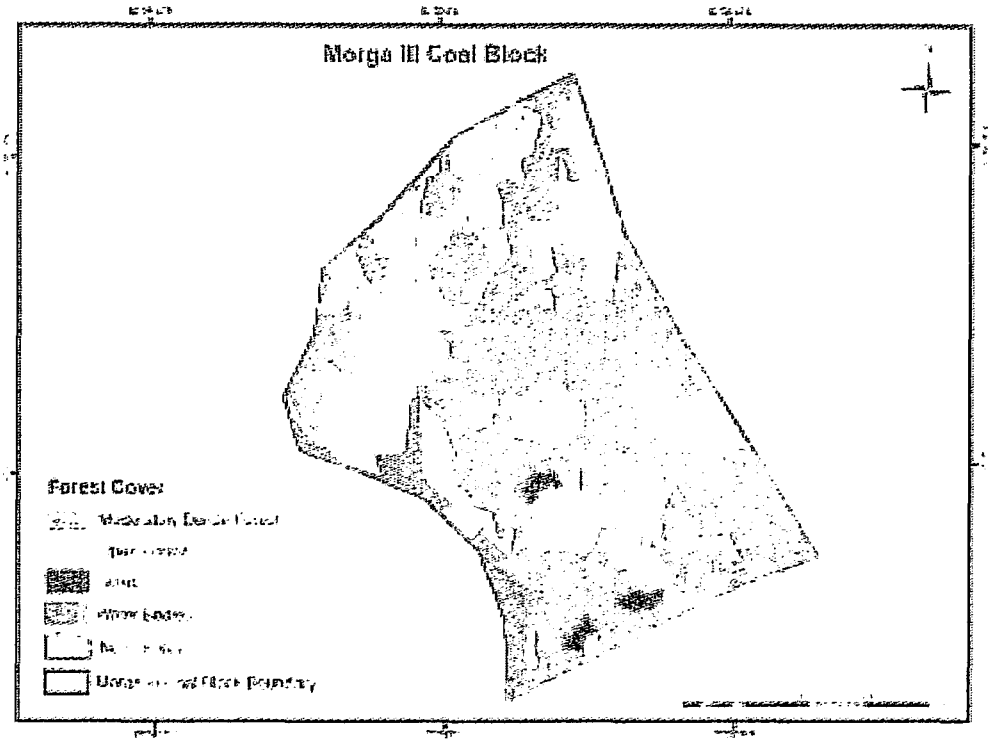


Figure 4.2k: Extent of forest cover in Morga –III coal block in Hasdeo-Arand Coalfield within Korba district of Chhattisgarh

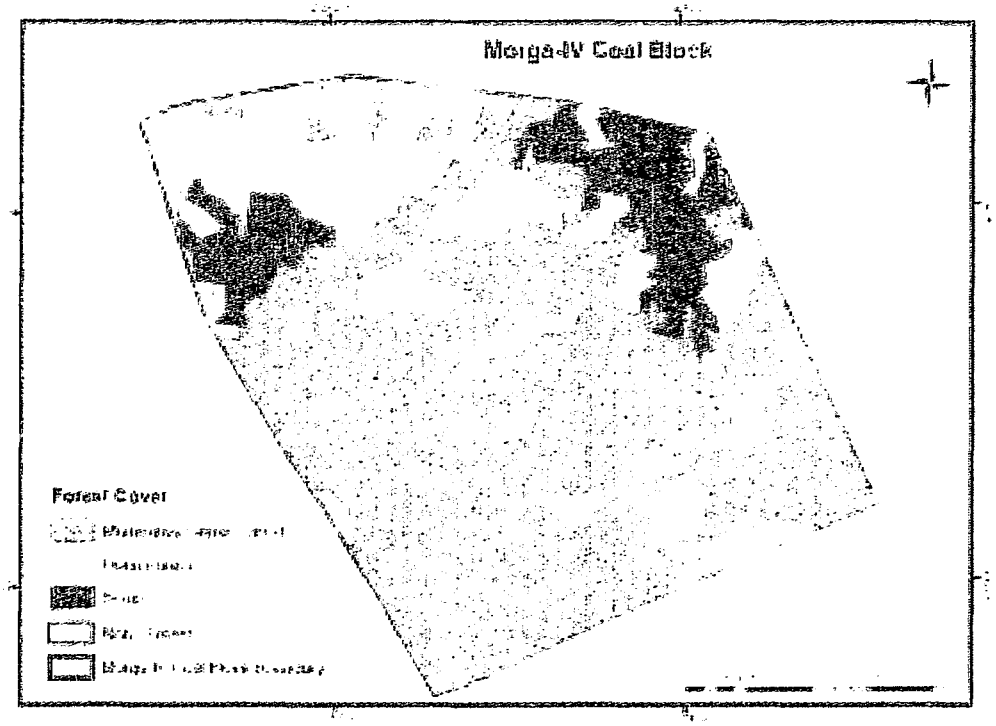


Figure 4.2l: Extent of forest cover in Morga –IV coal block in Hasdeo-Arand Coalfield within Korba district of Chhattisgarh

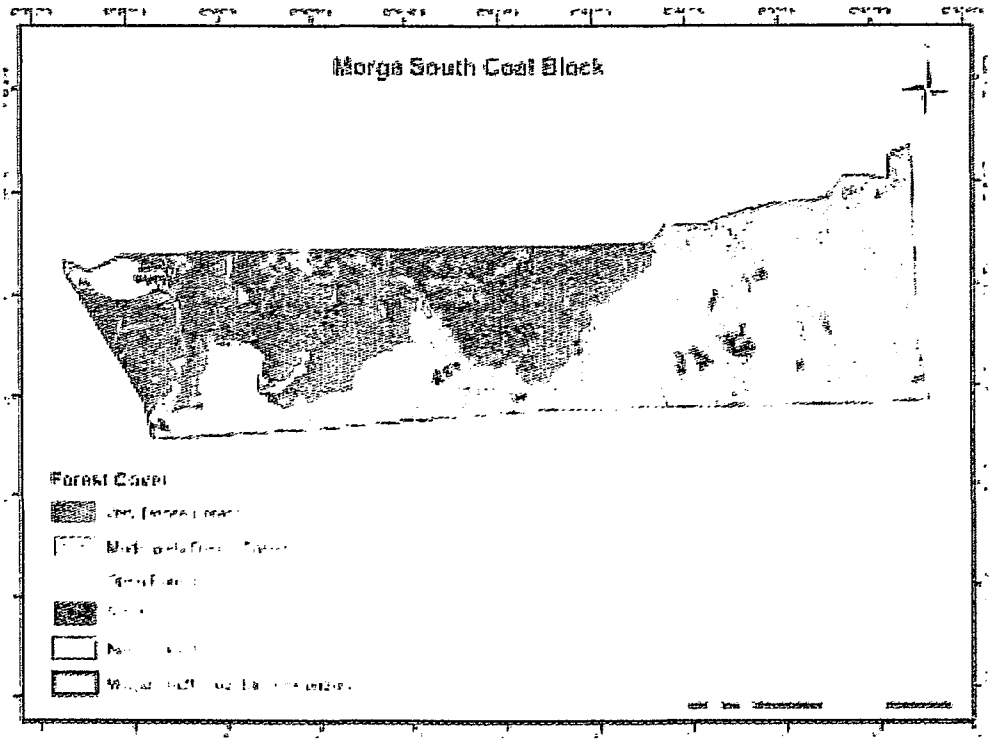


Figure 4.2m: Extent of forest cover in Morga South coal block in Hasdeo-Arand Coalfield within Korba district of Chhattisgarh

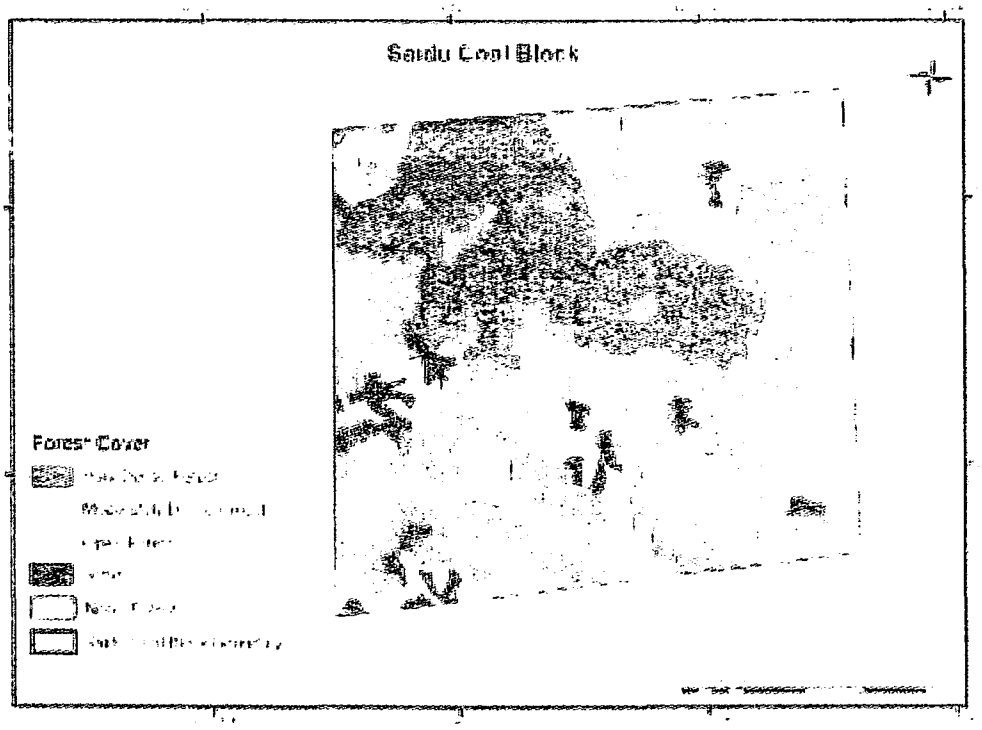


Figure 4.2n: Extent of forest cover in Saidu coal block in Hasdeo-Arand Coalfield within Korba and Surguja districts of Chhattisgarh

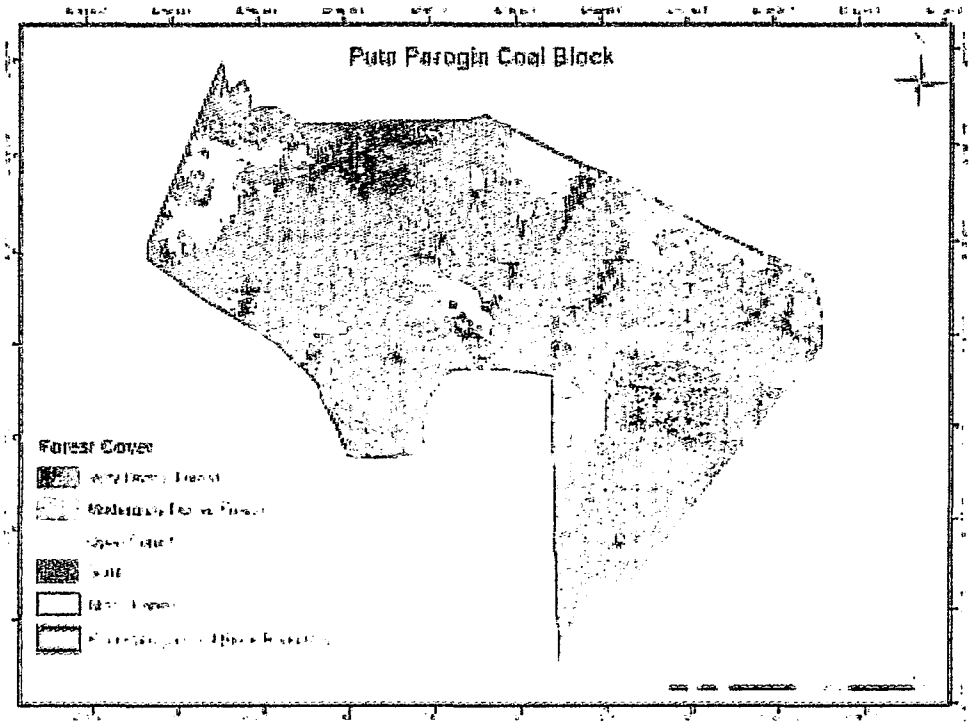


Figure 4.2o: Extent of forest cover in Puta-Parogia coal block in Hasdeo-Arand Coalfield within Korba, Surguja and Surajpur districts of Chhattisgarh

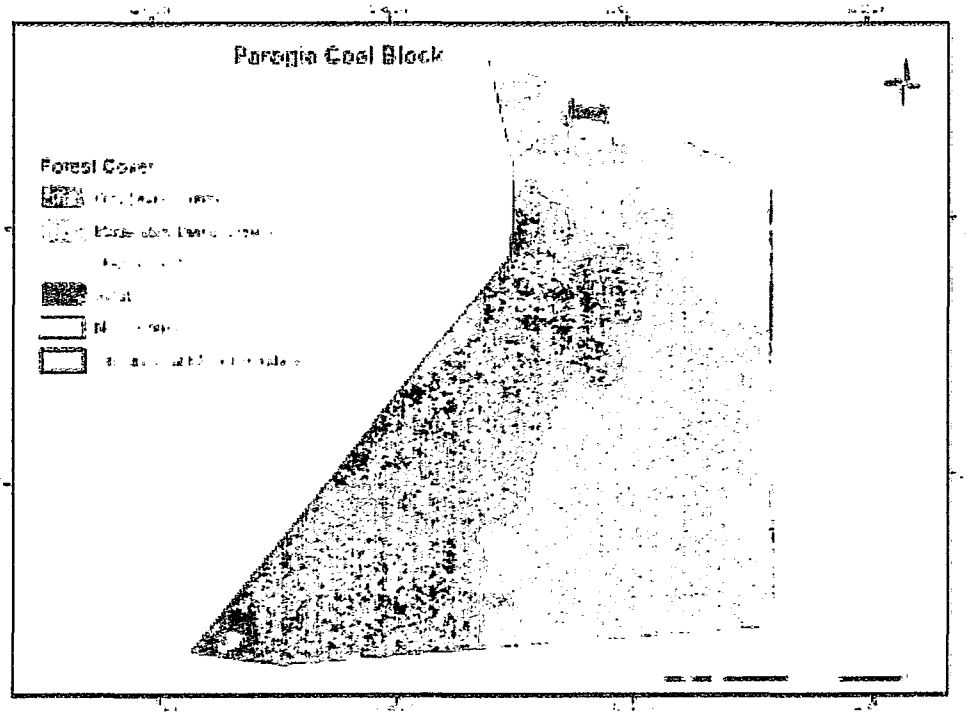


Figure 4.2p: Extent of forest cover in Parogia coal block in Hasdeo-Arand Coalfield within Surguja district of Chhattisgarh

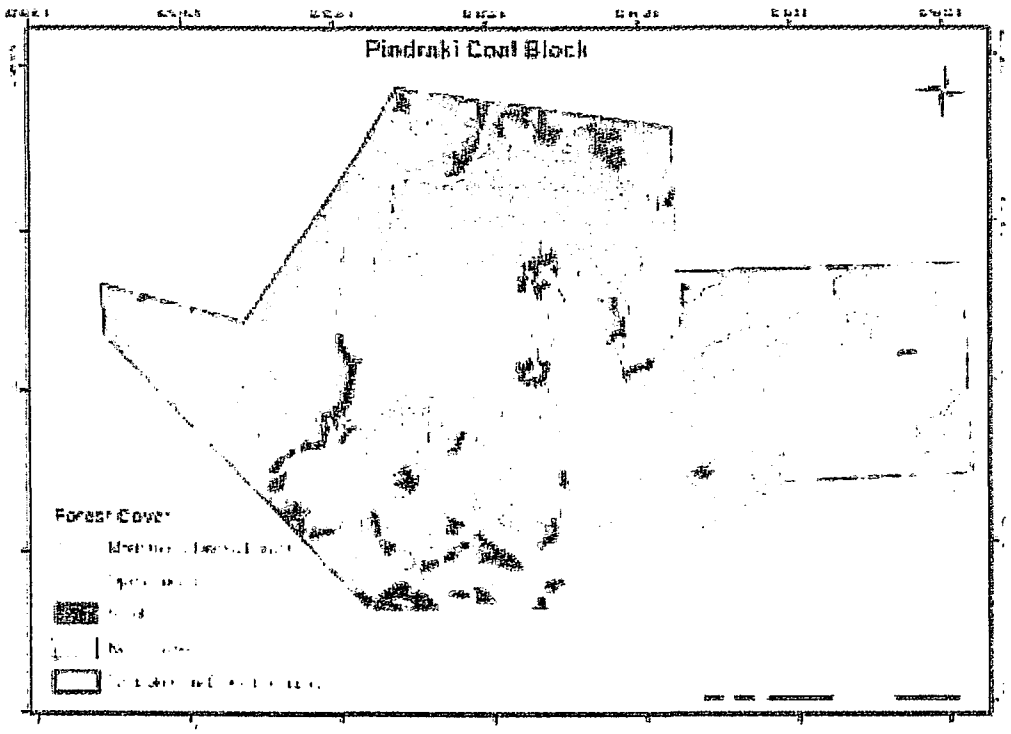


Figure 4.2q: Extent of forest cover in Pindraki coal block in Hasdeo-Arand Coalfield within Surguja district of Chhattisgarh

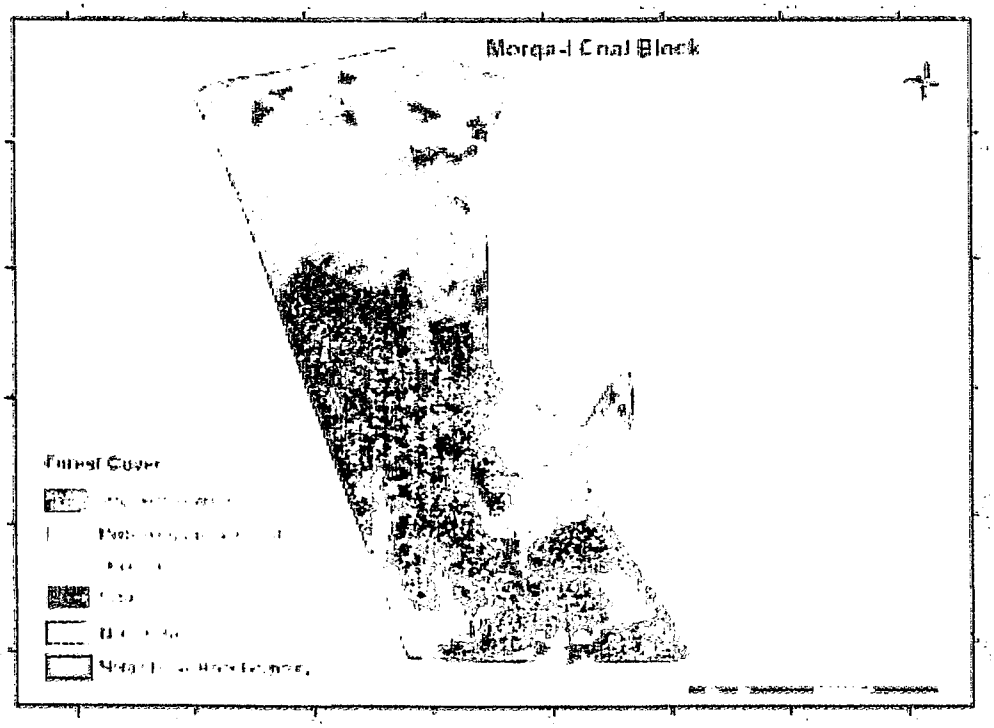


Figure 4.2r: Extent of forest cover in Morga-I coal block in Hasdeo-Arand Coalfield within Korba district of Chhattisgarh

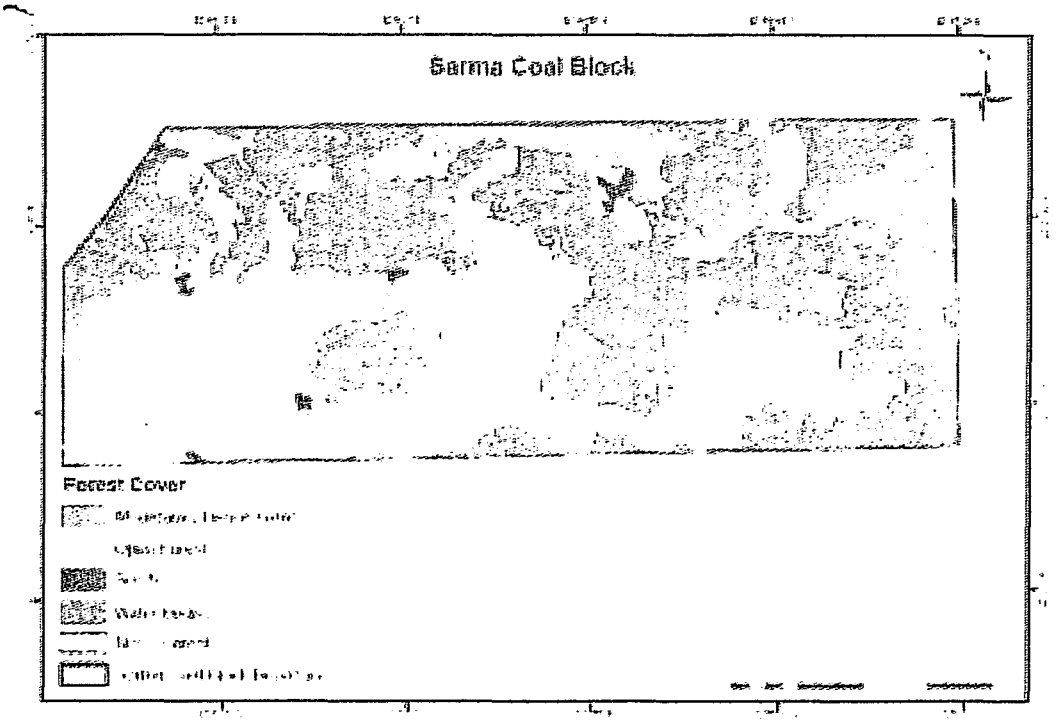


Figure 4.2s: Extent of forest cover in Sarma coal block in Hasdeo-Arand Coalfield within Surguja district of Chhattisgarh

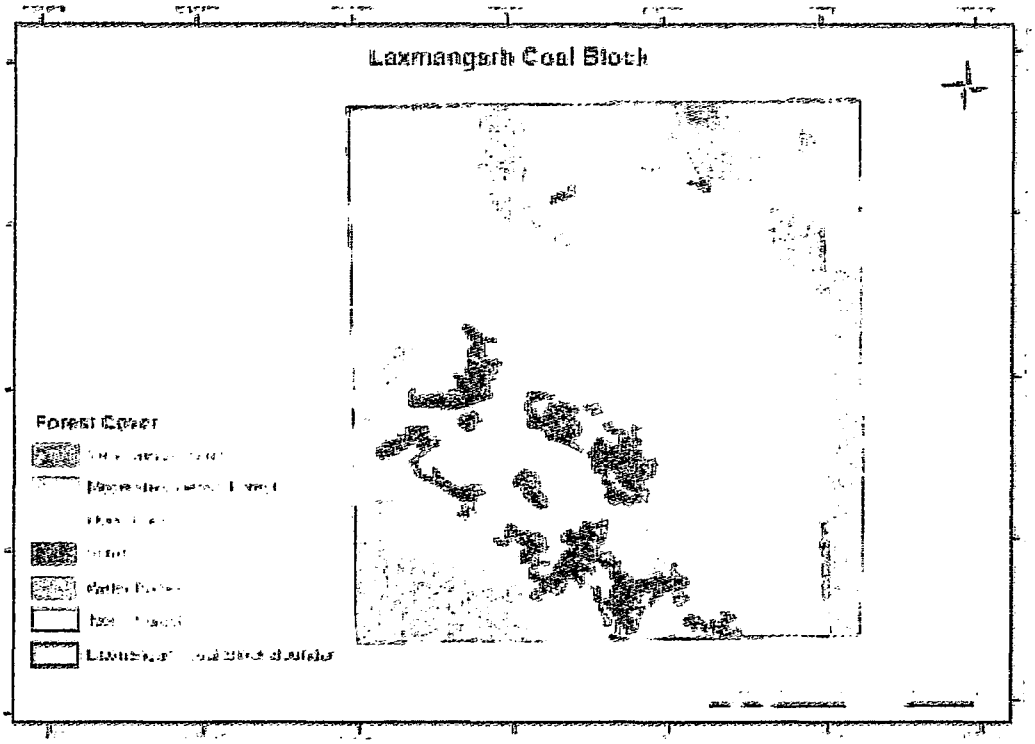


Figure 4.2t: Extent of forest cover in Laxmangarh coal block in Hasdeo-Arand Coalfield within Surguja district of Chhattisgarh

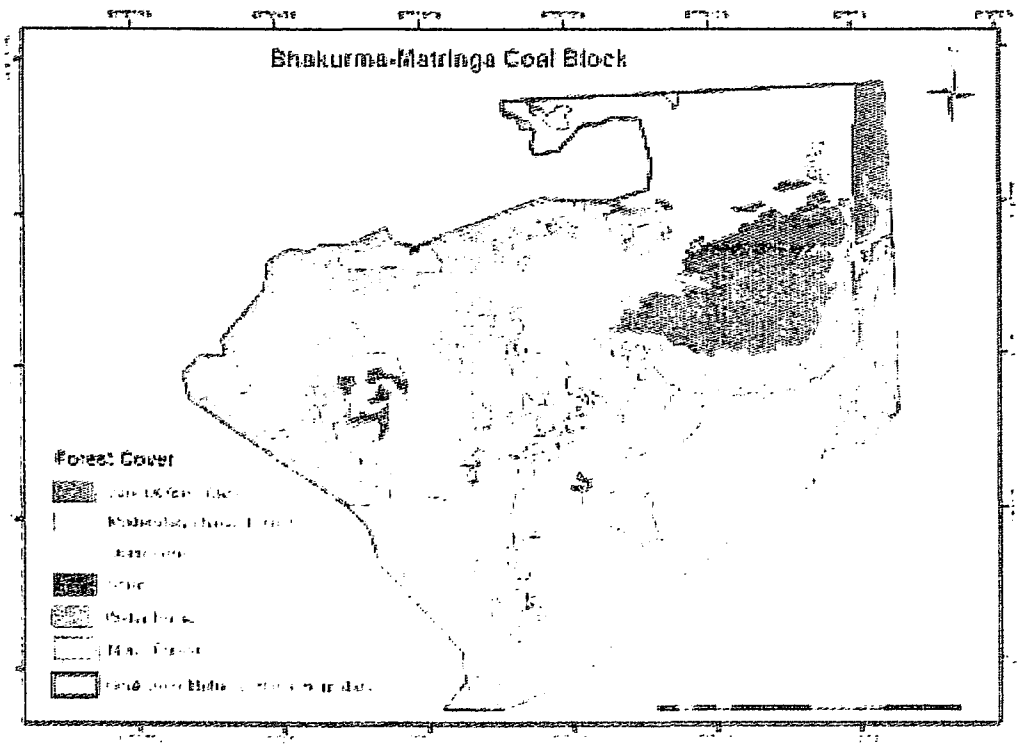


Figure 4.2u: Extent of forest cover in Bhakurma-Matringa coal block in Hasdeo-Arand Coalfield within Surguja district of Chhattisgarh

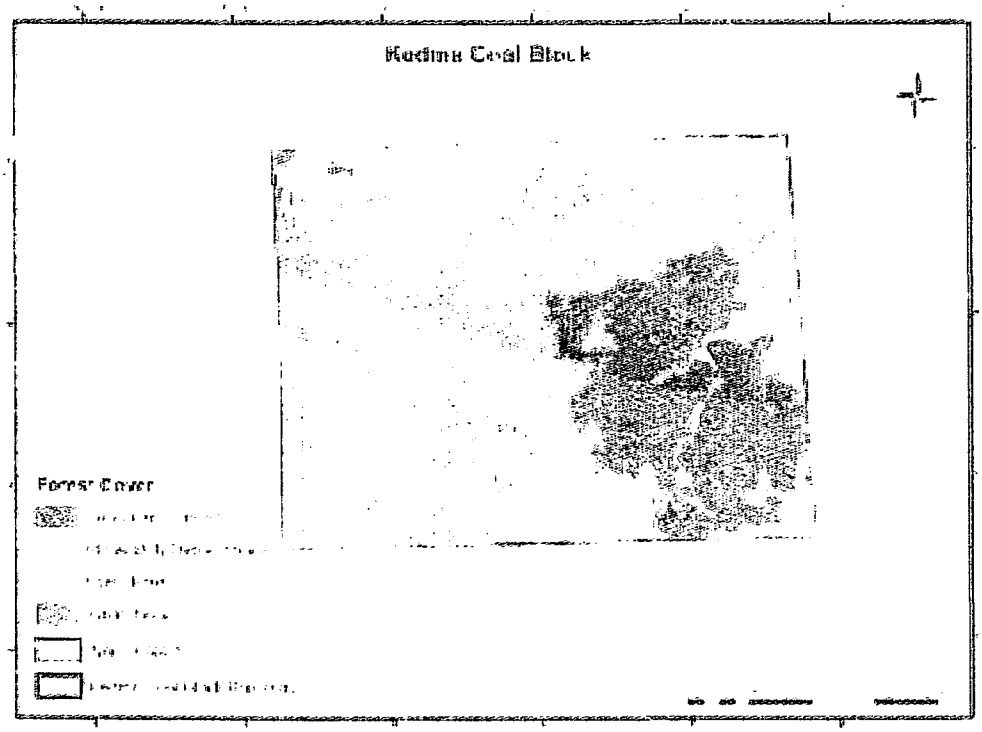


Figure 4.2v: Extent of forest cover in Kedma coal block in Hasdeo-Arand Coalfield within Surguja district of Chhattisgarh

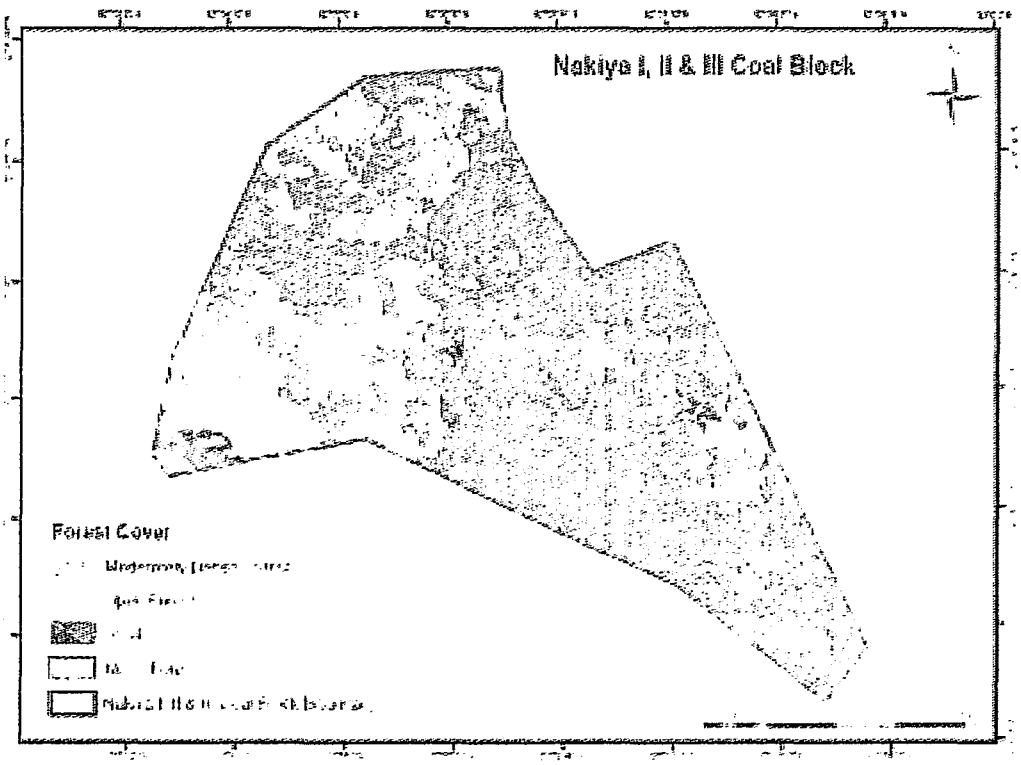


Figure 4.2w: Extent of forest cover in Nakiya coal block in Hasdeo-Arand Coalfield within Korba district of Chhattisgarh

Table 4.4: Comparative account of the extent of forest cover in 23 coal blocks that fall within entire Hasdeo-Arand Coalfield within Korba, Surguja and Surajpur districts of Chhattisgarh

Forest Cover Class	Entire HAC Area (Sq.km)	23 coal blocks Area in Sq.km (% of the HAC area)
Water body	12.69	0.66 (5.20%)
Scrub	33.52	11.21 (33.44%)
Very Dense Forest	126.72	69.18 (54.59%)
Open Forest	197.57	52.65 (26.65%)
Non-Forest	351.05	104.16 (29.67%)
Moderate Dense Forest	1158.04	233.40(20.15%)
Total	**1879.58**	**472.13 (25.12%)**
Source: Estimated using 2015 digital format (FSI, 2017)		

The extents of forest cover class were estimated in the entire Hasdeo- Arand Coalfield and 23 coal blocks (Table 4.4 and 4.5). The total forest cover class within HAC is estimated to be 1879.58 with major area under moderately dense forest (1158.04 sq.km) followed by non-forest (351.05 sq.km); open forest (197.57 sq.km) and Very dense forest (126.72 sq.km). The major forest cover class in the 23 coal blocks were estimated to be moderate dense forest (233.40 sq.km) followed by non-forest (104.16 sq.km); very dense forest (69.18 sq.km) and open forest (52.65 sq.km).

Table 4.5: Total Forest cover estimated in the study area of Hasdeo-Arand Coalfield within Korba, Surguja and Surajpur districts of Chhattisgarh

Coal Block (Area in sq.km& percentage)	Class Name	Water	Non-Forest	Scrub	Open Forest	Moderately Dense Forest	Very Dense Forest	Grand Total
Nakiya I, II & III		0.00 (0.00%)	3.88 (11.32%)	0.19 (0.55%)	8.7 (25.37%)	21.53 (62.79%)	0.00 (0.00%)	34.29
Chotia		0.02 (0.06%)	12.24 (39.09%)	0.36 (1.15%)	7.90 (25.23%)	10.09 (32.23%)	0.7 (2.24%)	31.31
Morga I		0.00 (0.00%)	1.97 (9.11%)	0.79 (3.65%)	1.44 (6.66%)	8.86 (40.98%)	8.56 (39.59%)	21.62
Morga II		0.34 (1.29%)	2.77 (10.51%)	0.42 (1.59%)	1.52 (5.77%)	17.51 (66.43%)	3.81 (14.45%)	26.36
Morga III		0.17 (4.23%)	1.08 (26.87%)	0.04 (1.00%)	0.67 (16.67%)	2.06 (51.24%)	0.00 (0.00%)	4.02
Morga IV		0.00 (0.00%)	0.21 (4.40%)	0.52 (10.90%)	1.05 (22.01%)	2.98 (62.47%)	0.00 (0.00%)	4.77
Morga South		0.00 (0.00%)	5.12 (15.04%)	0.67 (1.97%)	1.2 (3.53%)	15.83 (46.50%)	11.22 (32.96%)	34.04
Gidmuri		0.00 (0.00%)	1.46 (19.13%)	0.28 (3.67%)	0.79 (10.35%)	5.09 (66.71%)	0 (0.00%)	7.63
Paturia		0.00 (0.00%)	3.95 (18.86%)	0.35 (1.67%)	1.35 (6.45%)	7.6 (36.29%)	7.68 (36.68%)	20.94
Madanpur North		0 00 (0.00%)	3.52 (18.72%)	0 39 (2.07%)	2 65 (14.10%)	11.86 (63.09%)	0 38 (2.02%)	18.8
Madanpur South		0.00 (0.00%)	1.72 (23.15%)	0.26 (3.50%)	0.81 (10.90%)	4.29 (57.74%)	0.35 (4.71%)	7.43
Kente Extension		0.00 (0.00%)	1.06 (5.76%)	0.7 (3.80%)	2.10 (11.41%)	11.91 (64.73%)	2.63 (14.29%)	18.4
Parsa		0.00 (0.00%)	6.94 (52.94%)	0.29 (2.21%)	0.75 (5.72%)	4.8 (36.61%)	0.33 (2.52%)	13.11
PEKB		0.00 (0.00%)	12.61 (43.86%)	0.71 (2.47%)	3.77 (13.11%)	9.1 (31.65%)	2.55 (8.87%)	28.75
Tara Central		0.00 (0.00%)	4.48 (16.78%)	0.51 (1.91%)	0.56 (2.10%)	4.29 (16.07%)	16.85 (63.11%)	26.7
Puta-Parogia		0.00 (0.00%)	5.14 (10.70%)	1.19 (2.48%)	4.71 (9.80%)	33.32 (69.36%)	3.68 (7.66%)	48.04
Parogia		0.00 (0.00%)	0.41 (5.73%)	0.09 (1.26%)	0.39 (5.45%)	3.46 (48.39%)	2.81 (39.30%)	7.15
Saidu		0.00 (0.00%)	0.48 (5.90%)	0.32 (3.94%)	1.09 (13.41%)	4.46 (54.86%)	1.74 (21.40%)	8.13
Pindraki		0.00 (0.00%)	3.34 (13.95%)	0.99 (4.14%)	2.92 (12.20%)	16.69 (69.72%)	0.00 (0.00%)	23.94
Sarma		0.02 (0.11%)	7.58 (41.76%)	0.09 (0.50%)	3.31 (18.24%)	7.15 (39.39%)	0.00 (0.00%)	18.15
Laxman garh		0.03 (0.13%)	14.97 (63.35%)	1.76 (7.45%)	3.44 (14.56%)	3.39 (14.35%)	0.04 (0.17%)	23.63
Bhakurma-Matringa		0.04 (0.15%)	6.59 (25.36%)	0.29 (1.12%)	1.54 (5.93%)	15.21 (58.52%)	2.32 (8.93%)	25.99
Kedma		0.04 (0.21%)	2.64 (13.95%)	0.00 (0.00%)	0.8 (4.23%)	11.92 (62.97%)	3.53 (18.65%)	18.93
Total		0.66	104.16	11.21	52.65	233.4	69.18	472.13

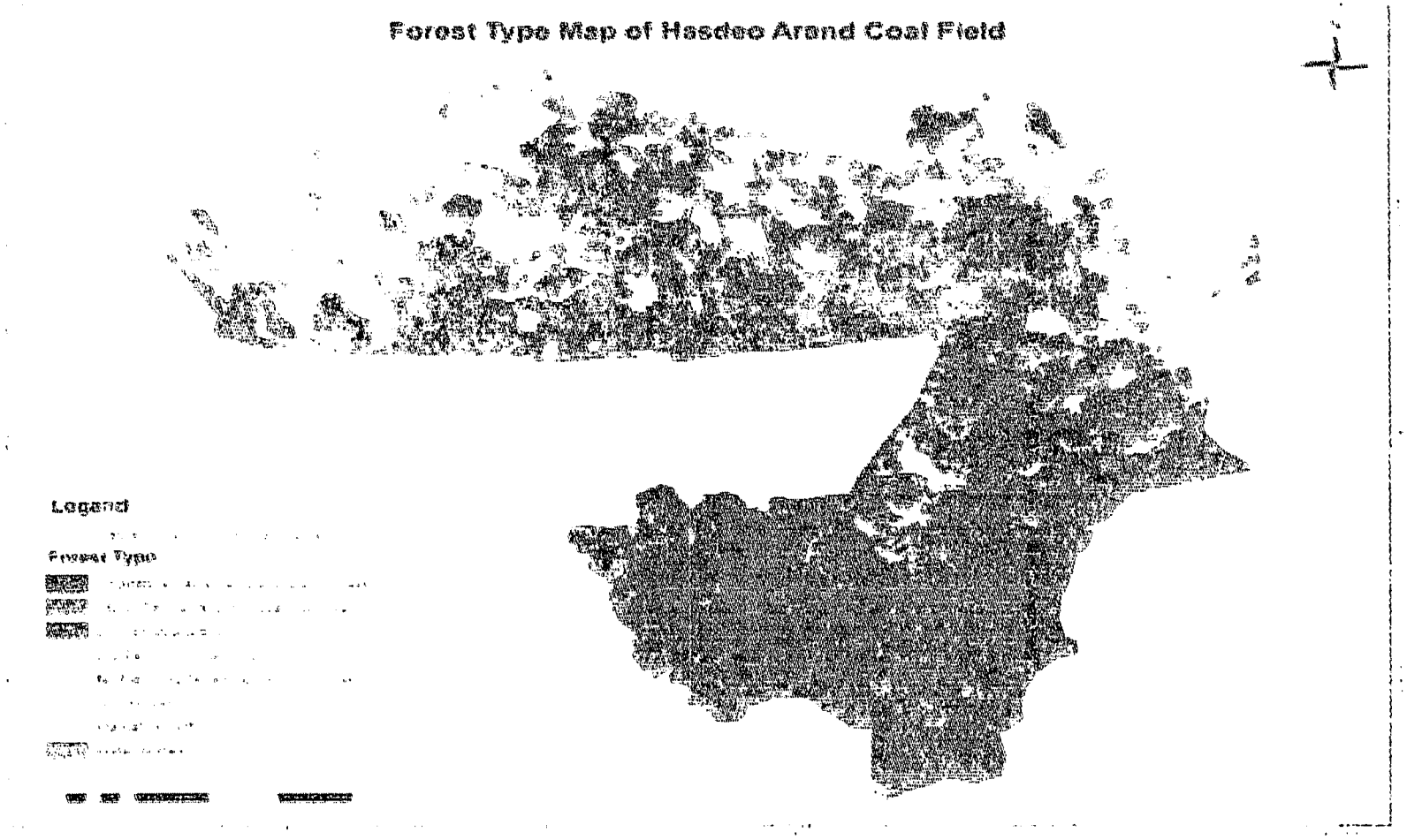


Figure 4.3: Extent of forest types in the study area of Hasdeo-Arand Coalfield within Korba, Surguja and Surajpur districts of Chhattisgarh

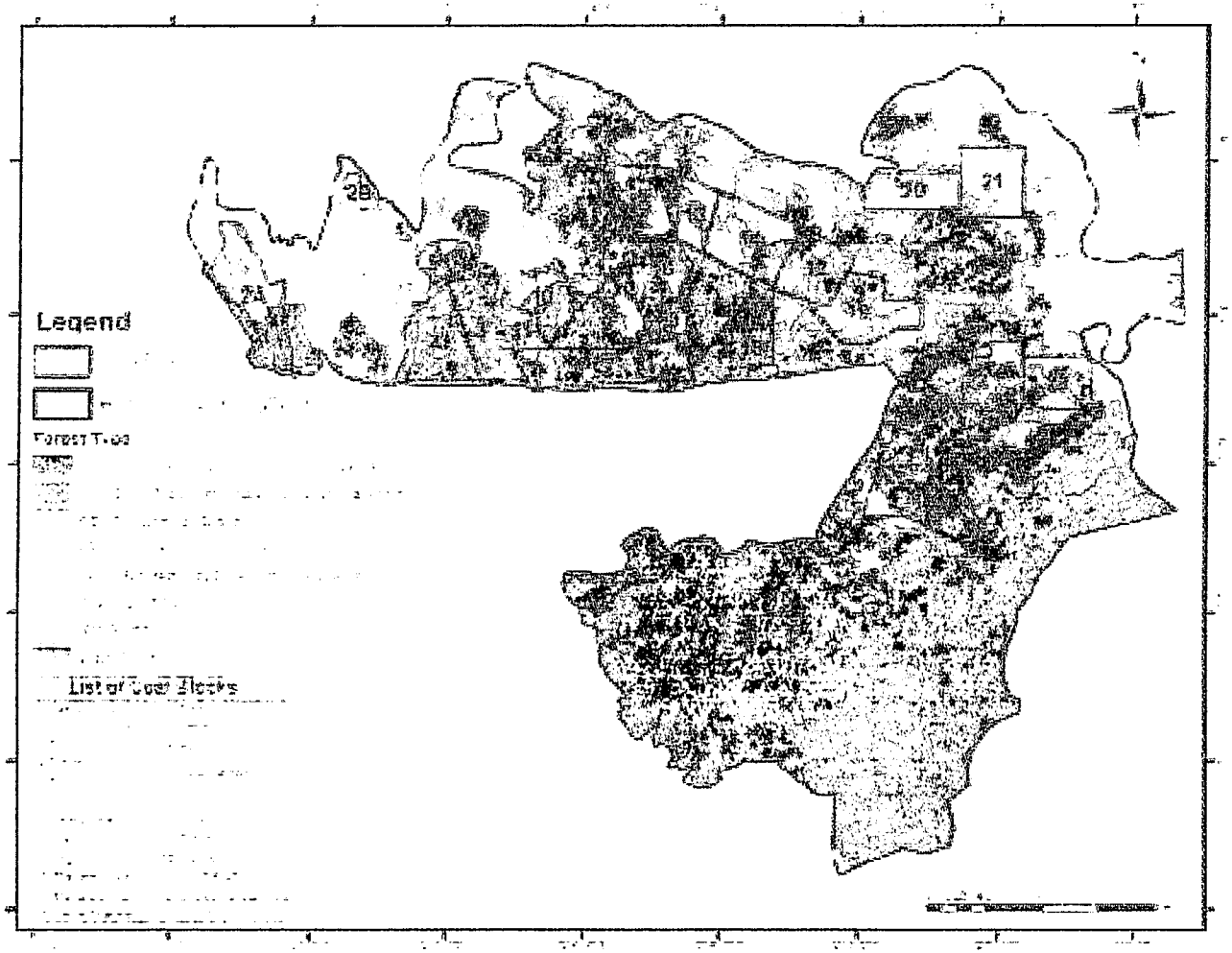


Figure 4.4: Forest types and the coal blocks within the study area of Hasdeo-Arand Coalfield within Korba, Surguja and Surajpur districts of Chhattisgarh

4.3.2.6 Extent of forest type

Hasdeo-Arand Coalfield Area

The forest types of HAC is divisible into eight classes (Table 4.6). The total area of Hasdeo-Arand Coalfield comprises of 1879.57 sq.km having forest area of 1400.95 sq.km; non-forest area 464.23 sq.km; water bodies 14.35 sq.km and plantation/ Tree outside forest 0.03 sq.km (Table 4.6, Figure 4.3 - 4.4).

Table 4.6: Forest types and extent of the area in Hasdeo-Arand Coalfield within Korba, Surguja and Surajpur districts of Chhattisgarh

S.No	Forest Type in Hasdeo-Arand Coalfield	Area (sq.km)
1	3C/C2e (ii) Moist Peninsular Low-Level Sal Forest	835.61
2	3B/C2 Southern Moist Mixed Deciduous Forest	314.53
3	5B/C1c Dry Peninsular Sal Forest	70.22
4	5/E9 Dry Bamboo Brakes	133.98
5	5B/C2 Northern Dry Mixed Deciduous Forest	46.61
	Total	**1400.95**
6	Non-Forest	464.23
	Total	**1865.19**
7	Plantation/ TOF	0.03
8	Water	14.35
	Total	**1879.57**
Source: Estimated using 2015 digital format (FSI, 2017)		

The extent of forest types and area in the individual coal block (Table 4.7) were worked out by using GIS and are presented below:

Parsa East & Kanta Basan (PEKB) coal block (14)

This coal block is in operation, allotted to M/s. Rajasthan Rajya Vidyut Utpadan Nigam Limited and that falls in Surguja district, Chhattisgarh. The coal block comprises of two forest types such as 3C/2e (ii) Moist Peninsular Low-Level Sal Forests and 3B/C2 Southern Moist Mixed Deciduous Forest covering an area of 15.27 sq.km; and a non-forest area of 13.47 sq.km (Figure 4.5a).

Parsa coal block (13)

The coal block is allotted to M/s. Rajasthan Rajya Vidyut Utpadan Nigam Limited that falls in Surguja and Surajpur districts, Chhattisgarh and it comprises of two forest types such as 3C/2e (ii) Moist Peninsular Low-Level Sal Forests and 3B/C2 Southern Moist Mixed Deciduous Forest covering an area of 6.21 sq.km; and a non-forest area of 6.91 sq.km (Figure 4.5b).

Kente Extension coal block (12)

This coal block is not in operation, allotted to M/s. Rajasthan Rajya Vidyut Utpadan Nigam Limited and that falls in Surguja district, Chhattisgarh. The coal block comprises of three forest types such as 3C/2e (ii) Moist Peninsular Low Level Sal Forests; 3B/C2 Southern Moist Mixed Deciduous Forest and 5B/C1 c Dry Peninsular Sal Forest covering an area of 14.86 sq.km; and non-forest area of 3.54 sq.km (Figure 4.5c).

Chotia coal block (02)

This coal block is in operation, allotted to M/s. BALCO-Vedanta group and that falls in Korba district, Chhattisgarh. The coal block comprises of five forest types, such as 3C/2e (ii) Moist Peninsular Low-Level Sal Forests; 3B/C2 Southern Moist Mixed Deciduous Forest; 5B/C1 c Dry Peninsular Sal Forest; 5/E9 Dry Bamboo Brake and 5B/C2 Northern Dry Mixed Deciduous Forest covering an area of 21.21 sq.km; and non-forest area of 10.09 sq.km (Figure 4.5d).

Tara coal block (15)

This coal block is not allotted and that falls in Surajpur district, Chhattisgarh. The coal block comprises of three forest types such as 3C/2e (ii) Moist Peninsular Low-Level Sal Forests; 3B/C2 Southern Moist Mixed Deciduous Forest and 5B/C1c Dry Peninsular Sal Forest covering an area of 21.61 sq.km; and non-forest area of 5.01 sq.km (Figure 4.5e).

Madanpur North coal block (10)

This coal block is not allotted and that falls in Korba and Surajpur districts of Chhattisgarh. The coal block comprises of two forest types such as 3C/2e (ii) Moist Peninsular Low Level Sal Forests and 3B/C2 Southern Moist Mixed Deciduous Forest covering an area of 10.08 sq.km; and non-forest area of 8.72 sq.km (Figure 4.5f)

Madanpur South coal block (11)

This coal block is not allotted and that falls in Korba district, Chhattisgarh. The coal block comprises of two forest types such as 3C/2e (ii) Moist Peninsular Low-Level Sal Forests and 3B/C2 Southern Moist Mixed Deciduous Forest covering an area of 4.66 sq.km; and non-forest area of 2.78 sq.km (Figure 4.5g).

Gidmuri coal block (08)

This coal block is not allotted and that falls in Korba district, Chhattisgarh. The coal block comprises of three forest types such as 3C/2e (ii) Moist Peninsular Low-Level Sal Forests; 3B/C2 Southern Moist Mixed Deciduous Forest and 5B/C1 c Dry

Peninsular Sal Forest covering an area of 5.78 sq.km; and non-forest area of 1.84 sq.km (Figure 4.5h).

Paturia coal block (09)

This coal block is not allotted and that falls in Korba district, Chhattisgarh. The coal block comprises of two forest types such as 3C/2e (ii) Moist Peninsular Low-Level Sal Forests and 3B/C2 Southern Moist Mixed Deciduous Forest covering an area of 14.89 sq.km; and non-forest area of 6.05 sq.km (Figure 4.5i).

Morga –II coal block (04)

This coal block is not allotted and that falls in Korba district, Chhattisgarh. The coal block comprises of two forest types such as 3C/2e (ii) Moist Peninsular Low-Level Sal Forests and 3B/C2 Southern Moist Mixed Deciduous Forest covering an area of 18.21 sq.km; non-forest area of 8.16 sq.km and a water body area of 0.84 sq.km (Figure 4.5 j).

Morga-III coal block (05)

This coal block is not allotted and that falls in Korba district, Chhattisgarh. The coal block comprises of two forest types such as 3C/2e (ii) Moist Peninsular Low-Level Sal Forests and 3B/C2 Southern Moist Mixed Deciduous Forest covering an area of 1.14 sq.km; non-forest area of 2.88 sq.km and a water body area of 0.45 sq.km (Figure 4.5k).

Morga –IV coal block (06)

This coal block is not allotted and that falls in Korba district, Chhattisgarh. The coal block comprises of two forest types such as 3C/2e (ii) Moist Peninsular Low-Level Sal Forests and 3B/C2 Southern Moist Mixed Deciduous Forest covering an area of 2.66 sq.km; and non-forest area of 2.11 sq.km (Figure 4.5l).

Morga South coal block (07)

This coal block is not allotted that and falls in Korba district, Chhattisgarh. The coal block comprises of three forest types such as 3C/2e (ii) Moist Peninsular Low-Level Sal Forests; 3B/C2 Southern Moist Mixed Deciduous Forest and 5/E9 Dry Bamboo Brake covering an area of 28.65 sq.km; and non-forest area of 5.38 sq.km (Figure 4.5m)

Saidu coal block (18)

This coal block is not allotted and that falls in Korba and Surguja districts, Chhattisgarh. The coal block comprises of three forest types such as 3C/2e (ii) Moist Peninsular Low-Level Sal Forests; 3B/C2 Southern Moist Mixed Deciduous Forest

and 5/E9 Dry Bamboo Brake covering an area of 7.02 sq.km; and non-forest area of 1.11 sq.km (Figure 4.5n)

Puta Parogia coal block (16)

This coal block is not allotted and that falls in Surguja, Surajpur and Korba districts, Chhattisgarh. The coal block comprises of four forest types such as 3C/2e (ii) Moist Peninsular Low Level Sal Forests; 3B/C2 Southern Moist Mixed Deciduous Forest; 5/E9 Dry Bamboo Brake and 5B/C1 c Dry Peninsular Sal Forest covering an area of 38.37 sq.km; and non-forest area of 9.67 sq.km (Figure 4.5o).

Parogia coal block (17)

This coal block is not allotted and that falls in Surguja district, Chhattisgarh. The coal block comprises of three forest types such as 3C/2e (ii) Moist Peninsular Low Level Sal Forests; 3B/C2 Southern Moist Mixed Deciduous Forest; and 5B/C1 c Dry Peninsular Sal Forest covering an area of 6.73 sq.km; and non-forest area of 0.43 sq.km (Figure 4.5p).

Pindraki coal block (19)

This coal block is not allotted and that falls in Surguja district, Chhattisgarh. The coal block comprises of four forest types such as 3C/2e (ii) Moist Peninsular Low-Level Sal Forests; 3B/C2 Southern Moist Mixed Deciduous Forest; 5B/C1 c Dry Peninsular Sal Forest and 5B/C2 Northern Dry Mixed Deciduous Forest covering an area of 19.03 sq.km; and non-forest area of 4.91 sq.km (Figure 4.5q).

Mogra-I coal block (03)

This coal block is not allotted and that falls in Korba district, Chhattisgarh. The coal block comprises of two forest types such as 3C/2e (ii) Moist Peninsular Low-Level Sal Forests; and 3B/C2 Southern Moist Mixed Deciduous Forest covering an area of 17.33 sq.km; and non-forest area of 4.30 sq.km (Figure 4.5r).

Sarma Coal block (20)

This coal block is not allotted and that falls in Surguja district, Chhattisgarh. The coal block comprises of four forest types such as 3C/2e (ii) Moist Peninsular Low Level Sal Forests; 3B/C2 Southern Moist Mixed Deciduous Forest; 5B/C2 Northern Dry Mixed Deciduous Forest and 5B/C1 c Dry Peninsular Sal Forest covering an area of 10.67 sq.km; and non-forest area of 7.49 sq.km (Figure 4.5s).

Laxmangarh Coal block (21)

This coal block is not allotted and that falls in Surguja district, Chhattisgarh. The coal block comprises of four forest types such as 3C/2e (ii) Moist Peninsular Low-Level Sal Forests; 3B/C2 Southern Moist Mixed Deciduous Forest; 5B/C2 Northern Dry

Mixed Deciduous Forest and 5B/C1 c Dry Peninsular Sal Forest covering an area of 8.59 sq.km; and non-forest area of 15.05 sq.km (Figure 4.5t).

Bhakurma-Matringa coal block (22)

This coal block is not allotted and that falls in Surguja district, Chhattisgarh. The coal block comprises of five forest types such as 3C/2e (ii) Moist Peninsular Low Level Sal Forests; 3B/C2 Southern Moist Mixed Deciduous Forest; 5B/C2 Northern Dry Mixed Deciduous Forest; 5B/C1 c Dry Peninsular Sal Forest and 5/E9 Dry Bamboo Brake covering an area of 21.04 sq.km; and non-forest area of 4.96 sq.km (Figure 4.5u).

Kedma coal block (23)

This coal block is not allotted and that falls in Surguja district, Chhattisgarh. The coal block comprises of four forest types such as 3C/2e (ii) Moist Peninsular Low Level Sal Forests; 3B/C2 Southern Moist Mixed Deciduous Forest; 5B/C1 c Dry Peninsular Sal Forest and 5/E9 Dry Bamboo Brake covering an area of 15.87 sq.km; non-forest area of 3.06 sq.km and water body of 0.10 sq.km (Figure 4.5v).

Nakiya coal block (01)

This coal block is not allotted and that falls in Korba district, Chhattisgarh. The coal block comprises of three forest types such as 3C/2e (ii) Moist Peninsular Low-Level Sal Forests; 3B/C2 Southern Moist Mixed Deciduous Forest; and 5/E9 Dry Bamboo Brake covering an area of 26.73 sq.km; and non-forest area of 7.56 sq.km (Figure 4.5w).

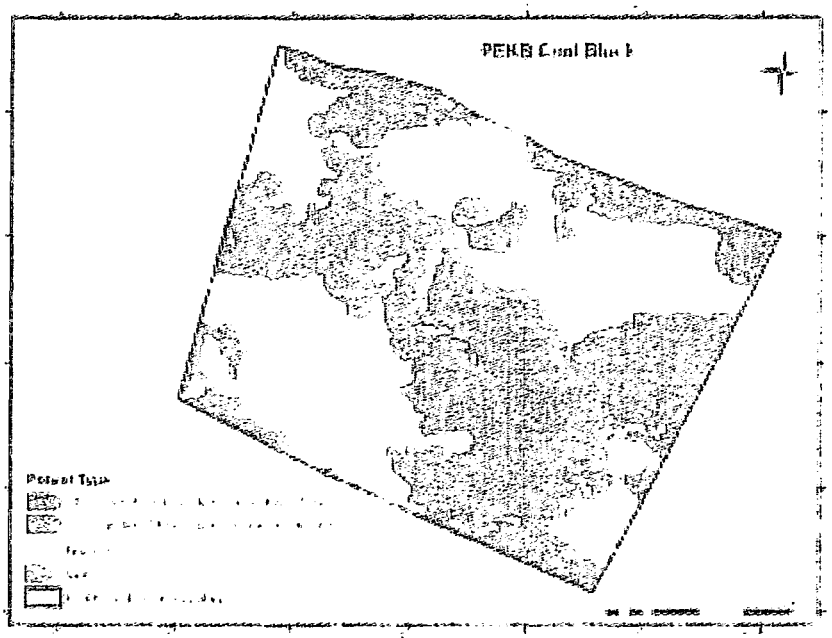


Figure 4.5a: Extent of forest type and extent of the area in Parsa East & Kanta Basan (PEKB) coal block in Hasdeo-Arand Coalfield within Surguja district of Chhattisgarh

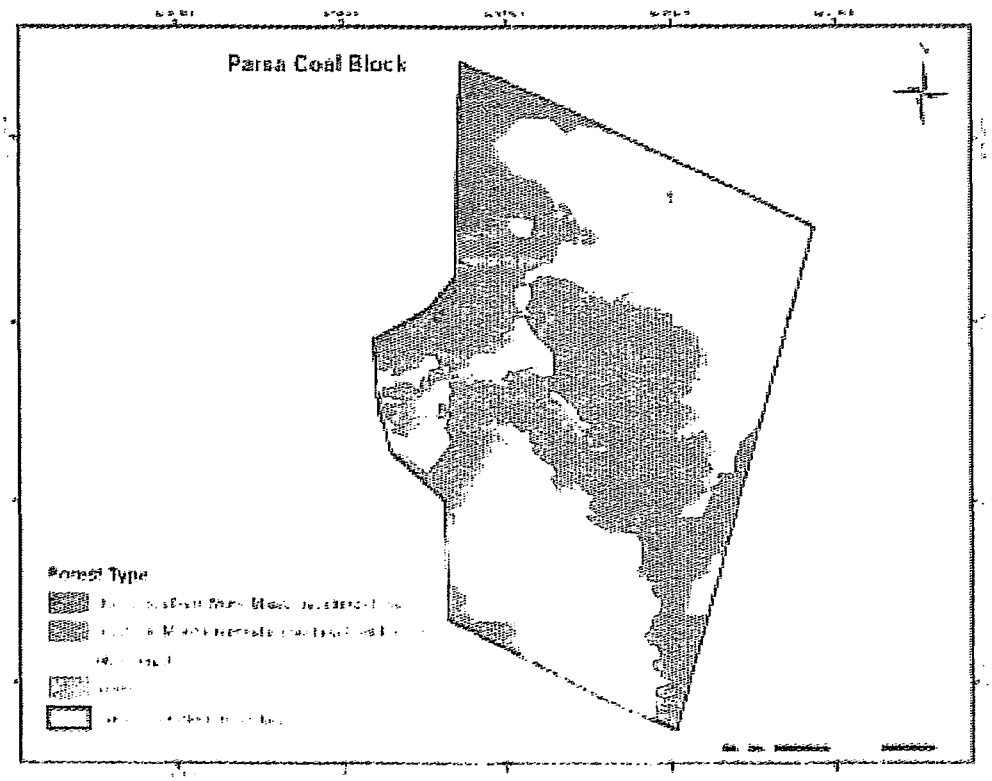


Figure 4.5b: Extent of forest type and extent of the area in Parsa coal block within Surguja and Surajpur districts of Chhattisgarh

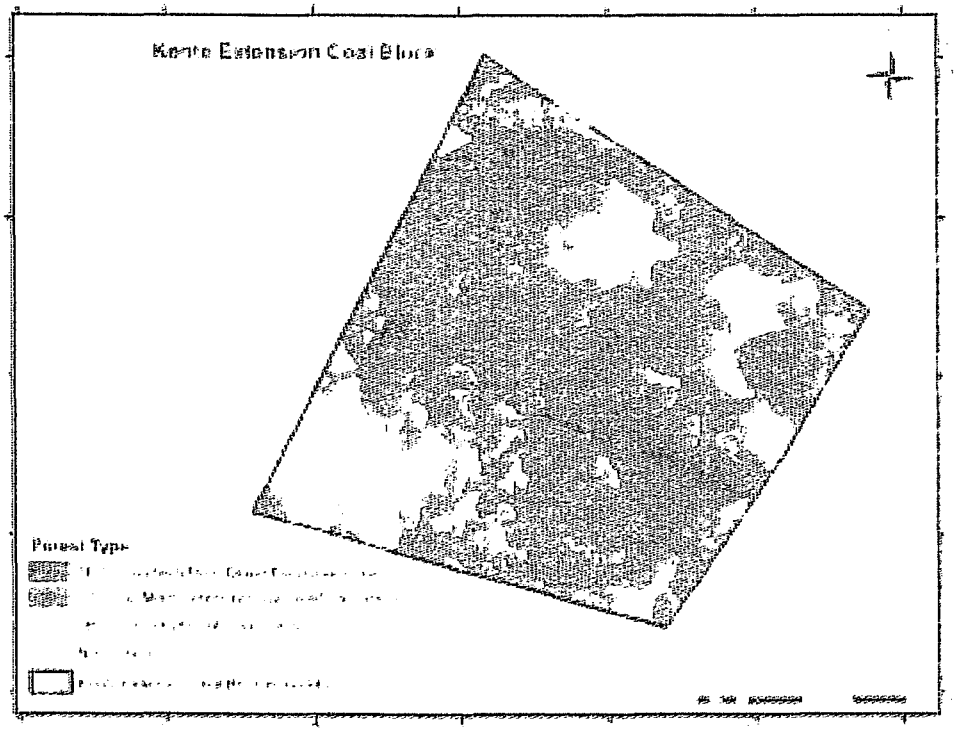


Figure 4.5c: Extent of forest type and extent of the area in Kente Extension coal block in Hasdeo-Arand Coalfield within Surguja district of Chhattisgarh

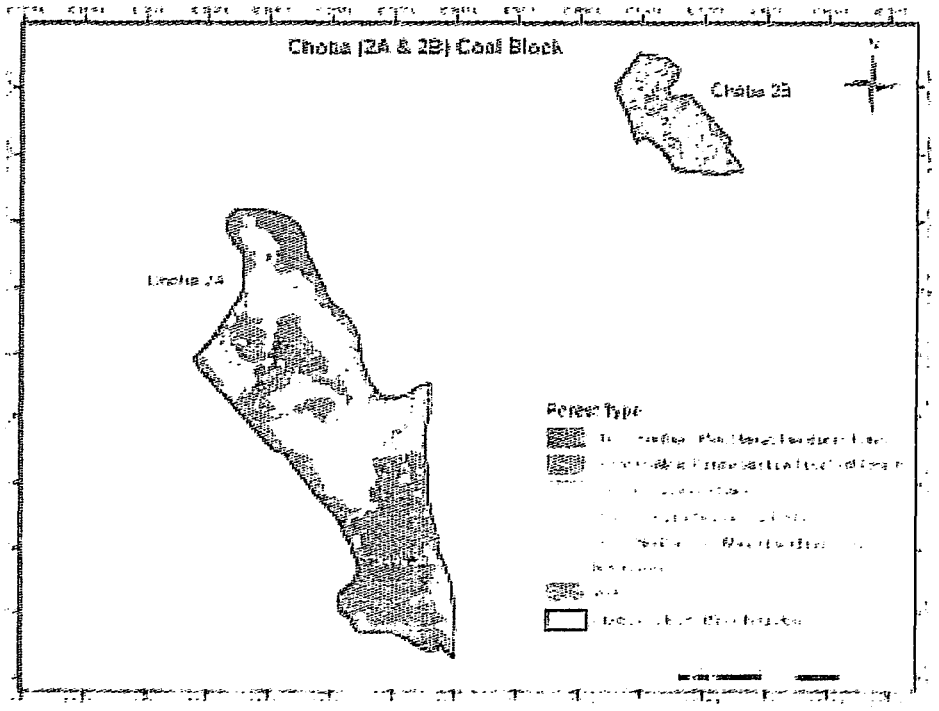


Figure 4.5d: Extent of forest type and extent of the area in Chotia coal block in Hasdeo-Arand Coalfield within Korba district of Chhattisgarh

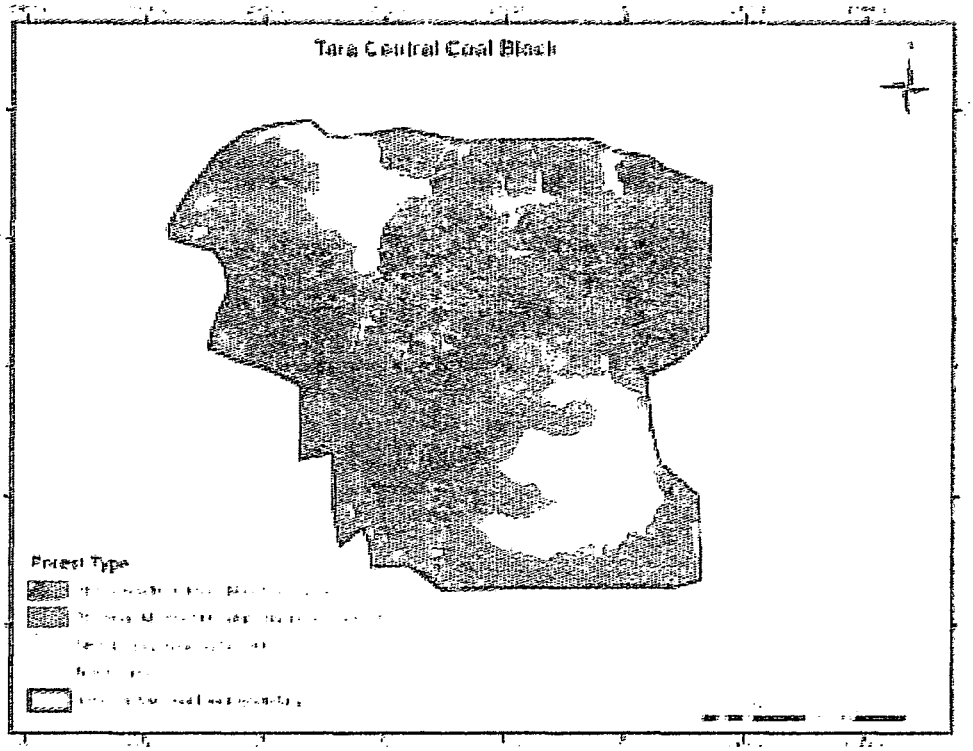


Figure 4.5e: Extent of forest type and extent of the area in Tara Central coal block in Hasdeo-Arand Coalfield within Surajpur district of Chhattisgarh

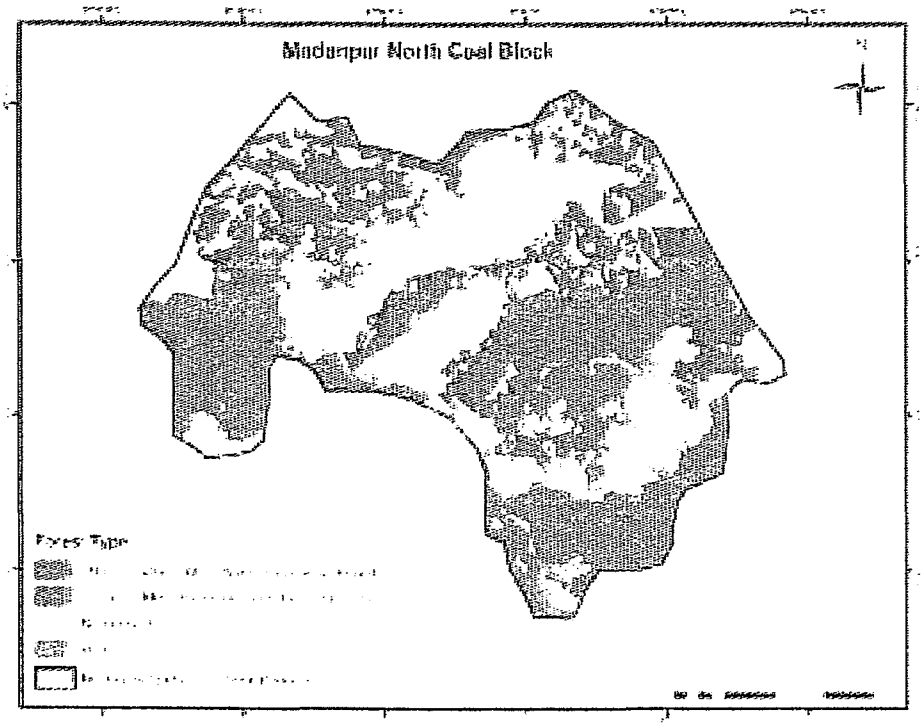


Figure 4.5f: Extent of forest type and extent of the area in Madanpur North coal block in Hasdeo-Arand Coalfield within Korba and Surajpur districts of Chhattisgarh

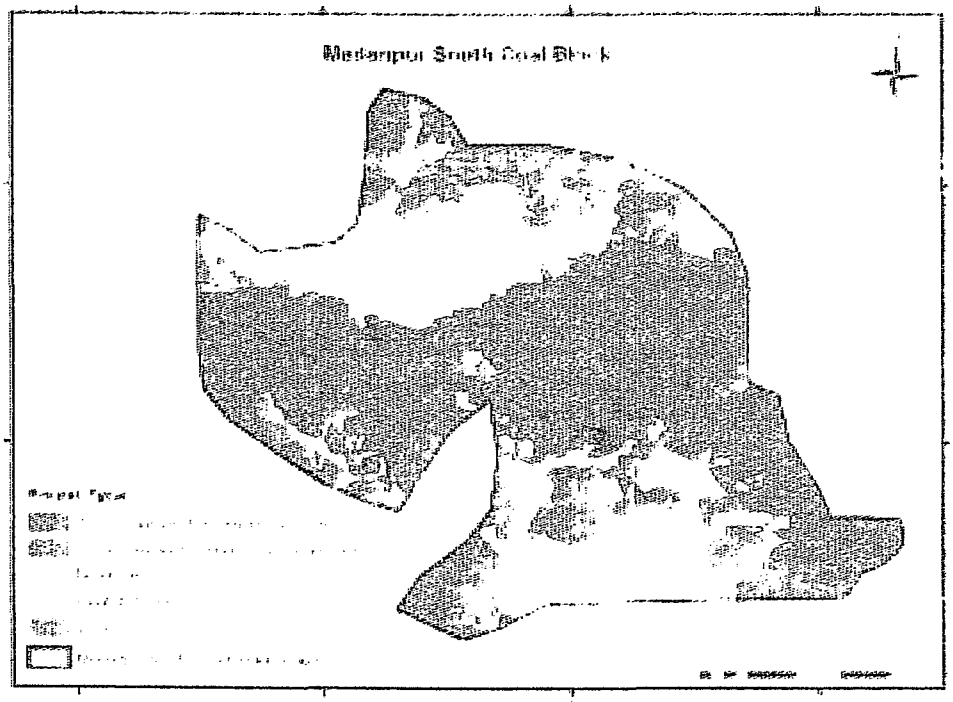


Figure 4.5g: Extent of forest type and extent of the area in Madanpur South coal block in Hasdeo-Arand Coalfield within Korba districts of Chhattisgarh

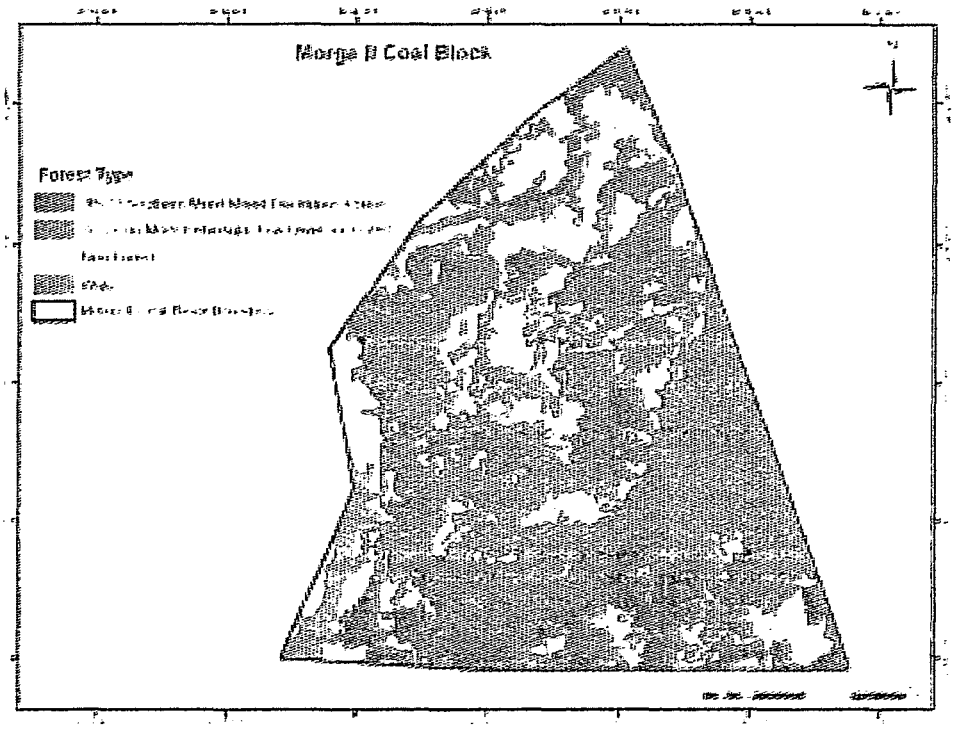


Figure 4.5j: Extent of forest type and extent of the area in Morga-II coal block in Hasdeo-Arand Coalfield within Korba district of Chhattisgarh

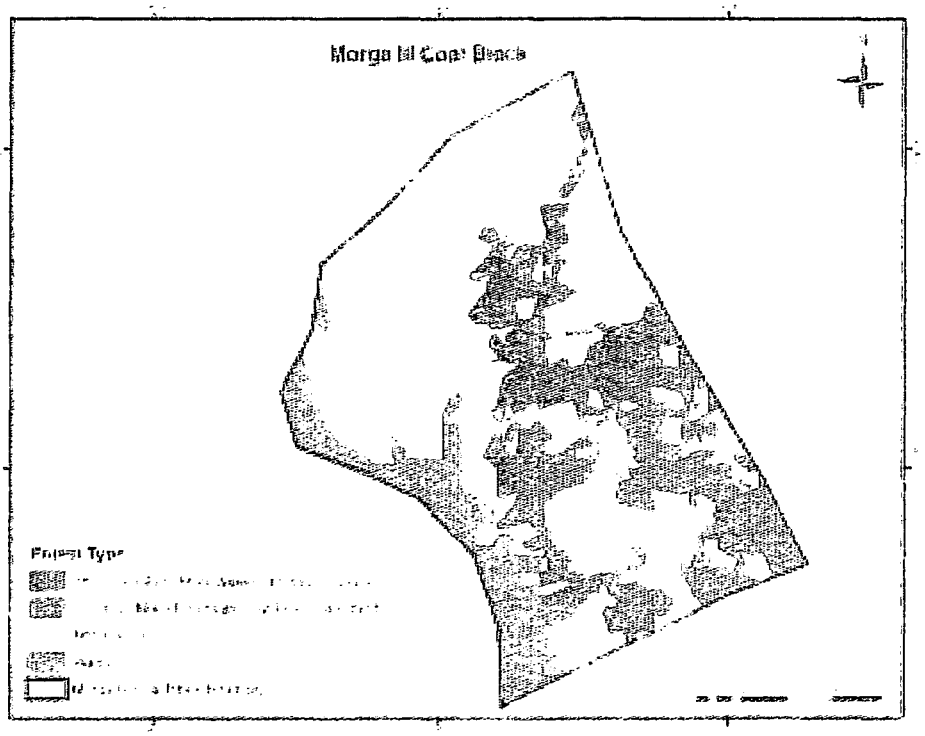


Figure 4.5k: Extent of forest type and extent of the area in Morga-III coal block in Hasdeo-Arand Coalfield within Korba district of Chhattisgarh

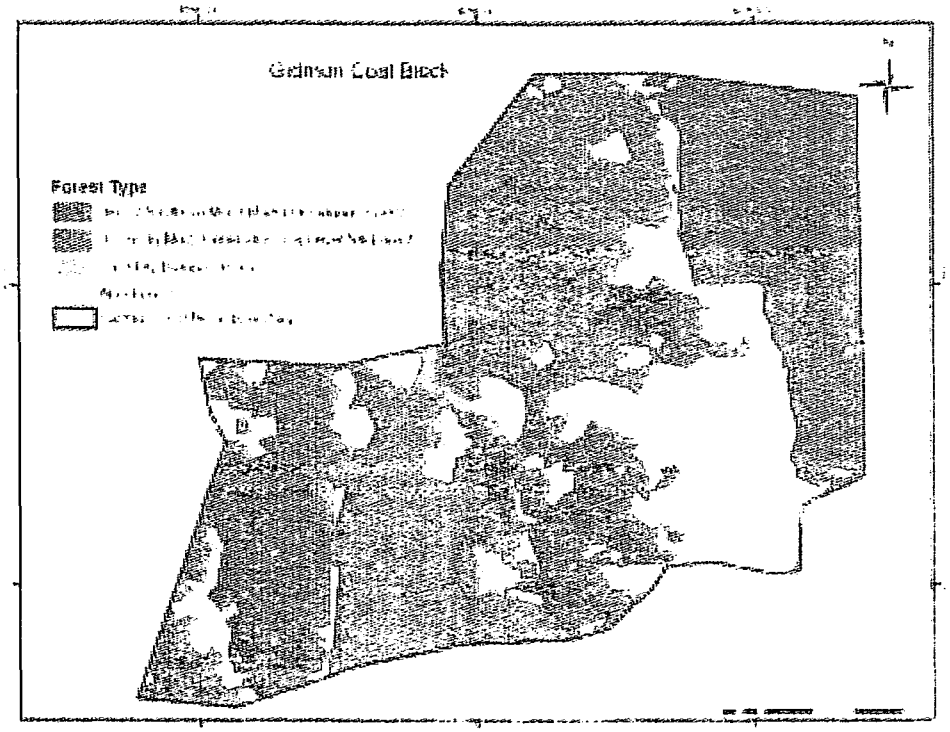


Figure 4.5h: Extent of forest type and extent of the area in Gidmuri coal block in Hasdeo-Arand Coalfield within Korba district of Chhattisgarh

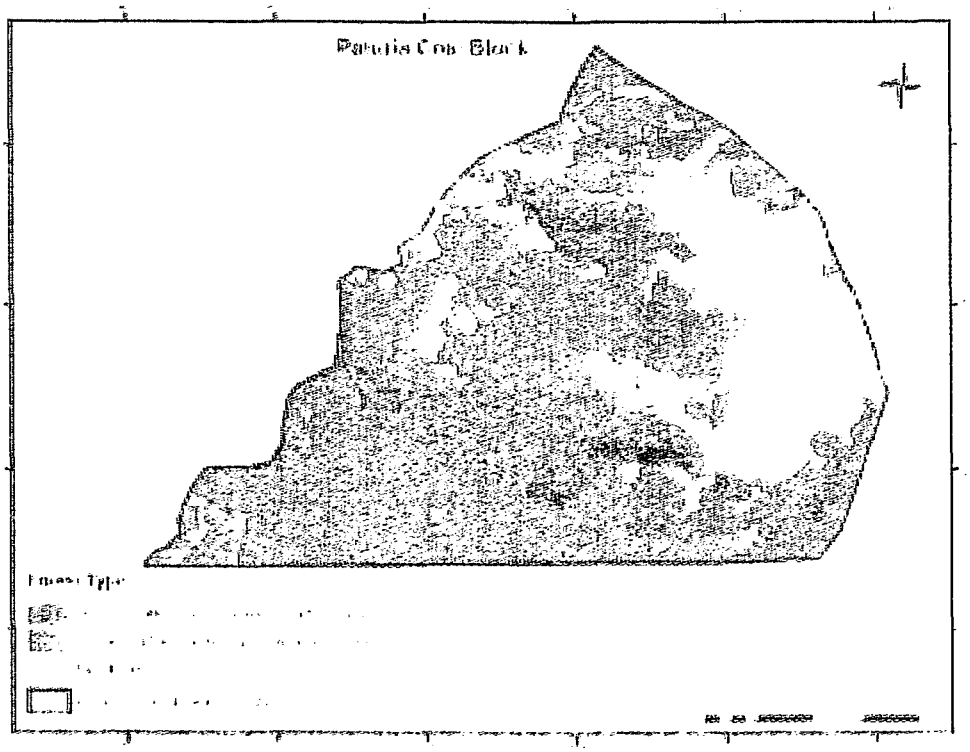


Figure 4.5i: Extent of forest type and extent of the area in Paturia coal block in Hasdeo-Arand Coalfield within Korba district of Chhattisgarh

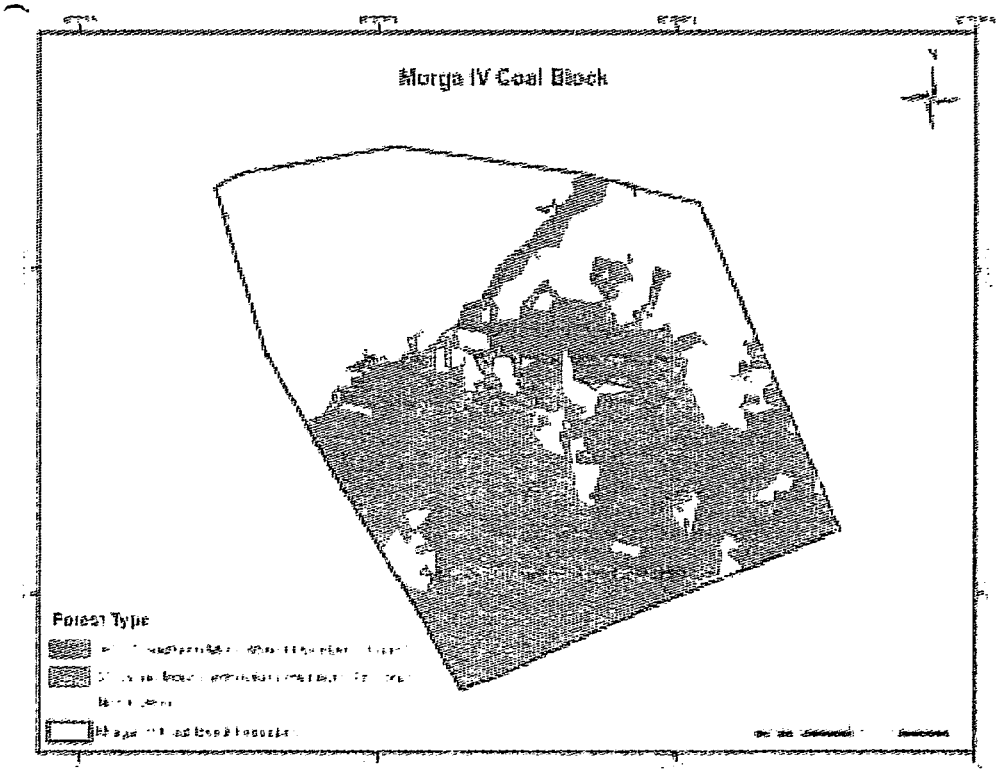


Figure 4.5l: Extent of forest type and extent of the area in Morga-IV coal block in Hasdeo-Arand Coalfield within Korba district of Chhattisgarh

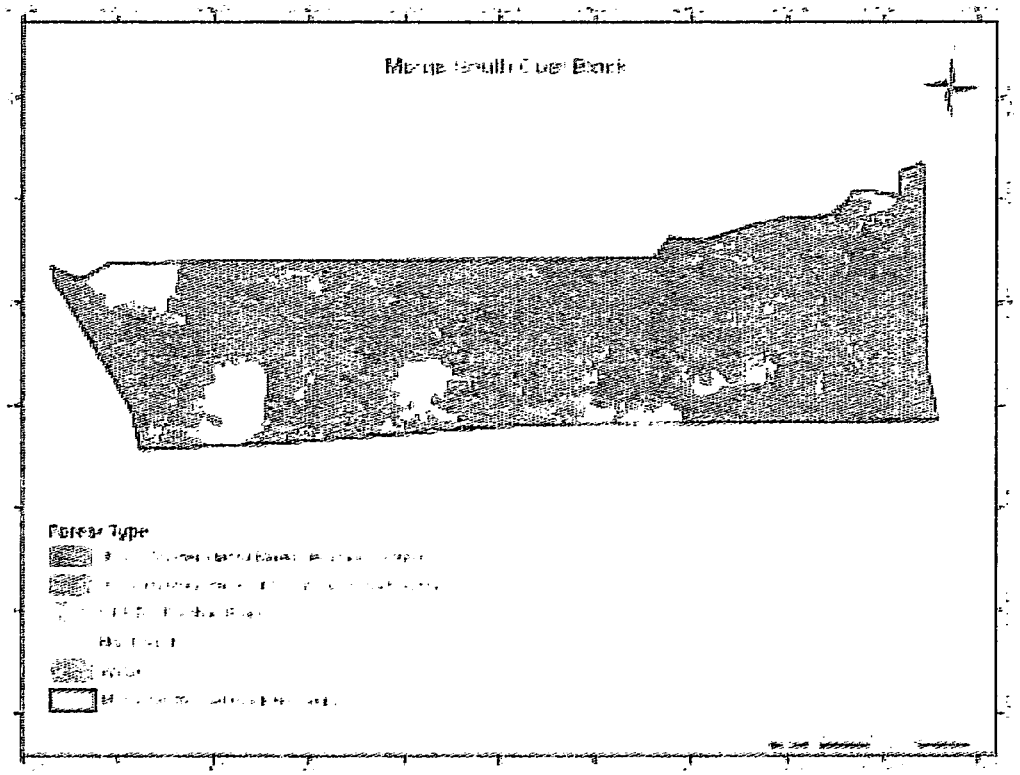


Figure 4.5m: Extent of forest type and extent of the area in Morga south coal block in Hasdeo-Arand Coalfield within Korba district of Chhattisgarh

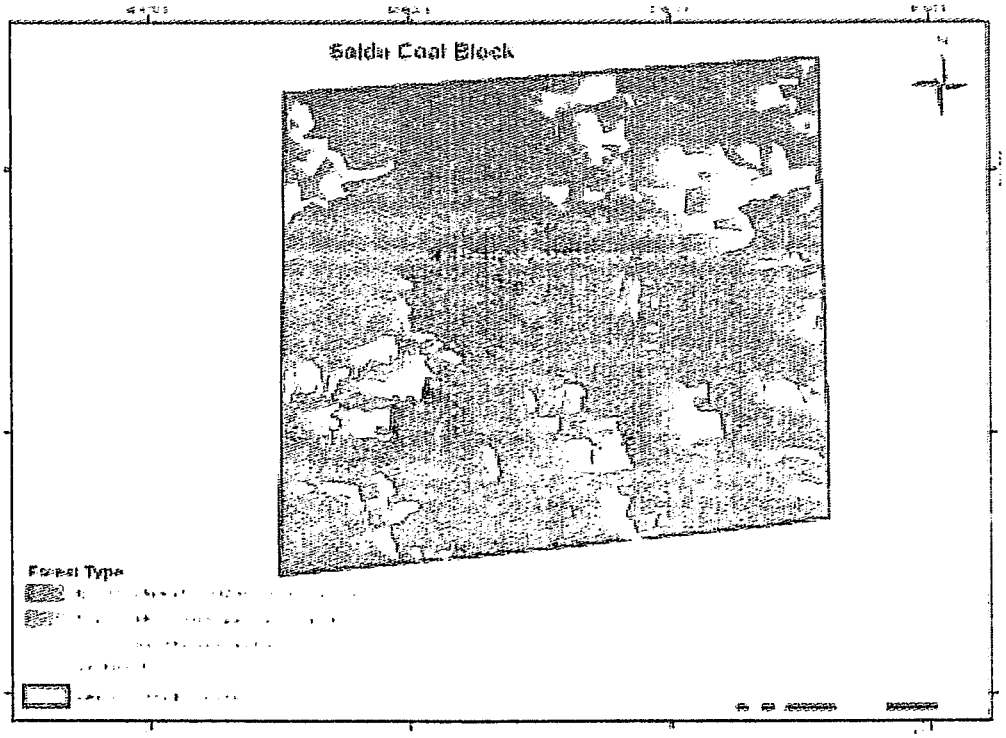


Figure 4.5n: Extent of forest type and extent of the area in Saidu coal block in Hasdeo-Arand Coalfield within Korba and Surguja districts of Chhattisgarh

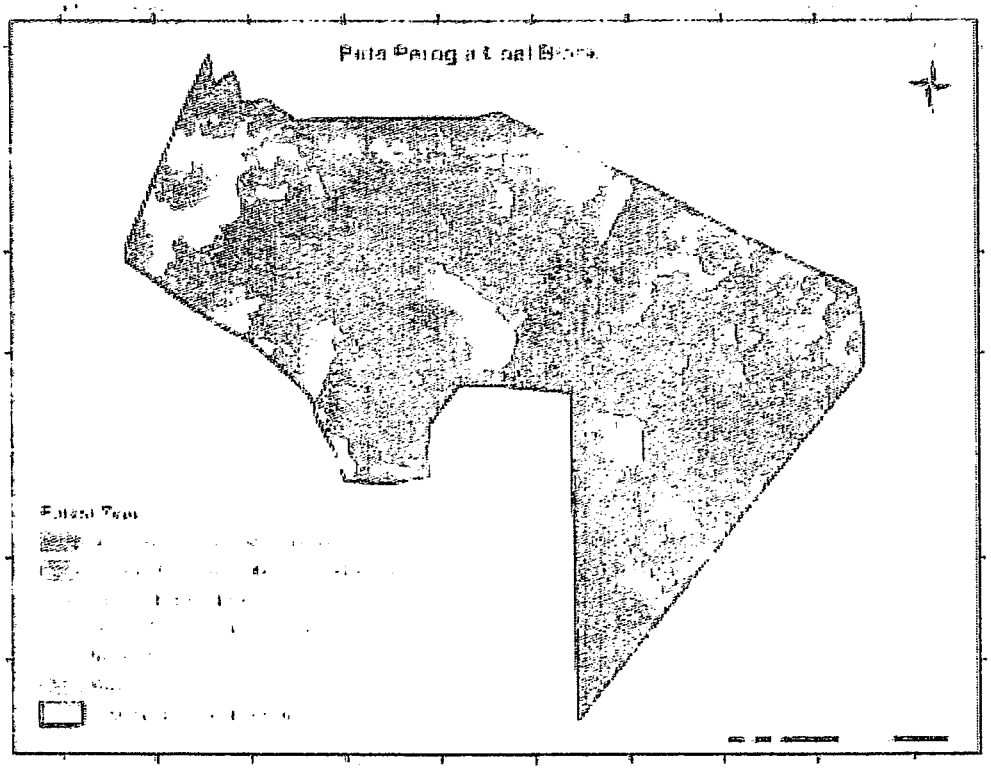


Figure 4.5o: Extent of forest type and extent of the area in Puta Parogia coal block in Hasdeo-Arand Coalfield within Korba, Surguja and Surajpur districts of Chhattisgarh

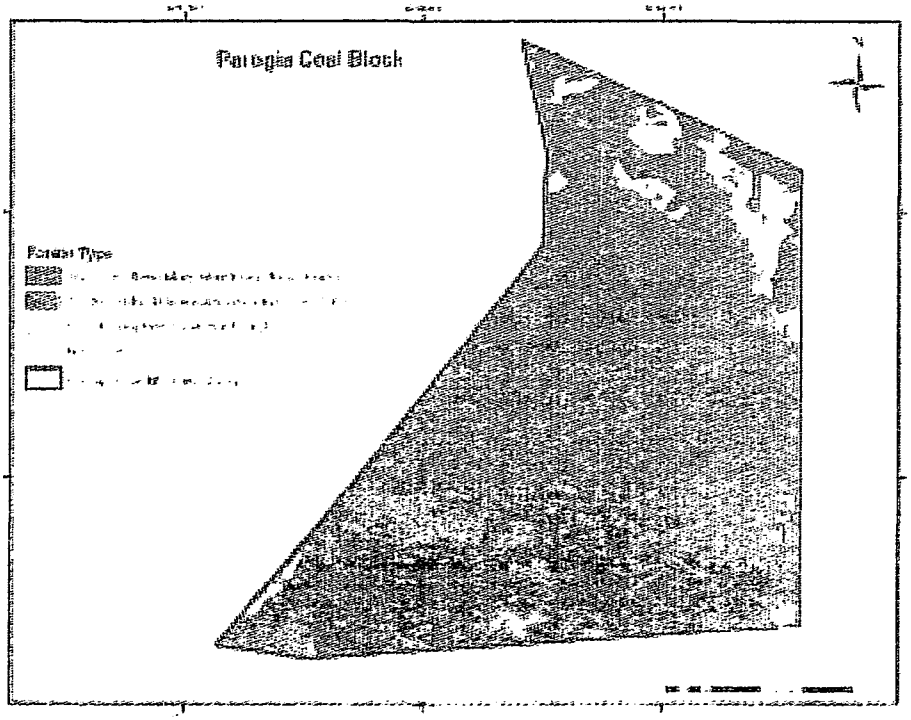


Figure 4.5p: Extent of forest type and extent of the area in Parogia coal block in Hasdeo-Arand Coalfield within Surguja district of Chhattisgarh

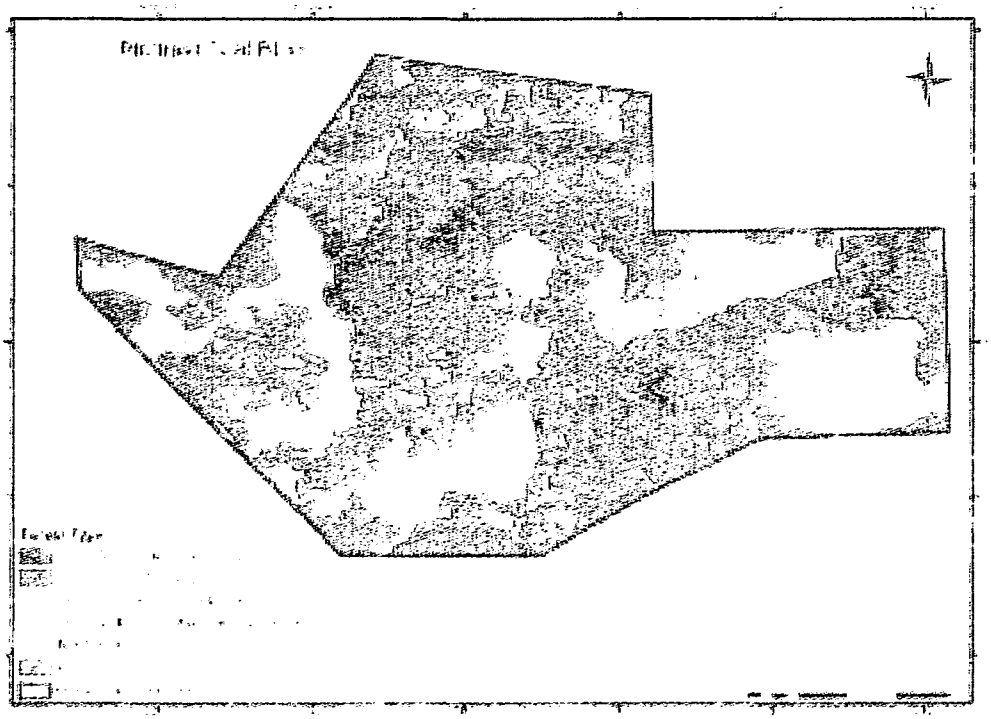


Figure 4.5q: Extent of forest type and extent of the area in Pindraki coal block in Hasdeo-Arand Coalfield within Surguja district of Chhattisgarh

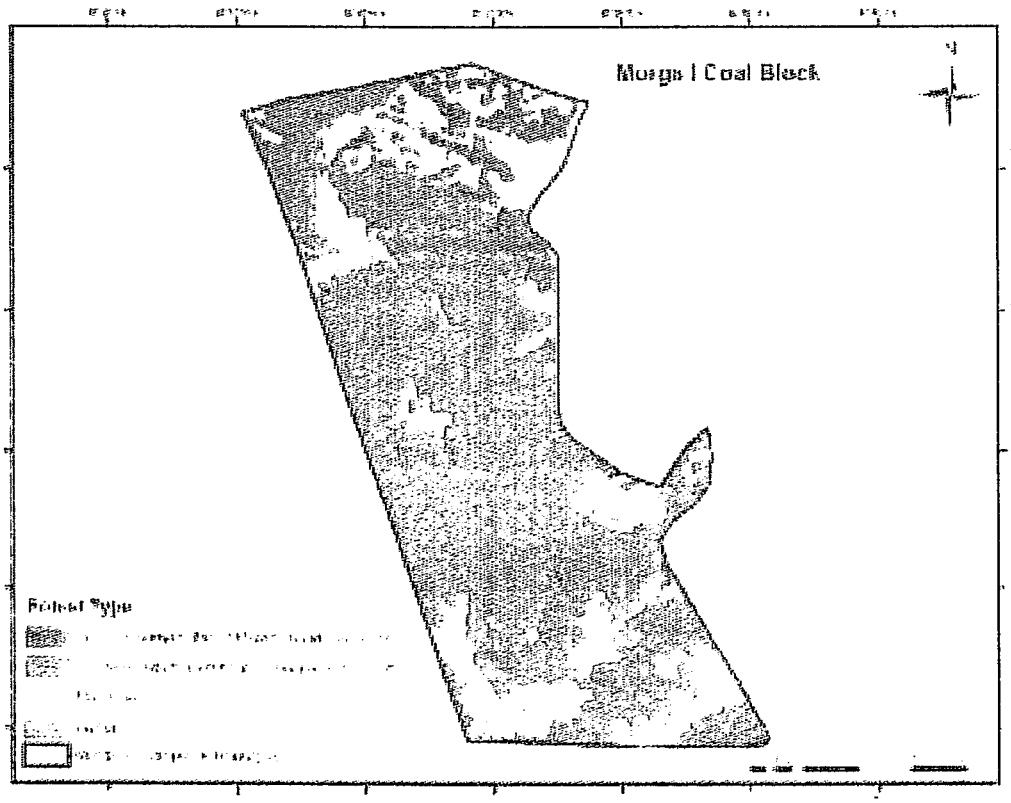


Figure 4.5r: Extent of forest type and extent of the area in Morga-I coal block in Hasdeo-Arand Coalfield within Korba district of Chhattisgarh

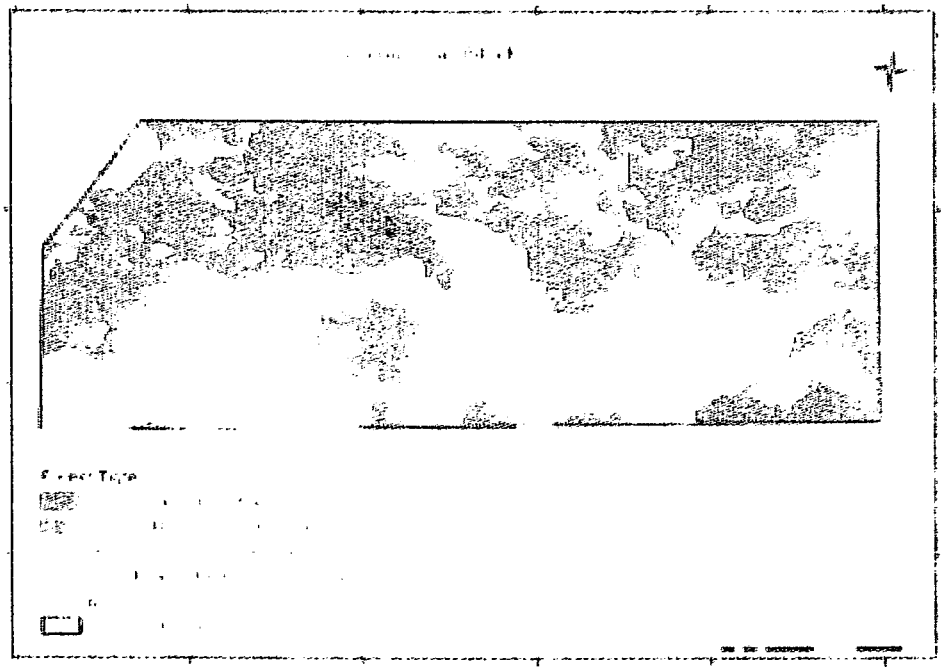


Figure 4.5s: Extent of forest type and extent of the area in Sarma coal block in Hasdeo-Arand Coalfield within Surguja district of Chhattisgarh

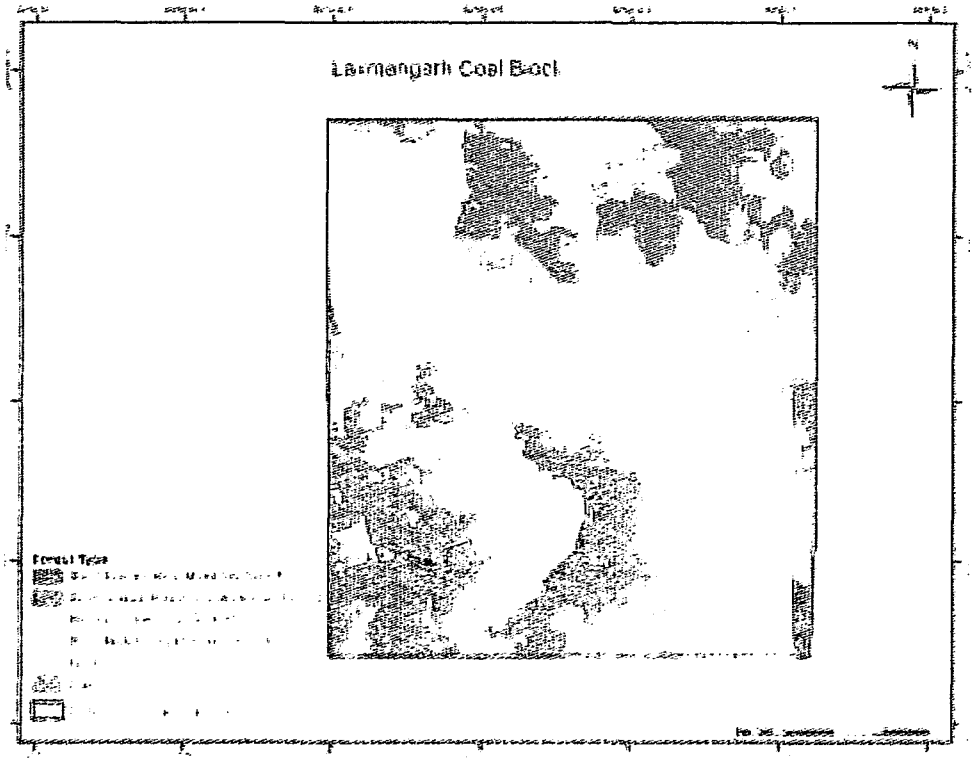


Figure 4.5t: Extent of forest type and extent of the area in Laxmangarh coal block in Hasdeo-Arand Coalfield within Surguja district of Chhattisgarh

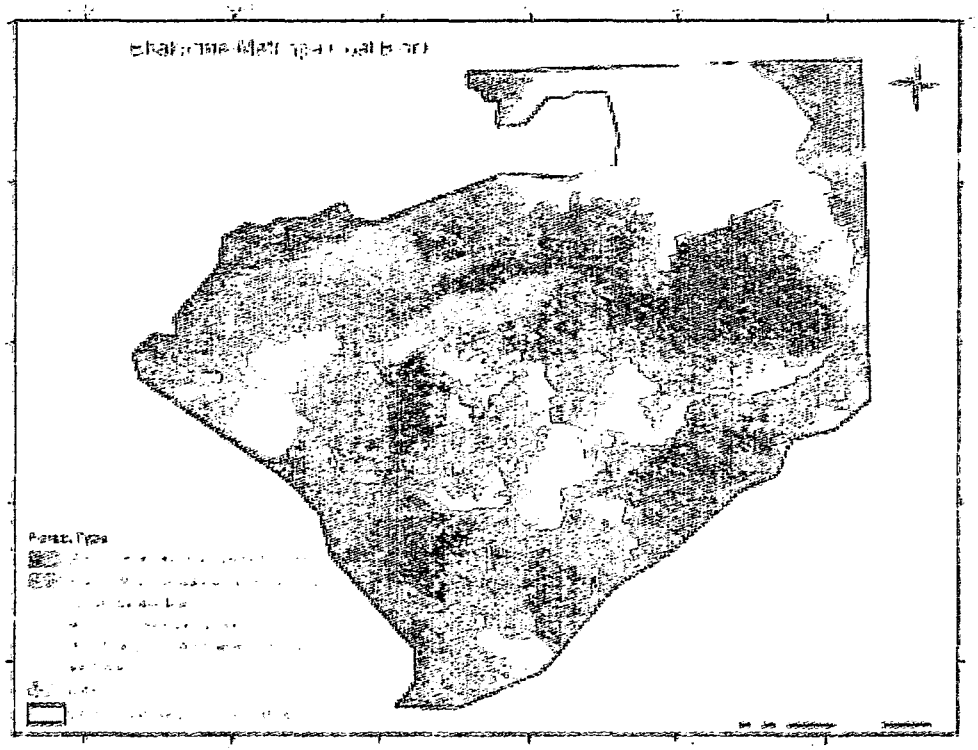


Figure 4.5u: Extent of forest type and extent of the area in Bhakurma-Matringa coal block in Hasdeo-Arand Coalfield within Surguja district of Chhattisgarh

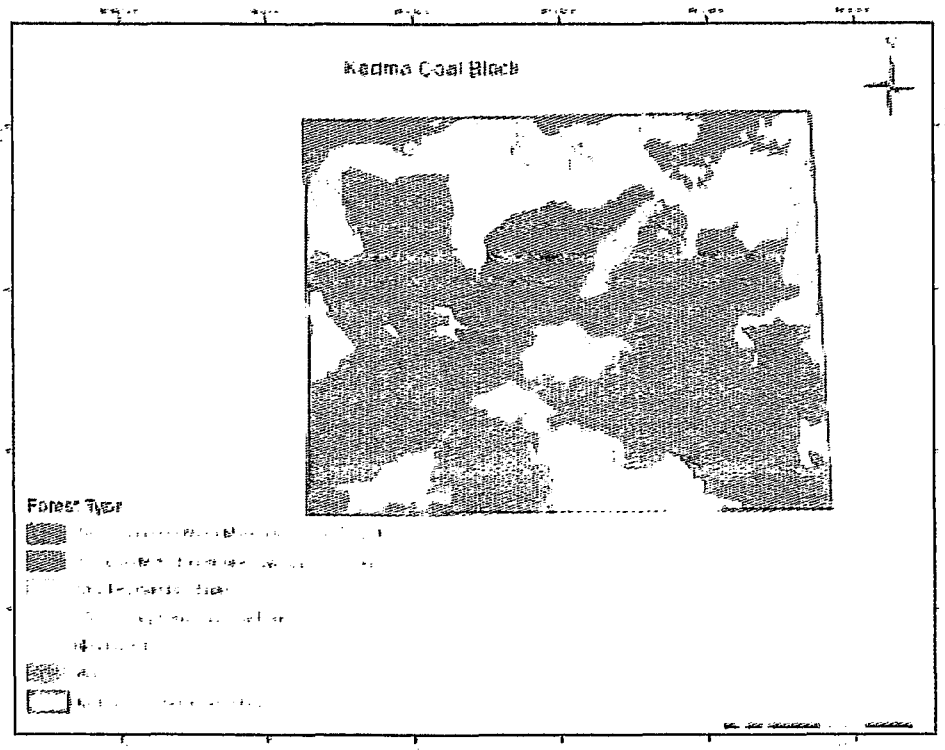


Figure 4.5v: Extent of forest type and extent of the area in Kedma coal block in Hasdeo-Arand Coalfield within Surguja district of Chhattisgarh

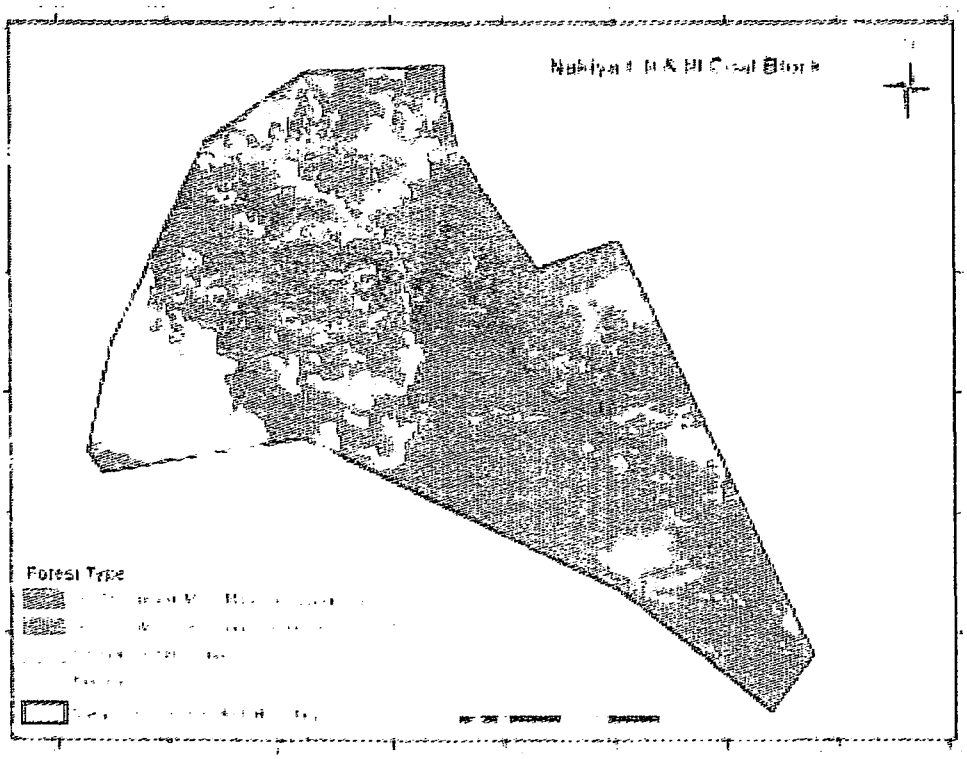


Figure 4.5w: Extent of forest type and extent of the area in Nakiya coal block in Hasdeo-Arand Coalfield within Korba district of Chhattisgarh

Table 4.7: Forest types and the area of extent in the individual 23 coal blocks in Hasdeo-Arand Coalfield within Korba, Surguja and Surajpur districts of Chhattisgarh

Coal block Area (in sq.km)	3C/C2e (ii) Moist Peninsular Low-Level Sal Forests	3B/C2 Southern Moist Mixed Deciduous Forest	5/E9 Dry Bamboo Brake	5B/C1 e Dry Peninsular Sal Forest	5B/C2 Northern Dry Mixed Deciduous Forest	Total Area Under Forest types	Non-Forest	Water	Total Area under non-forest and water	Grand Total
PEKB (14)	13.04	2.23	0.00	0.00	0.00	15.27	13.46	0.01	13.47	28.74
Parsa (13)	5.45	0.76	0.00	0.00	0.00	6.21	6.90	0.01	6.91	13.12
Kente Extension (12)	10.45	2.85	0.00	1.56	0.00	14.86	3.54	0.00	3.54	18.4
Chotia (2)	8.31	2.74	1.60	0.83	7.73	21.21	10.08	0.01	10.09	31.3
Tara Central(15)	10.47	10.86	0.00	0.28	0.00	21.61	5.01	0.00	5.01	26.62
Madanpur South (11)	3.51	1.15	0.00	0.00	0.00	4.66	2.78	0.00	2.78	7.44
Gidmuri (8)	2.67	3.04	0.07	0.00	0.00	5.78	1.84	0.00	1.84	7.62
Paturia (9)	10.90	3.99	0.00	0.00	0.00	14.89	6.05	0.00	6.05	20.94
Madanpur North (10)	6.07	4.01	0.00	0.00	0.00	10.08	8.71	0.01	8.72	18.8
Morga II (4)	13.85	4.36	0.00	0.00	0.00	18.21	7.32	0.84	8.16	26.37
Morga III (5)	0.37	0.77	0.00	0.00	0.00	1.14	2.43	0.45	2.88	4.02
Morga IV(6)	1.19	1.47	0.00	0.00	0.00	2.66	2.11	0.00	2.11	4.77
Morga South (7)	14.89	13.61	0.15	0.00	0.00	28.65	5.37	0.01	5.38	34.03
Saidu (18)	3.77	3.08	0.00	0.17	0.00	7.02	1.11	0.00	1.11	8.13
Puta-Parogia (16)	25.84	11.98	0.03	0.52	0.00	38.37	9.67	0.00	9.67	48.04
Parogia (17)	2.58	4.08	0.00	0.07	0.00	6.73	0.43	0.00	0.43	7.16
Morga 1 (3)	14.58	2.75	0.00	0.00	0.00	17.33	4.25	0.05	4.3	21.63
Pindraki (19)	13.50	1.38	0.00	3.92	0.23	19.03	4.85	0.06	4.91	23.94
Sarma (20)	6.67	0.79	0.00	3.13	0.08	10.67	7.49	0.00	7.49	18.16
Laxmangarh (21)	5.17	0.20	0.00	2.73	0.49	8.59	14.98	0.07	15.05	23.64
Bhakurma-Matringa (22)	11.32	6.42	1.73	1.28	0.29	21.04	4.90	0.06	4.96	26.00
Kedma (23)	7.88	3.75	1.79	2.45	0.00	15.87	2.95	0.11	3.06	18.93
Nakiya I, II & III (1)	5.53	19.44	1.76	0.00	0.00	26.73	7.56	0.00	7.56	34.29
Total	198.01	105.71	7.13	16.94	8.82	336.61	133.79	1.69	135.48	472.09
Forest Type										

The major forest group in the study area consists of Tropical Moist Deciduous forest and the Tropical Dry Deciduous forest and comprises of five forest types of 3C/2e (ii) Moist Peninsular Low Level Sal Forests (198.01sq.km), 5B/C2 Northern Dry Mixed Deciduous Forest (8.82 sq.km), 3B/C2 Southern Moist Mixed Deciduous Forest (105.71 sq.km), 5B/C1c Dry Peninsular Sal Forest (16.94 sq.km), 5/E9 Dry Bamboo Brake (7.13 sq.km); non-forest (133.79 sq.km) and water body (1.69 sq.km) covering a total area of 472.09 sq.km (Table 4.7 and 4.8).

Table 4.8: Comparative account of the extent of area of forest types within Hasdeo-Arand Coalfield and in the 23 coal blocks that fall within Korba, Surguja and Surajpur districts of Chhattisgarh

Forest Type	Area (sq.km) HAC	23 coal blocks sq.km and % of HAC area
3C/C2e (ii) Moist Peninsular Low-Level Sal Forest	835.61	198.01 (23.70%)
3B/C2 Southern Moist Mixed Deciduous Forest	314.53	105.71 (33.61%)
5B/C1c Dry Peninsular Sal Forest	70.22	16.94 (24.12%)
5/E9 Dry Bamboo Brakes	133.98	7.13 (5.132%)
5B/C2 Northern Dry Mixed Deciduous Forest	46.61	08.82 (18.92%)
Total	**1400.95**	**336.61 (24.03%)**
Non-Forest	464.23	133.79 (25.22%)
Total	**1865.19**	**470.40 (23.70%)**
Plantation/ TOF	0.03	
Water	14.35	1.69 (11.78%)
Total	**1879.57**	**472.09 (25.12%)**

Source: Estimated using 2011 digital format

4.3.2.3 Extent of forest compartment-wise forest cover

The entire Hasdeo Arand Coalfield falls within 04 forest divisions comprising of 12 forest ranges having 649 forest compartments. However, the 23 coal blocks fall within four forest divisions such as Surguja, Korba, Katghora and Surajpur comprised of 05 forest ranges and 230 forest compartments. The forest cover classes are comprised of open forest, moderately dense and very dense forest. The Hasdeo Arand region is one of the most extensive un-fragmented forests in the Central Indian landscape. The extent of compartment-wise forest cover within the 23 coal blocks was estimated using GIS and Remote Sensing using FSI (2017) digital format for the classification as per FSI Scheme Classification of Canopy Density *i.e.*, Very Dense (>70%); Moderately Dense (>40 to <70%) ; Open Forest (between >10 to <40%) and Scrub <10%. (Table 4.9 & Annexure 4.23).

Table 4.9: Forest compartment wise extent of forest cover in 23 coal blocks within Hasdeo-Arand Coalfield that falls within Korba, Surguja and Surajpur districts of Chhattisgarh

Name of Coal Block	Forest Division	Forest Range	No. of Compartment/ Village Name	Full or Part	Water	Non-Forest	Scrub	Open Forest	Moderately Dense Forest	Very Dense Forest	Total Area (sq.km)
					Area in sq.km (Area in %)						
Nakiya I, II & III	Korba	Lemru	17	Part	0.00(0.00)	3.4113 (12.21)	0.1775 (0.64)	6.0916 (21.81)	18.2521 (65.34)	0.00(0.00)	27.93
			1	Full	0.00(0.00)	0.0802 (1.90)	0 (0.00)	2.0588 (48.77)	2.0822 (49.33)	0.00(0.00)	4.22
			Nakiya	Part	0.00(0.00)	0.35 (23.53)	0.0149 (1.00)	0.3657 (24.58)	0.7569 (50.88)	0.00(0.00)	1.49
			Bimalta	Part	0.00(0.00)	0.0415 (18.38)	0 (0.00)	0.0406 (17.98)	0.1437 (63.64)	0.00(0.00)	0.23
			Pendradih	Part	0.00(0.00)	0.0035 (1.49)	0 (0.00)	0.0466 (19.82)	0.185 (78.69)	0.00(0.00)	0.24
	Surguja	Udaipur	2	Part	0.00(0.00)	0.0112 (5.96)	0 (0.00)	0.1127 (59.98)	0.064 (34.06)	0.00(0.00)	0.19
					0.00 (0.00)	**3.8977 (11.37)**	**0.1924 (0.56)**	**8.7159 (25.42)**	**21.4840 (62.65)**	**0.00 (0.00)**	**34.29**
Chotia 2A	Katghora	Pasan	3	Part	0.00(0.00)	1.5142 (34.09)	0.0655 (1.47)	1.1573 (26.05)	1.6718 (37.64)	0.03 (0.75)	4.44
		Kendai	8	Part	0.00(0.00)	1.8706 (18.28)	0.1350 (1.32)	3.2310 (31.57)	4.3501 (42.51)	0.65(6.31)	10.23
			Rode	Part	0.00(0.00)	0.305 (69.54)	0.0098 (2.23)	0.0782 (17.83)	0.0456 (10.40)	0.00 (0.00)	0.44
			Chotia	Part	0.0263 (0.49)	3.6407 (68.14)	0.0129 (0.24)	1.1384 (21.31)	0.5207 (9.75)	0.04 (0.07)	5.34
		Kendai & Pasan	Baniya	Part	0.00(0.00)	3.4846 (50.66)	0.037 (0.54)	1.649 (23.97)	1.6908 (24.58)	0.0173 (0.25)	6.88
					0.0263 (0.10)	**10.8151(39.57)**	**0.2601 (0.95)**	**7.2539 (26.54)**	**8.2790 (30.29)**	**0.7006 (2.56)**	**27.33**
Chotia 2B	Katghora	Kendai	3	Part	0.00(0.00)	1.1173 (33.53)	0.0936 (2.81)	0.5851 (17.56)	1.536 (46.10)	0.00(0.00)	3.33
			Sakhoda	Part	0.00(0.00)	0.264 (41.03)	0.0089 (1.38)	0.0672 (10.44)	0.3035 (47.16)	0.00(0.00)	0.64
					0.00 (0.00)	**1.3813 (34.75)**	**0.1025(2.58)**	**0.6523 (16.41)**	**1.8395 (46.27)**	**0.00 (0.00)**	**3.97**
Morga I	Katghora	Kendai	17	Part	0 (0.00)	1.1374 (7.22)	0.6521 (4.14)	0.8307 (5.27)	7.1482 (45.39)	5.9809 (37.98)	15.75
			2	Full	0 (0.00)	0.2526 (6.72)	0.1144 (3.04)	0.3078 (8.19)	1.0357 (27.55)	2.0483 (54.49)	3.76
			Kendai	Part	0 (0.00)	0.0412 (6.10)	0.0041 (0.61)	0.0816 (12.08)	0.1359 (20.12)	0.4129 (61.12)	0.68
			Morga	Part	0 (0.00)	0.5253 (36.59)	0.0185 (1.29)	0.2245 (15.64)	0.5253 (36.59)	0.142 (9.89)	1.44
					0.00 (0.00)	**1.9564 (9.05)**	**0.7891 (3.65)**	**1.4447 (6.68)**	**8.8451 (40.91)**	**8.5841 (39.71)**	**21.63**
Morga II	Katghora	Kendai	14	Part	0.3167 (1.81)	1.3302 (7.59)	0.1118 (0.64)	0.9089 (5.19)	12.0704 (68.89)	2.7834 (15.89)	17.52
			2	Full	0.0241 (0.33)	0.7956 (11.05)	0.2973 (4.13)	0.3754 (5.22)	4.7323 (65.75)	0.9729 (13.52)	7.20
			Kendai	Part	0.00(0.00)	0.634 (38.62)	0.0121 (0.74)	0.2209 (13.46)	0.7163 (43.63)	0.0583 (3.55)	1.64
					0.3408 (1.29)	**2.7598 (10.47)**	**0.4212 (1.60)**	**1.5052 (5.71)**	**17.5190 (66.46)**	**3.8146 (14.47)**	**26.36**
Morga III	Katghora	Kendai	4	Part	0.1676 (4.16)	1.0804 (26.84)	0.0429 (1.07)	0.6716 (16.69)	2.0624 (51.24)	0 (0.00)	4.02
					0.1676 (4.16)	**1.0804 (26.84)**	**0.0429 (1.07)**	**0.6716 (16.69)**	**2.0624 (51.24)**	**0 (0.00)**	**4.02**
Morga IV	Katghora	Kendai	3	Part	0.00(0.00)	0.2147 (4.50)	0.5232 (10.96)	1.055 (22.10)	2.9807 (62.44)	0 (0.00)	4.77
					0.00 (0.00)	**0.2147 (4.50)**	**0.5232 (10.96)**	**1.055 (22.10)**	**2.9807 (62.44)**	**0 (0.00)**	**4.77**
Morga South	Katghora	Kendai	22	Part	0.00(0.00)	1.0148 (4.55)	0.3818 (1.71)	0.7047 (3.16)	10.1664 (45.54)	10.0568 (45.05)	22.32
			2	Full	0.00(0.00)	0.1144 (2.46)	0.2166 (4.66)	0.1543 (3.32)	4.1287 (88.88)	0.0313 (0.67)	4.65

Name of Coal Block	Forest Division	Forest Range	No. of Compartment/ Village Name	Full or Part	Water	Non-Forest	Scrub	Open Forest	Moderately Dense Forest	Very Dense Forest	Total Area (sq.km)
					Area in sq.km (Area in %)						
			Morga	Part	0.00(0.00)	0.3543 (86.29)	0.0056 (1.36)	0.0037 (0.90)	0.0402 (9.79)	0.0068 (1.66)	0.41
			Uchlenga		0.00(0.00)	2.8832 (60.24)	0.0603 (1.26)	0.0305 (0.64)	0.6591 (13.77)	1.1527 (24.09)	4.79
			Arisiya		0.00(0.00)	0.6699 (38.13)	0.0136 (0.77)	0.3140 (17.87)	0.7095 (40.39)	0.0496 (2.82)	1.76
			Gidmuri		0.00(0.00)	0.00 (0.00)	0.00 (0.00)	0.0103 (8.85)	0.1061 (91.15)	0.00 (0.00)	0.12
					0.00 (0.00)	**5.0365 (14.80)**	**0.6779 (1.99)**	**1.2176 (3.58)**	**15.8101 (46.45)**	**11.2972 (33.19)**	**34.04**
Gidmuri	Surguja	Udaipur	2	Part	0.00(0.00)	0.00(0.00)	0.00(0.00)	0.00(0.00)	0.1611 (100.00)	0.00(0.00)	0.16
	Katghora	Kendai	6	Part	0.00(0.00)	0.8228 (15.00)	0.2463 (4.49)	0.4174 (7.61)	3.9974 (72.89)	0.00(0.00)	5.48
			Gidmuri	Part	0.00(0.00)	0.6261 (31.59)	0.0366 (1.85)	0.3709 (18.72)	0.9481 (47.84)	0.00 (0.00)	1.98
					0.00 (0.00)	**1.4489 (19.00)**	**0.2829 (3.71)**	**0.7883 (10.34)**	**5.1066 (66.96)**	**0.00 (0.00)**	**7.62**
Paturia	Katghora	Kendai	13	Part	0.00(0.00)	1.3802 (8.43)	0.2857 (1.75)	1.0069 (6.15)	6.6219 (40.47)	7.0693 (43.20)	16.36
			Uchlenga	Part	0.00(0.00)	0.00 (0.00)	0.00 (0.00)	0.0062 (1.10)	0.0117 (2.07)	0.5467 (96.81)	0.56
			Madanpur	Part	0.00(0.00)	0.1772 (25.10)	0.0356 (5.04)	0.1389 (19.67)	0.2998 (42.46)	0.0545 (7.72)	0.71
			Paturiyadand	Part	0.00(0.00)	2.3848 (72.25)	0.0292 (0.88)	0.1891 (5.73)	0.6924 (20.98)	0.0053 (0.16)	3.30
					0.00 (0.00)	**3.9422 (18.83)**	**0.3505 (1.67)**	**1.3412 (6.41)**	**7.6259 (36.43)**	**7.6758 (36.66)**	**20.93**
Madanpur North	Katghora	Kendai	15	Part	0.00(0.00)	3.4911 (18.74)	0.3853 (2.07)	2.5926 (13.92)	11.7971 (63.34)	0.3601 (1.93)	18.63
			Madanpur	Part	0.00(0.00)	0.0532 (30.77)	0.0235 (13.59)	0.0548 (31.69)	0.0413 (23.89)	0.00 (0.00)	0.17
					0.00 (0.00)	**3.5443 (18.85)**	**0.4088 (2.17)**	**2.6474 (14.08)**	**11.8384 (62.97)**	**0.3601 (1.92)**	**18.80**
Madanpur South	Katghora	Kendai	6	Part	0.00(0.00)	0.5159 (11.04)	0.218 (4.66)	0.4468 (9.56)	3.148 (67.36)	0.3449 (7.38)	4.67
			1	Full	0.00(0.00)	0.0133 (4.80)	0.00 (0.00)	0.00 (0.00)	0.2637 (95.20)	0.00 (0.00)	0.28
			Morga		0.00(0.00)	1.1694 (47.09)	0.0407 (1.64)	0.3616 (14.56)	0.9001 (36.24)	0.0116 (0.47)	2.48
					0.00 (0.00)	**1.6986 (22.85)**	**0.2587 (3.48)**	**0.8084 (10.87)**	**4.3118 (58.00)**	**0.3565 (4.80)**	**7.43**
Kente Extension	Surguja	Udaipur	15	Part	0.00(0.00)	0.9506 (6.42)	0.6858 (4.63)	1.9003 (12.83)	8.8158 (59.51)	2.4621 (16.62)	14.81
			1	Full	0.00(0.00)	0.0217 (0.72)	0.0172 (0.50)	0.1815 (5.31)	3.0518 (89.36)	0.1399 (4.10)	3.42
			Baseri	Part	0.00(0.00)	0.0854 (49.91)	0.00 (0.00)	0.0143 (8.36)	0.0493 (28.81)	0.0221 (12.92)	0.17
					0.00 (0.00)	**1.0607 (5.76)**	**0.7030 (3.82)**	**2.0961 (11.39)**	**11.9169 (64.76)**	**2.6241 (14.26)**	**18.40**
Parsa	Surajpur	Ramanuj Nagar	3	Part	0 (0.00)	0.1793 (14.12)	0.0735 (5.79)	0.0958 (7.54)	0.6186 (48.71)	0.3027 (23.84)	1.27
	Surguja	Udaipur	4	Part	0 (0.00)	0.9119 (20.44)	0.1636 (3.67)	0.3074 (6.89)	3.0778 (69.00)	0 (0.00)	4.46
			Fattepur	Part	0.00 (0.00)	2.1374 (83.11)	0.0066 (0.26)	0.1035 (4.02)	0.3243 (12.61)	0.00 (0.00)	2.57
			Salhi	Part	0.00 (0.00)	3.6672 (77.38)	0.0413 (0.87)	0.2445 (5.16)	0.7534 (15.90)	0.0328 (0.69)	4.74
	Surajpur	Ramanuj Nagar	Kamardi	Part	0.00 (0.00)	0.0240 (33.43)	0.0081 (11.28)	0.00 (0.00)	0.0397 (55.29)	0.00 (0.00)	0.07
					0.00 (0.00)	**6.9198 (52.77)**	**0.2931 (2.24)**	**0.7512 (5.73)**	**4.8139 (36.71)**	**0.3355 (2.56)**	**13.11**
PEKB	Surguja	Udaipur	14	Part	0 (0.00)	2.0629 (18.05)	0.459 (4.02)	2.2574 (19.76)	5.9764 (52.30)	0.6708 (5.87)	11.43

Name of Coal Block	Forest Division	Forest Range	No. of Compartment / Village Name	Full or Part	Water	Non-Forest	Scrub	Open Forest	Moderately Dense Forest	Very Dense Forest	Total Area (sq.km)
					Area in sq.km (Area in %)						
			2	Full	0 (0.00)	0.625 (11.05)	0.215 (3.80)	0.224 (3.96)	2.7536 (48.67)	1.8396 (32.52)	5.66
			Ghatbarra	Part	0.00 (0.00)	3.9315 (86.29)	0.0123 (0.27)	0.5543 (12.17)	0.0544 (1.19)	0.0035 (0.08)	4.56
			Baser	Part	0.00 (0.00)	0.0038 (7.97)	0.0056 (11.74)	0.0066 (13.84)	0.00 (0.00)	0.0316 (66.25)	0.05
			Salhi	Part	0.00 (0.00)	1.7798 (70.77)	0.0070 (0.28)	0.5811 (23.11)	0.1470 (5.85)	0.00 (0.00)	2.51
			Parsa	Part	0.00 (0.00)	4.1868 (92.10)	0.0089 (0.20)	0.1559 (3.43)	0.1797 (3.95)	0.0144 (0.32)	4.55
					0.00 (0.00)	**12.5899 (43.79)**	**0.7078 (2.46)**	**3.7793 (13.15)**	**9.1111 (31.69)**	**2.5600 (8.90)**	**28.74**
Tara Central	Surajpur	Ramanuj Nagar	13	Part	0 (0.00)	0.6178 (4.51)	0.1959 (1.43)	0.1513 (1.10)	2.706 (19.75)	10.0318 (73.21)	13.70
			3	Full	0.00(0.00)	0.3359 (5.91)	0.1998 (3.51)	0.0515 (0.91)	0.2899 (5.10)	4.8099 (84.58)	5.69
	Katghora	Kendai	1	Part	0.00(0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.0676 (100.00)	0.00 (0.00)	0.07
	Surajpur	Ramanuj Nagar	Tara	Part	0.00(0.00)	1.1363 (46.08)	0.0167 (0.68)	0.0543 (2.20)	0.4808 (19.50)	0.7777 (31.54)	2.47
			Janardanpur	Part	0.00 (0.00)	0.2576 (30.69)	0.0097 (1.16)	0.1211 (14.43)	0.0295 (3.51)	0.4214 (50.20)	0.84
			Kantaroli	Part	0.00 (0.00)	1.9543 (56.15)	0.0732 (2.10)	0.1611(4.63)	0.4983 (14.32)	0.7933 (22.79)	3.48
			Salhi	Part	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.0167 (25.00)	0.0017 (2.54)	0.0484 (72.46)	0.07
			Tattepur	Part	0.00 (0.00)	0.1355 (34.79)	0.0244 (6.26)	0.0090 (2.31)	0.2206 (56.64)	0.0001 (0.03)	0.39
					0.00 (0.00)	**4.4375 (16.62)**	**0.5196 (1.95)**	**0.5650 (2.12)**	**4.2945 (16.08)**	**16.8825 (63.23)**	**26.69**
Puta-Parogia	Surajpur	Ramanuj Nagar	2	Part	0.00(0.00)	0.1588 (2.73)	0.0403 (0.69)	0.3833 (6.59)	3.6616 (62.91)	1.5765 (27.09)	5.82
			Kantaroli	Part	0.00(0.00)	0.0001 (0.03)	0.00 (0.00)	0.0019 (0.32)	0.2577 (81.91)	0.0558 (17.74)	0.31
	Surguja	Udaipur	10	Part	0.00(0.00)	0.7459 (4.50)	0.5809 (3.50)	1.2707 (7.66)	11.9676 (72.18)	2.0144 (12.15)	16.58
			Ghatbarra	Part	0.00(0.00)	1.6457 (40.50)	0.0707 (1.74)	0.7776 (19.14)	1.5691 (38.62)	0.00 (0.00)	4.06
	Katghora	Kendai	14	Part	0.00(0.00)	2.1238 (10.75)	0.5071 (2.57)	2.1416 (10.84)	14.9547 (75.69)	0.0308 (0.16)	19.76
			Puta	Part	0.00 (0.00)	0.9888 (52.44)	0.1133 (6.01)	0.2001 (10.61)	0.5833 (30.94)	0.00 (0.00)	1.89
			Gidmuri	Part	0.00 (0.00)	0.4742 (31.51)	0.00 (0.00)	0.1563 (10.39)	0.8744 (58.10)	0.00 (0.00)	1.51
					0.00 (0.00)	**5.1484 (10.72)**	**1.1990 (2.50)**	**4.7306 (9.85)**	**33.2852 (69.29)**	**3.6775 (7.65)**	**48.04**
Parogia	Surguja	Udaipur	6	Part	0.00(0.00)	0.3724 (7.30)	0.0855 (1.68)	0.3526 (6.91)	2.2029 (43.16)	2.0907 (40.96)	5.10
			1	Full	0.00(0.00)	0.0345 (1.68)	0 (0.00)	0.0381 (1.86)	1.2584 (61.36)	0.7197 (35.10)	2.05
					0.00 (0.00)	**0.4069 (5.69)**	**0.0855 (1.20)**	**0.3907 (5.46)**	**3.4613 (48.38)**	**2.8104 (39.28)**	**7.15**
Saidu	Surguja	Udaipur	3	Part	0.00(0.00)	0.1246 (3.72)	0.0455 (1.36)	0.513 (15.33)	1.8149 (54.23)	0.8486 (25.36)	3.35
			1	Full	0.00 (0.00)	0.0546 (2.85)	0.0300 (1.56)	0.2099 (10.94)	0.8337 (43.46)	0.7902 (41.19)	1.92
			Saidu	Part	0.00 (0.00)	0.0082 (2.54)	0.0013 (0.40)	0.0262 (8.13)	0.1838 (57.03)	0.1028 (31.90	0.32
	Katghora	Kendai	4	Part	0.00(0.00)	0.2996 (11.79)	0.2462 (9.69)	0.3355 (13.21)	1.6525 (65.04)	0.0068 (0.27	2.54
					0.00 (0.00)	**0.4870 (5.99)**	**0.3230 (3.97)**	**1.0846 (13.34)**	**4.4849 (55.18)**	**1.7484 (21.51)**	**8.12**
Pindraki	Surguja	Udaipur	17	Part	0.00(0.00)	1.4568 (8.71)	0.651 (3.89)	1.7701 (10.59)	12.8437 (76.81)	0 (0.00)	16.72
			2	Full	0.00(0.00)	0.7774 (12.97)	0.3363 (5.61)	1.1383 (18.99)	3.7433 (62.44)	0 (0.00)	6.00
			Pendarkhi		0.00 (0.00)	1.0968 (89.67)	0.00 (0.00)	0.0191 (1.56)	0.1073 (8.77)	0.00 (0.00)	1.22

Name of Coal Block	Forest Division	Forest Range	No. of Compartment/ Village Name	Full or Part	Water	Non-Forest	Scrub	Open Forest	Moderately Dense Forest	Very Dense Forest	Total Area (sq.km)
					Area in sq.km (Area in %)						
					0.00 (0.00)	**3.3310 (13.31)**	**0.9873 (4.12)**	**2.9275 (12.23)**	**16.6943 (69.73)**	**0.00 (0.00)**	**23.94**
Sarma	Surguja	Udaipur	9	Part	0.00(0.00)	2.0483 (22.71)	0.0631 (0.70)	2.1676 (24.03)	4.7422 (52.57)	0 (0.00)	9.02
			2	Full	0.00(0.00)	0.8334 (26.18)	0.0131 (0.41	0.2382 (7.48)	2.0984 (65.92)	0 (0.00)	3.18
			Pota	Part	0.00 (0.00)	2.3984 (84.15)	0.0009 (0.03)	0.2984 (10.47)	0.1524 (5.35)	0.00 (0.00)	2.85
			Tendutikra	Part	0.00 (0.00)	1.0733 (83.57)	0.00 (0.00)	0.07.9 (5.68)	0.1381 (10.75)	0.00 (0.00)	1.28
			Chakra	Part	0.00 (0.00)	1.2152 (70.20)	0.0132 (0.76)	0.5010 (28.94)	0.0016 (0.09)	0.00 (0.00)	1.73
			Ramnagar	Part	0.00(0.00)	0.0331 (30.71)	0.00 (0.00)	0.0564 (52.32)	0.0183 (16.98)	0.00 (0.00)	0.11
					0.00 (0.00)	**7.6016(41.82)**	**0.0903 (0.50)**	**3.3345 (18.34)**	**7.1510 (39.34)**	**0.00 (0.00)**	**18.17**
Laxmangarh	Surguja	Udaipur	10	Part	0.00 (0.00)	1.8463 (24.48)	0.3618 (4.80)	2.2082 (29.28)	3.0817 (40.87)	0.0428 (0.57)	7.54
			1	Full	0.00 (0.00)	1.6991 (53.74)	0.9486 (30.00)	0.5125 (16.21)	0.0015 (0.05)	0.00 (0.00)	3.16
			Laxmangarh	Part	0.00 (0.00)	1.5121 (76.29)	0.1786 (8.84)	0.2809 (13.90)	0.0198 (0.98)	0.00 (0.00)	2.02
			Mahespur	Full	0.00 (0.00)	1.1292 (93.59)	0.0902 (2.04)	0.0326 (0.74)	0.1602 (3.63)	0.00 (0.00)	4.41
			Mohanpur	Part	0.0332 (2.14)	1.2448 (80.41)	0.0080 (0.52)	0.1856 (11.99)	0.0765 (4.94)	0.00 (0.00)	1.55
			Jhirmiti	Part	0.00 (0.00)	1.8784 (93.35)	0.0046 (0.23)	0.0994 (4.94)	0.0299 (1.49)	0.00 (0.00)	2.01
			Ramnagar	Part	0.00 (0.00)	1.4675 (97.85)	0.00 (0.00)	0.0262 (1.75)	0.0059 (0.39)	0.00 (0.00)	1.50
			Phungi	Part	0.00 (0.00)	1.1281 (78.11)	0.1720 (11.91)	0.1362 (9.43)	0.0079 (0.55)	0.00 (0.00)	1.44
					0.0332 (0.14)	**14.9356 (63.18)**	**1.7638 (7.46)**	**3.4815 (14.73)**	**3.3836 (14.31)**	**0.0428 (0.18)**	**23.64**
Bhakurma-Matringa	Surguja	Udaipur	18	Part	0.0147 (0.09)	4.6587 (27.78)	0.1053 (0.63)	0.7534 (4.49)	10.8046 (64.44)	0.4315 (2.57)	16.77
			04	Full	0.0232 (0.25)	1.9651 (21.29)	0.1843 (2.00)	0.7869 (8.53)	4.3999 (47.67)	1.8705 (20.27)	9.23
					0.0379 (0.15)	**6.6238 (25.48)**	**0.2896 (1.11)**	**1.5403 (5.92)**	**15.2045 (58.48)**	**2.3020 (8.85)**	**25.99**
Kedma	Surguja	Udaipur	12	Part	0.0365 (0.33)	1.3346 (12.03)	0.00 (0.00)	0.5176 (4.67)	7.6828 (69.25)	1.5221 (13.72)	11.09
			03	Full	0.00 (0.00)	0.2224 (3.55)	0.00 (0.00)	0.1898 (3.03)	3.8458 (61.47)	1.9987 (31.94)	6.26
			Kedma		0.00 (0.00)	0.3796 (57.45)	0.00 (0.00)	0.00 (0.00)	0.2813 (42.57)	0.00 (0.00)	0.66
			Badegaon		0.00 (0.00)	0.5185 (81.33)	0.00 (0.00)	0.0661 (9.80)	0.0537 (7.96)	0.0061 (0.90)	0.67
			Keshma		0.00 (0.00)	0.1565 (58.22)	0.00 (0.00)	0.0289 (10.75)	0.0834 (31.03)	0.00 (0.00)	0.27
					0.0365 (0.19)	**2.6416 (13.94)**	**0.00 (0.00)**	**0.8024 (4.23)**	**11.9469 (63.03)**	**3.5269 (18.61)**	**18.95**

Source: 1. Forest compartment provided by Chhattisgarh State Forest Department

2. Forest cover classification as per FSI scheme of classification of canopy density *i.e.*, very dense forest (>70%); moderately dense forest (>40% and <70%); open forest ((>10% and < 40%) and scrub (< 10%);

Forest cover area: The minimum area of very dense forest was recorded from Laxmangarh (0.043 sq.km) followed by Parsa (0.34 sq.km), Madanpur South and Madanpur North (0.36 sq.km), while maximum areas were recorded from Tara (16.88 sq.km) followed by Morga South (11.97 sq.km), Morga- I (8.58 sq.km) Paturia (7.68 sq.km), Morga-II (3.81 sq.km), Puta Parogia (3.68 sq.km) and Kedma (3.53 sq.km).

4.4 GROUND SURVEY FROM THE COAL BLOCKS

Chotia Coal block

Chotia coal block constitutes two sub blocks such as Chotia- 2A & 2B, which falls in Korbi forest circle with Sakhoda, Lalpur, Parla, Korbi, Lad and Kapanpara forest beats under Kendai forest range of Katghora Forest Division, Korba district. Chotia sub block-2A falls in Parla Protected forest and Chotia, Baniya and Rhode are its fringe villages. Chotia sub- block-2B falls in Lad protected forest belonging to Sakhoda forest beat and Bhujang Kachar (Sakhoda/Salaigote para), Jajgi, Guchanpur, Fulsar are its fringe villages.

- **Chotia-sub block 2A** falling under Parla forest beat is constituted of Parla protected forest compartments of P-347 to P-351 and orange areas of OA-703 to OA-707.
- The vegetation in Chotia-sub block 2A is dominated by Northern Dry Mixed Deciduous forests followed by Moist Peninsular Low-Level Sal forests and patches of Southern Moist Mixed Deciduous Forests and Dry Peninsular Sal Forests with density class of moderately dense to open forests.
- **Chotia-sub block 2B** falling under Sakoda forest beat is constituted of Lad protected forest compartments of P-328, P-329, P-330, P 331, P 332, P-333 and P 334.

The vegetation in Chotia sub–block 2B is dominated by Northern Dry Mixed Deciduous forests and sporadic patches of Moist Peninsular Low Level Sal forests and Dry Peninsular Sal Forests with density class of moderately dense to open forests.

The buffer zone falling in Lad protected forest compartments of P 352, P 353, P 354 and orange area OA 708, OA-709 in Kapanpara forest beat; and P-335, P-341 and OA 708 to OA 712 in Lalpur forest beat; and P-342, P-343, P-344, P-345, P-346 and orange areas like OA-713, OA-714, OA-715, OA-717, OA 719 in Korbi forest beat which is dominated by Northern Dry Mixed Deciduous forests and sporadic patches of Moist Peninsular Low Level Sal forests.

Morga-I Coal Block boundary provisionally falls under Dhajak and Lam Pahar protected forest constituting of forest compartments like P-370 to P-374, P-379, P-401 to P-404 and OA-701 to OA-702, and Ketma, Morga, Kendai, Dhajak and its Para Botopal as their fringe villages. The vegetation is dominated by Moist Peninsular

Low-Level Sal Forests followed by patches of Southern Moist Mixed Deciduous Forests with moderately dense forest canopy. Moist Peninsular Low-Level Sal Forests with very dense forest canopy is found in forest compartments P-372, P-379, P-390, P-401 to P-404 and OA-702 parts of the coal block falling under Lam Pahar protected forests.

Morga-II Coal Block boundary provisionally falls under Dhajak protected forest constituting of forest compartments of P-373, P-375, P-377 to P-383, P-390 to P-391, P-394 and Kendai and Sagbari as its fringe villages. The vegetation is dominated by Moist Peninsular Low-Level Sal Forests, followed by patches of Southern Moist Mixed Deciduous Forests with moderately dense forest canopy. Moist Peninsular Low Level Sal Forests and patches of Southern Moist Mixed Deciduous Forests with very dense forest canopy are found in forest compartments of P-380, P-383, P-391 parts of the coal block.

Morga-III and **Morga-IV Coal Block** boundaries provisionally falls under Dhajak protected forest constituting of forest compartments such as P 355 & P 356, P-374 & P 375 respectively and Botopal Para of Dhajak village as fringe village. The vegetation is dominated by Moist Peninsular Low Level Sal Forest Type and patches of Southern Moist Mixed Deciduous Forest Type with moderately dense forest canopy to open forest canopy and scrub.

Morga South Coal Block provisionally falls under Lam Pahar, Dhajak and Paturia protected forest constituting of forest compartments P 385, P 365 & P 366, P-421 to P 423, P 427 & P 428, P 737 to P-740, OA-698 to OA 700 and Morga, Uchlenga, Arsiya and Thirmana as their fringe villages. The vegetation is dominated by Moist Peninsular Low Level Sal Forests, followed by Southern Moist Mixed Deciduous Forests with very dense to moderately dense forest canopy and sporadic open forest canopy Moist Peninsular Low Level Sal Forests and patches of Southern Moist Mixed Deciduous Forests with very dense forest canopy are found in forest compartments of P 365, P-427 to P 428, OA 698 to 700.

Puta Parogia Coal Block provisionally falls under Fathepur and Paturia protected forest and Pidiya Reserve Forest constituting of forest compartments P 430, P 431, P 433, P-435, P 440 to P 442, P 1980 to P 1981, P 998, P 2000 to P 2002, P 2014, P 2015, P 2070, and Puta and Paturiya as their fringe villages. The vegetation is dominated by Moist Peninsular Low-Level Sal Forest Type followed by Southern Moist Mixed Deciduous Forest Type and Dry Peninsular Sal Forest types with very dense to moderately dense forest and sporadic open forest. Very dense forest is found in forest compartments P 2001 and P 1980.

Parogia Coal Block provisionally falls under Fathepur protected forest consisting of forest compartments like P-2111 to P-2114, P-2070 and P 2116 and Saidu, Ghatbara and Parogia as its fringe villages. The vegetation is dominated by Moist Peninsular Low Level Sal Forests, followed by Southern Moist Mixed Deciduous Forests and

Dry Peninsular Sal Forests with very dense canopy in compartments of P-2113, P-2114, P- 2116 and P-2070 to moderately dense forest canopy and sporadic open forest canopy.

Saidu Coal Block provisionally falls under Pidiya protected forest constituting of forest compartments like P-2116 to P-2118, P-2070 and P-441, P-444 to P-446 and Saidu, Thiramna, Suskam, Gidmuri and Khotkhuri as its fringe villages. The vegetation is dominated by Moist Peninsular Low-Level Sal Forests followed by Southern Moist Mixed Deciduous Forests with very dense canopy in compartments of P 2116 & 2117, P-2070 to moderately dense forest canopy and sporadic open forest canopy and scrub.

Pindraki Coal Block provisionally falls under Pindrikhi protected forest consists of forest compartments such as P 2074, P-2075, P-2122 to P 2125, P-2127, P-2130 to P-2135, P-2137, and Pindrikhi, Chakeri and Parogia as its fringe villages. The vegetation is dominated by Moist Peninsular Low-Level Sal Forests followed by Southern Moist Mixed Deciduous Forests and Dry Peninsular Sal Forests with moderately dense forest canopy to sporadic open forest canopy and scrub. Siar forest circle under Udaipur forest range of Surguja Forest Division consists of 04 forests beats *viz.* Siar, Khoji, Pindraki and Bakoi. The forest compartments of P-2121, P-2122, P-2071, P-2072, P-2135, P-2136, P-2137, P-2138 of Khoji beat, P-2137 to P-2147 are forming boundary with seasonal Dokar nala with P-2047 and Chornai River with P-2044 of Bakoi Beat and P 2037 to P 2045, P-2080 to P-2082, P 2085 and P-2090 of Siar forest beat. Khoji beat forest is dominated by Sal and associates with density of 0.5 and site quality of III and IV Beat has natural boundary of Bhunbhoki nala at compartment P 2121 and 2122. A mixed forest with canopy density of 0.7 is found in the Bakoi beat. The Sal is dominant species intermixed with associated species and density of 0.5 in Siar beat.

Madanpur North Coal Block provisionally falls under Dhajak protected forest constituting of forest compartments like P 359, P 363, P 367 to P 369, P 371 and P-388, and Madanpur and Khirti as its fringe villages. The vegetation is dominated by Moist Peninsular Low Level Sal Forests followed by Southern Moist Mixed Deciduous Forests with moderately dense forest canopy to sporadic open forest canopy and scrub.

Paturia Coal Block falls under Dhajak and Paturia forest consists of forest compartments of P 364, P-367, P-386, P-387, P-427 to P 430, P 433 to P 436, and Madanpur, Paturia, Uchlenga as fringe villages. The vegetation is dominated by Moist Peninsular Low-Level Sal Forests followed by Southern Moist Mixed Deciduous Forests with very dense to moderately dense forest canopy and sporadic open forest canopy. Moist Peninsular Low-Level Sal Forests and patches of Southern Moist Mixed Deciduous Forests with very dense forest canopy were observed in forest compartments like P-365, P-366, P-427 to 429, OA- 698 of Paturia CB.

Gidmuri Coal Block falls in Paturia protected forest constituting of forest compartments like P-433 to P-435, and Gidmuri and Paturia as its fringe villages. The vegetation is dominated by Moist Peninsular Low-Level Sal Forests followed by Southern Moist Mixed Deciduous Forests with moderately dense to open forest canopy.

Madanpur South Coal Block falls under Dhajak protected forest constituting of forest compartments like P 368, P 385, P 386, P 389 and OA 701, and Morga and Ketma as its fringe villages. The vegetation is dominated by Moist Peninsular Low-Level Sal Forests and sporadic patches of Southern Moist Mixed Deciduous Forests with moderately dense forest canopy and sporadic open forest canopy and scrub. Site quality of IVa and b and bamboo are absent. Manasi and Bamhani nalas and Bisrar nala are major drainages.

Operational Parsa East & Kanta Basan Coal Block (PEKB) falls under Fathepur, Matringa and Ghatbara Protected Forest constituting of compartments such as P 2002 to P 2005, P 2007 & P 2008, P 2106 and P 2111, and Ghatbara, Kete, Parsa and Hariharpur as its fringe villages. The vegetation is dominated by Moist Peninsular Low Level Sal Forests and patches of Southern Moist Mixed Deciduous Forests with moderately dense forest canopy and open forests and scrub. Very dense forest canopy can be seen in compartments like P 2002 to 2004.

Tara Coal Block falls under Pidiya Reserve forest constituting of compartments such as P 1932, P 1977 to P 1979, P 1983 to P 1987, P 1992, P 1997, and Tara and Kantaroli as its fringe villages. The vegetation is dominated by Moist Peninsular Low Level Sal Forests followed by Southern Moist Mixed Deciduous Forests and small patches of Dry Peninsular Sal Forests. Whole of area under coal block boundary has very dense forest and moderately dense forest canopy.

Parsa Coal Block falls under Pidiya Reserve forest constituting of compartments such as P 1982, P 1986, P 1998, P 2005 & P 2006, and Fathepur and Hariharpur as its fringe villages. The vegetation is dominated by Moist Peninsular Low Level Sal Forests and patches of Southern Moist Mixed Deciduous Forests with moderately dense forest canopy and open forests and scrub.

Kente Extension Coal Block falls in Ghatbara and Matringa Protected Forest with forest compartments like P 2003, P 2069, P 2099, P 2104 to P 2112, P 2124 to P 2130, and Kete, Chakeri, Parogia and Basan as fringe villages. The vegetation is dominated by Moist Peninsular Low Level Sal Forests followed by Southern Moist Mixed Deciduous Forests and Dry Peninsular Sal Forests with moderately dense, open forest canopy and scrub forest.

Laxmangarh Coal Block provisionally falls in Puta Protected Forest constituting of compartments such as P 2035, P 2046 to P 2048, P 2063 to P 2065. The vegetation is dominated by Moist Peninsular Low Level Sal Forests and Dry Peninsular Sal Forests

with open forest canopy and scrub in fringes of Laxmangarh village. Moderately dense forest canopy exists in patches along the block boundary.

Sarma Coal Block provisionally falls in Chakeri and Puta Protected Forest constituting of compartments of P-2055, P-2056, P-2060 to P-2062, P- 2067. The vegetation is dominated by Moist Peninsular Low-Level Sal Forests and Dry Peninsular Sal Forests and small patches of Southern Moist Mixed Deciduous Forests with moderately dense forest canopy. Open forest canopy and scrub in fringes of Chakeri, Sarma and Tendu tikra villages.

Bhakurma-Matringa Coal Block provisionally falls in Kedma Protected Forest constituting of compartments such as P-2144 to P-2146, P-2149, P-2164 to P-2167, P-2181, P-2186 to P-2190, and Kedma and Khudarbasar as its fringe villages. The vegetation is dominated by Moist Peninsular Low-Level Sal Forests followed by Southern Moist Mixed Deciduous Forests and small patches of Dry Peninsular Sal Forests and dry bamboo brakes with moderately dense forest canopy. Open forest canopy and scrubs in fringes of Kedma and Khudarbasar villages.

Kedma Coal Block provisionally falls in Kedma protected forest constituting compartments like P-2164, P-2172 to P-2174, P-2221 to P-2225, P-2234, and Kedma, Bule, Badegaon as its fringe villages. The vegetation is dominated by Moist Peninsular Low-Level Sal Forests followed by Southern Moist Mixed Deciduous Forests and small patches of Dry Peninsular Sal Forests and dry bamboo brakes with moderately dense forest canopy. Very dense forest canopy is in compartments such as P-2173 & P-2174 and P- 2221 & P-2222. Open forest canopy is in fringes of Bule, Badegaon and Kedma villages. Dense forests mainly of Sal mixed with Saja, Dhavda, Tendu, Mahua, Harar, Bahera, Amla, Char, Tinsa, Beeja, etc., with site quality of III and IVB.

Nakiya Coal Block provisionally falls in Matringa Protected Forest constituting of compartments such as P 876 to P 879, P-901 to P 904, OA- 1196, OA- 1198 & OA-1199, and Nakiya and Bimalata as fringe villages. The vegetation is dominated by Southern Moist Mixed Deciduous Forests followed by Moist Peninsular Low Level Sal Forests and patches of dry bamboo brakes with moderately dense forest canopy and open forest canopy.

4.5 VEGETATION STRUCTURE

The structure of vegetation in the study area of Hasdeo-Arand Coalfield is represented by Sal and mixed forests, intermixed with dry bamboo breaks. Sal forests are found to the extent of 80% and mixed forests to the extent of 20%. The forests of the area are mainly tropophilous type (neither damp nor very dry) dominated by Sal as the climatic climax. Due to prevalence of optimal climatic conditions for better germination, establishment and development, these forests are known as the home of Sal. Important tree species associated with the Sal in these forests were *Diospyros*

melanoxylon, Madhuca longifolia var. *latifolia, Buchanania lanzan, Lagerstroemia parviflora, Terminalia elliptica, Anogeissus latifolia, Boswellia serrata, Semecarpus anacardium, Cascaria graveolens, Syzygium cumini, Terminalia chebula, Lannea coromandelica, Syzygium nervosum, Symplocos racemosa, Haldina cordifolia, Pterocarpus marsupium, Croton persimilis, Dalbergia latifolia,* and *Cleistanthus collinus.* The structural composition of Sal forest is given as below:

4.5.1 Top canopy: *Shorea robusta, Diospyros melanoxylon, Terminalia elliptica, T. chebula, Anogeissus latifolia, Madhuca longifolia* var. *latifolia, Pterocarpus marsupium, Lagerstroemia parviflora, Syzygium cuminii, Chloroxylon swietenia, Dalbergia paniculata, Bridelia retusa, Miliusa tomentosa,* etc.

4.5.2 Middle canopy: *Phyllanthus emblica, Bauhinia racemosa, Buchanania lanzan, Semecarpus anacardium, Careya arborea, Lannea coromandelica, Cleistanthes collinus, Cassearia graveolens, C. tomentosa, Bauhinia retusa, B. variegata, Mallotus philippensis, Holarrhena pubescens, Wendlandia exserta,* etc.

4.5.3 Lower canopy: *Abutilon indicum, Ardisia solanacea, Cipadessa baccifera, Clerodendrum infortunatum, Colebrookia oppositifolia, Desmodium pulchellum, Dodonaea viscosa, Embelia tsjeriam cottam, Flemingia semialata, Flemingia strobilifera, Gardenia gummifera, Grewia hirsuta, Helicteres isora, Indigofera cassioides, Leea asiatica, Murraya paniculata, Nyctanthes arbortristis, Phoenix loureirii, Senna auriculata, Thespesia lampas* and *Woodfordia fruiticosa.*

Significant species of lianas were *Acacia pennata, Acacia caesia, Bauhinia vahlii, Butea superba, Entada rheedii, Cryptolepis buchanani, Millettia extensa, Millettia racemosa, Spatholobus parviflorus, Symphorema involucratum, Ventilago maderaspatana etc.* Major shrubby climbers were *Ampelocissus latifolia, Asparagus racemosus, Cissampelos pareira, Cocculus hirsutus, Cryptolepis buchananii, Gymnema sylvestre, Hemidesmus indicus, Jasminum multiflorum, Dioscorea* spp., *Pueraria tuberosa, Smilax perfoliata, S. zeylanica, Thunbergia fragrans* and *Tinospora cordifolia.*

4.5.4 Ground flora: The ground flora consists of herbs and sedges like *Acrocephalus indicus, Adiantum philippense, Ageratum conyzoides, Alysicarpus monilifer, Andrographis paniculata, Biophytum reinwardtii, Blumea flava, Bytneria herbacea, Cajanus scarabaeoides, Cheilanthus farinosa, Commelina diffusa, Corchorus aestuans, Curculigo orchioides, Cyperus iria, Cyperus rotundus, Desmodium triflorum, Elephantopus scaber, Emilia sonchifolia, Evolvulusalsinoides, Evolvulus nummularius, Justicia glauca, Justicia quinquangularis, Lindernia ciliata, Lindernia crustacea, Mitracarpus hirtus, Murdannia nudiflora, Murdannia spirata, Oldenlandia herbacea, Phyllanthus urinaria, Rungia pectinata,Sida acuta, Sida cordata, Spermacoce articularis, Spermacoce latifolia, Spermacoce ocymoides, Spilanthes calva, Triumfetta rhomboidea, Vernonia cinerea* and *Zornia gibbosa; and grasses like Alloteropsis cimicina, Aristida adscensionis, Imperata cylindrica, Themeda*

quadrivalvis, Heteropogon contortus, Eulaliopsis binata, Iseilema nervosum, Eragrostis tenella Aristida setacea, Arthraxon lancifolius, Bothriochloa pertusa, Chloris dolichostachya, Cynodon dactylon, Digitaria abludens, Digitaria ciliaris, Eragrostis ciliaris, Hackelochloa granularis, Imperata cylindrica Oplismenus burmannii, etc.

Sal forests are represented by following forest types classified by Champion and Seth, 1968:

Moist Peninsular Low-Level Sal Forests (3C/2e (ii)): The most dominant species is *Shorea robusta* and associate species are *Terminalia elliptica, Cascaria graveolens, Anogeissus latifolia, Lagerstroemia parviflora, Buchanania lanzan, Croton persimilis Cassia fistula*, etc. The shrub layer includes *Indigofera cassioides, Phoenix loureirii, Woodfordia fruticosa, Flemingia chappar, etc.*

Dry Peninsular Sal Forest (5B/C1): The most dominant species is *Shorea robusta* and associate species are *Buchanania lanzan, Terminalia elliptica, Diospyros melanoxylon, Haldina cordifolia, Lannea coromandelica, Boswellia serrata* and *Schleichera oleosa.* The shrub species are *Carissa spinarum, C. carandas* and *Woodfordia fruticosa. Bauhinia vahlii* also found as climber.

Mixed forests are found to the extent of 20% in the study area and constituted with top, middle and lower canopy. The structural composition of mixed forests is given below:

Top canopy is represented by *Terminalia elliptica, T. chebula, Anogeissus latifolia, Boswellia serrata, Shorea robusta, Lannea coromandelica, Diospyros melanoxylon, Pterocarpus marsupium, Ougeinia oojeneusis*, and *Madhuca longifolia* var. *latifolia, Mitragyna parvifolia, Lagerstroemia parvflora, Grewia tiliaefolia, Syzygium cuminii, Garuga pinnata, Kydia calycina, Haldina cordifolia, Cleistanthus collinus, Sterculia urens, Hymenodictyon excelsum* and *Dalbergia paniculata.*

Middle canopy is represented by *Phyllanthus emblica, Bauhinia racemosa, Buchanania lanzan, Cassia fistula, Semecarpus anacardium, Acacia catechu, Cascaria graveolens, Careya arborea, Ziziphus xylopyrus, Butea monosperma, Aegle marmelos, Chloroxylon swietenia, Bridellia retusa* and *Flacourtia indica.*

Lower canopy is represented by *Gardenia gummifera, Nyctanthes arbor tristis, Woodfordia fruiticosa, Holarrhena pubescens, Indigofera cassioides, Grewia hirsuta, Phoenix loureirii, Helicteres isora*in association of some grasses like *Heteropogon contortus, Imperata cylindrica, Eulaliopsis binata, Eragrostis tenella, etc.* Some prominent climbers include *Butea superba, Bauhinia vahlii, Ventilago maderaspatana, Combretum roxburgii, Milletia extensa, Celastrus paniculata* and *Smilax macrophylla* are also found in the mixed forest.

Southern Moist Mixed Deciduous Forest (3B/C2): This type of forest spread in ridge and lower slopes and mostly confined to moist sub humid zone have a close canopy with tall and cylindrical trees. The under storey is well defined and the forest floor is full of vegetal growth. The important species are Sal in association with *Terminalia elliptica, Pterocarpus marsupium, Haldina cordifolia, Anogeissus latifolia, Mitragyna parvifolia, Lagerstroemia parviflora, Mangifera indica* and *Dalbergia latifolia.* The understory consists of *Schleichera oleosa, Lannea coromandelica, Diospyros melanoxylon, Phyllanthus emblica, Careya arborea, etc. Dendrocalamus strictus* is the typical bamboo species.

Northern Dry Mixed Deciduous Forest (5B/C2): This type of forest is mostly represented by economically important and deciduous trees. It occurs on steep slope and in upper valley with low frequency of *Shorea robusta.* The species compositions are *Haldina cordifolia, Terminalia elliptica, Madhuca longifolia* var. *latifolia, Butea monosperma, Holoptelea integrifolia, Ougeinia oojeinensis, Pterocarpus marsupium, Diospyros melanoxylon, Buchanania lanzan* and *Dalbergia latifolia.*

Dry Bamboo Brake (5/E9): The presence of dry bamboo (Dendrocalamus strictus) formations is one of the dominant features of the forest type. They are more or less spread in patches. In fertile patches, the Bamboo is found growing luxuriously in dense patches along with the grasses and deciduous trees, often thorny scrub in between. Other associate species were *Boswellia serrata* and *Sterculia urens* of this type of forest. The shrubs are *Justicia adhatoda, Carissa spinarum, Woodfordia fruticosa,* etc.

4.6 VEGETATION COMPOSITION

4.6.1 Secondary sources

A total of 281 species of Phanerogams belonging to 195 genera covering 60 families were listed from different sources of secondary information (Working Plan, EIA/EMP, articles and research papers) from the Surguja and nearby forest areas. As per information, Leguminosae (Fabaceae, Caesalpinaceae and Mimosaceae) with 54 species were found as dominant family followed by Poaceae (34 species), Rubiaceae (16 species) and Apocynaceae (11 species) while genus *Ficus* was the dominant genera followed by *Bauhinia, Acacia* and *Ziziphus.*

Hait and Sharma, (2013) reported that Surguja Coalfield area is major coal mining areas of Surguja district which are prone for ecological imbalance. Chatterjee (2014a) carried out ecological studies of vegetation of Odgi forest of Surguja district and recorded 22 tree species. Sinha *et al.,* (2015) assessed the Sal Seedlings in the Khairbar plantation site of Surguja Forest Division and reported 27 herb species. A total of 15 species (6 herb species under 4 families and 9 shrub species under 8 families) recorded from five vegetation stands (*i.e.,* Teak, Sal, Mangium, Eucalyptus and Bamboo) to assess the understory vegetation stratum associated with floral

diversity and litter biomass of the Surguja forest (Rajput *et al.*, 2019). Quamar & Bera (2016) have reported 60 species under 23 families from Surguja region that consists of four types of forest [i. Teak (*Tectona grandis*); ii. Sal (*Shorea robusta*) iii. Bamboo (*Bambusa arundinacea*) trees; and iv. mixed forest].

As per working plan of Korba and Katghora forest divisions, 209 plant species (101 trees, 45 shrubs and herbs, 28 climbers, 28 grasses, 04 bamboos and 03 parasites) have been listed from the area. The Rajpur block of Surguja district had good diversity of trees in contrast to other areas of Chhattisgarh (Jhariya and Oraon, 2012; Sinha & Sinha, 2013; Chatterjee, 2014a). About 79 deciduous forest trees species belonging to 32 families were reported from this area by Shukla & Singh 2014. A total of 84 plant species (15 from core zone and 69 from buffer zone) belonging to 39 families have been recorded from the Parsa open cast coal mine area (EIA report 2018). As per EIA report of Parsa East and Kanta Basan open cast coal mine, occurrence of 26 plant species in core zone and 87 plant species in buffer zone of the coal mine have been reported. Kumar *et al.*, (2016) studied the three plantation sites (*Eucalyptus*, Teak and Mixed *i.e. Cassia* and *Mangium*) for vegetation dynamics at Bishrampur collieries in Surajpur district and found that 07 shrub species with 06 families in the different sites of mining areas, 05 species with 04 families in the different plantation sites and in seedling layer a sum of 18 species with 10 families were recorded in different plantation sites. Prakash *et al.*, (2020) have recorded 97 plant species (44 trees, 16 shrubs, 35 herbs and 02 fungi species) from the HAC in the winter season. Based on the IVI value of 10 km radius area the Sal (*Shorea robusta*) has been considered as dominant species in the area.

The forest of core zone of PEKB OCP is dominated by *Shorea robusta* (Sal) and thus categorized as Sal forest. *Madhuca longifolia* var. *latifolia* (*Madhuca indica*), *Diospyros melanoxylon*, *Buchanania lanzan*, *Anogeissus latifolia* and *Boswellia serrata* were the major associates on companion species of Sal forest in both core and buffer zones. *Syzygium salicifolium* (*Eugenia heyneana*), *Lagerstromia parviflora*, *Haldina cordifolia*(*Adina cordifolia*), *Terminalia tomentosa*, *Garuga pinnata*, *Phyllanthus emblica*, *Semecarpus anacradium*, *Bridelia retusa* and *Symplocos racemosa* were the major species in terms of frequency, density and dominance. (EIA Report of PEKB coal mines for expansion from 10 to 15 MTPA, 2016). Core and buffer zone areas of PEKB OCP are reported to be represented by 167 species of vascular plants belonging to 53 families classified over different life forms like 75 tree species, 39 shrubs, 42 herbs, grasses and climbers and 11 woody climber species. Within core zone a total of 101 species of vascular plants were reported of different life forms like 50 trees, 22 shrubs, 21 herbs, grasses and climbers and 08 woody climbers (Wildlife Conservation Plan of PEKB OCP & Washery Project, 2012). As per Prakash, *et al.*, (2020), 1.41 lakh saplings have been planted in the mining area with a highest number (43,144) of saplings of the Shishu (*Dalbergia sissoo*), followed by Karanj (*Pongamia pinnata*) with 17,185 saplings, Khamhar/ gamhar (*Gmelina*

arborea) having 10,173 saplings. *Lantana camera* and *Leucaena leucocephala* were considered as a highly invasive species.

Flora of core zone of Parsa mine is represented by Sal dominated forests having composition of 08 tree species, 03 species each of shrubs and herbs and 01 climber. Buffer zone is represented by 64 tree species, 02 species each of shrubs and climbers & lianas (EIA Report of Parsa coal 05 MTPA, 2018). Thirteen species of pteridophytes under 09 families were recorded from Ambikapur, Surguja district of Chhattisgarh by Sharma and Roy (2018). Gond *et al.* (2014) reported 16 species of pteridophytes under 13 genera and 12 families which were medicinally used by the Gond tribe of Korba district. Tiwari and Sharma (2017) recorded the 15 species of Mushrooms (edible, non edible and medicinal) from the Surguja region.

A total of 12 species (01 endangered and 11 vulnerable) of conservation concern have been reported from the Parsa East and Kanta Basan open cast coal mine area (EIA). A total of 75 medicinal plant species (trees 29, herbs 29, shrubs 12 and climbers 05) with varied 40 families used for economic purposes (Plate 4.6) were recorded in and around the Chendra forest of Surguja district (Yadav *et al.*, 2015). Of the total plant species in the PEKB mine lease area, 18 species fall under various categories as per IUCN red list criteria to the state of Chhattisgarh (EIA Parsa East and Kanta Basan). There are two Medicinal Plant Conservation Areas (MPCA) which are falling in forest compartment P 2124 under Udaipur forest range of Surguja forest division and P 943 under Balco forest range of Korba forest division each of 200 ha area (Figure 4.6).

4.6.2 Primary Baseline data

The Floristic study was aimed at enumeration, quantification to obtain the broad representation of the existing floristic plant resources of the study area of Hasdeo Arand Coalfield falling in South Surguja, Surajpur, Korba and Katghora Forest Divisions in Surguja, Surajpur and Korba districts of Chhattisgarh state. Enumeration of the plant wealth was made through comprehensive ground truth survey in the study area during the period from May 2019 to October 2020 by walking along the forests covering various microhabitats, altitudes, aspects and terrain types, followed by collection and identification of plant specimens with the help of floras during all three seasons (Plate 4.1 4.2). Phyto sociological aspects of the study were carried out by perambulating and sampling through quadrat method.

Sample plots were selected in such a way to get maximum representation of different types of vegetation and plots were laid out in different parts of the areas within the coal blocks (core areas) to represent the individual coal mine lease and the surrounding (Buffer) areas. Floristic composition is one of the major characteristic features of any plant community and varies depending upon the site and its environmental features (Plate 4.3).

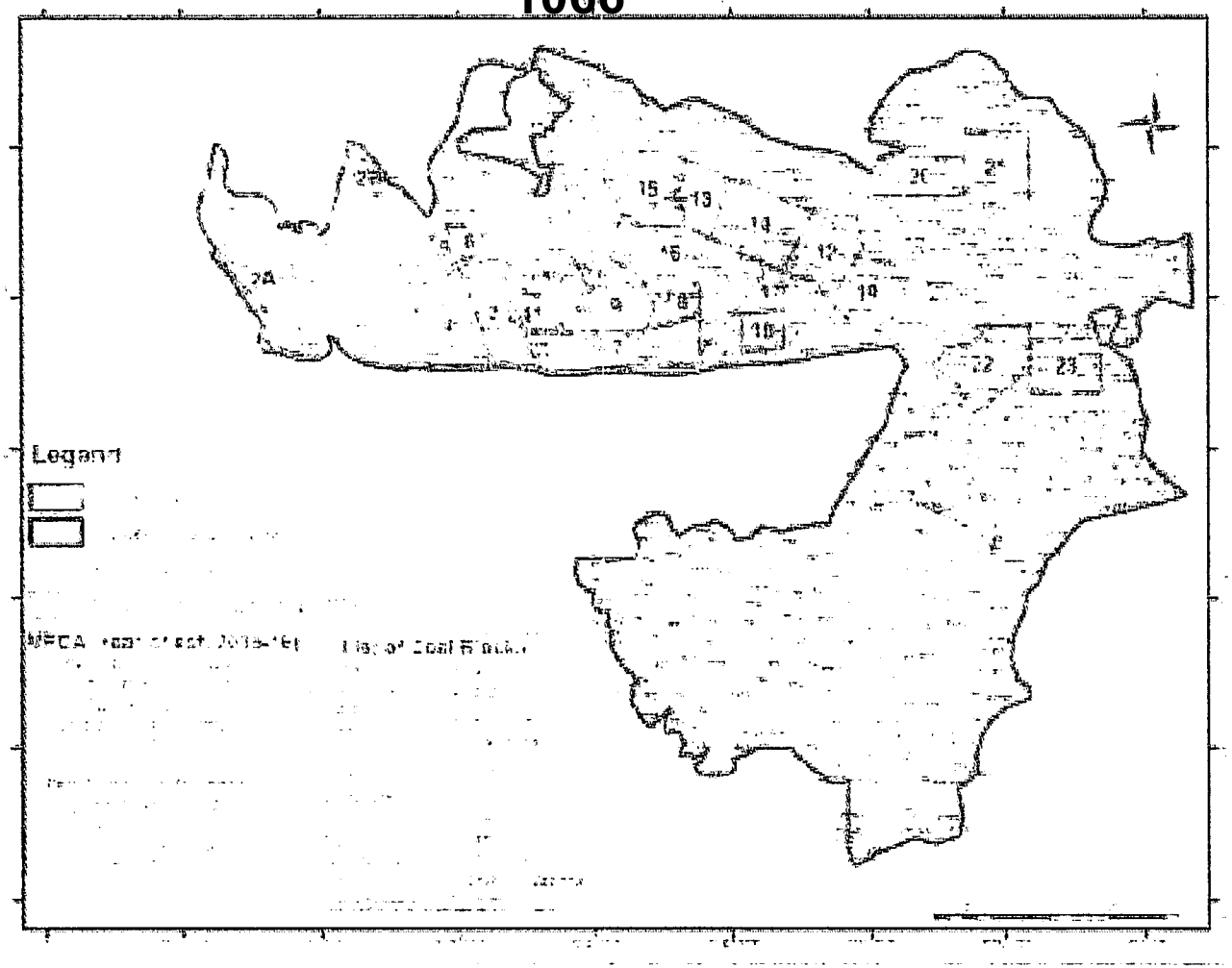


Figure 4.6: Location of Medicinal Plant Conservation Areas (MPCAs) in the study area of Hasdeo-Arand Coalfield within Surguja and Korba districts of Chhattisgarh

Sources: http://cgvanoushadhi.gov.in/hi/07-medicinal-plant-protection-area-mpca-forest-management-committee

4.6.2.1 Vegetation composition in Hasdeo-Arand Coalfield

The vegetation in core and buffer areas of Hasdeo-Arand Coalfield is dominated by Sal, and the flora consisted of 640 species belonging to 400 genera and 109 families (Table 4.10, Annexure 4.1-4.3, Plate 4.4). Poaceae and Fabaceae were the most specious families with 72 and 64 species respectively, followed by Rubiaceae and Asteraceae with 31 and 27 species respectively. Thirty-eight families were represented by only one species each (Annexure 4.2). A total of 146 species of trees, 363 herbs including grasses and ferns, 66 shrubs, 48 climbing shrubs and 17 woody climbers (Annexure 4.3) were recorded. Based on the enumeration 128 species are medicinally important (Annexure 4.4), 40 timber species (Annexure 4.5), 60 edible plants (Annexure 4.6), 65 fodder plants (Annexure 4.7), 75 categorized as fuel wood species (Annexure 4.8), 59 commercially important species (Annexure 4.9). The area is also very important in view of its rich diversity and occurrence of 33 rare, endangered and threatened (RET) plant species (Annexure 4.10). A total of nine invasive and weedy species were also recorded (Table 4.11).

Table 4.10: Vegetation composition in the study area of Hasdeo-Arand Coalfield region within Korba, Surguja and Surajpur districts of Chhattisgarh

Floral Diversity		Resources	
No. of species	640	Medicinal plants	128
No. Genera	400	Timber yielding plants	40
No. families	109	Edible plants	60
No. of Invasive species	9	Fodder plants	65
No. of threatened (RET) species	33	Fuel plants	75
		Commercial plants	59

Table 4.11: Invasive Plant species recorded from HAC Region

Sl. No	Name of the Plant species
1	*Ageratum conyzoides* L.
2	*Argemone mexicana* L.
3	*Chromolaena odorata* (L.) King & Robins
4	*Hyptis suaveolens* (L.) Poit.
5	*Ipomoea carnea* Jacq.
6	*Lantana camara* L.
7	*Parthenium hysterophorus* L.
8	*Pennisetum pedicillatum* Trin.
9	*Xanthium strumarium* L.

4.6.2.2 Phytosociology

The baseline data were collected during three seasons from Hasdeo Arand Coalfield region (core and buffer) especially Katghora, Surajpur, Surguja and Korba Forest Divisions. The core areas block of PEKB (14) and neighbouring three coal blocks such as Kente Extension (Block No. 12), Parsa (Block No. 13), and Tara (Block No. 15) and surrounding buffer areas up to 10 km. The core areas of other individual coal

blocks (19 coal blocks) in Hasdeo-Arand Coalfield region {Nakiya (Block No. 1), Chotia (Block No. 2), Morga I (No.3), Morga II (No.4), Morga III (No.5), Morga IV (No.6), Morga South (No.7), Gidmuri (No.8), Paturia (No.9), Madanpur North (No.10), Madanpur South (No.11), Puta Parogia (No.16), Parogia (No.17), Saidu (No.18), Pindraki (No.19), Sarma (No.20), Laxmangarh (No.21), Bhakurma-Matringa (No.22) and Kedma (No.23)} and the buffer areas up to 10 km were extensively surveyed to arrive at different phyto-sociological attributes, namely, density, frequency, abundance, basal area, IVI values that are summarized in Annexure 4.11 to 4.22.

Stand density values in the core zone of the PEKB (14) and surrounding three coal mine blocks{Kente Extension (Block No. 12), Parsa (Block No. 13), and Tara (Block No. 15)}for trees, shrubs and herbs were 424 stems/ha, 95.6 stems/100 m^2 and 350 stems/100 m^2 (Annexure 4.11 to 4.13) respectively. Highest density value was recorded in the case of *Shorea robusta* (116/ha) followed by *Diospyros melanoxylon* (107/ha) and *Madhuca longifolia* var. *latifolia* (52/ha) among trees (Annexure 4.11); *Phoenix loureiroi* (51.65/100 m^2) followed by *Woodfordia fruticosa* (12.09/100 m^2) and *Ichnocarpus frutescens* (8.79/100 m^2) among shrubs; (Annexure 4.12). *Evolvulus nummularius* (113.74/100 m^2) followed by *Elephantopus scaber* (78.57/100 m^2) and *Sida cordata* (41.76/100 m^2) among herbs (Annexure 4.13).

Stand density values in buffer areas (10 km radius) of the PEKB (14) and surrounding three **coal mine blocks** {Kente Extension (Block No. 12), Parsa (Block No. 13), PEKB (Block No. 14) and Tara(Block No. 15)} for trees, shrubs and herbs were 535.71 stems/ha, 12.17 stems/100 m^2 and 3055 stems/100 m^2 (Annexure 4.14 to 4.16) respectively. Highest density value was recorded in the case of *Shorea robusta* (154.29 stems/ha) followed by *Madhuca longifolia* var. *latifolia* (148.57 stems/ha) and *Diospyros melanoxylon* (95.71 stems/ha) among trees (Annexure 4.14); *Phoenix loureiroi* (5.44/100 m^2), followed by *Ichnocarpus frutescens* (1.74/100m^2) and *Hemidesmus indicus* (1.50/100 m^2) among shrubs (Annexure 4.15); *Desmodium triflorum* (377/100 m^2) followed by *Phyllanthus urinaria* (245/100 m^2) and *Rungia pectinata* (180/100 m^2) among herbs (Annexure 4.16).

Stand density values in core areas of all the individual coal mine blocks for trees, shrubs and herbs were 599.46 stems/ha, 120.67 stems/100 m^2 and 2610.31 stems/100 m^2 (Annexure 4.17 – 4.19) respectively. Highest density value was recorded in the case of *Shorea robusta* (196.19 stems/ha) followed by *Diospyros melanoxylon* (98.09 stems/ha) and *Madhuca longifolia* var. *latifolia* (86.38 stems/ha) among trees (Annexure 4.17); *Phoenix loureiroi* (18.89/100 m^2), followed by *Dioscorea bulbifera* (16.00/100 m^2) and *Holostemma ada kodien* (14.00/100m^2) among shrubs (Annexure 4.18); *Desmodium triflorum* (216.23/100 m^2) followed by *Rungia pectinata* (180.26/100 m^2) and *Justicia quinquangularis* (120.39/100 m^2) among herbs (Annexure 4.19).

Stand density values in buffer areas of all the coal mine blocks (10 km radius) *ie* HAC measured for trees, shrubs and herbs were 910.55 stems/ha, 19.66 stems/100 m^2 and 2806 stems/100 m^2 (Annexure 4.20 -4.22) respectively. Highest density value was recorded in the case of *Shorea robusta* (249.25 stems/ha) followed by *Diospyros melanoxylon* (121.11 stems/ha) and *Madhuca longifolia* var. *latifolia* (95.48 stems/ha) among trees (Annexure 4.20); *Phoenix loureiroi* (4.88/100 m^2), followed by *Hemidesmus indicus* and *Ichnocarpus frutescens* (each 2.84/100 m^2) among shrubs (Annexure 4.21); *Desmodium triflorum* (286.80/100 m^2) followed by *Rungia pectinata* (238.40/100 m^2) and *Phyllanthus urinaria* (158.00/100 m^2) among herbs (Annexure 4.22).

The density of various trees and herbs varied greatly within the study areas, which may be attributed to the site quality and climatic conditions of the area. The density of shrubs, in general found to be low (Table 4.12) may be because of frequent fire and removal of shrubs for cleaning the ground for collection of NTFPs like Mahua flowers, Tendu leaves, fuel wood collection by local populace, presence of more canopy also hiders the growth of shrubs, *etc.* Stand basal area ranged from 13.98 m^2/ha (Buffer of the PEKB and surrounding 3 coal blocks) to 28.87 m^2/ha (Buffer of all individual coal blocks/HAC) (Table 4.13) and intermediate being 19.92 m^2/ha (Core of all coal blocks) and 21.87 m^2/ha (Core of 4 coal blocks).

Table 4.12: Comparative account of Stand density in and around the individual mine block in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

Life forms	Blocks	Stand density (stems /ha)
Trees	Core of all mine lease/blocks	599.46
	Buffer of all mine/blocks	910.55
	Core of 4 mine lease/blocks	424.00
	Buffer of 4 mine lease/blocks	535.71
Shrubs	Core of all mine lease /blocks	12067.00
	Buffer of all mine/blocks	1966.00
	Core of 4 mine lease/blocks	9560
	Buffer of 4 mine lease/blocks	1217
Herbs	Core of all mine lease/blocks	261031.00
	Buffer of all mine/blocks	280600.00
	Core of 4 mine lease/blocks	35000.00
	Buffer of 4 mine lease/blocks	305500.00

Table 4.13: Comparative account of Stand density and Stand basal area of trees in and around the individual mine lease in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

Locations	Stand density (stems/ ha)	Stand basal area(m^2/ha)	Mean Basal area/ plant(m^2)
Core of all individual mine lease /blocks	599.5	19.92	0.033
Buffer of all the mine lease /blocks	910.6	28.87	0.032
Core of 4 mine lease /blocks	424.0	21.87	0.052
Buffer of 4 mine lease/ blocks	535.7	13.98	0.026

From the above table, Mean Basal Area/plant (m^2) values clearly shows that, in the areas of PEKB and the surround three coal blocks recorded higher girths (with contribution of 0.052 m^2/plant) for tree than all other individual blocks. This may due to selective removal of lower girth class individuals of all species in PEKB and surround three coal blocks. All other areas showed the contribution of single plant towards the stand basal areas that were similar varied from 0.026 m^2 to 0.033 m^2.

Dominance and ecological success of a species is expressed as a single value in terms of Importance Value Index (IVI). This index utilizes three parameters for trees *viz.*, relative frequency, relative density and relative dominance or basal area. In case of shrubs and herbs, only two former parameters were taken into consideration. In all the study locations, *Shorea robusta* was recorded to be dominant tree with highest IVI values (ranging from 87.80 to 120.06). *Diospyros melanoxylon* showed second highest values except in buffer areas PEKB and other three coal blocks (Table 4.14).

Table 4.14: Comparative account of Dominant Tree species of different locations based on IVI values in and around the individual mine blocks in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

S.No	Name of the species	Core of 4 Coal blocks	Buffer of 4 Coal blocks	Core of All Coal blocks	Buffer of all Coal blocks
1.	*Shorea robusta*	100.58	120.06	104.18	87.80
2.	*Diospyros melanoxylon*	55.27	40.78	41.46	35.45
3.	*Madhuca longifolia* var. *latifolia*	35.48	58.30	38.52	29.22
4.	*Buchanania lanzan*	16.23	21.50	18.62	21.97
5.	*Lagerstroemia parviflora*	10.80	18.38	8.38	14.68
6.	*Terminalia elliptica*	17.76	7.61	14.33	14.18
7.	*Anogeissus latifolia*	16.45	11.01	12.70	13.14
	Total values	**252.57**	**277.64**	**238.79**	**216.44**
	Percentage of total IVI values of all species (*i.e.* 300)	**84.19%**	**92.55%**	**79.40%**	**72.15%**

The three species such as *Shorea robusta*, *Diospyros melanoxylon* and *Madhuca longifolia* var. *latifolia* are the highest contributors of IVI values in all study locations (Table 4.14). (The total IVI values of any stand will always be 300 when we take three relative values for calculation of IVI). **The IVI values of seven common species across the study sites have contributed more than 50% (varied from 216.44 to 277.64) of the total IVI values of all species (*i.e.* 300), indicating their dominance in all locations.**

High IVI values of a species indicate its high regeneration capacity and greater ecological amplitude. Dominant species among trees contribute more to the micro-environment within vegetation, but species with few individuals contribute

to the community structure of the vegetation. The number of tree species with small population size, especially the species represented by only by one or two individuals, like, *Acacia catechu, Albizia procera, Antidesma ghaesembilla, Bauhinia racemosa, Bombax ceiba, Bridelia retusa, Celastrus paniculatus, Dalbergia paniculata, Ehretia leavis, Ficus religiosa, Gardenia latifolia, Gardenia resinifera, Mitragyna parvifolia, Nyctanthes arbortristis, Oroxylum indicum, Pterospermum xylocarpum, Stereospermum colais and Terminalia bellirica* in these study area, have a close correlation with the tree diversity values. These species are important components in the composition of species diversity of local forest vegetation. Existence of a species in a particular habitat depends on the associated species and the abiotic environment. Hence, quantitative relationship between dominant and rare species is an important structural property in any community (Cao and Zhang, 1996).

Among shrubs, in general *Phoenix loureirii* was the dominant species common to all blocks in core and buffer areas (Table 4.15) followed by *Ichnocarpus frutescens* and *Hemidesmus indicus*. Four species such as *Phoenix loureirii, Ichnocarpus frutescens, Woodfordia fruticosa, Hemidesmus indicus* which are common dominant species, contribute about 50% of the total IVI values of shrubs except surveyed areas of all coal blocks (The total IVI values of any stand will always be 200 when we take two relative values for calculation of IVI).

Table 4.15: Comparative account of dominant species of shrubs (based on IVI values) and climbers across locations in and around the individual mine block in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

Species	Core of 4 coal mine lease/blocks	Buffer of 4 Coal mine lease/blocks	Core of all coal mine lease/blocks	buffer of all coal mine lease/blocks
Phoenix loureirii	107.12	60.85	35.59	48.32
Ichnocarpus frutescens	18.93	20.61	15.38	28.18
Woodfordia fruticosa	17.95	0.00	0.0	4.69
Hemidesmus indicus	17.21	16.40	26.7	31.28
Total	**161.21**	**97.86**	**77.67**	**112.47**
Percentage of total IVI values of all species (*i.e.* 200)	**80.61%**	**48.93%**	**38.84%**	**56.24%**

Among herbs, *Elephantopus scaber* was one among the four dominant species common to all blocks in core and buffer areas (Table 4.16) followed by *Rungia pectinata*. Six species such as *Elephantopus scaber, Evolvulus nummularius, Sida cordata, Rungia pectinata, Desmodium triflorum* and *Phyllanthus urenaria* dominate all locations with highest contribution by *Elephantopus scaber*.

Table 4.16: Comparative account of dominant species of herbs (based on IVI values) in and around the individual mine blocks in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

Species	Core 4 coal mine lease/ blocks	Buffer of 4 coal mine lease/blocks	Core of all coal mine lease blocks	buffer of all coal mine lease/ blocks
Elephantopus scaber	51.55	9.81	12.25	10.75
Evolvulus nummularius	44.67	0	8.61	0
Sida cordata	27.80	0	0	0
Rungia pectinata	17.71	9.46	10.87	14.52
Desmodium triflorum	0	17.9	11.57	14.68
Phyllanthus urenaria	0	12.0	0	8.77
Total	141.73	49.17	43.3	48.72
Percentage of total IVI values of all species (*i.e.* 200)	70.86%	24.58%	21.65%	24.36%

In all the sample locations in and around the individual coal blocks more number of species contributed towards the dominance (The total IVI values of any stand will always be 200 when we take two relative values for calculation of IVI) except for the operational PEKB and three surrounding coal blocks. The diversity values (Shannon Wiener index) for trees ranges from 1.87 to 2.68 and for shrubs ranges from 1.67 to 2.87, indicate that the area is medium diverse with regards to plant diversity and in case of herbs, it is very high diversity, ranges from 3.83 to 4.10, except the PEKB and the surrounding three coal blocks (2.1).

The Table 4.17 indicates that the diversity values (Shannon Wiener index) of trees in all individual blocks were medium and minimum value of 1.87 (buffer area of PEKB and the surrounding three coal blocks). Simpson's Index (λ) values for trees ranges from 0.12 to 0.21, for shrubs it ranges from 0.08 to 0.33 indicate that HAC areas are comparatively less diverse than herbs, which ranged from 0.03 to 0.19. High Shannon-Weiner index value with low Simpson index of a stand indicates that the study area is more diverse in character. These diversity values are comparable to the diversity values reported by various workers for central Indian forests (Illorkar, 1999, Dixit, 1997, Kunhikannan, 1999). Comparatively, the PEKB and the surrounding three coal blocks was recorded to less diverse in case of plant diversity which can be attributed to the disturbance due to the cumulative impact of open cast coal mining and allied activities in PEKB.

Table 4.17: Comparative account of diversity between different locations in and around the individual mine lease in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

Life forms	Coal Blocks	H'	λ	E
Trees	Core of all individual coal mine lease/blocks	2.40	0.17	0.63
	Buffer of all coal mine lease/blocks	2.68	0.12	0.66
	Core of 4 coal mine lease /blocks	2.28	0.17	0.66
	Buffer of 4 coal mine lease/blocks	1.87	0.21	0.65
Shrubs	Core of all individual coal mine lease/blocks	2.87	0.08	0.63
	Buffer of all coal mine lease/blocks	2.56	0.12	0.68
	Core of 4 coal mine lease /blocks	1.67	0.33	0.62
	Buffer of 4 coal mine lease/blocks	1.80	0.25	0.72
Herbs	Core of all individual coal mine lease/ blocks	3.99	0.03	0.78
	Buffer of all coal mine lease/blocks	4.10	0.03	0.79
	Core of 4 coal mine lease /blocks	2.10	0.19	0.66
	Buffer of 4 coal mine lease/blocks	3.83	0.04	0.79

H'=Shannon Weiner index; λ=Simpson index; E=Buza and Gibson's evenness index

4.6.3 Impact on Forest and Floral Diversity

The study area *i.e.* the Hasdeo Arand Coalfield is the third largest in terms of coal reserves (17%) in the country with an area of 1879.8 sq.km spread over north Korba to south Surguja and Surajpur districts of Chhattisgarh. The next largest is Korba Coalfield lies over an area of 530 km^2. The 80% of the coal resources are reported to be under forest land use and the total estimated coal reserves is 5.179 billion tones out of which 1.369 billion tones are proven reserve. Out of the total coal bearing area in HAC, 1502 sq.km falls in the forest, which is reported to be the largest un fragmented forests in Central India consisting of pristine Sal (*Shorea robusta*) and teak forests outside the official protected area system which is an important corridor for movement of flagship species like elephants and tigers in Chhattisgarh.

4.6.3.1 Land use land cover changes

Hasdeo Arand Coalfield (HAC) has good forests and productive landscapes that conserve local biodiversity and offer important ecological services. Any large scale land use land cover changes (LULC) in the form of opencast or underground mining will have negative impact on the ecosystem structure. The mining proposed in the HAC involve both open cast and underground mining. The conventional opencast practices like drilling, blasting and crushing invariably cause pollution. The resultant problems are land degradation, degradation of the forest and biodiversity, air

pollution, water pollution and noise pollution. Most significant impact arising out of open cast mining activity include degradation of the land use to open cast mining are mainly in the form of alteration of land structure due to excavation, dumping of mine waste and overburden soil. Underground mine requires careful consideration.

Two coal blocks (Parsa East & Kanta Basan and Chotia sub block 2A & 2B) are opencast mines in operation; Chotia sub-block 2B has proposed for underground, other proposed coal blocks such as Parsa, Kente Extension Tara and Madanpur south are of open cast; Three identified have proposed for both open cast and underground coal blocks. Rest 14 coal blocks identified have no information on the mining process. The forest in the total coal bearing area is reported to be the largest un-fragmented forests in Central India consisting of pristine Sal (*Shorea robusta*) and teak forests outside the official protected area system. Assuming that, if mining is allowed 25% of the entire HAC will have major impact on land use land cover change and fragmentation of forest due to mining and allied activities. Forest fragmentation will contribute to decreased continued connectivity of the forest and increased edge density. The loss of soil due to land excavation and subsequent soil erosion would be very high as the HAC receives high rainfall.

4.6.3.2 Loss of forest cover and types

The impact of mining on forest cover, forest type and plant diversity have been made taking into consideration of all the 23 coal blocks within the Hasdeo Arand Coalfield. Accordingly, the core and buffer area of all the coal blocks; and also detailed assessment in the core area and buffer of the four blocks i.e., Tara, Parsa, Parsa East Kanta Basan (PEKB) and Kente Extension were surveyed exhaustively were considered for the study. The findings are presented below:

4.6.3.3 Loss of forest cover

Open cast mining is being operated in the allotted coal blocks of PEKB and Chotia sub blocks 2A & 2B. Chotia sub block 2A reserve is exhausted but it is active till date and further proposed to opt for Underground coal mining in Chotia sub blocks 2A & 2B. The identified three coal blocks (Madanpur North, Gidhmuri, and Paturia) has proposed for both Open cast and underground; Tara, Parsa, Kente Extension, and Madanpur South are proposed for only Open cast mining. The remaining 14 coal blocks identified have no information on the method of mining proposed. However, assuming that all the coal blocks proposed for open cast mining will have impact on the 366.44 sq.km of forest cover comprising of very dense, moderate dense, open and scrub forest; 104.16 sq.km non-forest and 0.66 sq.km of water body out of 1879.58 sq.km (i.e. result in loss of 25.12% forest cover) will be lost within HAC (Table 4.18).

Table 4.18: Forest cover and extent of the area in Hasdeo-Arand Coalfield within Korba, Surguja and Surajpur districts of Chhattisgarh

Forest Cover Class	Entire HAC Area (Sq.km)	23 coal blocks Area in Sq.km (% of the HAC area)
Water body	12.69	0.66 (5.20%)
Scrub	33.52	11.21 (33.44%)
Very Dense Forest	126.72	69.18 (54.59%)
Open Forest	197.57	52.65 (26.65%)
Non Forest	351.05	104.16 (29.67%)
Moderate Dense Forest	1158.04	233.40(20.15%)
Total	**1879.58**	**472.13 (25.12%)**

Source: Estimated using 2015 digital format (FSI, 2017)

Forest compartment wise extent of forest cover which falls partially and fully within the respective coal blocks estimated using GIS and RS. All most all the coal blocks (23) have presence of moderately dense forest that varies from minimum extent area of 1.84 sq.km (Chotia sub block 2B) to a maximum extent area of 33.29 sq.km (Puta Parogia coal block). Similarly, very dense forest were recorded from 17 coal blocks at varied scale with a minimum extent of area 0.04 sq.km (Laxmangarh) and maximum of 16.88 sq.km (Tara). The extent of moderately dense and very dense forest estimated are presented in Table 4.9 & 4.10.

4.6.3.4 Loss of forest type

There are five forest types that occur in HAC comprising of **1400.95 sq.km** of which the 23 coal blocks encompass **336.61 sq.km (24.03% of the total HAC)**. Open cast mining proposed in the mine lease areas will loss all vegetation completely to facilitate mining and related activities within mine lease of HAC and adjacent areas. The mining proposed in the HAC involve both open cast and underground mining. The conventional opencast practices like drilling, blasting and crushing invariably cause pollution. The resultant problems are land degradation, degradation of the forest and biodiversity, air pollution, water pollution and noise pollution. Underground mine requires careful consideration. Due to open cast mining the forest types 3B/C2 Southern Moist Mixed Deciduous Forest having maximum area (105.71 sq.km, which is 33.61% of the total forest type in HAC) would be either lost due to open cast or negatively impacted; followed by 5B/C1c Dry Peninsular Sal Forest (16.94 sq.km, which is 24.12% of the total available in HAC), 3C/C2e (ii) Moist Peninsular Low Level Sal Forest (198.01 sq.km, which is 23.70% of the total available in HAC) and 5B/C2 Northern Dry Mixed Deciduous Forest (08.82 sq.km, which is 18.92% of the total available in HAC) and 5/E9 Dry Bamboo Brakes (7.13 sq.km), provided in the Table 4.19. Non Forest area of 133.79 sq.km and 1.69 sq.km of water body will be lost due to mining. Over all the HAC region will lose 472.09 sq.km of the land area in the form of forest, non-forest and water body (Table 4.19) due to mining and its allied activities.

Table 4.19: Forest type and extent of area in Hasdeo-Arand Coalfield within Korba, Surguja and Surajpur districts of Chhattisgarh

Forest Type	Area (sq.km) HAC	23 coal blocks sq.km and % of HAC area
3C/C2e (ii) Moist Peninsular Low-Level Sal Forest	835.61	198.01 (23.70%)
3B/C2 Southern Moist Mixed Deciduous Forest	314.53	105.71 (33.61%)
5B/C1c Dry Peninsular Sal Forest	70.22	16.94 (24.12%)
5/E9 Dry Bamboo Brakes	133.98	7.13 (5.32%)
5B/C2 Northern Dry Mixed Deciduous Forest	46.61	08.82 (18.92%)
Total	**1400.95**	**336.61 (24.03%)**
Non-Forest	464.23	133.79 (25.22%)
Total	**1865.19**	**470.40 (23.70%)**
Plantation/ TOF	0.03	
Water	14.35	1.69 (11.78%)
Total	**1879.57**	**472.09 (25.12%)**
Source: Estimated using 2011 digital format		

4.6.3.5 Land degradation

It is the most significant impact arising out of mining activity. The degradation of the land due to open cast mining are mainly in the form of alteration of land structure due to excavation and dumping of mine waste and overburden soil. The loss of soil due to land excavation and subsequent soil erosion would be very high as the HAC receives high rainfall.

- Phyto sociological pattern of Indian deciduous forests is not well known as these forests have diversified life forms but are not considered species rich. However, still these forests assume unusual significance for conservation since they are the most used and threatened ecosystems. The tropical deciduous forests occur under varied climatic conditions, but essentially with alternate wet and dry tropics that support unique fauna and the indigenous human community that depends on the nature for their sustenance.

- The HAC is characterized by tropical dry deciduous forests and a large area under tropical moist deciduous forests, which is the home for unique wild faunal diversity. The study area has dense coverage of trees, shrubs and herbaceous plants including grasses, which form the dominant community. The composition of natural vegetation will drastically change immediately due to mining and its allied activities.

- The predominant Sal forests and miscellaneous forests in the HAC landscape have a great ecological role in conservation of moisture and soil nutrients. During rainy season, the vegetation and the underneath strata of soil act as sponge in holding

the moisture and help in percolation of water. The water is released from this ecosystem slowly even after the end of rainy season contributed to the hydrological flow to the primary feeder drainage, which contributed to the streams and rivulets in the forest of Sal for continuous/perennial supply of water in to the Hasdeo river /dam and downstream. The rivulets and soil moisture not only help in growth and regeneration of the Sal, but also act as the sole drinking water source for adjacent villages and further help life sustaining activities downstream.

- *Shorea robusta* is an important climax tree species, deciduous, light demanding, gregarious and dominant tree species in its stand (Champion & Osmaston 1962, Troup 1986) comes under Dipterocarpaceae family, mainly distributed in the Northern, central and eastern region of Indian subcontinent. Natural regeneration takes place by seeds but is affected greatly by its shorter viability period. *S. robusta* has establishment problems as their seeds are recalcitrant and viability is lost within a week after falling to the ground. The environmental conditions such as light, temperature, soil quality, moisture availability and drainage system affect the regeneration of Sal forest into various form of even aged, relatively pure and mixed type of vegetation.

- The forests in the coal blocks and the buffer areas have very good capacity for regeneration of woody species through root suckers and facilitate other seedlings to come as a successional species under its shade. The presence of good regeneration potential shows the suitability of a species to a given environment and the Edapho climatic factors and biotic interference influence the regeneration of different species in the vegetation. Development of coal mining will have a serious impact on the vegetation in the HAC.

- The HAC area is very important in view of its phyto geography and occurrence of rare endangered and threatened (RET) plant species such as, *Aegle marmelos, Andrographis paniculata, Aristolochia indica, Asparagus racemosus, Bacopa monnieri, Boswellia serrata, Celastrus paniculatus, Cheilocostus speciosus, Chlorophytum tuberosum, Clerodendrum serratum, Dalbergia latifolia, Drosera indica, Drosera burmannii, Embelia tsjeriam cottam, Entada rheedii, Gloriosa superba, Habenaria diphylla, Holostemma ada kodien, Homalium nepalense, Iphigenia indica, Ixora macrophylla, Mitrasacme pygmaea, Ophioglossum reticulatum, Oroxylum indicum, Premna herbacea, Pterocarpus marsupium, Rauvolfia serpentina, Schrebera swietenioides, Strychnos nux vomica, Strychnos potatorum, Symphorema involucratum, Symplocos racemosa* and *Uraria picta* are recorded both from core and buffer areas of coal mine lease/blocks (Annexure 4.10, Plate 4.5). These RET plant species will be lost /affected due to mining.

4.6.3.6 Loss of floral biodiversity

The mining activity in the region may alter the landscape and lead to the fragmentation of forest land. Mined site with OB dumps leaves the land devoid of top

soil nutrient and supportive micro flora and fauna causing loss of biodiversity, triggering adverse environmental impact.

- Nine invasive and weedy plant species, namely *Ageratum conyzoides, Argemone mexicana, Chromolaena odorata, Hyptis suaveolens, Ipomoea carnea, Lantana camara, Parthenium hysterophorus, Pennisetum pedicillatum* and *Xanthium strumarium* was recorded from the entire HAC region/study area, having high potential to produce numerous propagules. Fragmentation due to mining and loss of top soil, nutrient and supportive micro flora and fauna may have negative impact on the growth of the indigenous flora of the adjacent forest areas and promote invasive species if not taken adequate mitigation measures.

4.6.3.7 Fragmentation of land and forest

The Chotia sub block 2A and 2B allotted to BALCO are situated 10 km apart and connected by tar road constructed by the lessee. Un allotted coal block viz., Morga III (5) and Morga - IV (6) are situated adjacent each other; Other un allotted Coal Blocks such as Morga-II (4), Morga I (3), Morga south (7), Gidmuri (8), Paturia (9), Madanpur North (10), Madanpur (11), Tara (15), Puta-Parogia (16), Parogia (17), Saidu (18),Pindraki (19) and allotted Coal blocks such as Kente Extension (12), Parsa (13), Parsa East & Kanta Basan (14) are contiguous. And coal blocks such as Sarma (20) and Laxmangrah (21) located in the north east of the HAC region; Bhakurma-Matringa (22) and Kedma (23) are adjacent to each other situated in the south east of the HAC region and Nakiya (1) is situated in isolation in Korba forest division (Figure 4.7).

- The Chotia 2A and 2B allotted to BALCO are situated 10 km apart and connected by tar road constructed by the lease having 31.31 sq.km comprising of 21.21sq.km forest area; 10.08 sq.km non forest area and water body 0.01 sq.km.
- Similarly, the unallotted coal blocks Morga III (5) and Morga - IV (6) covering an area of 8.79 sq.km are situated adjacent each other having 3.80 sq.km sq.km forest area; 4.54 sq.km non-forest area and water body 0.45 sq.km.
- Morga II (4), Morga I (3), Morga south (7), Gidmuri (8), Paturia (9), Madanpur North (10), Madanpur (11), Tara (15), Puta Parogia (16), Parogia (17), Saidu (18),Pindraki (19)and allotted Coal blocks such as Kente Extension (12), Parsa (13), Parsa East & Kanta Basan (14, which is in operation) are contiguous. The total area consists of 310.98 sq.km that include the forest types (228.70 sq.km); non-forest (81.29 sq.km) and water body (0.99 sq.km).
- Sarma (20) and Laxmangrah (21) in the north east of the HAC coal blocks covering an area of 41.80 sq.km which include forest type area (19.26 sq.km); non forest area (22.47 sq.km) and water body (0.07 sq.km).
- Bhakurma-Matringa (22) and Kedma (23) covering an area of 44.93 sq.km are adjacent to each other situated in the south east of the HAC coal blocks consists

of forest type area (36.95 sq.km); non-forest area (7.85sq.km) and water body (0.17 sq.km)

- Nakiya (1) is situated in isolation in Korba forest division, comprising of area 34.29 sq.km that include forest type area (26.73 sq.km) and non-forest (7.56 sq.km).

Fragmentation of forests will result in edges containing communities different from interior forests due to an altered climate with higher light availability, loss of soil moisture, increased incursion of predators and competitors. Therefore, fragmentation result in changes in microclimatic near edges favouring establishment of weed species and a decline in native species, particularly in forests highly fragmented due to contiguous mining. Fragmentation of land, forest and hydrological system will have negative impact on biodiversity and the ecosystem health of the area that consists of Sal climax forest specific to the central Indian region. Sal is deciduous, light demanding, gregarious and dominant tree species in its stand (Champion & Osmaston 1962, Troup 1986) comes under Dipterocarpaceae family. Sal forest is relatively rich in ground flora diversity, which included ferns, herbs, grasses and lianas. Environmental conditions such as light, temperature, soil quality, moisture availability and drainage system affect the regeneration of Sal forest and tend into various form of even aged, relatively pure and mixed type of vegetation (Troup 1986, Rautiainen & Suoheimo 1997, Mishra *et al.*, 2013).

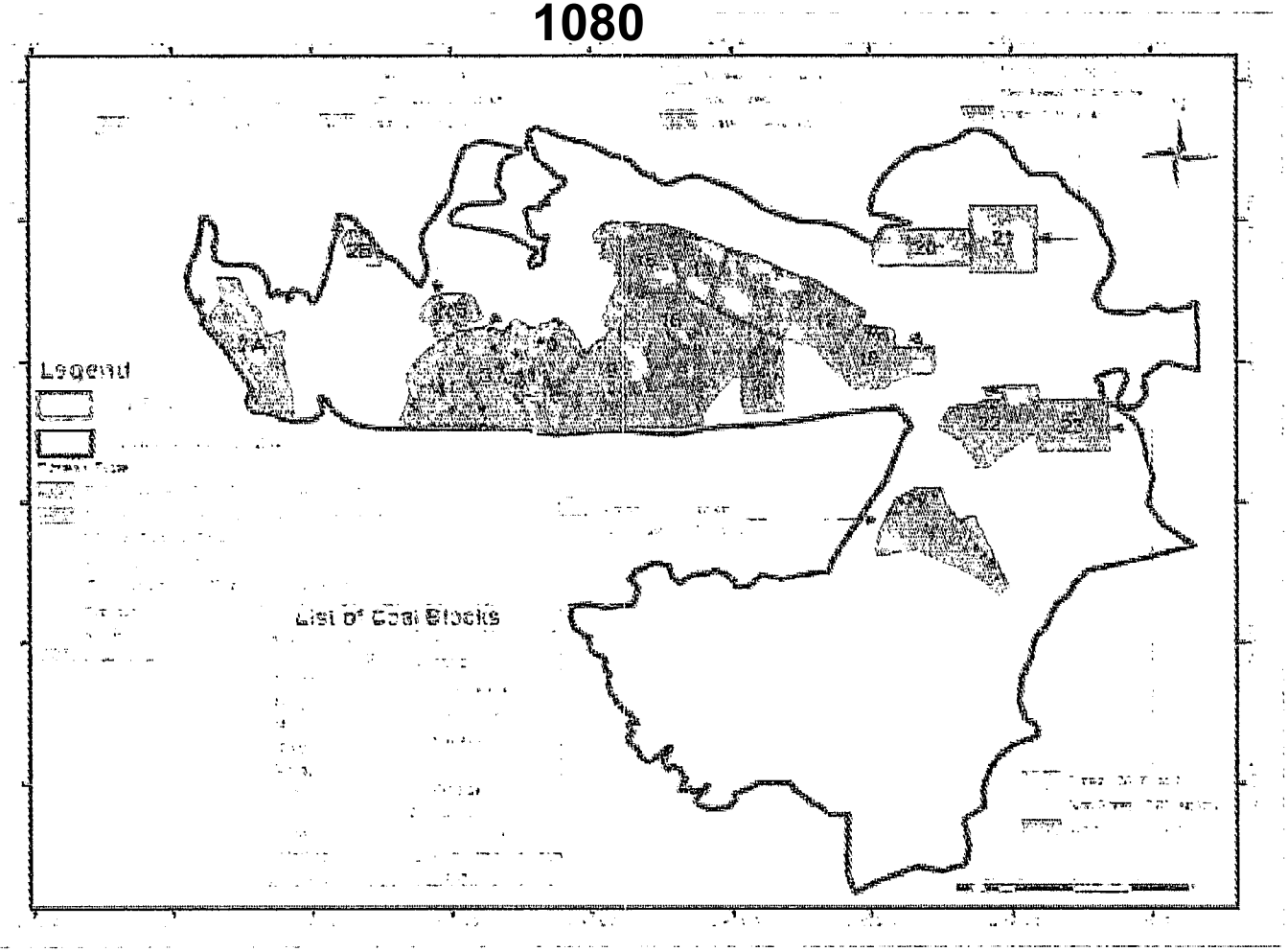


Figure 4.7: Extent of fragmentation of forest type, non-forest and water within Hasdeo-Arand Coalfield region that falls in Korba, Surguja and Surajpur districts of Chhattisgarh



Plate 4.1: Floral expert team of ICFRE conducting field survey in HAC, Chhattisgarh

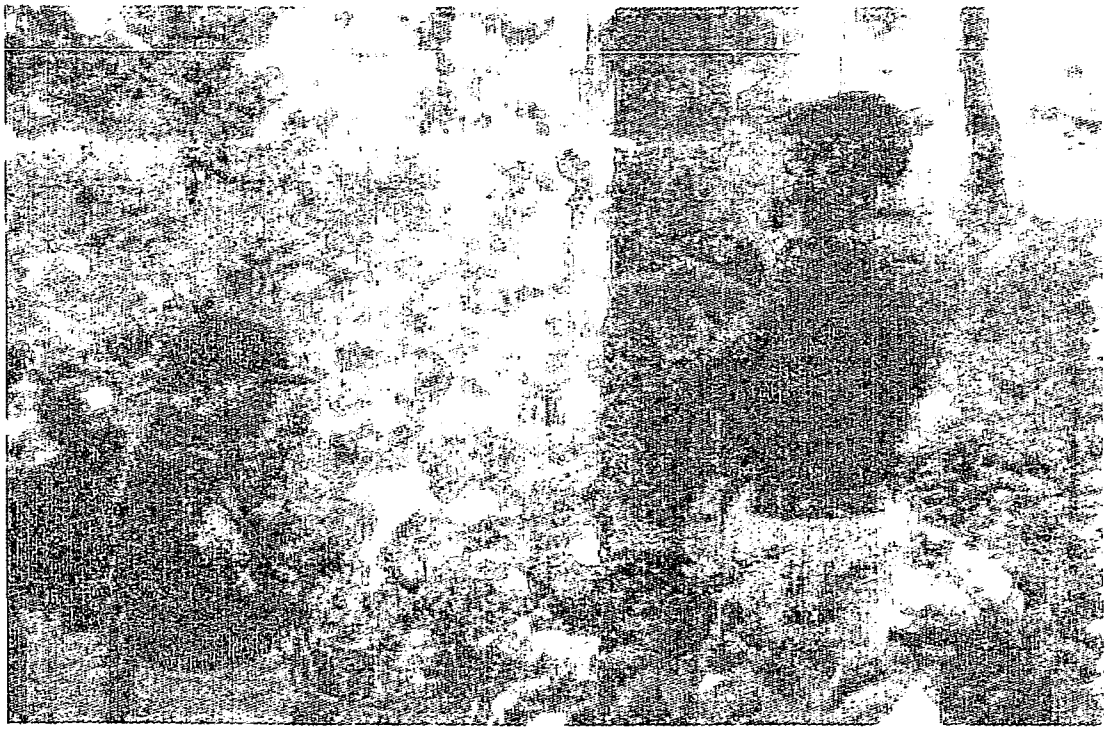
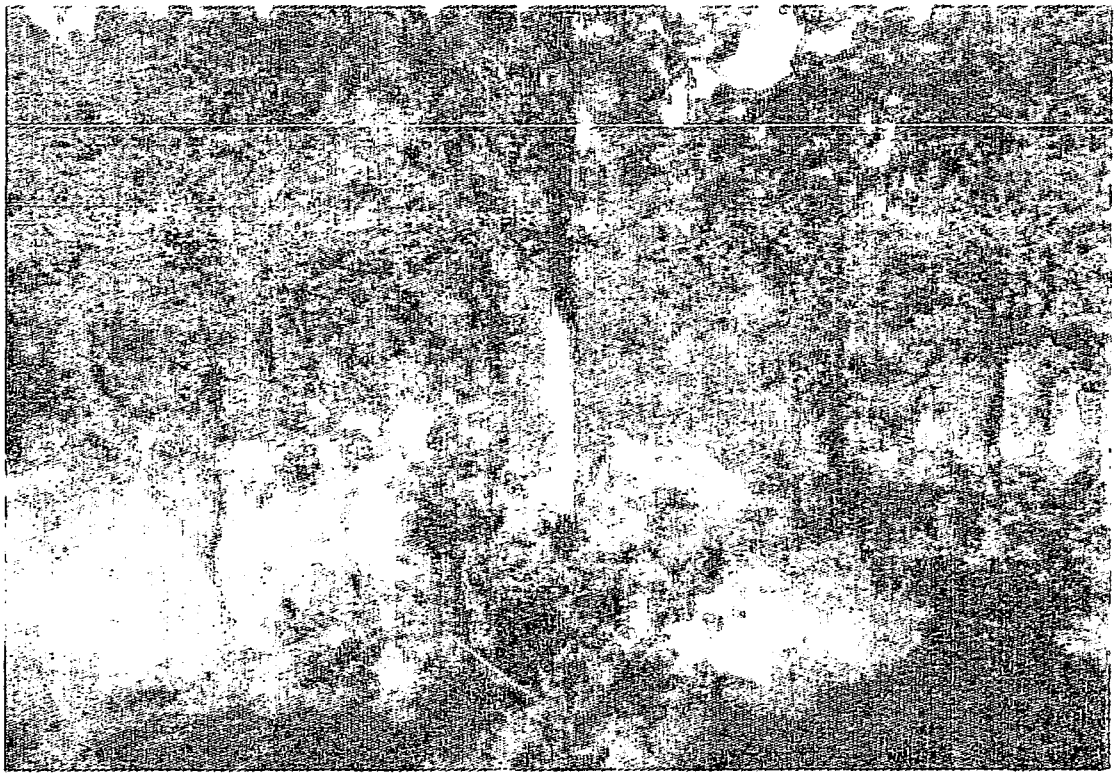


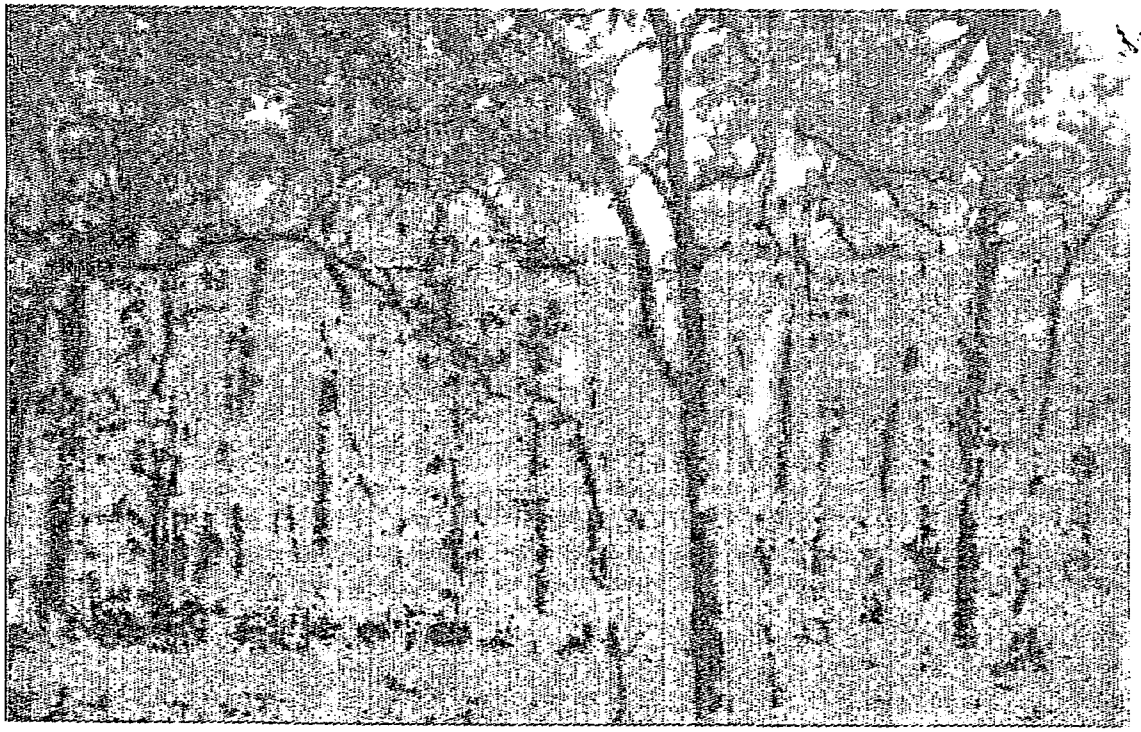
Plate 4.2: Floral expert team of ICFRE conducting vegetation study in the buffer area of Nakia coal block in HAC, Chhattisgarh



Vegetation in the buffer area of Kedma coal block in HAC, Chhattisgarh



Vegetation in the buffer area of Saidu coal block in HAC, Chhattisgarh



Vegetation in the core area of Parogia coal block in HAC, Chhattisgarh



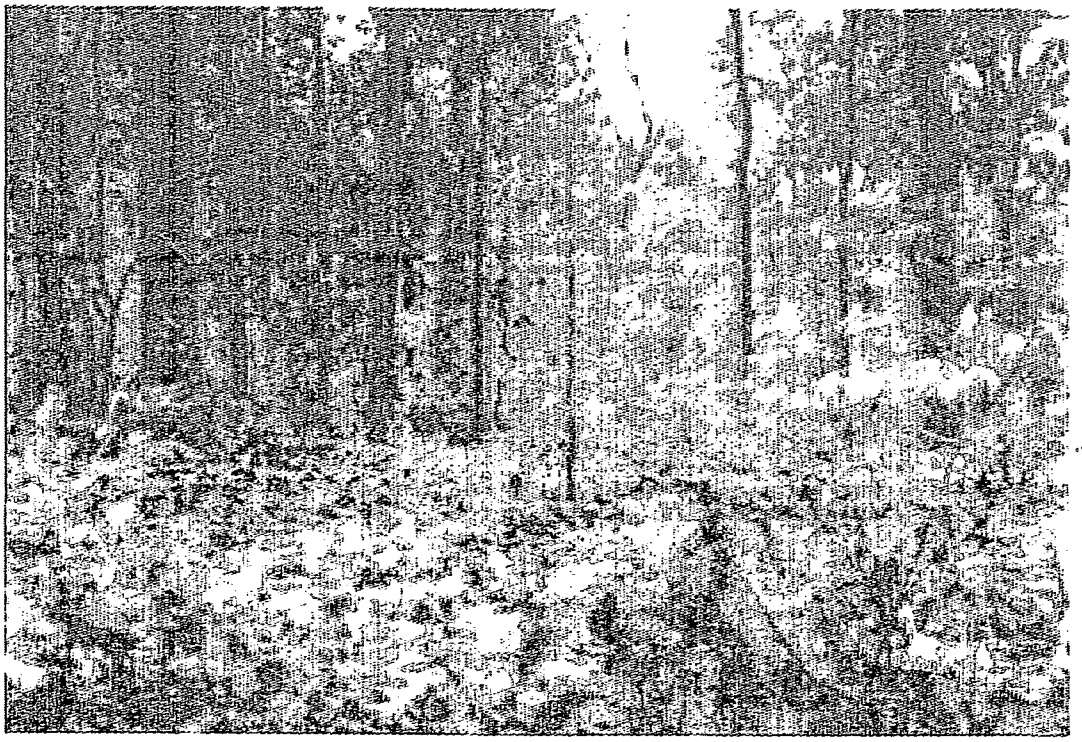
Vegetation in the buffer area of Sarma and Laxmangarh coal blocks in HAC, Chhattisgarh



Vegetation in the core area of Laxmangarh coal block in HAC, Chhattisgarh



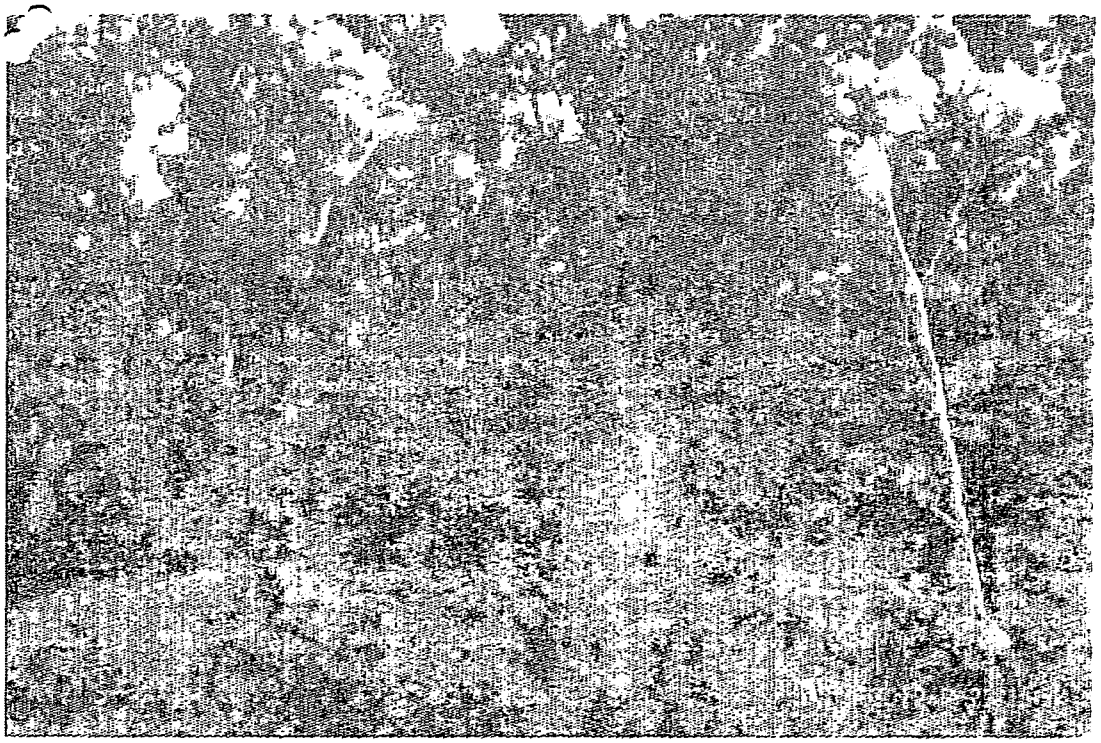
Vegetation in the core area of Madanpur South coal block in HAC, Chhattisgarh



Vegetation in the core area of Tara coal block in HAC, Chhattisgarh



Vegetation in the buffer area of Madanpur North and Madanpur South coal blocks in HAC, Chhattisgarh

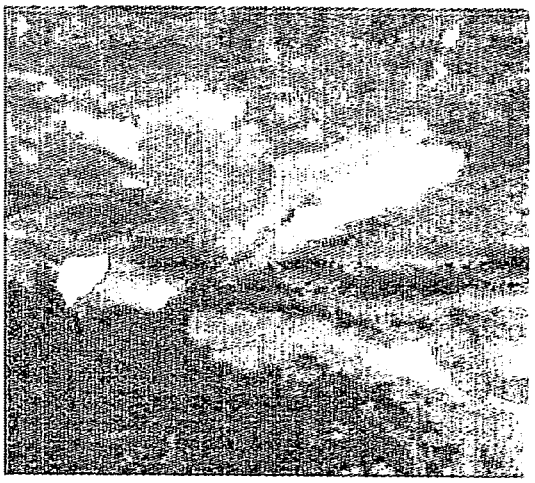


Vegetation in the core area of Morga-II coal block in HAC, Chhattisgarh



Vegetation in the core area of Nakia coal block in HAC, Chhattisgarh

Plate 4.3: Glimpse of vegetation in different coal blocks in HAC area, Chattishgarh



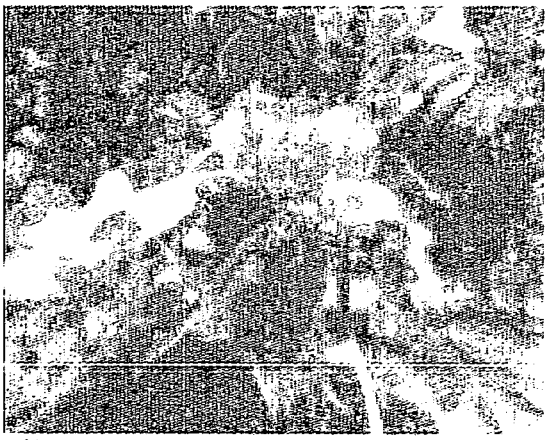
Dillenia pentagyna a very sparsely found in the HAC region



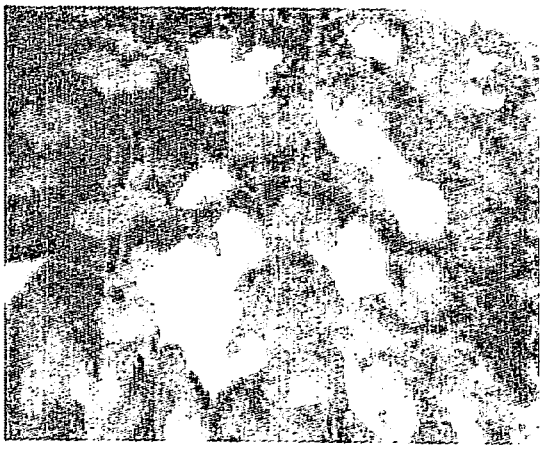
Lucea leontopetaloides a sparsely found in the HAC region



Flemingia nana a sparsely found in the HAC region



Bauhinia kurzii a multipurpose tree in HAC region



Cissus repanda a climbing shrub found in HAC region



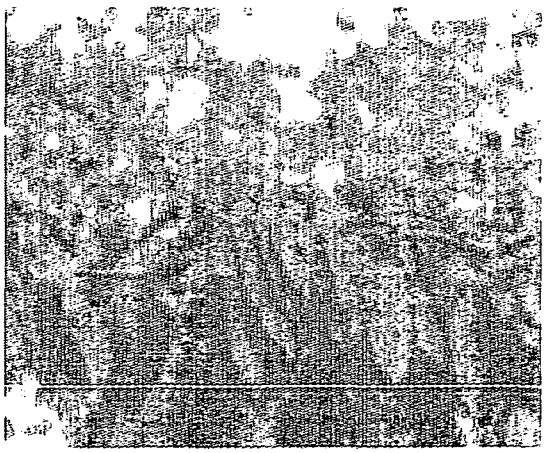
Melastoma malabathricum an ornamental plant found in the riparian areas HAC region



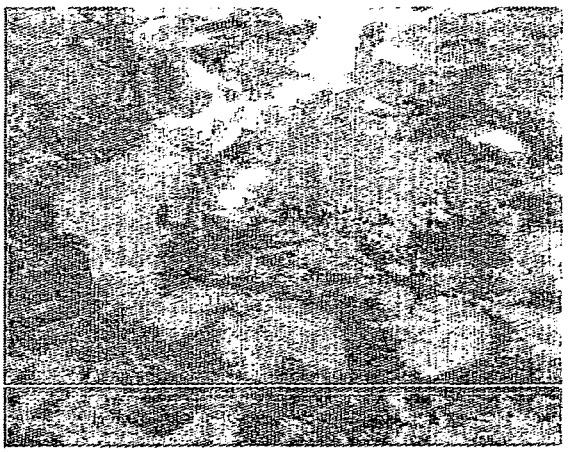
Rivea hypocrateriformis a climbing shrub in HAC region



Pyrcibe paniculata a woody climber found in Nakia coal block

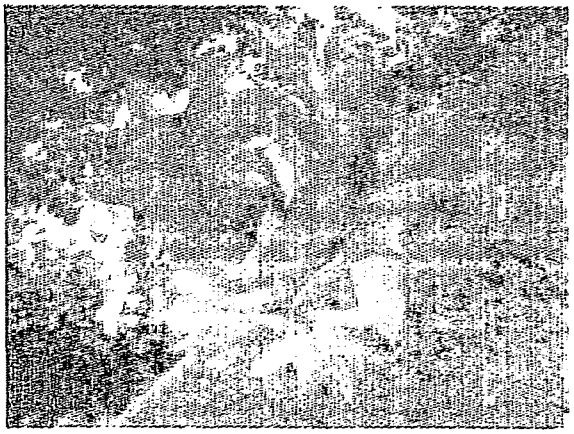


Ochna gamblei commonly found in the HAC region



Geodorum densiflorum a ground Orchid in the coal block of Nakia

Plate 4.4 Plant diversity in the HAC area falls under Surguja, Surajpur and Korba districts of Chhattisgarh



Chelocostus speciosus a RET medicinal plant species



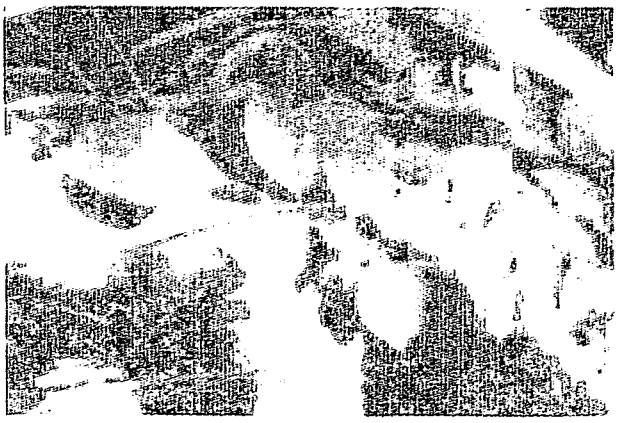
Asparagus racemosus a multipurpose RET species



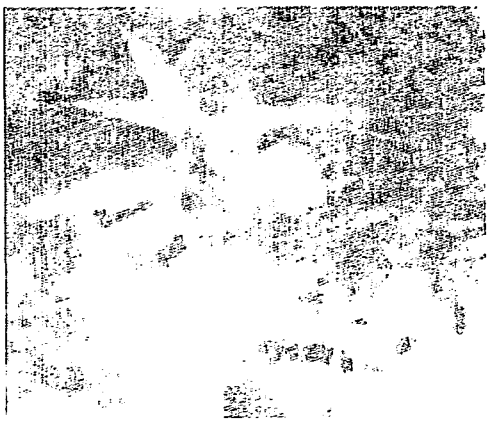
Entada rheedii a RET Woody liana on the way to Nakia



Prosopis indica a RET plant species in the coal blocks of 1,10,15,16,23



Celastrus paniculatus a RET and multipurpose plant species

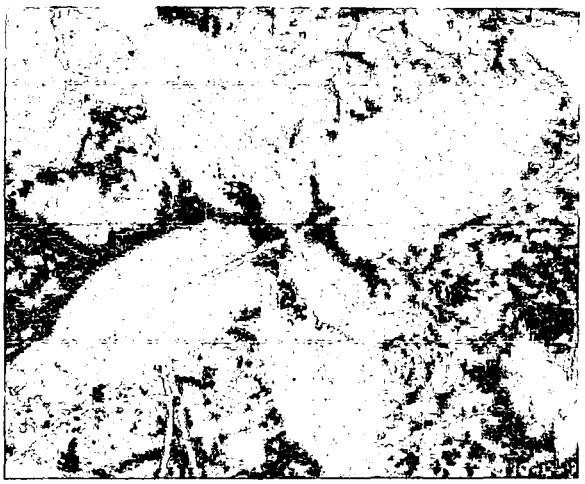


Glochidion superba a RET and multipurpose plant species in HAC region

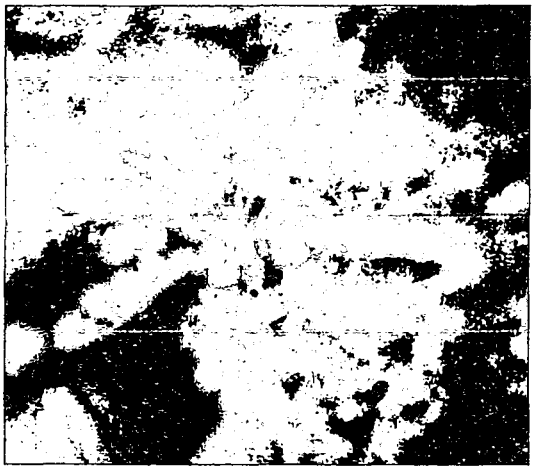
Plate 4.5: RET species recorded from HAC area falls under Surguja, Surajpur and Korba districts of Chhattisgarh found in HAC area



Hemidesmus indicus-a medicinal plant in all the HAC coal blocks



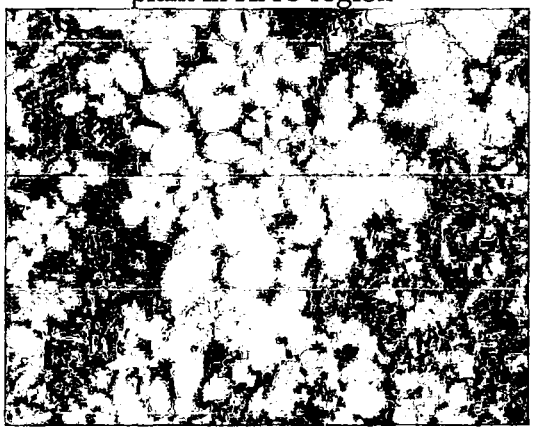
Holostemma ada-kodien-a rare medicinal plant found sparsely in all coal blocks



Biophytum reinwardtii-a medicinal plant in HAC region



Centella asiatica-a medicinal plant



Cleistanthus collinus-Leaves and bark used as fish poison by the tribes of HAC region



Colocasia esculenta-an edible plant processed by the tribes of HAC region

Plate 4.6: Species of economic importance found in the HAC area falls under Surguja, Surajpur and Korba districts of Chhattisgarh

5.1 BACKGROUND AND SCOPE OF THE STUDY

This chapter provides a comprehensive baseline information on terrestrial and avian faunal diversity in Hasdeo-Arand Coalfield (HAC) comprising 23 coal blocks that include of Parsa East and Kanta Basan (PEKB), Parsa, Kente Extension and Tara with special reference to endemic & threatened species /sensitive areas, ecological and likely threats based on detailed surveys conducted by the **Wildlife Institute of India (WII), Dehradun**. In addition, details on the migratory route/corridor of wild mammals particularly elephant and tiger based on the habitat availability and movement in the entire Hasdeo-Arand Coalfield (HAC) were studied and reported. The report is annexed as Volume -II for ready reference.

5.2 APPROACH

An extensive field work for data collection on selected faunal group such as mammals, avifauna and herpetofauna from the entire HAC that fall within Surguja, Surajpur and Korba districts of Chhattisgarh state by following standard methods and practices was initiated during October 2019. Subsequently, the field work was suspended from last week of March 2020 till October 2020 due to Covid-19 related nationwide lockdown. The field work was resumed from November 2020 onwards.

As envisaged in the ToR, the assessment of likely impacts on biodiversity due to the 23 coal blocks in the whole HAC that include proposed/active coal blocks of Parsa, Parsa East & Kanta Basan (PEKB), Tara and Kente Extension were considered for the study. Various methods such as Camera trap, sign, habitat use and analysis survey were employed to generate baseline data. Detailed inventory of mammals was surveyed in core zone of Parsa, PEKB, Tara and Kente Extension coal blocks and its 10 km buffer zone. However, the habitat use of birds and mammals was surveyed and reported from the entire HAC area. Further, the impact assessment, mitigation measures, biodiversity and management plan mainly for the PEKB coal block are detailed in the respective chapter of the report (Volume-II).

5.3 METHODOLOGY

5.3.1 Avifauna Assessment

A total of 30 transects were laid in and around 12 out of 23 coal blocks (in coal blocks of 1, 10, 12, 13, 14, 15, 17, 19, and near the blocks 4, 18, 20, and 22) and adjoining areas during post monsoon (October, 2019) and winter (Feb 2019) seasons (15 transects in each season). The survey was conducted during morning and evening hours when birds are known to be more active (Tranka *et al.*, 2006). Each transect was walked on the existing forest trails for an hour between the length of 400 m to

1000 m. All the encountered species were recorded in the list along with their individuals. Species were identified with the help of a field guide (Grimmett *et al.*, 2011). In addition, the bird species that observed and recorded during the *recce* surveys and field visits are included in the checklist of birds.

5.3.2 Avifaunal Diveristy

Shannon diversity and Margalef richness was computed for each transect using Past 4x software (Hammer *et al.*, 2001). For blocks with more than one transects, the mean value was taken for diversity (D) and richness (R) to represent the bird diversity in the respective block. Abundance status was assigned to the species based on the number of individuals sighted in the study area such as, individual species recorded 8 or more than 8 were assigned as very common; between 4 to 7 as Common; 2 and 3 as fairly common; and only one individual as uncommon. Birds of the World (2021) was followed to assign the endemic status to the bird species. Migration status to the species was assigned based on the field observations and by following Grimmett *et al.*, (2011). In addition to this, 12 species of birds were opportunistically observed during the field visit carried out between 20 and 23 February 2021 are included in the checklist. The encounter rate and abundance status to opportunistic bird sightings are not assigned in the checklist.

5.3.3 Camera Trap

To reliably record wildlife presence and to develop a photo-repository of rare, elusive and nocturnal species, mammal's camera traps (Cuddeback C1) were placed in the forest trails and dry stream beds. A total of 37 cameras traps were deployed and mounted at a height of 40-50 cm on the trees in order to photo capture a wide variety of animals that could occur in and around Parsa, PEKB, Tara and Kente Extension coal blocks. The cameras were left for 24 hours for a period of 20 to 30 days as determined by field logistics.

5.3.4 Sign Survey

The sign survey was carried out during dry months *i.e.*, December 2019 to March 2020. Field team comprising of three to four surveyors, including the forest guard from the Forest Department walked the forest trails, streams and forest roads to record the presence of mammals that include large carnivores, meso carnivores and ungulates in and around Parsa, PEKB, Tara and Kente Extension coal blocks. Fresh and reasonably fresh signs of large carnivores, lesser carnivores and wild ungulates were recorded during the surveys along with their GPS location. A total of 120 km of walk effort was made to collect the sign survey. In addition, the mammalian species identified by the villagers during the interview survey were also incorporated in the inventory.

An area of 630 km^2 comprising four identified coal blocks of Tara, Parsa, PEKB and Kente Extension and a 10-km of its aerial buffer around was demarcated in GIS. In addition to the biodiversity assessment, the area was used to assess the habitat use pattern for the selected species that include large carnivores, meso carnivores and ungulates. The species occurrence was generated using camera traps and sign survey. The presence-only data were interpolated or extrapolated for the requirements (Feeley and Silman 2011). The species occurrence data was spatially thinned by using 'spThin' package (Aiello Lammens *et al.,* 2015) in 'R' to create a data set such that the locations were spatially apart from each other. The thinning was repeated for 100 times for the random process of removing nearest-neighbour to different of coordinates. Considering the spatial occupancy characteristics of species, the location dataset of large carnivores and ungulates were thinned 1 km apart and 0.5 km in case of meso-carnivores. A total of ten environment variables (Table 5.1), such as six bioclimatic variables (BIO3, BIO4, BIO7, BIO15, BIO17 and BIO18), population density, distance to water and distance to the nearest village were used as predictor variables. As the environment variables used for prediction are scale-dependent (Hortal *et. al,* 2010), the relative variable importance was estimated. Highly correlated variables (Pearson's $r < 0.75$) were removed from analysis (Elith and Leathwick 2009, Elith *et al.,* 2011). Rasters of different resolution were re-sampled using resample function in raster package of R, which transfer values between the raster for projection into coordinate system (Hijmans *et al.,* 2015). To predict the distribution of species in the prescribed area, maximum entropy algorithm in Program Maxent was used (Phillips *et al.*, 2006). Model selection was done by using 'SSDM' package (Schmitt *et al.,* 2017), which provides tools to evaluate individual species distribution probabilities.

5.3.6 Elephant Habitat Use, Movement Pattern and Human Elephant Conflict

A robust assessment process for elephant occurrence, use of habitat, movement pattern using multi-pronged approach and a combination of methods were employed.

- Elephant occurrences were mapped at forest compartment level using the data for the period from 2018 to 2020 meticulously maintained by the respective State Forest Divisions (SFD). The data was decoded as 1 (recorded use of elephants in the compartment) and 0 (non-detection in the compartment). As part of WII-CGFD collaborative project on elephants in northern Chhattisgarh, the WII research team has been monitoring elephants using (i) individual recognition of elephants and re-sighting approach and (ii) satellite collaring of select elephants that operate in the landscape. The monitoring program has begun during the year 2017 and is on-going. Data obtained from the monitoring program were used to understand elephant home range and movement pattern within Tara, Parsa, PEKB and Kente Extension coal blocks

and in entire HAC landscape. Elephant home ranges were computed using Minimum Convex Polygon (MCP) approach (Powell, 2000).

- In addition, data on the incidents of crop, property losses caused by elephants, and Human Elephant Conflict (HEC) related human fatalities were obtained and mapped in GIS based on compensation data collated from the State Forest Department. Using this, the spatio-temporal patterns of HEC were established.

5.3.7 Tiger Presence and Habitat Recovery

Probability of tiger presence in a landscape is determined by combination of factors that include availability of forest cover, availability of ungulate prey (Karanth *et al.*, 2004 & 2011; Andheria *et. al.*, 2007) and minimal human disturbance to the habitat (Hebblewhite *et. al.*, 2014).

Sporadic tiger movement around the Korba Forest Division area is reported by the Forest Department. Therefore, potential habitat of tigers in the HAC area by factoring the availability of habitat, extent of habitat connectivity and dispersal potential from the nearby tiger habitats were developed using a hypothetical framework and hierarchical approach following:

- Land-use land-cover (LULC) layer developed by RRSC-IRSO for northern Chhattisgarh were used to delineate potential tiger habitat. The LULC was re-sampled to 100 m resolution to create a resistance layer for the landscape. For settlements, transportation infrastructure and active mines, low conductance value were assigned as these could impede animal movement. For crop fields and water bodies, moderate conductance values were assigned. For the forests and scrubs, higher conductance values were assigned
- Circuitscape Plug-in tool in ArcGIS (10.6.1) was used to assess the strength of habitat connectivity between (KBA) complex, which is the nearest potential tiger source habitat, and the area
- A total of 12 ecologically similar protected areas (PAs) in Central India were selected and vegetation productivity of the area was compared with those PAs.
- A qualitative SWOT (Strength, Weakness, Opportunity and Threat) analysis was carried out to evaluate its tiger conservation potential.

Table 5.1: List of Variables used for Habitat use predictions in Hasdeo-Arand Coalfield that falls within the districts of Surguja, Surajpur and Korba in Chhattisgarh

Variable		Code	Source	Type
Climate	BIO1 = Annual Mean Temperature		Worldclim	Continuous
	BIO2 = Mean Diurnal Range (Mean of monthly (max temp - min temp))			
	BIO3 = Isothermality (BIO2/BIO7) (×100)	BIO3		
	BIO4 = Temperature Seasonality (standard deviation ×100)	BIO4		
	BIO5 = Max Temperature of Warmest Month			
	BIO6 = Min Temperature of Coldest Month			
	BIO7 = Temperature Annual Range (BIO5-BIO6)	BIO7		
	BIO8 = Mean Temperature of Wettest Quarter			
	BIO9 = Mean Temperature of Driest Quarter			
	BIO10 = Mean Temperature of Warmest Quarter			
	BIO11 = Mean Temperature of Coldest Quarter			
	BIO12 = Annual Precipitation			
	BIO13 = Precipitation of Wettest Month			
	BIO14 = Precipitation of Driest Month			
	BIO15 = Precipitation Seasonality (Coefficient of Variation)	BIO15		
	BIO16 = Precipitation of Wettest Quarter			
	BIO17 = Precipitation of Driest Quarter	BIO17		
	BIO18 = Precipitation of Warmest Quarter	BIO18		
	BIO19 = Precipitation of Coldest Quarter			
Population Density			CIESIN	Continuous
Distance to the nearest water source (m)			RRSC-IRSO	Continuous
Distance to the nearest village/ tribal settlement (m)			RRSC-IRSO	Continuous

5.4 TERRESTRIAL AND AVIFAUNAL DIVERSITY

5.4.1 Secondary source of information

Chhattisgarh has been an area of neglect as far as ecological studies and biodiversity assessments are concerned. Although the state harbours a rich biodiversity, which are under tacit threat from agricultural expansion, industrial and infrastructure growth, forest produce collection, and diversion of forest lands for non-forestry purposes; published information on the state of biodiversity in Chhattisgarh continues to be sparse and fragmented. During the last few years, there has been a positive change in this regard in recent past and important ecological assessments are being carried out across diverse regions in the state focusing on a variety of taxa. Ecological assessments, reports and other published information are collated and presented in this review:

5.4.1.1 Mammals

Human–elephant conflict in the villages of northern Chhattisgarh was assessed through a rapid survey (Singh, 2002). In this assessment, the aspects of dispersal of elephants from the neighboring states into Chhattisgarh were elaborated by using a GIS and remote sensing framework. Areendran *et al.* (2011) assessed habitat suitability and corridor viability for elephants in northern Chhattisgarh. This work serves as an important reference for future works on elephants in the landscape. Bisen (2017) had compiled aspects of human–elephant conflict for the entire state of Chhattisgarh by collating forest department records. There were many individual studies focusing on the human–sloth bear (*Melursus ursinus*) conflict in northern Chhattisgarh, which seems to be a localised problem, but spread out almost all through the landscape. Bargali *et al.* (2004, 2005 & 2012) studied the characteristics of human-sloth bear conflict in and around the North Bilaspur Forest Division, which comprises parts of the demarcated study area as well. In addition to conflict aspects, had also studied the characteristics of sloth bear den use and highlighted the use of boulder-strewn hillocks as den sites for raising sloth bear litter (Akhtar *et al.* (2007). Using habitat suitability modelling, Bargali *et al.* (2012) found that habitat selection by sloth bear was high in Sal-dominated mixed forests in boulder hillocks in the vicinity of water bodies and agricultural fields. In Marwahi Forest Division, which lies to the east of the HAC and the landscape surrounding it, was assessed the status of human-wildlife conflict and suggested management implications for conflict management for the species like sloth bear, jackal (*Canis aureus*) and leopard (*Panthera pardus*) by Akhtar and Chauhan (2008).

Golden jackal (*Canis aureus*) is commensal, and widespread in northern Chhattisgarh. Akhtar and Chauhan (2009) was studied the human-jackal interactions along with their food habits and showed that jackal diet is highly catholic. In a landscape-level study encompassing large tracts of forests in the Central Indian landscape, observed several potential corridors for tigers (*Panthera tigris*) and indicated a strong habitat

connectivity between Achanakmar, Kanha, Sanjay and other Central Indian tiger reserves located towards the west of HAC (Dutta *et. al.*, 2016). This finding indicate potential tiger dispersal and range establishment in some of the Central Indian forest habitats if habitat protection, prey species recovery and other conditions known to recover tigers improve. Mandal *et al.* (2017) assessed tiger recovery in Achanakmar tiger reserve, which is contiguous to HAC and a potential nearest source site for the tigers. The study also assessed the status of other large carnivores like leopard (*Panthera pardus*) and striped hyena (*Hyaena hyena*). Using geospatial tools, Singh *et al.* (2009) developed habitat suitability models for tigers and their prey in Achanakmar tiger reserve.

Based on villager interview surveys across 16 villages, Ahmed *et al.* (2012) identified human-carnivores conflict in Kanha-Achanakmar corridor located towards the west of the HAC and the surrounding landscape. The study throws light on the fact that conflict concerning large carnivores is widespread in the landscape and that eco-development extensions in select villages may be critical to address conflict. The last of the cheetahs (*Acinonyx jubatus*) to be shot in India were found inhabiting in the forests of Surguja in present day Chhattisgarh state as reported by Kazmi (2019). This landscape is near to the Hasdeo-Arand area indicating the historic importance of the landscape. The smallest of the wild felids, the rusty-spotted cat (*Prionailurus rubiginosus*), was first reported from Udanti Sita-Nadi Tiger Reserve, located in the south-central Chhattisgarh (Basak *et al.*, 2017). One of the least studied large carnivores, the Asiatic wolf (*Canis lupus*), was studied in a larger landscape south of the Gangetic plains, using habitat suitability framework (Sharma *et al.*, 2019). This survey indicated a wider distribution of the species in East Central region.

5.4.1.2 Avifauna

The ruddy-breasted crake (*Porzana fusca*) was reported for the first time in Dalpat Sagar lake in Bastar district of the state (Dutta, 2017), it has also been reported that this species has been sighted in the Jangir-Champa district, located in the south of HAC of the state. Many winter migrant birds have been reported in and around HAC. Bharos *et al.* (2019) reported the first record of nesting of little-ringed plover (*Charadrius dubius*) in Chhattisgarh (location not mentioned in the paper). It may be noted that the reported species breeds in Pakistan and Kashmir and it is a winter visitor to Indian Subcontinent. Further, the same assessment reported range extension of grey-headed lapwing in the states of Chhattisgarh, eastern Madhya Pradesh and Jharkhand. Vishwakarma *et al.* (2020) explored the avifaunal diversity in Kopra wetland, at Bilaspur district for three consecutive winters during the period between 2016 and 2018. They recorded a total of 133 avifauna species belonging to 18 orders and 47 families that includes four near-threatened species.

5.4.1.3 Invertebrates and Herpetofauna

Presence of *Petrelaea dana*, a species of butterfly belonging to the family Lycaenidae, from the Kurandi Range of Kanger Valley National park, Bastar, Chhattisgarh has been documented (Sisodia, 2019*a* & *b*). Although this species was not reported from northern Chhattisgarh, its presence in southern Chhattisgarh elicits interest in species exchange and is important from biogeography point of view. An assessment of butterfly diversity in Achanakmar–Amarkantak biosphere reserve, located to the west of study area revealed reasonably high species richness which records of 133 species belonging to six families including 55 new species (Tiple and Ghorpadé, 2012). A checklist prepared by Gupta and Chandra (2017) reveals a total of 174 species of butterflies, along with 100 sub-species across Chhattisgarh. A survey conducted by Minz *et al.* (2020) in National parks, various wildlife sanctuaries and various districts in central Chhattisgarh and recorded a total of 14 species of bees Hymenoptera order belonging to three different species in agro-climatic zones. Dawn and Chandra (2014) discovered 10 new species of Odonata from the state of Chhattisgarh, increasing the total number to 95. Gupta (2016) reported new addition of one species to the existing 41 species and subspecies under 37 genera belonging to five families of Orthopteran fauna in the Surguja district, Chhattisgarh. Gupta and Chandra (2017) surveyed the Achanakmar landscape located in the west of study area and reported 33 species and subspecies pertaining to 30 genera under five families. Literature analysis shows that few studies have been conducted to form a checklist or an inventory of herpetofauna in the Central India, most important of them would be the review work conducted by Chandra and Gajbe (2005), which shows that Chhattisgarh accounts for 11 species of amphibians under nine genera of four families and 45 species of reptiles under 29 genera of 11 families.

5.5 PRIMARY BASELINE

5.5.1 Inventory of Mammals

As part of the biodiversity assessment, the list of mammals that occur in and around the Parsa, PEKB, Kente Extension and Tara coal blocks were recorded during the field surveys is presented in Table 5.2 (Plate 5.1). A total of 25 mammalian vertebrates were recorded in the field. The signs of Indian wild dogs (dhole, *Cuon alpinus*) and sambar (*Rusa unicolor*) were not recorded during the field survey, however, during interview with the villagers, 16% (n = 18) respondents reported presence of dhole and 34.2% (n = 38) of respondents reported presence of sambar. The camera traps placed within the study area (Figure 5.1) and the sign survey recorded within the study area (Figure 5.2) and various mammals recorded during the survey is reflected in the Figure 5.3 to 5.13.

Table 5.2: Mammalian species recorded during the survey in and around the Parsa, PEKB, Kente Extension and Tara coal blocks in Hasdeo-Arand Coalfield that falls within Surguja, Korba and Surajpur districts of Chhattisgarh

S.No.	Species	Scientific name	Sign survey	Camera trap survey	Interview survey	IUCN	Wildlife (Protection) Act
1	Golden jackal	*Canis aureus*	✓	✓	✓	LC	Schedule II (Part II)
2	Striped hyena	*Hyaena hyaena*	✓	✓	✓	NT	Schedule III
3	Sloth bear	*Melursus ursinus*	✓	✓	✓	VU	Schedule I
4	Indian grey wolf	*Canis lupus*	✓	✓	✓	LC	Schedule I
5	Jungle cat	*Felis chaus*	✓	✓	✓	LC	Schedule II (Part II)
6	Honey badger	*Mellivora capensis*		✓		LC	Schedule I
7	Common leopard	*Panthera pardus*	✓		✓	VU	Schedule I
8	Elephant	*Elephas maximus*			✓	EN	Schedule I
9	Spotted deer	*Axis axis*	✓	✓	✓	LC	Schedule III
10	Four-horned antelope	*Tetracerus quadricornis*		✓	✓	VU	Schedule I
11	Indian fox	*Vulpes bengalensis*		✓	✓	LC	Schedule II (Part II)
12	Rhesus macaque	*Macaca mulatta*	✓	✓	✓	LC	Schedule II (Part I)
13	Common langur	*Semnopithecus entellus*	✓	✓	✓	LC	Schedule II (Part I)
14	Barking deer	*Muntiacus muntjac*	✓	✓		VU	Schedule III
15	Rusty spotted cat	*Prionailurus rubiginosus*		✓		NC	Schedule I
16	Black-naped hare	*Lepus nigricollis*	✓	✓	✓	LC	Schedule IV
17	Giant squirrel	*Ratufa indica*	✓		✓	NT	Schedule I
18	Palm civet	*Paradoxurus hermaphroditus*		✓		LC	Schedule II
19	Small Indian civet	*Viverricula indica*		✓		LC	Schedule II
20	Indian crested porcupine	*Hystrix indica*	✓	✓	✓	LC	Schedule IV
21	Smooth-coated otter	*Lutragale perspicillata*	✓		✓	VU	Schedule II (Part II)
22	Indian pangolin	*Manis crassicaudata*	✓		✓	EN	Schedule I
23	Wild pig	*Sus scrofa*	✓	✓	✓	LC	Schedule III
24	Ruddy mongoose	*Herpestes smithii*	✓	✓	✓	LC	Schedule II
25	Common grey mongoose	*Herpestes edwardsii*	✓	✓	✓	LC	Schedule II
LC-Least Concern NT-Near Threatened, VU-Vulnerable, EN-Endangered, NC- Nationally Critical							

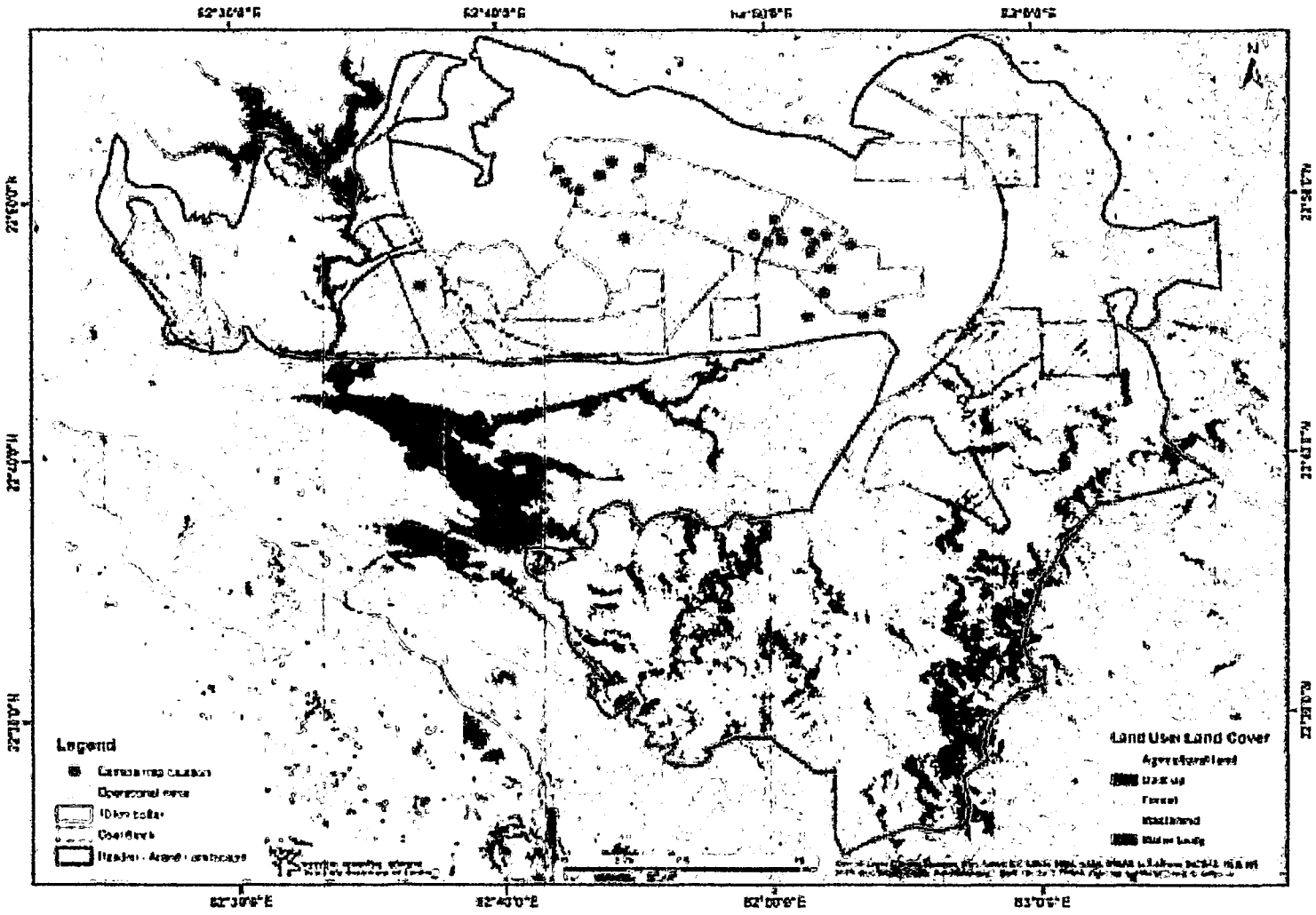


Figure 5.1: Location details of the camera traps within the four coal blocks and its 10 km radius in Hasdeo-Arand Coalfield that falls within the districts of Surguja, Surajpur and Korba in Chhattisgarh

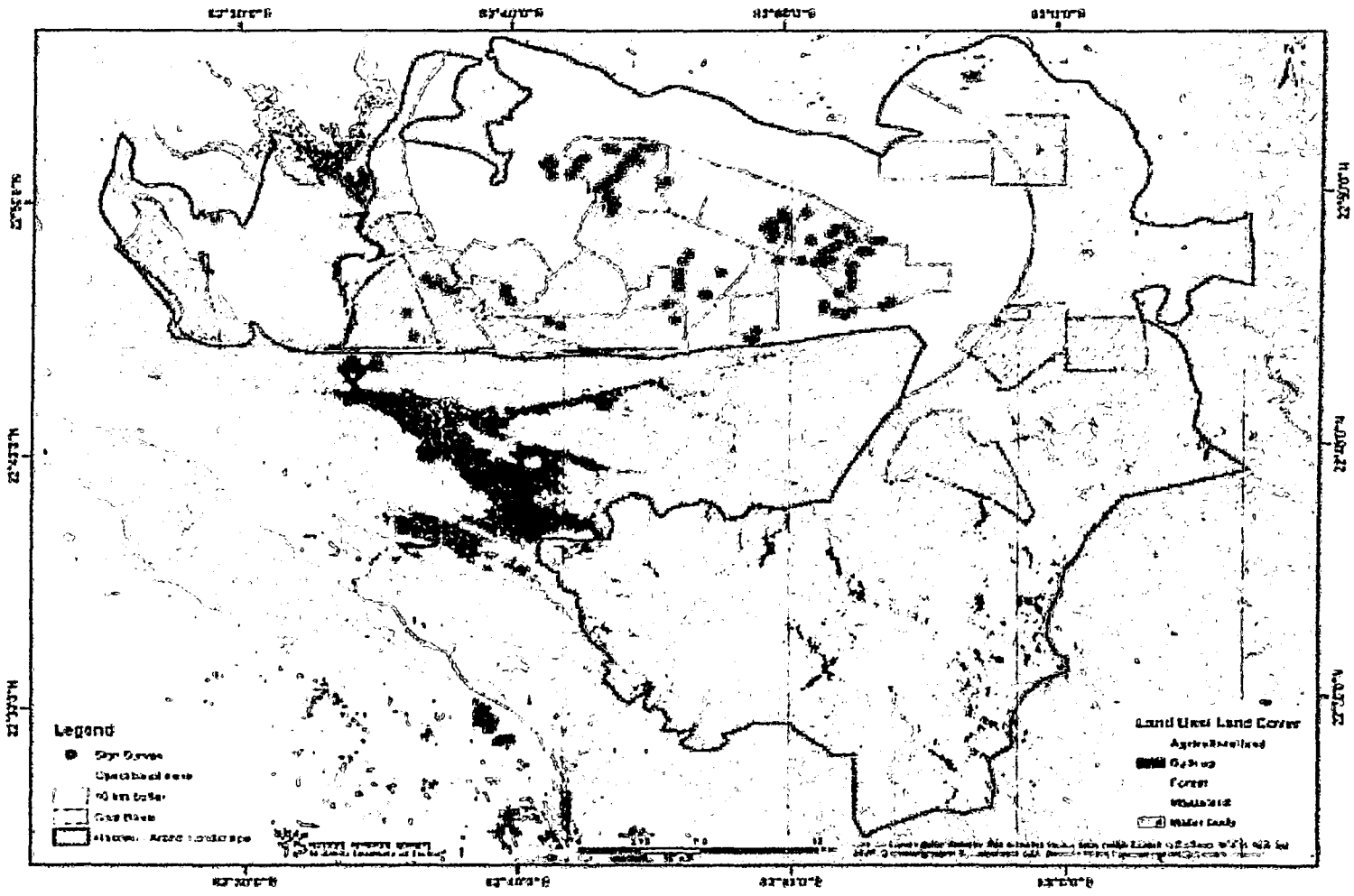


Figure 5.2: Location details of the Sign survey carried out within the four blocks and its 10 km radius in Hasdeo-Arand Coalfieldthat falls within the districts of Surguja, Surajpur and Korba in Chhattisgarh

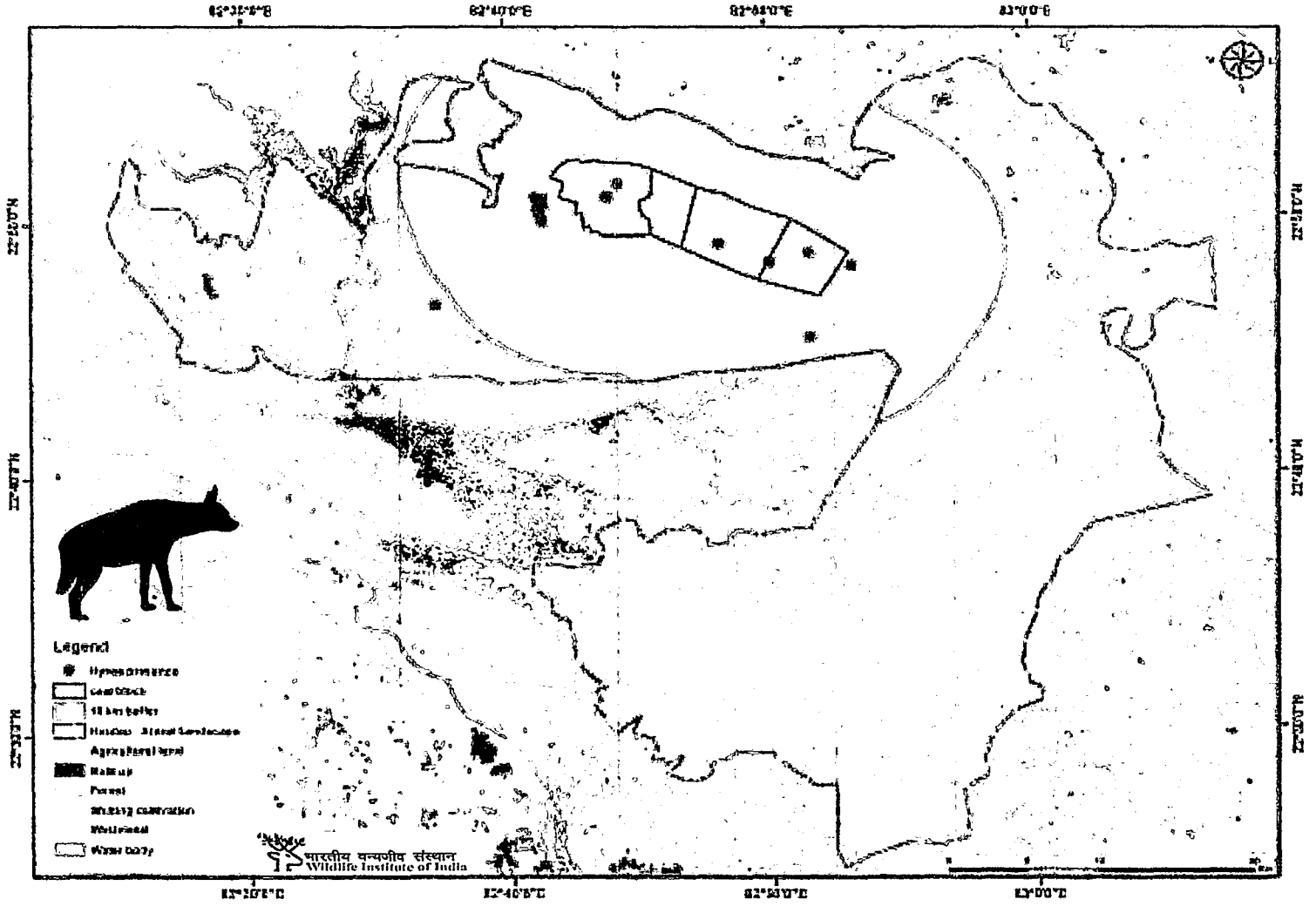


Figure 5.3: Location details of the stripped Hyena presence within the four blocks and its 10 km radius in Hasdeo-Arand Coalfield that falls within the districts of Surguja, Surajpur and Korba in Chhattisgarh

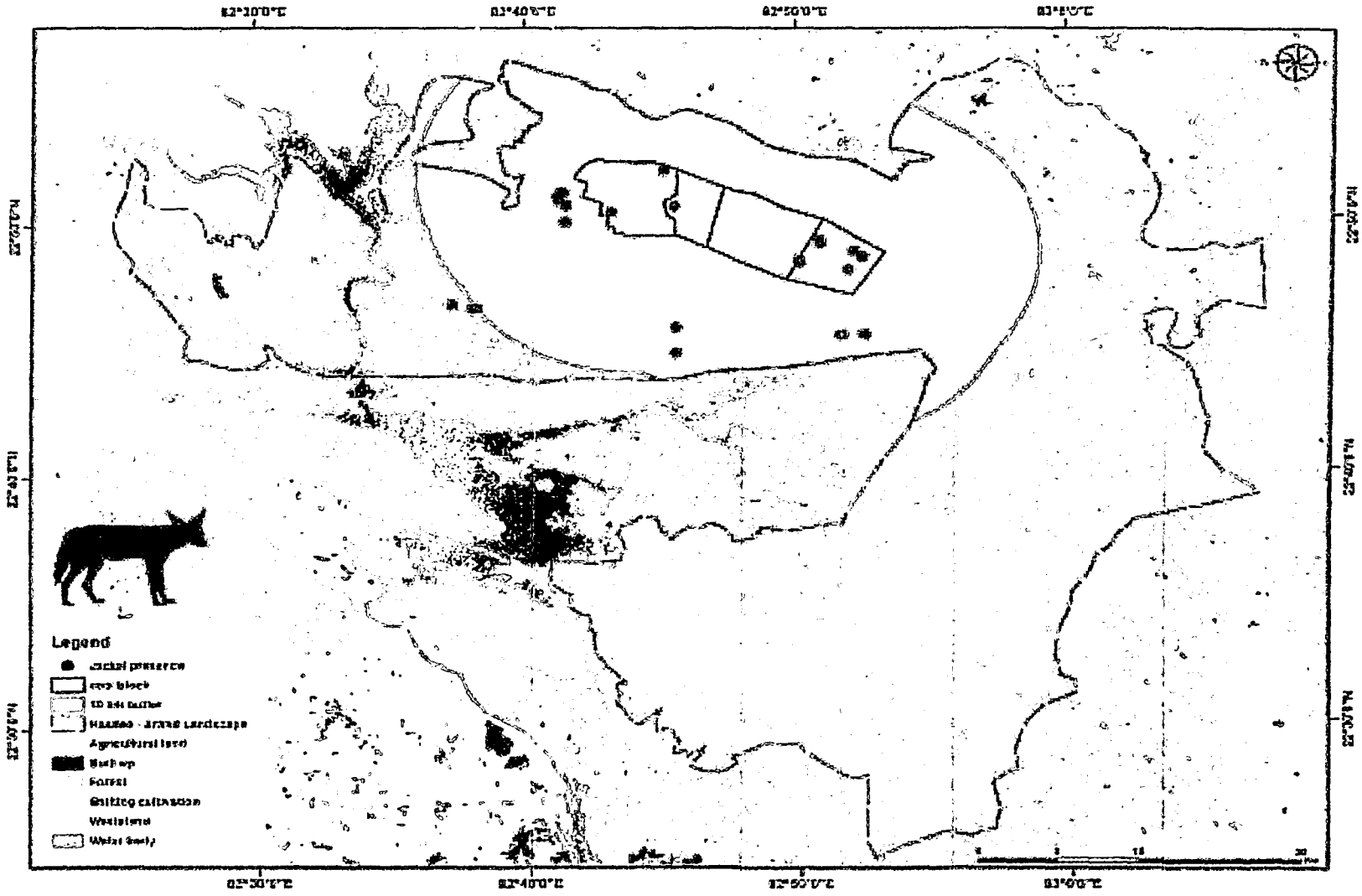


Figure 5.4: Location details of the Golden Jackal presence within the four blocks and its 10 km radius in Hasdeo-Arand Coalfield that falls within the districts of Surguja, Surajpur and Korba in Chhattisgarh

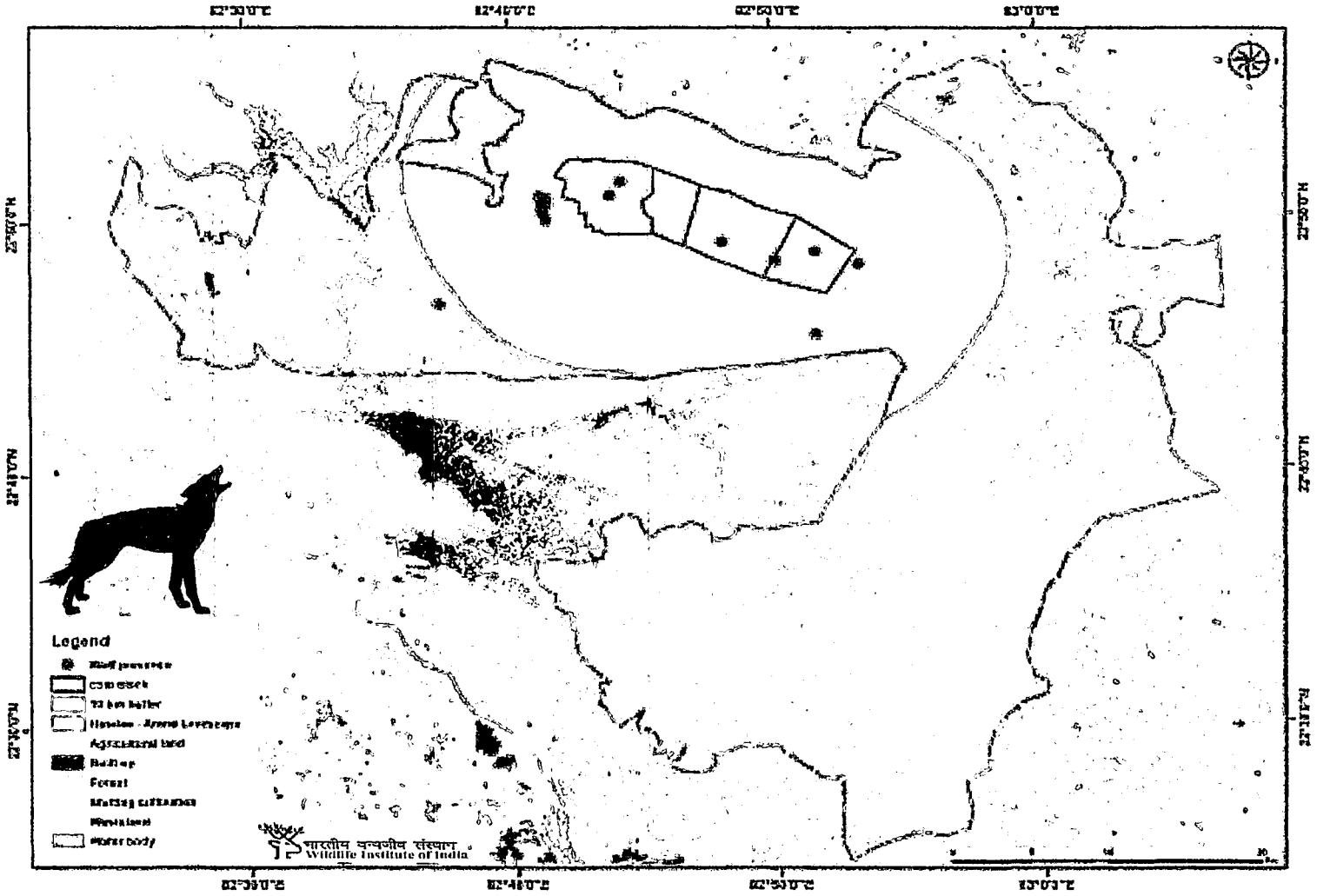


Figure 5.5: Location details of the Grey wolf presence within the four blocks and its 10 km radius in Hasdeo-Arand Coalfield that falls within the districts of Surguja, Surajpur and Korba in Chhattisgarh

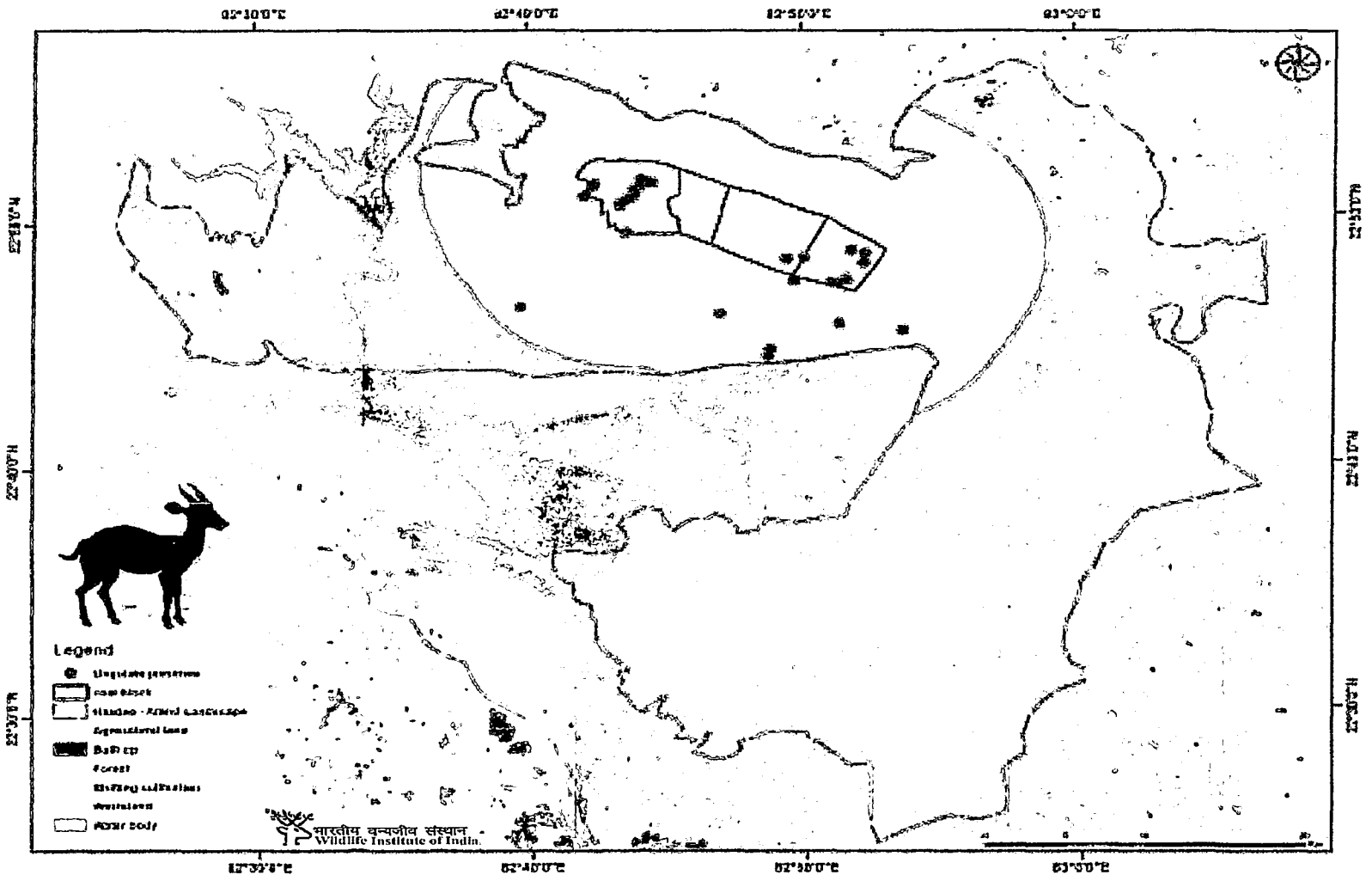


Figure 5.6: Location details of the Ungulates presence within the four blocks and its 10 km radius in Hasdeo-Arand Coalfield that falls within the districts of Surguja, Surajpur and Korba in Chhattisgarh

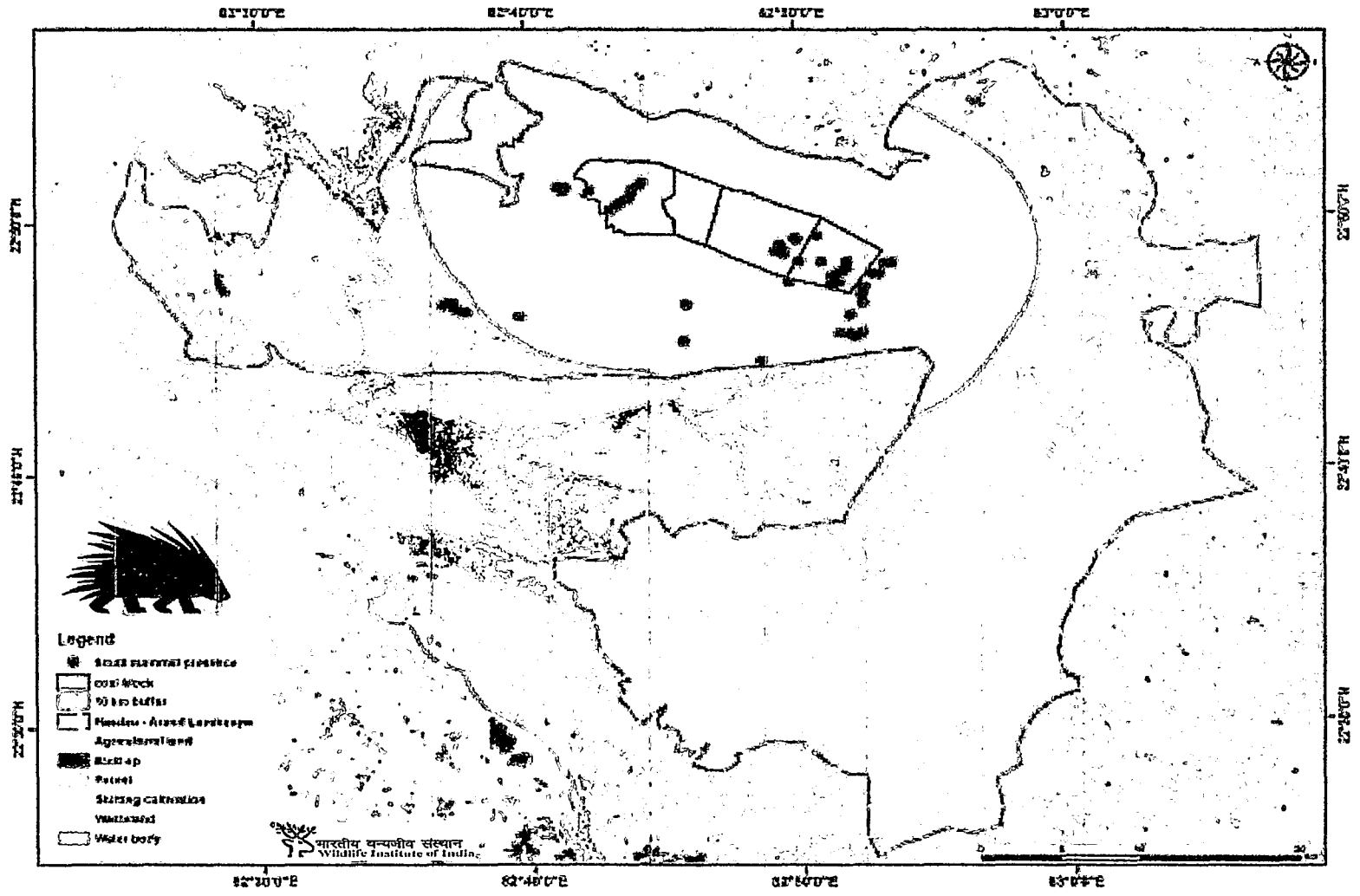


Figure 5.7: Location details of the small mammals within the four blocks and its 10 km radius in Hasdeo-Arand Coalfield that falls within the districts of Surguja, Surajpur and Korba in Chhattisgarh

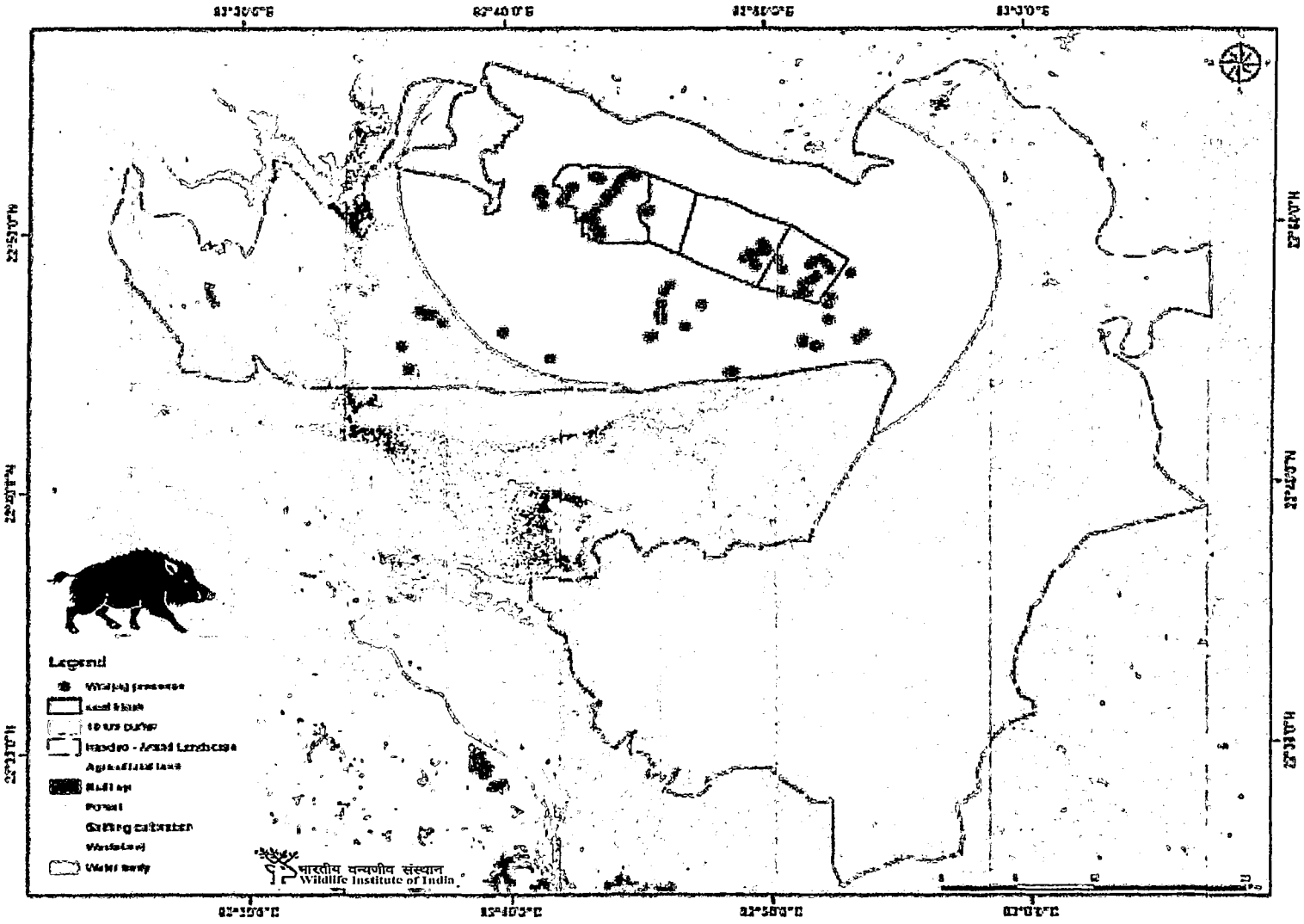


Figure 5.8: Location details of the wild pig within the four blocks and its 10 km radius in Hasdeo-Arand Coalfield that falls within the districts of Surguja, Surajpur and Korba in Chhattisgarh

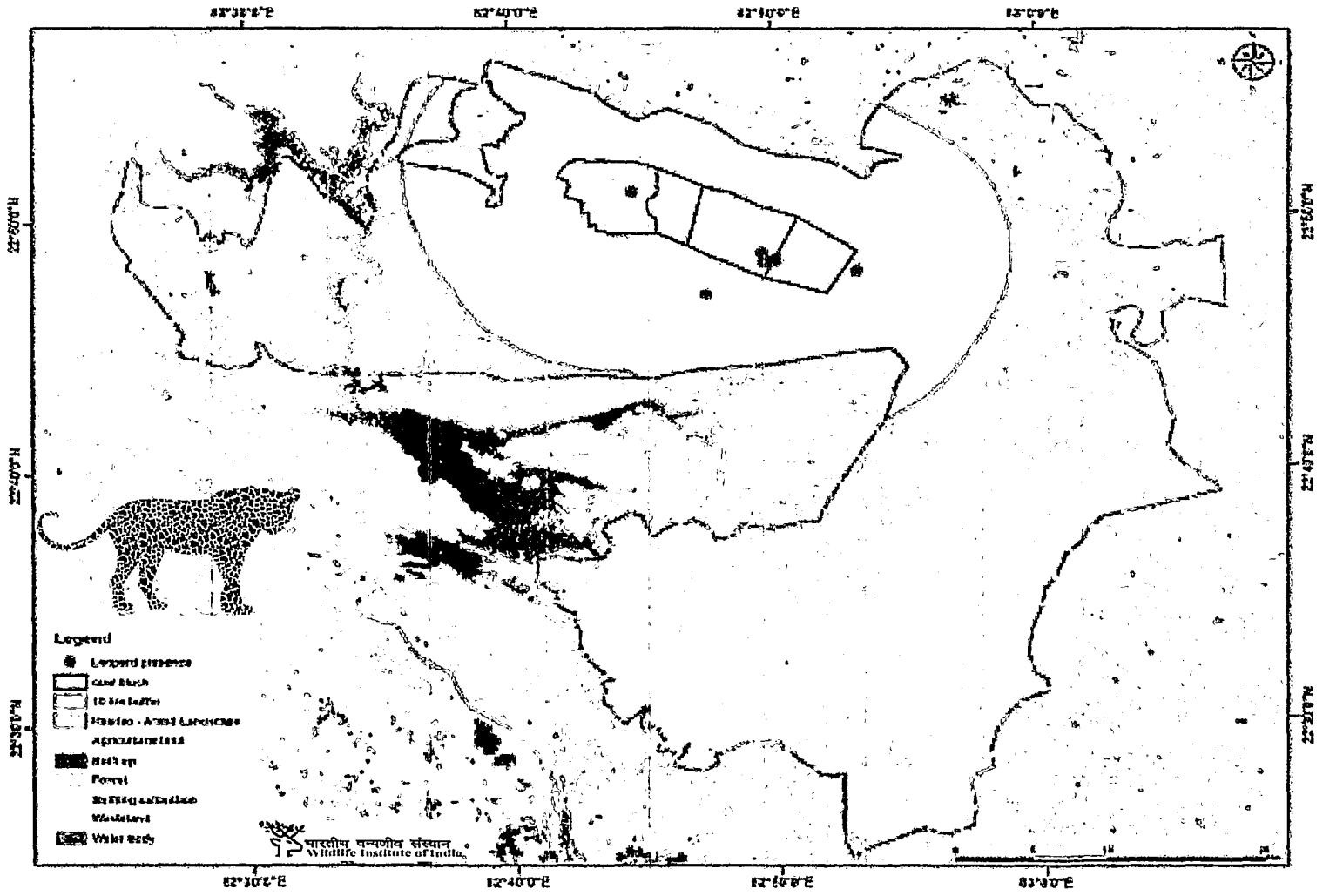


Figure 5.9: Location details of the Common leopard within the four blocks and its 10 km radius in Hasdeo-Arand Coalfield that falls within the districts of Surguja, Surajpur and Korba in Chhattisgarh

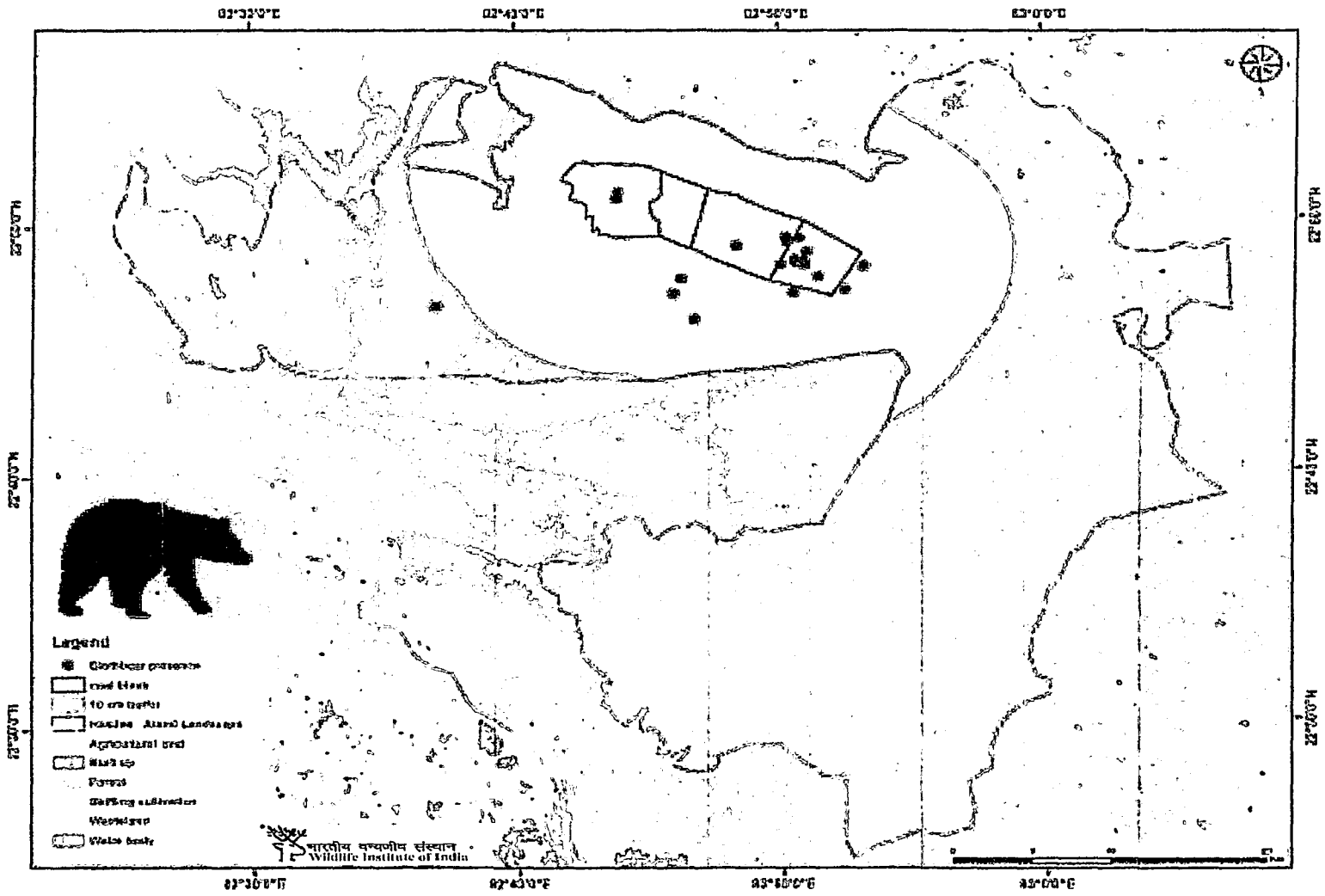


Figure 5.10: Location details of the sloth bear within the four blocks and its 10 km radius in Hasdeo-Arand Coalfield that falls within the districts of Surguja, Surajpur and Korba in Chhattisgarh

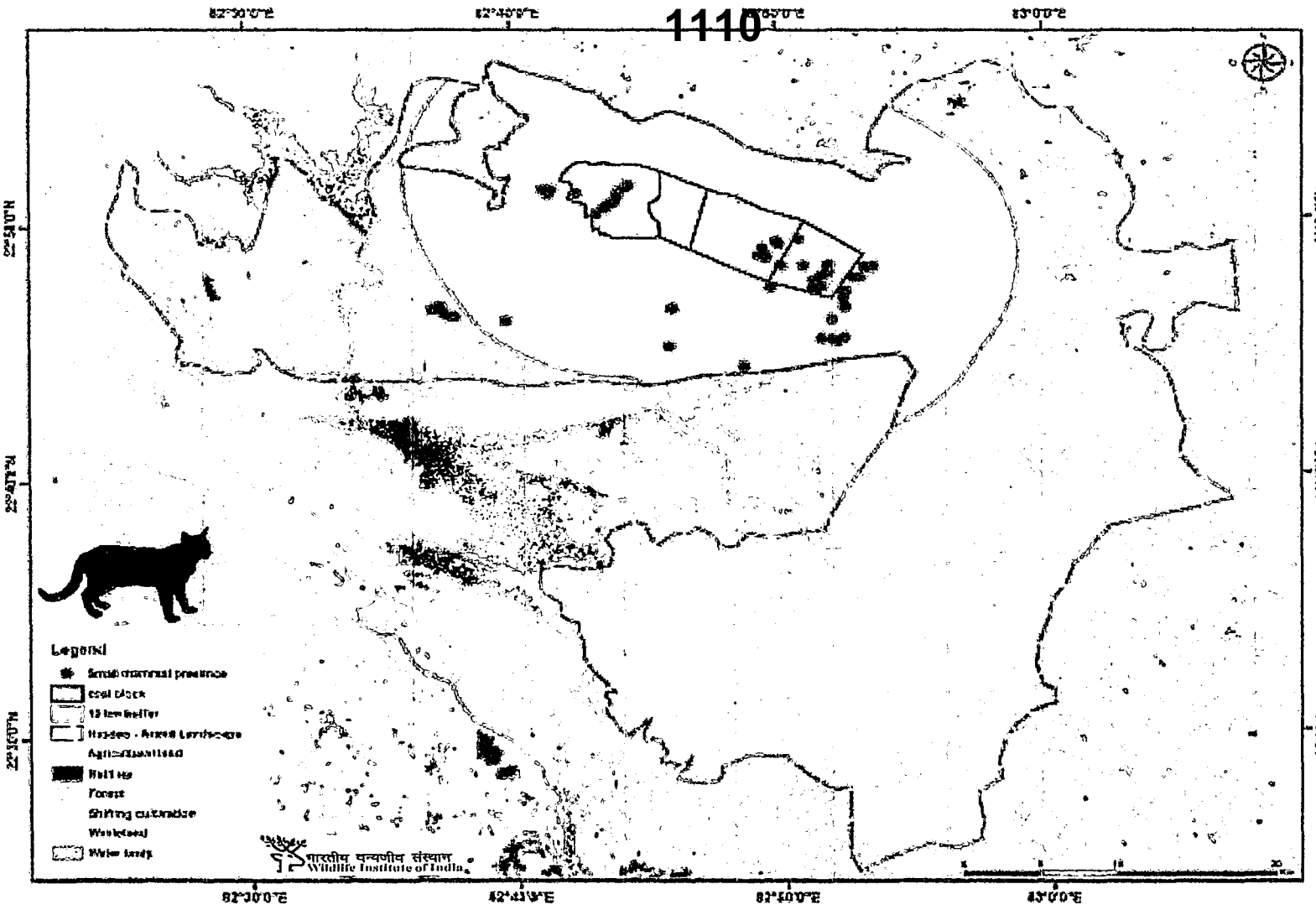


Figure 5.11: Location details of the Small cats within the four blocks and its 10 km radius in Hasdeo-Arand Coalfield that falls within the districts of Surguja, Surajpur and Korba in Chhattisgarh

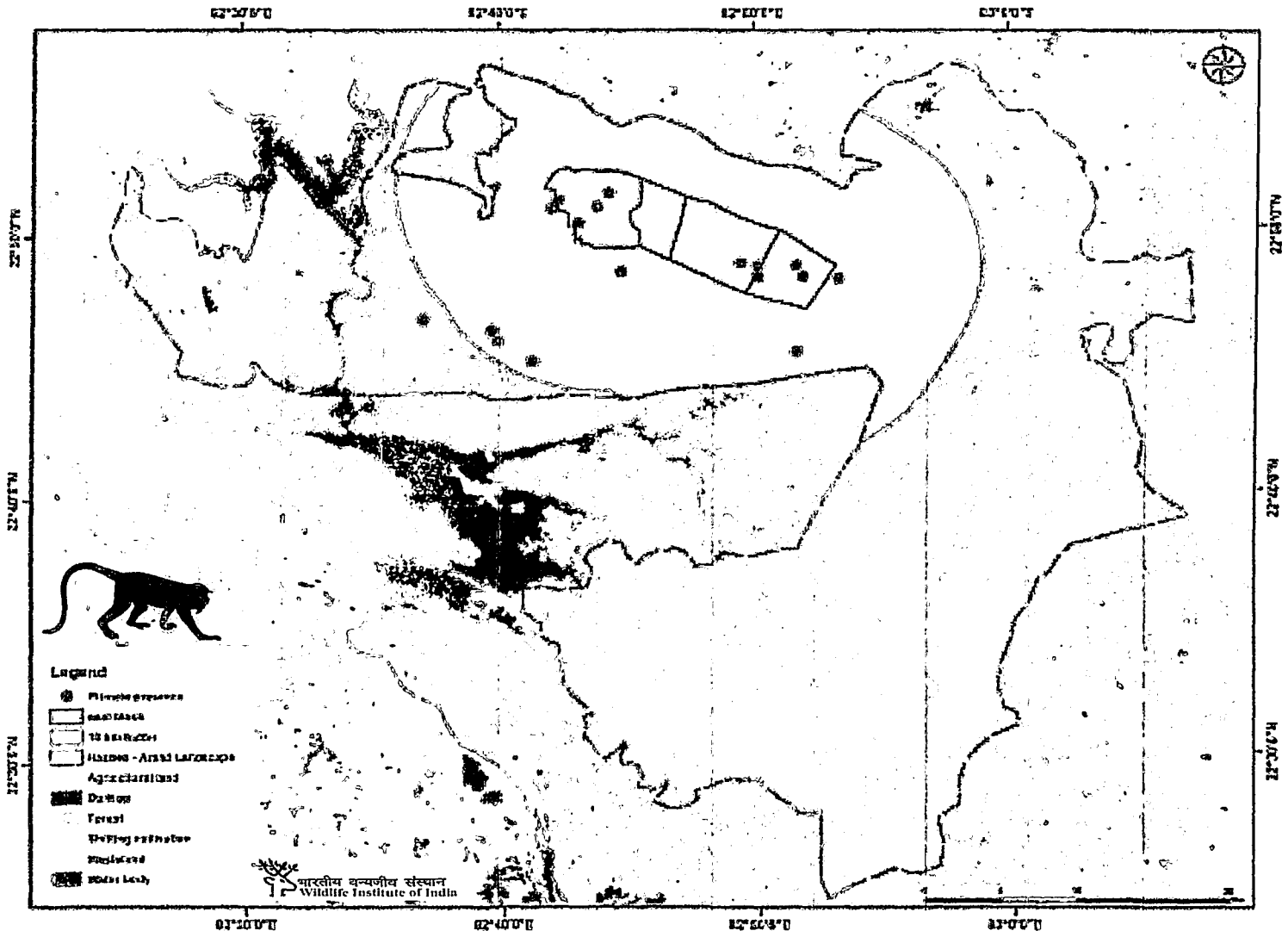


Figure 5.12: Location details of the Primates within the four blocks and its 10 km radius in Hasdeo-Arand Coalfield that falls within the districts of Surguja, Surajpur and Korba in Chhattisgarh

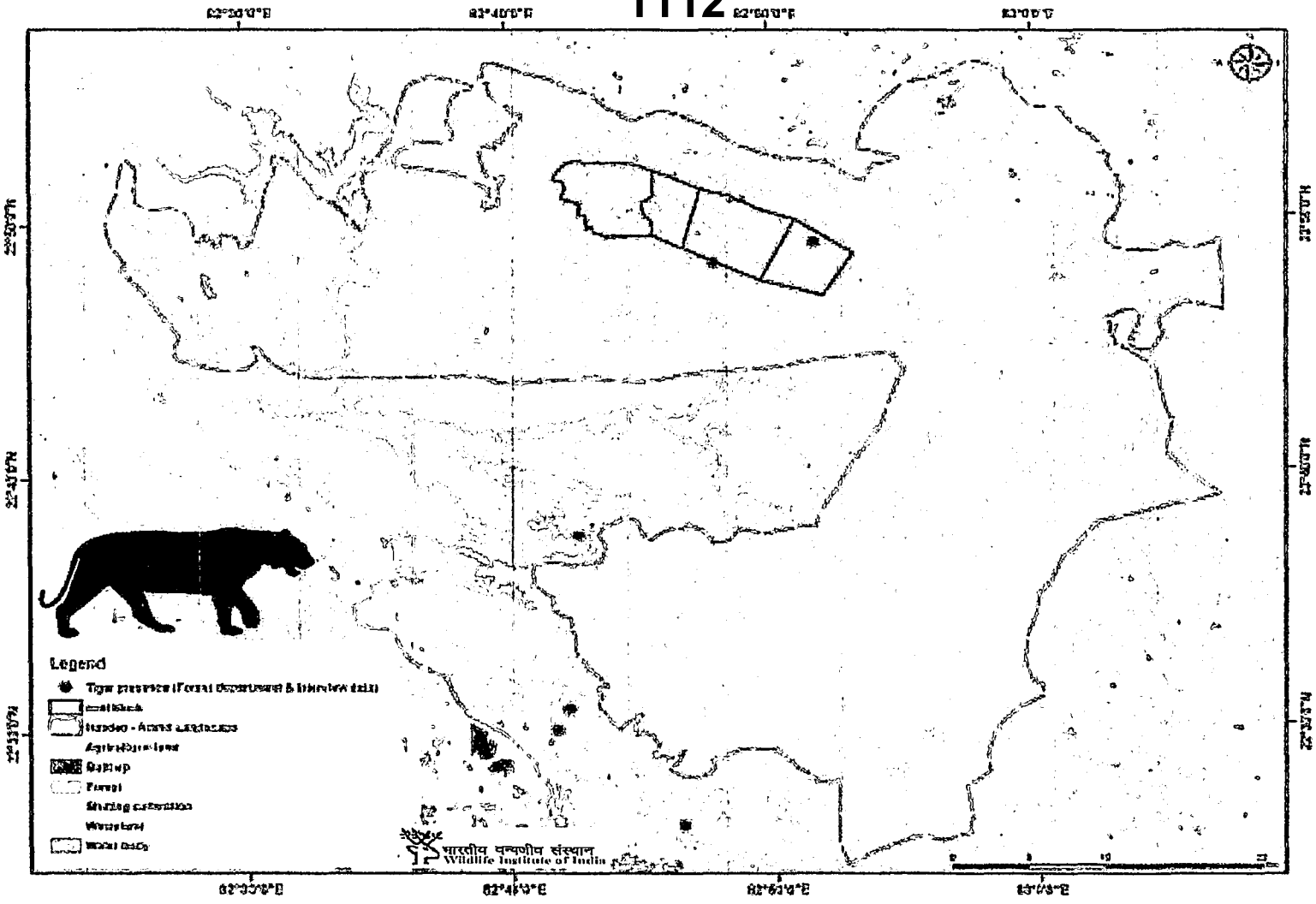


Figure 5.13: Location details of the tiger reported within the four blocks and its 10 km radius in Hasdeo-Arand Coalfieldthat falls within the districts of Surguja, Surajpur and Korba in Chhattisgarh

5.5.2 Avifaunal Diversity

The survey was made in all the 23 coal blocks and the details of the sampling locations covered during different seasons are provided in Table 5.3.

Table 5.3: Details of sampling sites covering all the 23 coal blocks and adjoining areas in Hasdeo-Arand Coalfield that falls within the districts of Surguja, Surajpur and Korba in Chhattisgarh

Sl. No.	A. Samplinglocations during winter season survey (February, 2020)				
	Transect codes	Sampling points	Coordinates		Altitude (m)
			Latitude (N)	Longitude €	
1	1	Kente Extension1	22°49'31.7"	82°51'16.5"	548
2	2	Kente Extension2	22°48'418".	82°51'26.9"	560
3	3	NCPA Area	22°47'40.2"	82°51'53.4"	518
4	4	ChorniNadi	22°46'37.2"	82°52'22.1"	428
5		Pindraki	22°46'29.8"	82°53'22.2"	489
6		PatharKorja	22°47'08.3"	82°58'31.5"	574
7	5	PKEB1	22°49'11.9"	82°49'31.8"	562
8		PKEB2	22°48'31.7"	82°48'54.5"	564
9	6	Saidu 2111	22°47'51.2"	82°48'49.0"	564
10		Saidu 2111	22°47'14.9"	82°48'56.3"	534
11	7	Saidu 2113	22°47'00.8"	82°49'07.5"	548
12	8	Kothri-Parogiya	22°43'56.6"	82°47'40.3"	413
13	9	Mahesh Pahar-Tara	22°51'39.0"	82°41'37.2"	575
14		Mahesh Pahar Temple Top	22°51'51.5"	82°43'25.3"	941
15		Tara-PPA	22°50'35.7"	82°51'16.5"	590
16	10	Nakiya-Lamti Nallah	22°38'46.0"	82°55'54.0"	503
17		Nakiya-Lamti Nallah 2	22°38'57.3"	82°56'54.6"	519
18	11	Pindarikih-Syang	22°37'05.6"	82°59'14.4"	587
19		Pindarikih-Syang2	22°37'47.3"	82°58'36.6"	546
20	12	Lemru	22°36'51.3"	82°50'29.4"	419
21		Lemru 2	22°32'35.6"	82°48'54.8"	487
22	13	Morga South-Paturia	22°44'36.8"	82°42'46.1"	503
23		Morga South- Paturia2	22°44'52.5"	82°42'54.9"	503
24	14	Morga South -p426/7	22°44'53.3"	82°43'31.3"	511
25		Morga South -p426/7-2	22°45'13.0"	82°43'55.9"	541
26		Arsiya	22°44'54.0"	82°43'20.2"	450
27		P-449	22°42'54.6"	82°46'25.0"	413
28	15	Chotyia-Maradai	22°47'53.6"	82°29'02.5"	401
29		18 Elephants	22°42'33.5"	82°28'23.5"	410
30		25 Elephants-Maradai	22°43'13.0"	82°29'19.9"	427

Sl. no.	B. Sampling locations during summer season survey (May, 2019)				
	Transect codes	Sampling points	Coordinates		Altitude (m)
			Latitude (N)	Longitude (E)	
31	A	Kente Extension	22°49'37.6"	82°51'12.4"	564
32	B	Kente Extension	22°48'38.4"	82°51'28.4"	567
33	C	Kente Extension	22°48'45.0"	82°51'40.8"	541
34	D	Barsen Pindraki	22°46'35.7"	82°52'26.1"	422
35	E	Tara central-Parsa	22°51'51.6"	82°45'25.9"	529
36	F	Tara -Tara Chowki	22°50'51.3"	82°44'59.1"	522
37	G	Madanpur	22°49'58.3"	82°41'31.8"	458
38	H	Kanta Roti	22°52'02.3"	82°43'23.9"	516
39	I	Mendra	22°52'57.0"	82°43'53.8"	501
40	J	Tara Central	22°51'91.6"	82°42'35.7"	538
41	K	Tara Central	22°50'25.5"	82°43'03.0"	578
42	L	Tara Central	22°50'30.0"	82°40'36.0"	465
43	M	PEKB (N)	22°49'80.0"	82°49'28.0"	566
44	N	PEKB (N)	22°48'36.0"	82°48'56.0"	565
45	O	Saidu	22°45'30.0"	82°47'39.0"	478
46	P	Chotia	22°44'20.0"	82°29'44.0"	442
47	Q	Chotia	22°43'21.0"	82°31'27.0"	443
48	R	Buka	22°43'17.0"	82°33'13.0"	355
49	S	Pindrakhi	22°46'10.0"	82°54'15.0"	581
50	T	Sarma	22°50'36.0"	82°53'10.0"	544
51	U	Nakiya	22°38'57.0"	82°55'10.0"	484
52	V	Lamti nala	22°38'27.0"	82°55'13.0"	456
53	W	Nakiya	22°38'54.0"	82°56'32.0"	502
54	X	Nakiya	22°39'04.0"	82°59'18.0"	517
55	Y	Elephant point before Korba	22°32'13.0"	81°54'28.0"	578

A total of 92 species belonging to 44 families were recorded of which six species are protected under the schedule I of Indian Wildlife (Protection) Act, 1972 and 19 species range restricted to the only Indian subcontinent. A total of 74 resident and four summer migrants; 14 species are winter migrants; Twelve species that are endemic to Indian subcontinent were observed (Annexure 5.1).

Accipitridae (Raptors and Scavengers), Muscicapidae (Flycatchers, Robins, Rock-chat) and Cuculidae (Koel, Cuckoo, Coucal), Ardieidae (Egrets), Dicruridae (Drongos) and Ardeidae (Herons and Egrets) were the most species-rich families recorded from thestudy area (Figure 5.14). In terms of abundance, fairly common species were highest (29%) followed by Common (25%), Uncommon (24%) and Very common (22%) classes of the abundance category within the HAC (Figure 5.15).

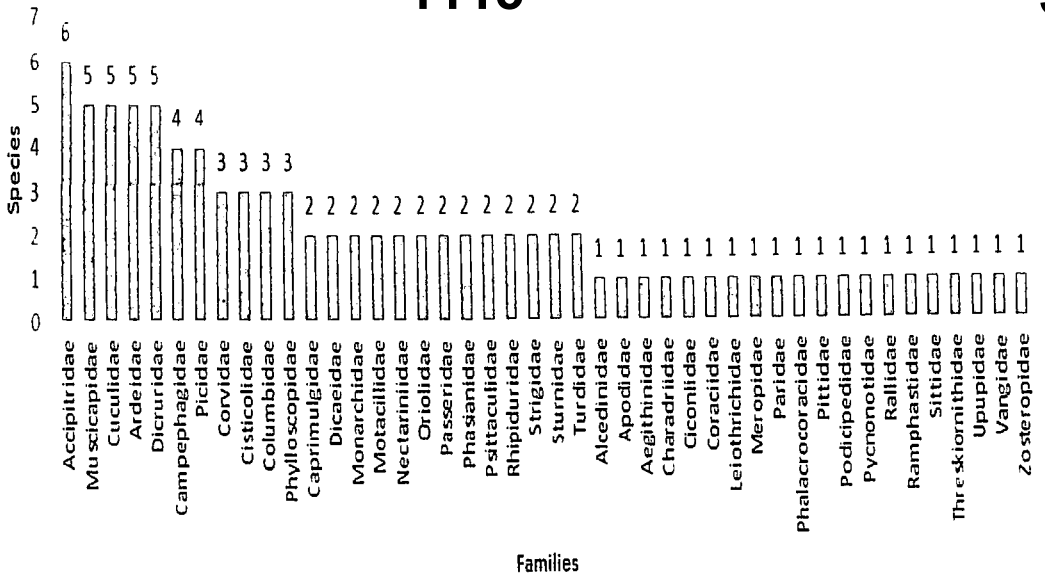


Figure 5.14: Family wise recorded Bird species within Hasdeo-Arand landscape that falls in Surguja, Surajpur and Korba district, Chhatishgarh

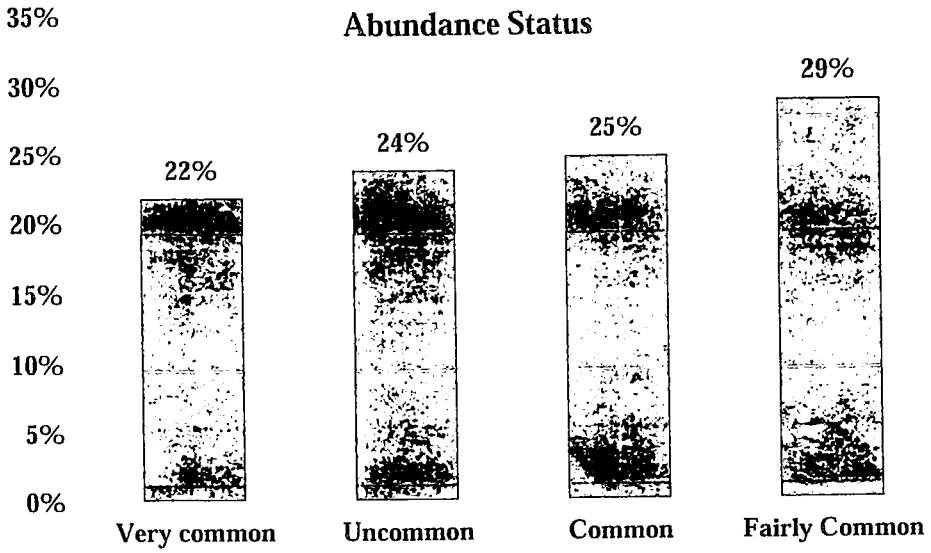


Figure 5.15: Abundance status of Birds in the Hasdeo-Arand that falls in Surguja, Surajpur and Korba district, Chhatishgarh

5.5.2.1 Diversity indices within coal blocks

Overall, maximum diversity (D 2.49) and richness (R 4.27) of birds was recorded near coal block 4 of *Morga II* followed by near coal block 18 of *Saidu* (D 2.48 and R 4.23) and in coal block 19 of *Pindraki* (D 2.42 and R 4.05) (Table 5.4).

Table 5.4: Overall diversity and richness of birds in different coal blocks and adjoining areas

Avi-Faunal	Coal blocks											
	1	Near 4	10	12	13	14	15	17	Near 18	19	Near 20	Near 22
Diversity	1.58	**2.49**	1.92	2.18	1.91	2.4	1.97	1.85	**2.48**	**2.42**	**1.1**	**1.39**
Richness	2.15	**4.27**	2.95	3.55	2.65	3.75	3.13	2.66	**4.23**	**4.05**	**1.82**	**2.16**

During the summer season, maximum species diversity (2.56) and richness (4.53) was recorded from coal block 14 of *PKEB* followed by coal block 19 of *Pindraki* (D 2.55 and R 4.41) and near coal block 4 of *Morga II* (D 2.49 and R 4.27) (Table 5.5).

Table5.5:Diversity Indices for birds during summer in surveyed Sampling blocks

Avi-Faunal	Coal Blocks								
	1	Near 4	10	12	13	14	15	19	Near 20
Diversity	1.58	2.49	1.92	2.32	1.91	**2.56**	1.66	2.55	1.1
Richness	2.15	4.27	2.95	3.8	2.65	**4.53**	2.3	4.41	1.82

During the winter season, highest bird species diversity was recorded near coal block 18 of *Saidu* (D 2.48) followed by coal block 19 of *Pindraki* (D 2.29) and coal block 15 of *Tara central* (D 2.28), while species richness was highest in coal block 18 of *Saidu* (R 4.23) followed by coal block 15 of *Tara central* (R 3.97) and coal block 19 of *Pindraki* (R 3.69) (Table 5.6).

Table 5.6: Diversity Indices for birds during Winter in surveyed Sampling blocks

Avi-Faunal	Coal Blocks						
	12	14	15	17	Near 18	19	Near 22
Diversity	2.05	2.25	2.28	1.85	**2.48**	2.29	1.39
Richness	3.3	2.97	3.97	2.66	**4.23**	3.69	2.16

5.5.2.2 Diversity indices in different transects

Transect wise species diversity indices represent the maximum bird species diversity and richness was recorded from the transect M, N, O followed by D, P and Q during the summer season, where overall diversity (3.51) and richness (9.59) is slightly lower than the winter season (Table 5.7).

Table 5.7: Diversity Indices in different transects during the summer season

Avi-Faunal	Sampling Transects														
	A,B,C	D	E	F	G	H	I	K	L	M,N,O	P,Q	T,U	V	W,X	Overall
Diversity	2.38	2.55	1.91	1.78	1.75	.69	1.79	2.4	2.11	**2.56**	2.49	1.61	1.1	1.54	**3.51**
Richness	3.8	4.41	2.65	2.34	2.57	.56	2.38	3.94	3.34	**4.53**	4.53	2.22	1	2.08	**9.59**

In the Winter season, highest species diversity and richness was recorded from transect 4 (D 2.61, R 4.72) followed by 1 (D 2.59, R 4.53) and 14 (D 2.49, R 4.58) (Table 5.8).

Table 5.8: Diversity Indices in different transects during the winter season

Avi-Faunal	Sampling transects														
	1	2	3	4	5	6	7	8	10	11	12	13	14	15	Overall
Diversity	2.59	2.14	1.73	**2.61**	1.97	1.39	2.44	2.06	1.68	2.02	2.48	2.08	2.49	1.73	3.64
Richness	4.53	3.3	2.28	**4.72**	2.67	2.16	3.78	3.25	2.28	3.04	4.23	3.37	4.58	3.06	10.19

The HAC supports rich avifaunal diversity with over 92 species recorded in a short study duration, probably due to occurrence of diversified habitats that include dense forests, relatively open forests, scrub land and riparian tracts in the entire HAC the landscape having part of a large forested landscape in the Central Highlands, which itself is an amalgamation of diverse landforms. High habitat diversity has been reported to support high avifaunal diversity (Hortal, 2009). Among the recorded species:

- Six species are under Schedule I of Wildlife (Protection) Act, 1972;
- 12 species are endemic to Indian Subcontinent, and 19 are winter visitors, it represents the importance of the landscape in providing the suitable habitat to these critical species.
- All the coal blocks, particularly the Morga II, Saidu and Pindraki and the surrounding habitats support high species richness as well as diversity of birds. Presence of high number of birds of prey may indicate good habitat quality (Sergio *et al.*, 2004) and abundance of prey species.
- Family Muscicapidae, Cuculiade are the species-rich in HAC and as most of them are insect eaters. The diversity of insectivorous birds is reported to usually high in the forest ecosystems (Stratford and Sekercioglu 2015). Among the winter migrants' species, most of them are insectivores in the study area and probably migrate from the Himalayas to spend the harsh and cold months in Peninsular India (McGuir *et al.*, 2013).

5.5.3 Mammal Habitat Assessment

The mammalian species occurrence data generated using camera trap and sign survey was spatially thinned and developed model using 'SSDM' package to evaluate individual species distribution probabilities. Predicted habitat-use maps for each functional guild large carnivore (Figure 5.16), meso-carnivore (Figure 5.17), ungulates (Figure 5.18) and overall species richness (Figure 5.19) depict habitat use were developed.

The Area Under the Curve (AUC) values of the models suggests good prediction accuracy with estimated values of 0.71, 0.63 and 0.66 for large carnivores, meso-carnivores and ungulates respectively. The variable "Precipitation of Warmest Quarter" emerged as the significant variable to predict habitat-use of large carnivores (variable contribution in the model = 30%) and ungulates (variable contribution in the model = 33%). The variable, human population density emerged as the significant

variable to predict habitat-use of meso-carnivores (variable contribution in the model = 29%).

- The habitat-use patterns of the species under the guild's large carnivores, meso-carnivores and ungulates, modelled under SDM framework suggests relatively high habitat-use in the forested habitats of the four coal blocks, namely Tara, Parsa, PEKB and Kente Extension and the surrounding areas.
- Observed habitat-use by all large carnivores (common leopard, stripped hyena, sloth bear and Indian grey wolf) and the ungulates modelled show relatively high use in forests – a pattern that is consistent with general understanding of the occurrence of forest-dwelling carnivores and ungulates.
- Asiatic wolves are typically a species of open grasslands and scrub, grasslands and scrub. In HAC and surrounding landscape there are no large grasslands, and wolves selecting forests may hint at the adaptation of the species to local habitat conditions. The forests in the study area are heterogeneous and may provide essential micro-habitats like denning sites to the wolves.
- The ungulate species that occur in study area, such as the barking deer (would prefer relatively dense forests), four-horned antelope (would prefer relatively low dense forests), spotted deer and wild pigs are typically forest-dwelling species (Johnsingh and Manjrekar 2012). Thus, the ungulates showing high use in the forests are counter-intuitive.
- Many species of the meso-carnivores (or the lesser carnivores) modeled in the assessment are commensal such as golden jackal, Indian fox, jungle cat, honey badger and others. This could explain high habitat-use of meso-carnivores in the vicinity of the villages. Around the villages, meso-carnivores may opportunistically subsist on domestic foul, cattle and ground birds like partridges that are known to occur close to human-use areas in the village settings. Availability of sufficient spaces as habitat near the settlement are known to play a role in fulfillment of ecological needs of small carnivores, as observed in many protected areas in India (Kalle *et al.,* 2013).

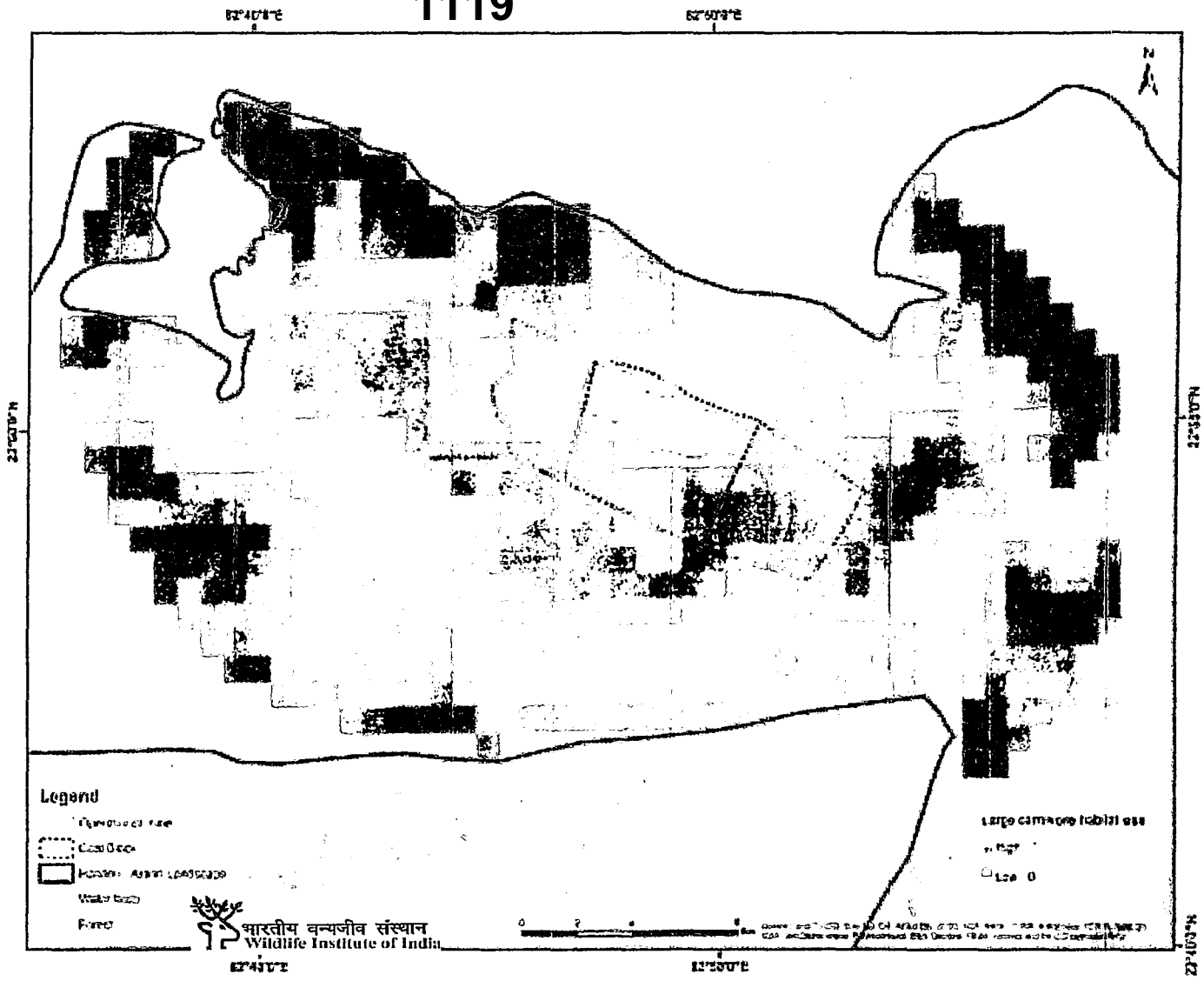


Figure 5.16: Estimated habitat use for large carnivores in and around 10 km buffer of Parsa, Kente Extension, Tara and PEKB coal blocks in Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts, Chhattisgarh

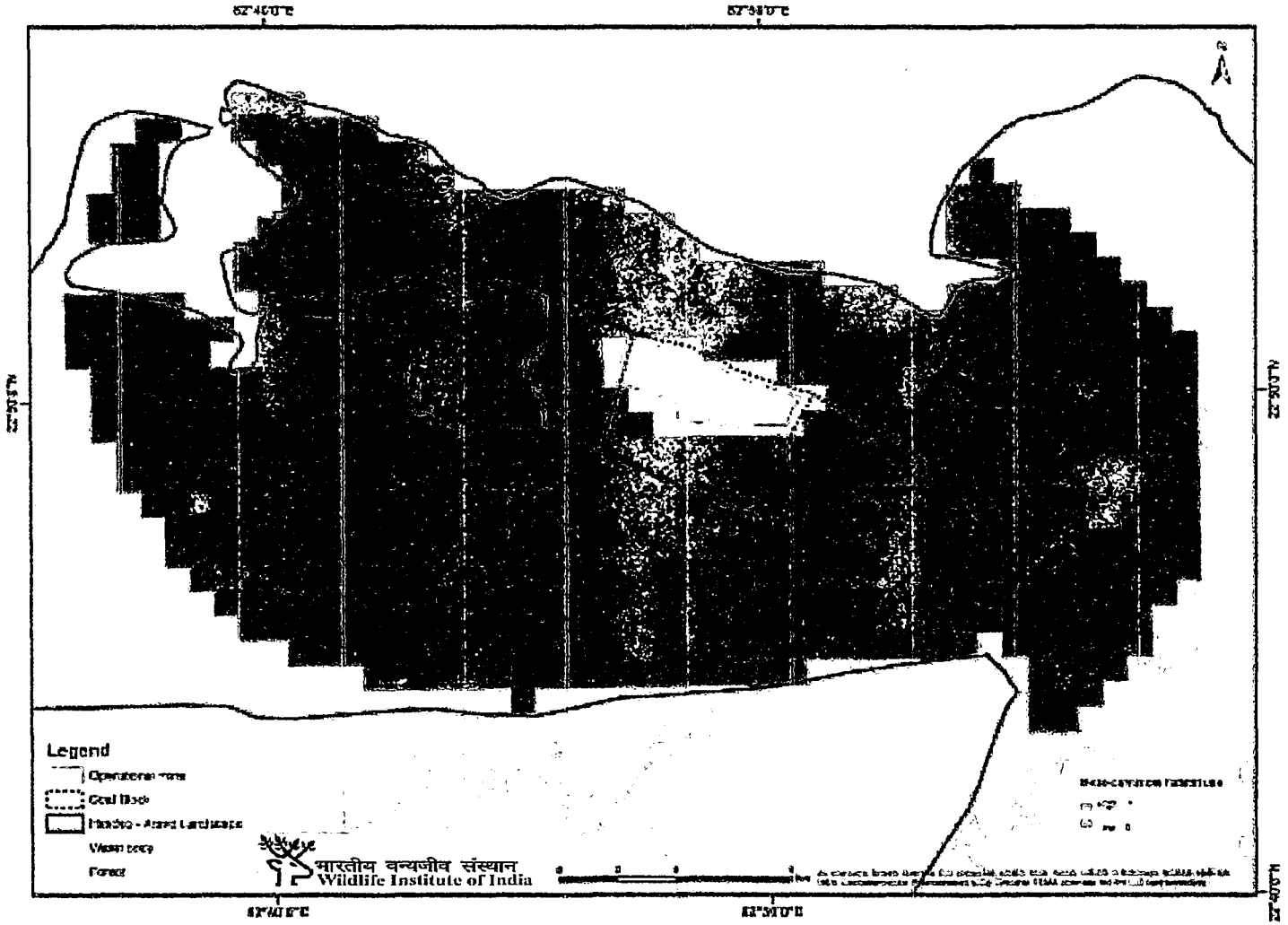
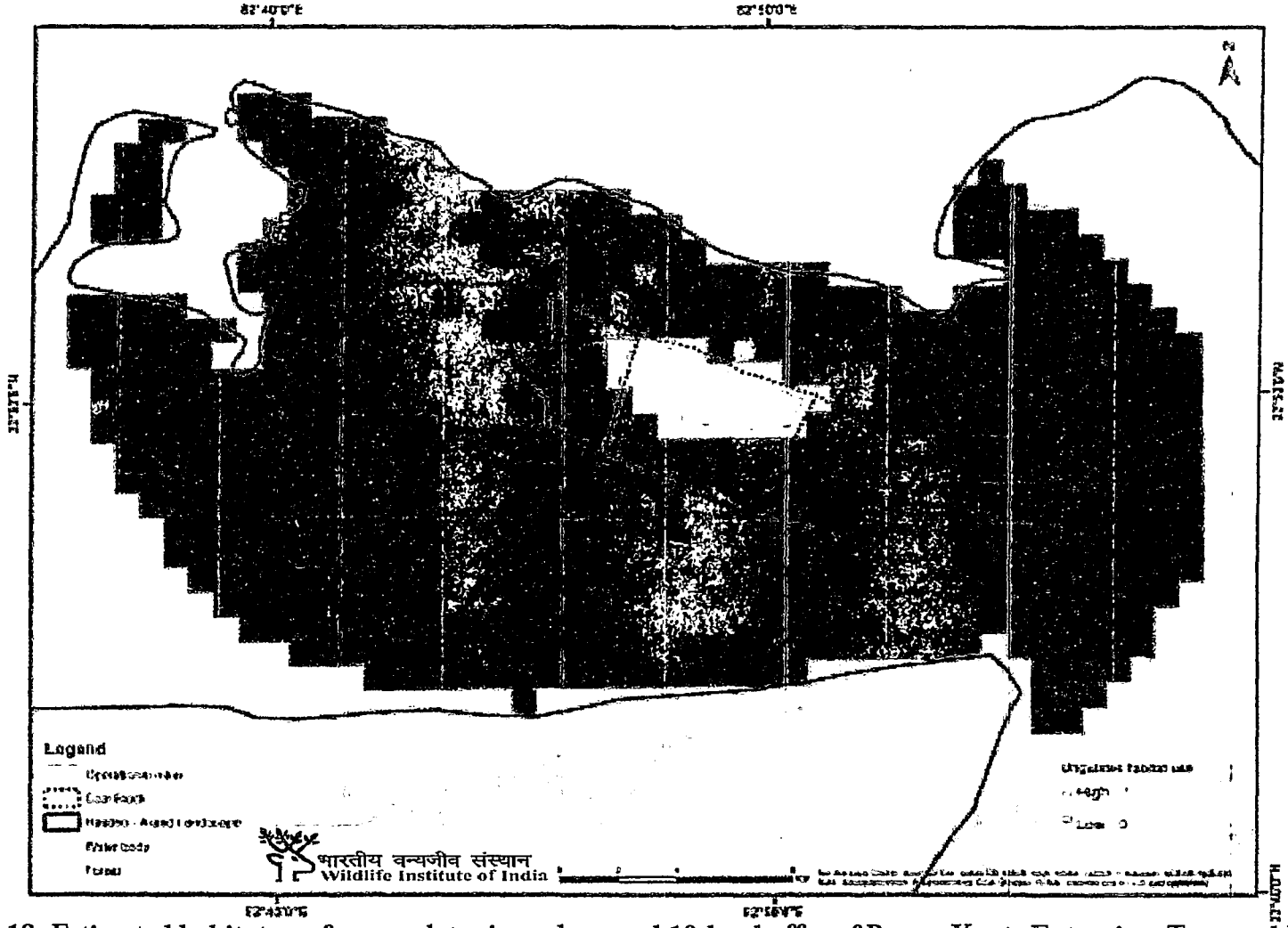


Figure 5.17: Estimated habitat use for meso-carnivores in and around 10-km buffer of Parsa, Kente Extension, Tara and PEKB coal blocks in Hasdeo-Arand Coalfield, that falls in Surguja, Surajpur and Korba districts, Chhattisgarh



Map 5.18: Estimated habitat use for ungulates in and around 10-km buffer of Parsa, Kente Extension, Tara and PEKB coal blocks in Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts, Chhattisgarh

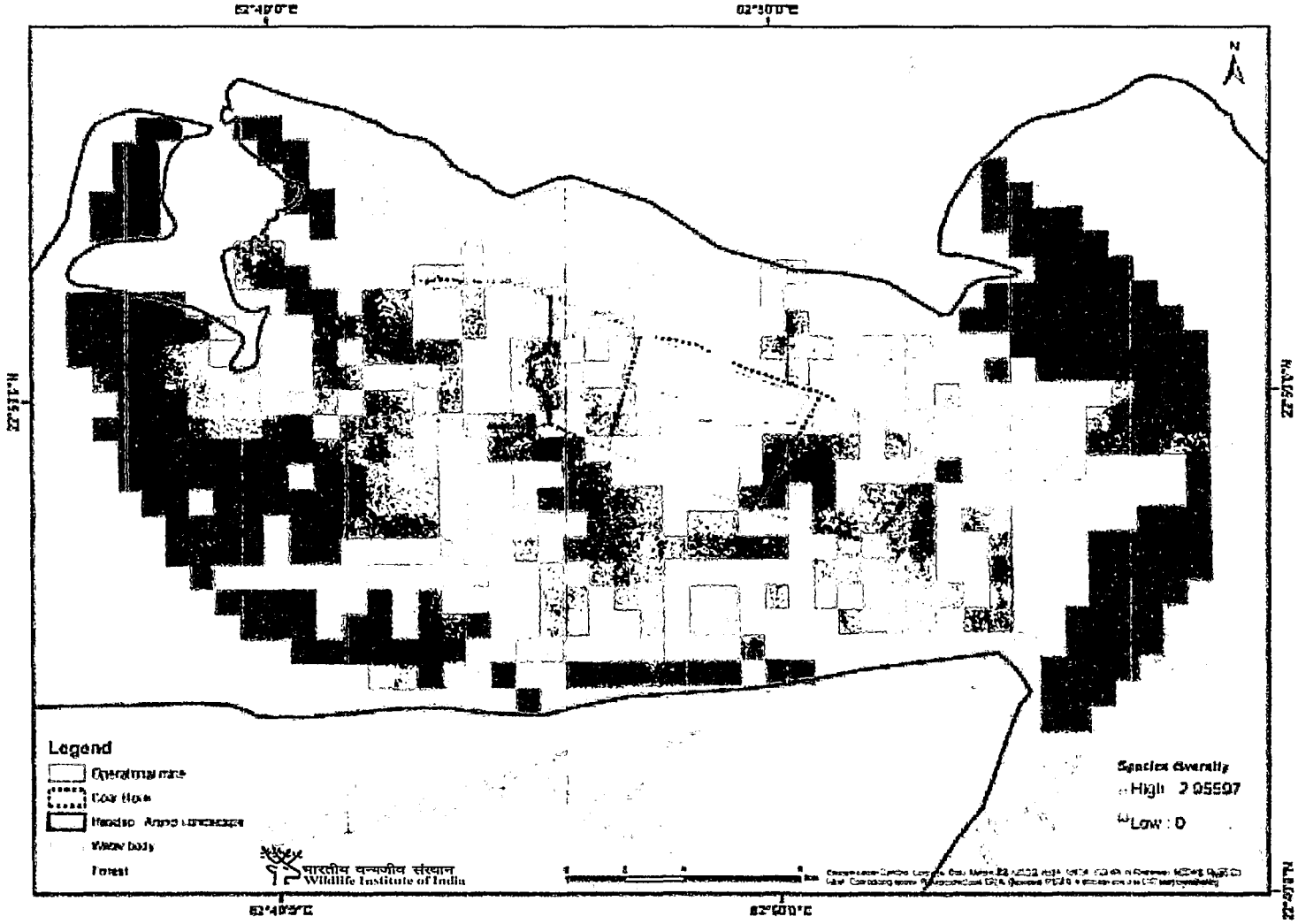


Figure 5.19: Species diversity of select mammalian species in and around 10-km buffer of Parsa, Kente Extension, Tara and PEKB coal blocks in Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts, Chhattisgarh

5.5.4 Elephant Habitat Assessment

Elephant occurrence is not limited to any part, but, is spread across in HAC landscape and surroundings. The entire HAC landscape comprise of 647 forest compartments spread over 12 forest ranges in 4 forest divisions. Of the 647 forest compartments, elephant occurrence is recorded in 148 compartments during the period 2018-2020 (Figure 5.21) in all the 12 forest ranges. The number of compartments with reported elephant occurrence is best considered minimum, for obtaining compartment-level information in large forested tracts is seldom easy as elephants could occur undetected in dense conditions also do occur outside of HAC landscape and surroundings. Wildlife Institute of India (WII) has been assessing the elephant movement and its home range pattern since 2017 in collaboration with Chhattisgarh Forest Department and has established large home ranges for elephants in the area. .

- An adult bull tusker elephant satellite collared by CGFD-WII during July 2019, *viz.,* Ganesh (CGM023) has a large home range and include habitats located in the southern portion of HAC and the surrounding landscape (Figure 5.20). During the year 2018-2019, CGM023 had operated with a breeding herd of over 30 elephants. In addition to the collared elephants, a breeding herd of elephants that CGFD-WII were monitored using an approach involving sighting-re-sighting of known individuals operates in the northern portion of the Hasdeo-Arand Area (Figure 5.20). This group, which, as per WII's elephant monitoring program known as Torn Ear (CGF002) group has an estimated group size of 7 to 12 elephants.
- The home range of a cow elephant Gautami (CGF010) satellite collared by CGFD-WII during June 2018 includes north-eastern parts of landscape (Figure 5.21). This cow elephant was part of a breeding herd of elephants that was collared and monitored by WII and Chhattisgarh FD for a period of 18 months. The size of the herd during the monitoring period was highly variable (9 to 22 individuals were observed along with CGF010 in different locations and across different seasons).
- In general, the elephant social organization is fluid, with seasonal fission and fusion of groups. The group dynamics of CGF010 and its group confirms to this pattern of social organization.

Elephant ID	Sex and age-class	Home range (100% Minimum Convex Polygon)
CGM001	Adult male	1416.00 sq.km
CGF010	Adult female	2562.00 sq.km
CGM003	Young male	1711.99 sq.km

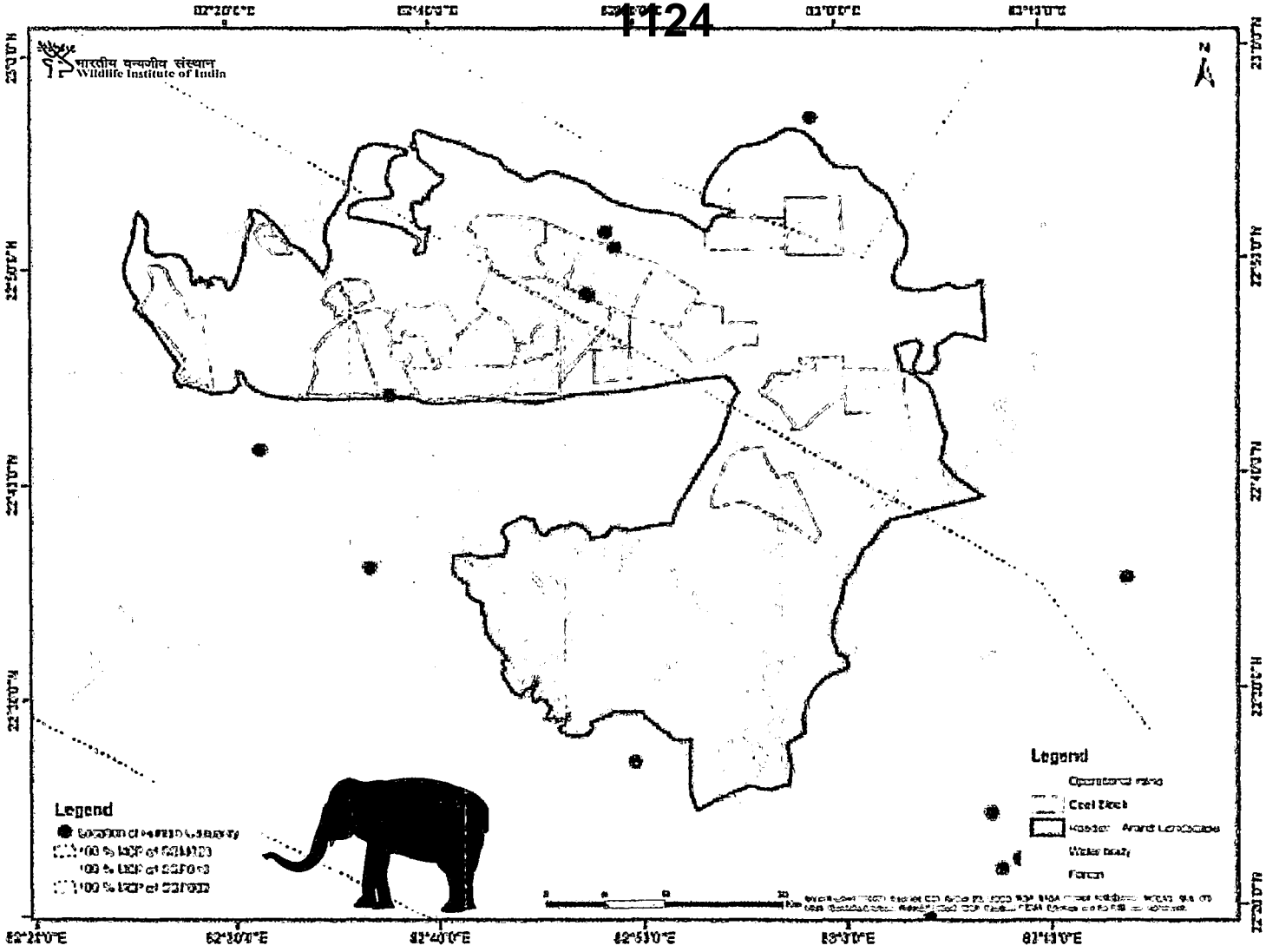


Figure 5.20: Ranging patterns of elephants within and around the Hasdeo-Arand Coalfield and surrounding landscape, Chhattisgarh

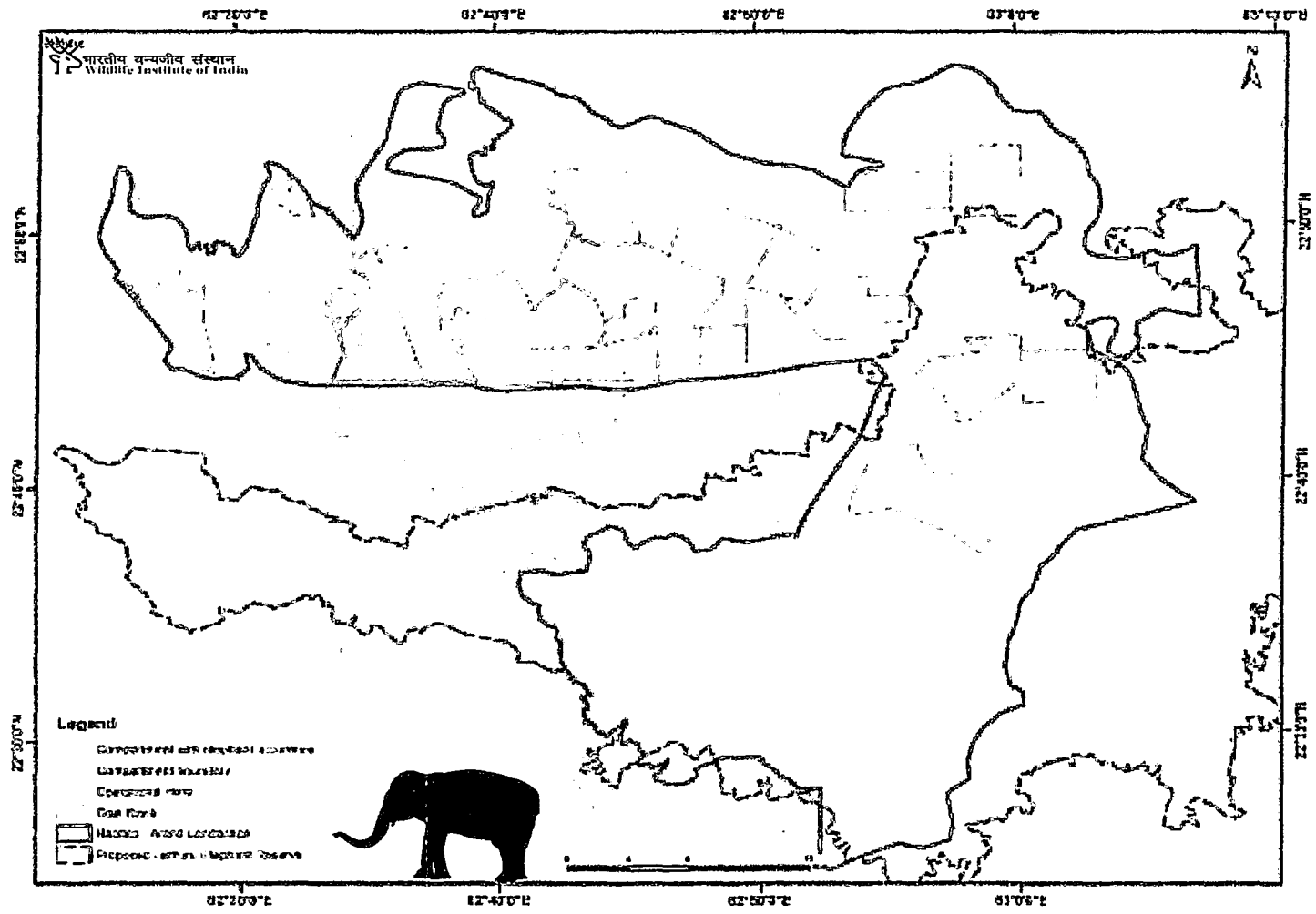


Figure 5.21: Elephant occurrence in and around the Hasdeo-Arand Coalfield and surrounding landscape, Chhattisgarh

(Map prepared based on compartment-level information obtained from Chhattisgarh FD for the period 2018-2020)

Chhattisgarh human-elephant conflict (HEC) situation is a paradox with a relatively low number of elephants (<300, which is <1% of India's wild elephant population) but high levels of HEC with over 60 human lives are lost every year due to conflict (>15% of the reported human deaths due to Human Elephant Conflict (HEC). In addition to loss of human lives, crop loss and damage to property due to HEC are severe. The Elephant Conflict (EC) region harbours less than 1/10th (<3000) of country's elephants, but loses over 40% (over 200 HEC-related deaths) of reported 500 HECrelated human fatalities in the country. The HEC-related human fatalities reported in the region are highly disproportionate to its elephant population in the country. The increasing levels of HEC have resulted in considerable public resentment against the management and elephant conservation as a whole. HEC resolution is challenging in EC region due to fragmentation, loss and degradation of intact elephant habitats.

- Major disturbances to habitats such as mining not only cause habitat loss and fragmentation (as understood generally) but can affect individual herd's home ranges. Such disturbances can lead to abandonment of habitats as threats to home ranges have a threshold limits.
- The effect of mining on elephant habitat may not reflect in the same habitat, but could be a silent trigger for HEC in some other areas within the landscape. In general, one of the reasons for HEC being disproportionately high in EC region is the elephant dispersal from forest habitats through fragmented human use areas. This large scale elephant dispersal out of intact forests coincide with commencement of large-scale mining projects and associate infrastructure developments in the EC region, particularly in the states of Odisha and Jharkhand.
- There is continuous dispersal of elephant herds from the neighbouring states of Jharkhand and Odisha. The study carried out by WII in collaboration with Chhattisgarh Forest Department from the year 2017 onwards have highlighted that elephants have large home ranges. The forests where the elephants currently occur are highly fragmented and degraded due to incompatible land-use. Infrastructure development and mining are further fragmenting the habitats making conflict mitigation is a huge challenge.
- The elephant home ranges tend to be large in highly fragmented areas and the small degraded forest patches cannot sustain herds. It is observed that home range size is a function of habitat quality - in areas that support good intact habitats, the elephant home ranges are relatively small (*eg.* Rajaji, Mudumalai, etc.). However, in fragmented areas, elephant home ranges are typically large.
- The elephant herds are generally interlinked and home ranges spread over two or more states. One of the main reasons as to why elephants start dispersing into human-use areas is the threat to habitat especially the elephant home ranges. While threat to habitat can be identified and sometimes even addressed, threats within individual home ranges of elephants are hard to

evaluate and hence, difficult to mitigate. The latter threats are more insidious and lasting.

5.5.5 Human–Elephant Conflict (HEC)

A total of 2357 elephant-related crop and property damage incidents were reported during the period from 2015-2018 in HAC and surrounding landscape. High fraction (19.3%) of crop loss cases were reported during December followed by October (18.45%) coinciding with paddy harvest (Figure 5.21a). House/building damage instances were recorded mostly during July and January. A total HEC-related human fatalities were reported between 2009 and 2018 are presented in Figure 5.21b.

In general, one of the reasons for HEC being disproportionately high in EC region is that the elephant dispersal from forest habitats through fragmented human use areas. This large-scale elephant dispersal out of intact forests coincide with commencement of large-scale mining projects and associate infrastructure developments in the EC region, particularly in the states of Odisha and Jharkhand. Major disturbances to habitats such as mining not only cause habitat loss and fragmentation (as understood generally) but can affect individual herd's home ranges. Such disturbances can lead to abandonment of habitats as threats to home ranges have a threshold limit. The effect of mining on elephant habitat may not reflect in the same habitat, but could be a silent trigger for HEC in some other areas within the landscape.

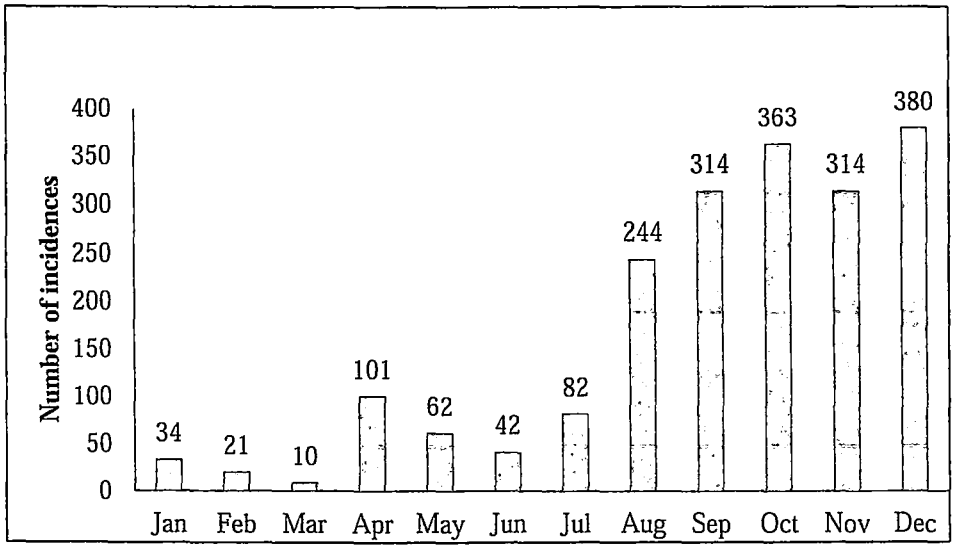


Figure 5.21a: Monthly patterns of crop damage incidents between 2015 and 2018

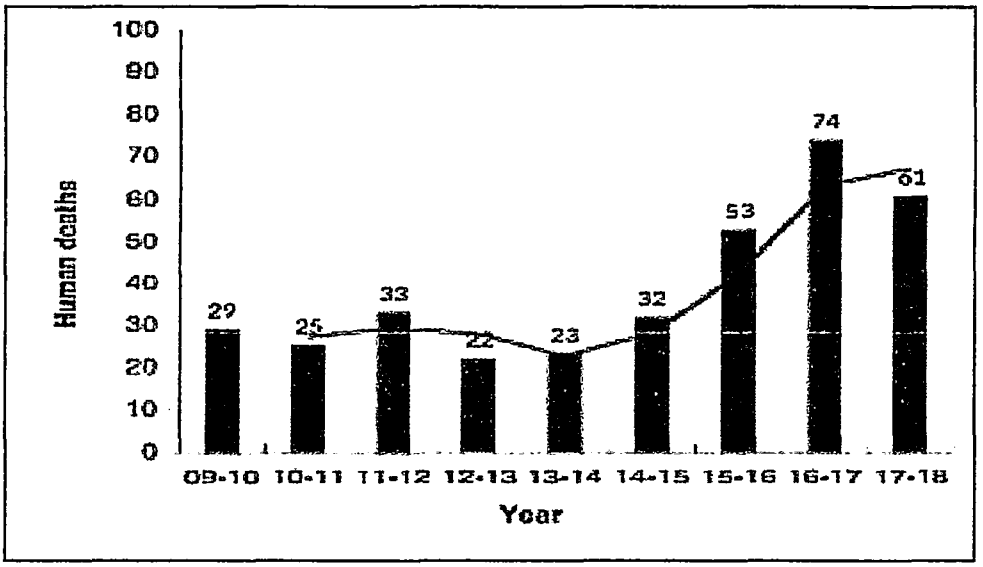


Figure 5.21b: Yearly patterns of human casualty incidents between 2010 and 2018

Elephants are wide ranging animals with reported home ranges in East Central landscape spanning over 1000 km^2. The effect of loss of part of home range for elephants is difficult to assess. Based on the general understanding of elephant ecology and behavior learned from long-term studies, it is certain that habitat loss is one of the major triggers for elephant dispersal into human-use landscapes culminating into Human Elephant Conflict (HEC). In general, elephants operating in Chhattisgarh have large home ranges as the forests are highly fragmented and they cannot be contained in small patches. Considering this, the following points may be noted:

1. As a conservative estimate, about 40 to 50 elephants may use HAC and the landscape surrounding it at different times of the year. Habitat use by elephants is not limited to any specific area, but is spread out across the landscape
2. Elephants (both breeding herds and bulls) use with varying intensities. Home range polygons of some of the elephants that were monitored using satellite collars fall within the landscape.
3. If habitat conditions improve in southern parts of HAC and landscape surrounding it, elephant use could increase in such areas, which is highly desirable from HEC management standpoint, as the habitat along the southern portion is relatively less fragmented.
4. HEC management strategies include improving habitat condition for elephants needs to be prioritized in the wake of HEC incidences. Conflict management strategies may include:

    a. Judicious use of physical barriers (like solar-powered electric fences). Choice of barriers and placement of them may require a detailed assessment

b. Temporary fences around settlements may be experimented in areas where elephant-related property damage is reportedly high
c. Provisioning electric lights (high-mast lights) around settlements would be beneficial to villagers
d. Improving habitat conditions for elephants is crucial. The habitat needs to be protected from further levels of degradation and fragmentation.
e. Loss of any forest cover due to anthropogenic activities should strictly be avoided.

5.5.6 Potential Habitat for Tiger

The Central Indian landscape spanning the states of Maharashtra, Madhya Pradesh and Chhattisgarh still has immense potential to recover tigers and augment their population in many landscapes. Working plans of Korba Forest Division suggested presence of sizeable number of tigers in the area during 1970s (Working Plan, 1970, Korba Forest Division, Chhattisgarh Forest Department). Over the time, tigers have become rare in this area. Presently, only sporadic tiger movement around the area is reported by the Forest Department (Annexure 5.2). Kanha-Boramdeo-Achanakmar (KBA) habitat complex in Central India is one such that has high tiger recovery potential (Dutta *et al.*, 2016). Hasdeo-Arand Landscape is located towards the east of KBA complex which has potential habitat of tigers in the area by factoring in availability of habitat, extent of habitat connectivity and dispersal potential from the nearby tiger habitats using a hypothetical framework were assessed.

5.5.6.1 Habitat connectivity

The habitat connectivity between KBA and the HAC area is strong, and offers minimal resistance for wildlife movement (Figure 5.22). *Circuitscape* models show higher conductance values (2-2.8) indicate strong connectivity. Sporadic reports of tiger presence in Korba forest division suggest that habitat connectivity between KBA and Hasdeo-Arand area could be still functional for tigers. It is pertinent to note that the forest department at Korba Forest Division has recorded tiger presence in a few locations within Hasdeo-Arand area (Table 5.9; Annexure 5.2). The major linear infrastructure in KBA and Hasdeo-Arand tiger dispersal corridor include Ambikapur to Bilaspur National Highway and the Bilaspur-Anuppur Railway line. Maintaining the current level of connectivity would be essential to facilitate putative tiger dispersal from KBA to Hasdeo-Arand Area.

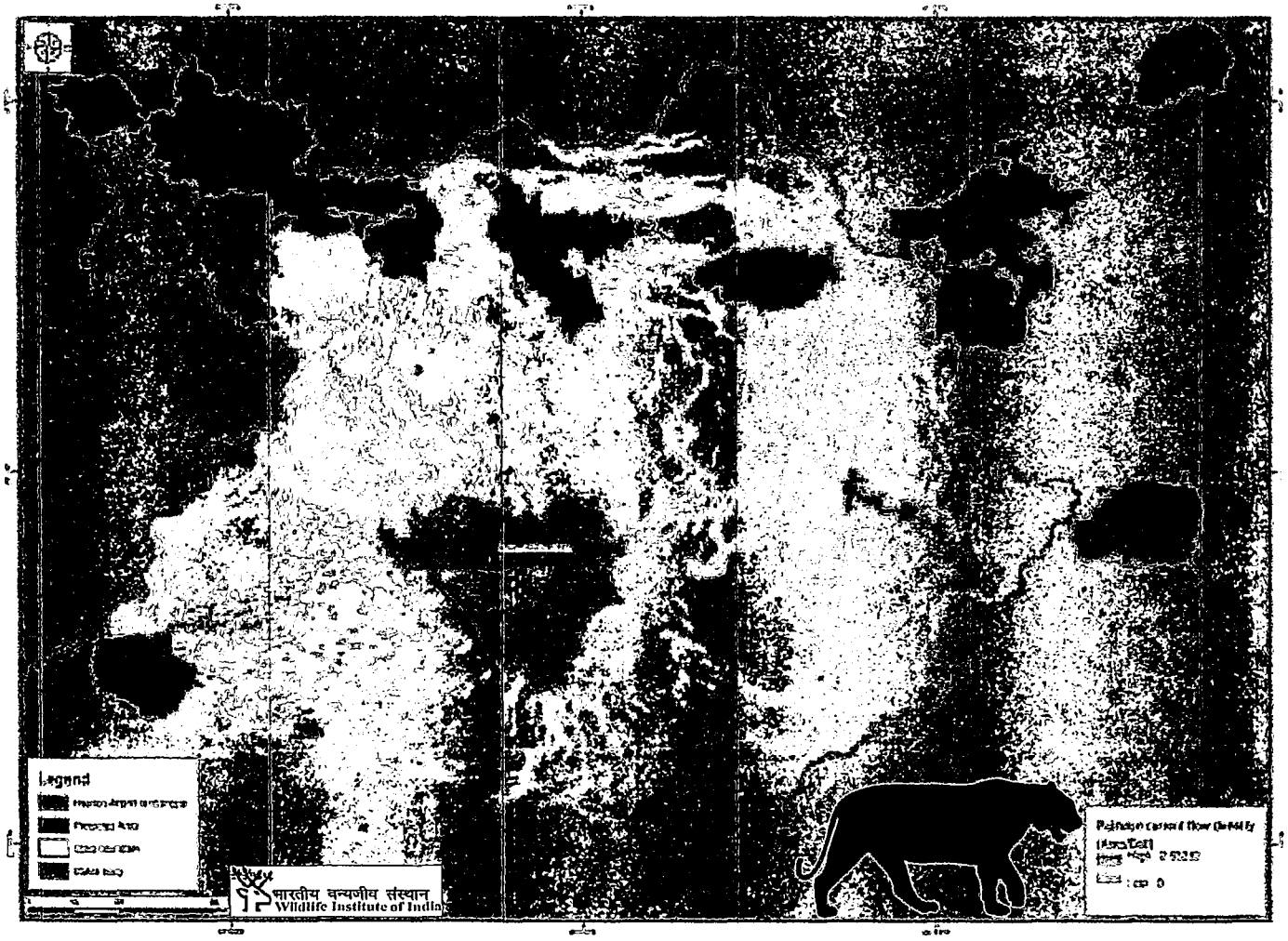


Figure 5.22: Pairwise current flow density, shown in shades of pale yellow to red gradient, indicates areas where current flow is high between adjacent pair of PAs from Hasdeo-Arand landscape

Table 5.9: Tiger population status (size) in selected Central Indian tiger habitats (as per all-India Tiger Estimation Report, 2018)

Protected Area	State	Area in Km^2	Abundance (±density) # 2006	Abundance (±density) # 2010	Abundance (±density) # 2014	Abundance (±density) # 2018
Kanha	Madhya Pradesh	917.4	89	60, 28 (6.83)	74 (6.10)	88 (4.40)
Bandavgarh	Madhya Pradesh	1536.9	47	59, 37 (16.25)	60 (4.47)	104 (5.83)
Sanjay Dubri	Madhya Pradesh	1674.5	NA	NA	6 (4.4)	5 (0.23)
Tadoba-Andheri	Maharashtra	1727	34	NA	47 (4.85)	82 (6.09)
Nagzira Navegaon	Maharashtra	1706.3	NA	20	6 (0.95)	6 (0.49)
Achanakmar	Chhattisgarh	532	19	12, 1(0.11)	11	5 (0.46)
Boramdeo	Chhattisgarh	170.4	NA	NA	NA	NA
Udanti-Sitanadi	Chhattisgarh	1842.5	6 to 8	8	4	1
Guru Ghasidas	Chhattisgarh	1093.9	NA	NA	NA	NA
Pench	Madhya Pradesh	1179.3	33	65, 23 (3.62)	44 (5.67)	56 (5.50)
Panna	Maharashtra	1545	24	4	17	25 (1.41)
Indravati	Chhattisgarh	1258	NA	NA	12	3

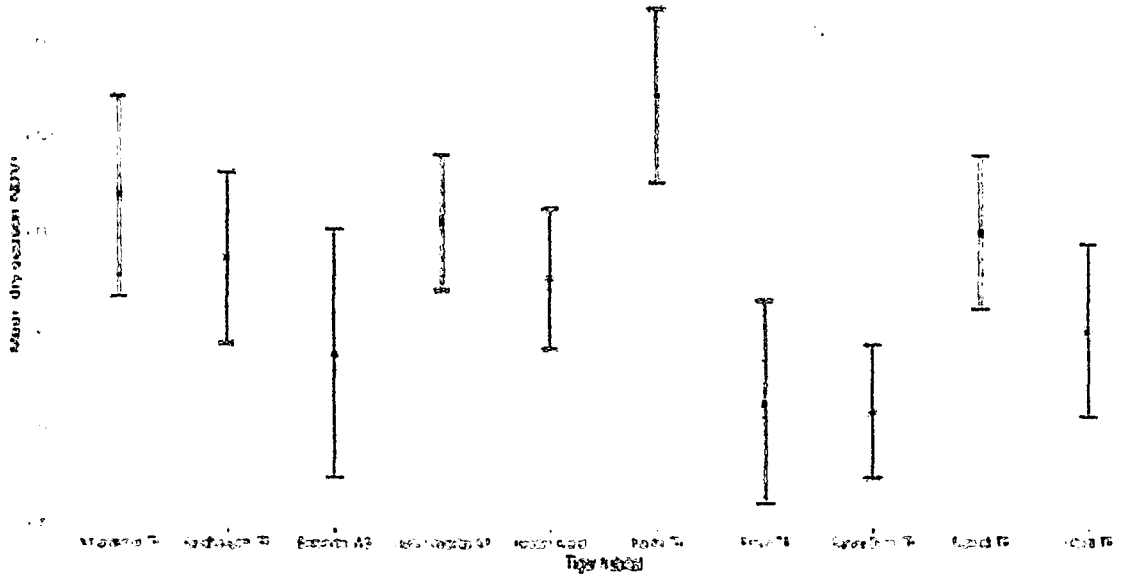


Figure 5.23: Mean (±Std. deviation) of dry season NDVI for some of the Central Indian tiger habitats

5.5.6.2 Habitat status

The forested habitats in Hasdeo-Arand area in conjunction with other connected forested areas in Surguja, Surajpur, Dharamjaigarh, Korba and Katghora forest divisions is large. The total forest cover in HAC landscape is 1518 km^2 of which around 1160 km^2 of habitat is reasonably intact.

- In the tropical deciduous forests, dry-season habitat productivity can be a limiting factor in determining the carrying capacity of large-bodied mammals (Harihar *et al.*, 2020).

- The dry-season (February to April) mean NDVI (Normalized Difference Vegetation Index) – a proxy for habitat productivity in Hasdeo-Arand area is comparable with other Central Indian tiger habitats like BandavgarhTR, Achanakmar TR, Guru Ghasidas National Park, *etc.* (Table 5.9 & Figure 5.23). Although NDVI is a crude measure of vegetation productivity, it may not reflect edible biomass for ungulates (Vaidyanathan *et al.,* 2010). Therefore, field assessment of vegetation productivity from large herbivore point of view is essential in Hasdeo-Arand area to estimate carrying capacity of tigers and their main prey animals.

5.5.6.3 Target tiger densities and factors pre-empting tiger colonization

HAC landscape and its surrounding is ecologically similar to other tiger habitats in central India however, low density of ungulate prey is the reason for tiger recovery in the HAC landscape. Tiger recovery and persistence in Hasdeo-Arand area seems conditional on four main factors namely

1. Recovery of ungulate prey,
2. Maintaining the existing habitat connectivity with KBA
3. Enriching habitat conditions through protection and habitat management, and
4. Real-time mitigation of human-wildlife conflict (like compensation for livestock loss)

If these conditions are met, Hasdeo-Arand area can support a minimum crude density of 1 tiger/ 100 km^2 (this density is arrived based on the median tiger densities in ecologically comparable tiger habitats in Central India) Thus, in highly suitable areas encompassing over 1000 km^2 in Hasdeo-Arand area, it could be possible to support 10 to 15 tigers. It may also be noted that the Hasdeo-Arand area is contiguous to other forests in Surguja, Raigarh and Surajpur districts. Thus, the estimates of potential tiger abundance in Hasdeo-Arand area are best considered conservative.

5.6 LIKELY IMPACTS

Majority of the mining proposed and in operation are of open cast mining which have direct impact due to removal of trees from the forest and increased traffic, and other developmental activities. The magnitude of the impacts will depend on the area of forest / forest type removed or fragmented.

- Coal mining displaces and disturbs the wildlife populations which is the most obvious impact and force the wildlife living on that landscape to move due to loss of habitat, destruction, fragmentation, or degradation of habitat. Further, it gets aggravated when that wildlife is forced to move to locations already occupied by other wildlife result into greater competition for the resources leading to conflict for resources, into agriculture land resulting in human wildlife conflict.

- Fragmentation affects forests through increased edge to interior ratio, leading to increased light and temperatures in a buffer zone that extends into the fore from artificial edges. Edge adapted species, especially weedy species of native and non-native plants and animals, respond to the change in environment at the expense of forest interior species, and these impacts can extend well into otherwise undisturbed forests. Loss of trees will directly lead to less nesting habitat for birds.

5.6.1 Habitat Fragmentation

Habitat fragmentation is considered a primary issue in conservation biology. Elephants are reported to occur in the entire HAC and the State Forest Department has also recorded its occurrence from 148 forest compartments. In general, elephants operating in Chhattisgarh have large home ranges as the forests are highly fragmented and elephants cannot be contained in small patches.

- This large-scale elephant dispersal out of intact forests coincides with commencement of large-scale mining projects and associate infrastructure developments in the EC region, particularly in the states of Odisha and Jharkhand. Major disturbances to habitats such as mining not only cause habitat loss and fragmentation (as understood generally) but can affect individual herd's home ranges. Such disturbances can lead to abandonment of habitats, as threats to home ranges have a threshold limit. The effect of mining on elephant habitat may not reflect in the same habitat, but could be a silent trigger for HEC in some other areas within the landscape.

- A total of 2357 elephant-related crop and property damage incidents were reported from 2015-2018 in HAC and surrounding landscape. A total of ten HEC-related human fatalities were reported between 2018 and 2019.

- Large scale mining in Orissa and Chhattisgarh have already have contributed to habitat fragmentation of forest and resources conflict leading to HEC in HAC region (Figure 5.24 and Table 5.10).

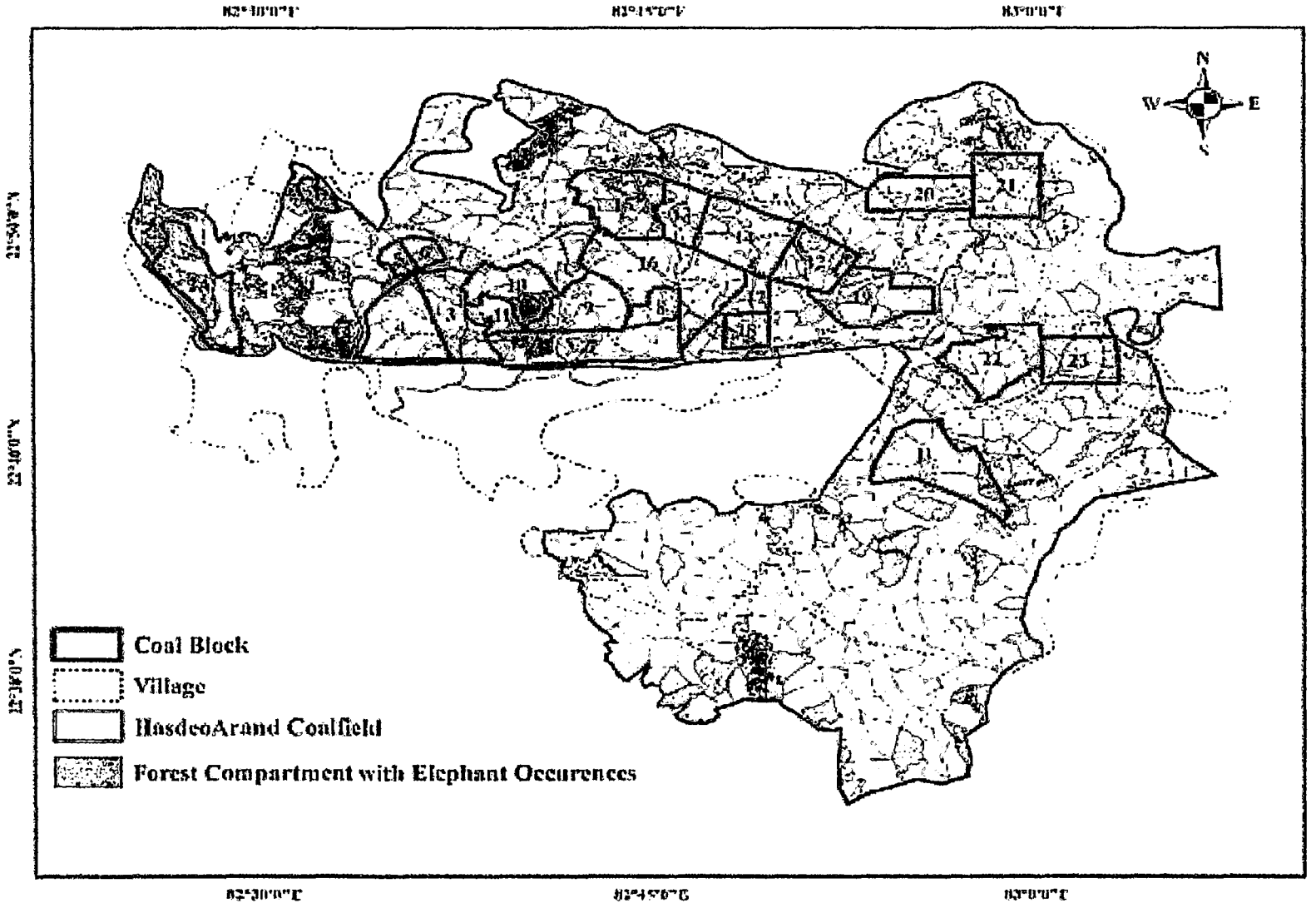


Figure 5.24: Coal block wise forest compartment with elephant occurences in Hasdeo-Arand Coalfield landscape in Chhattisgarh

Table 5.10: Coal block wise forest compartment and elephant occurences in Hasdeo-Arand Coalfield landscape in Chhattisgarh

Sl. No.	Coal Blocks	Forest Division	Forest Range	Beat Name	AREA (km^2)	Forest Compartment
1	Nakiya	Korba	lemru	Bimalta	1.81	OA 1196
	Nakiya			Rapta	2.74	P910
	Nakiya			Bimalta	5.24	P912
	Nakiya			Bimalta	5.86	P913
2A	Chotia-I	Katghora	Pasan	-	5.22	OA628
	Chotia-I		Kendai	-	0.81	OA705
	Chotia-I			-	7.45	OA713
	Chotia-I		Pasan	Baniya	1.39	P210
	Chotia-I			Semrha	0.54	P212
	Chotia-I		Kendai	Parla	2.09	P349
	Chotia-I			Parla	3	P350
3	Morga-I			-	0.25	OA701
	Morga-I			Ghjak	4.49	P373
	Morga-I			Botopal	4.27	P374
	Morga-I			Botopal	3.62	P375
	Morga-I			Morga	2.52	P385
	Morga-I			Ketma	2.5	P403
6	Morga IV			Ghjak	3.99	P357
7	Morga South			Morga	3.1	P365
	Morga South			Morga	3.31	P366
	Morga South			Arsiya	0.38	P421
	Morga South			Uchlainga	2.85	P428
	Morga South			Gidhamudi	2.34	P440
	Morga South			Gidhamudi	3.21	P442
8	Gidmuri			Gidhamudi	2.02	P434
9	Paturia			Morga	4.91	P367
10	Madanpur North			Ghjak	2.72	P358
12	Kente Extension	Surguja	Uadipur	Basen	3.06	P2104
	Kente Extension			Parsa	2.25	P2105
	Kente Extension			Ghatbarra	1.06	P2111
	Kente Extension			Rarogiya	2.87	P2127
	Kente Extension			Basen	2.32	P2130
13	Parsa	Surajpur	Ramauj Nagar	Tara	3.88	1982
	Parsa			Tara	1.1	P1986
	Parsa			Tara	3.3	P1997
	Parsa	Surguja		salhi	2.75	P2007
15	Tara	Surajpur		Kataroli	2.54	1983

Sl. No.	Coal Blocks	Forest Division	Forest Range	Beat Name	AREA (km^2)	Forest Compartment
	Tara			Kantaroli	2.23	1984
	Tara			Tara	0.91	1985
	Tara			Mendra	3.07	P1992
	Tara			Mendra	4.33	P1993
16	Puta-Parogia	Katghora	Kendai	-	1.2	P425
	Puta-Parogia			Gidhamudi	1.98	P441
18	Saidu			Khotkhori	1.94	P445
	Saidu			Khotkhori	2.13	P446
19	Pindraki	Surjapur	Udaipur	Rarogiya	3.25	P2123
	Pindraki			Penerakhi	2.79	P2134
	Pindraki			Khujhi(Pendeekhi)	2.74	P2137
21	Laxmangarh			Maheshpur	2.36	P2031
	Laxmangarh			Laxmangarh	2.9	P2036
	Laxmangarh			Laxmangarh	2.63	P2046
	Laxmangarh			Puta	2.72	P2048
22	Bhakurma- Matringa			Bakoi	3.03	P2146
	Bhakurma- Matringa			Part Kedma	3.65	P2164

Opencast mining and associated developmental activities in forested habitats could potentially affect a variety of taxonomic groups. Therefore approaches that focus on monitoring large mammal populations on the "umbrella species concept" that are globally accepted to protect umbrella species in the landscape were adopted. HAC and the surrounding landscape is an integral part of the elephant range in northern Chhattisgarh. Different herds and individual elephants use this area as part of their range. A conservative minimal estimate of 40 to 50 elephants could be using the area at different times of the year. For the period 2018 - 2020 elephant occurrence was reported by Forest Department in a minimum of 148 out of 640 forest compartments in this landscape. Elephant occurrence in HAC and the landscape surrounding it, is not limited to any particular portion, but spread throughout. Elephants use the area as both habitat as well as corridor for movement. With respect to human-elephant conflict, there are records of crop loss, property loss and even loss of human lives. Considering this, advancing landscape-level HEC mitigation strategies by considering elephant movement and connectivity at a larger spatial scale is essential.

Chhattisgarh human-elephant conflict situation is a paradox with a relatively low number of elephants (<300, which is <1% of India's wild elephant population) but high levels of HEC with over 60 human lives are lost every year due to conflict (>15% of the reported human deaths due to HEC). In addition to loss of human lives, crop loss and damage to property due to HEC are severe. There is continuous dispersal of elephant herds from the neighbouring states of Jharkhand and Odisha. The study carried out by WII in collaboration with Chhattisgarh Forest Department from the year 2017 onwards clearly highlight that elephants have large home ranges. The forests that elephants currently occur are highly fragmented and degraded due to incompatible land-use. Infrastructure development and mining are further fragmenting the habitats making conflict mitigation a huge challenge. In fragmented habitats conventional fencing approaches minimally work due to high perimeter to area ratio of habitats. The HEC related human fatalities reported in the region are highly disproportionate to its elephant population in the country. The increasing levels of HEC have resulted in considerable public resentment against the management and elephant conservation as a whole. HEC resolution is challenging in EC region due to fragmentation, loss and degradation of intact elephant habitats. The elephant home ranges tend to be large in highly fragmented areas, and the small, degraded forest patches cannot sustain herds. It is observed that home range size is a function of habitat quality – in areas that support good intact habitats, the elephant home ranges are relatively small (*eg.* Rajaji, Mudumalai, etc.). However, in fragmented areas, elephant home ranges are typically large. The elephant herds are generally interlinked and home ranges spread over two or more states.

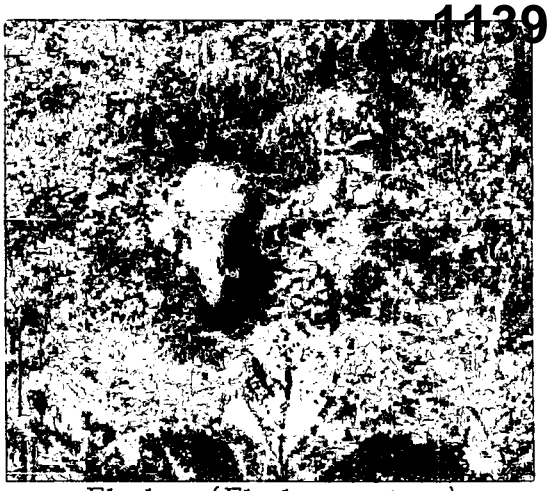
One of the main reasons as to why elephants start dispersing into human-use areas is the threat to habitat. In particular, threat to elephant home ranges. While threat

to habitat can be identified and sometimes even addressed, threats within individual home ranges of elephants are hard to evaluate and hence, difficult to mitigate. The latter threats are more insidious and lasting. Major disturbances to habitats such as mining not only cause habitat loss and fragmentation (as understood generally) but can affect individual herd's home ranges. Such disturbances can lead to abandonment of habitats as threats to home ranges have a threshold limits. The effect of mining on elephant habitat may not reflect in the same habitat, but could be a silent trigger for HEC in some other area within the landscape. In general, one of the reasons for HEC being disproportionately high in EC region is the elephant dispersal from forest habitats through fragmented human use areas. This large scale elephant dispersal out of intact forests coincide with commencement of large-scale mining projects and associate infrastructure developments in the EC region, particularly in the states of Odisha and Jharkhand.

5.6.2 Loss of bird's habitat

HAC is part of a large forested landscape in the Central Highlands, which itself is an amalgamation of diverse landforms. Therefore, the HAC supports rich avi-fauna with over 92 species, this is probably that the landscape supports a diversity of habitats that include dense forests, relatively open forests, scrubland and riparian tracts.

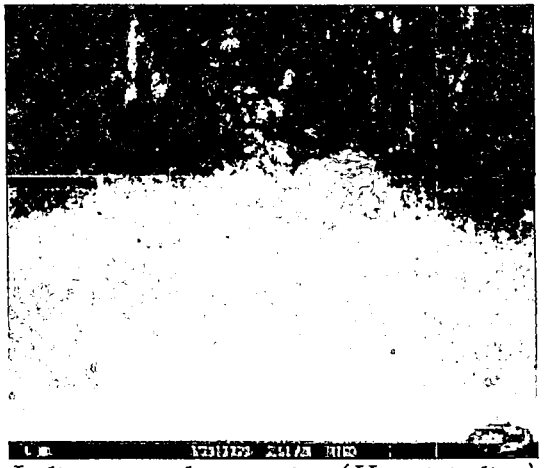
Among the recorded species, six species are under Schedule I of Wildlife (Protection) Act, 1972, 12 species are endemic to Indian Subcontinent, and 19 are winter visitors, it represents the importance of the landscape in providing the suitable habitat to these critical species. All the coal blocks, particularly the Morga II, Saidu and Pindraki and the surrounding habitats support high species richness as well as diversity of birds. Presence of high number of birds of prey may indicate good habitat quality (Sergio *et al,* 2004) and abundance of prey species. Family Muscicapidae, Cuculiade are species-rich HAC and as most them are insect eaters. The diversity of insectivorous birds is usually high the forest ecosystems (Stratford and Sekercioglu, 2015). Among the winter migrants' species, most of them are insectivores in the study area and probably migrate from the Himalayas to spend the harsh, cold months in Peninsular India (McGuir *et al.,* 2013). Mining will certainly contribute to loss of habitat for birds.



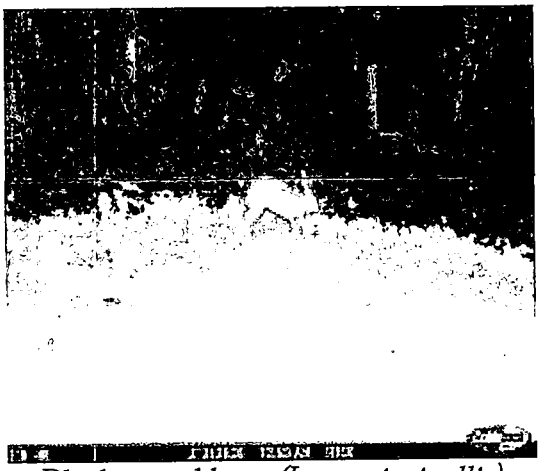
Elephant (*Elephas maximus)*



Common langur (*Semnopithecus entellus*)



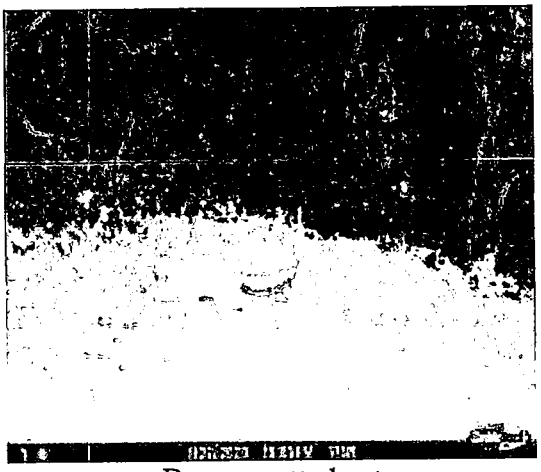
Indian crested porcupine (*Hystrixindica)*



Black-naped hare *(Lepusnigricollis)*



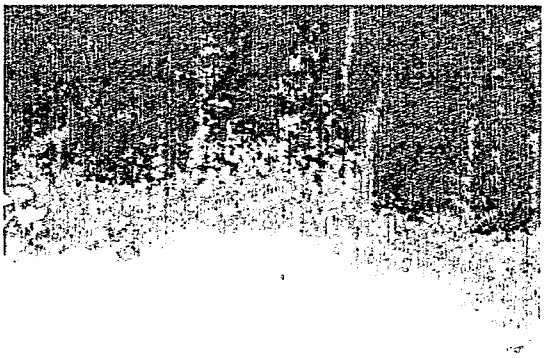
Jungle cat *(Felis chaus)*



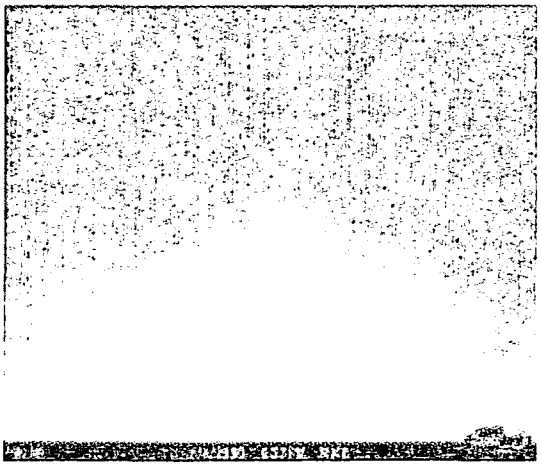
Rusty spotted cat
(Prionailurus rubiginosus)



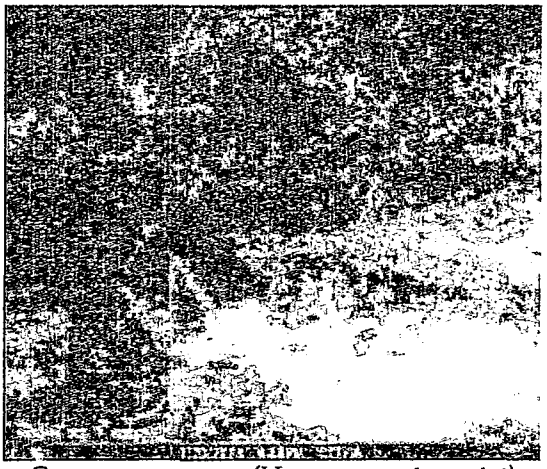
Common leopard *(Panthera pardus)*



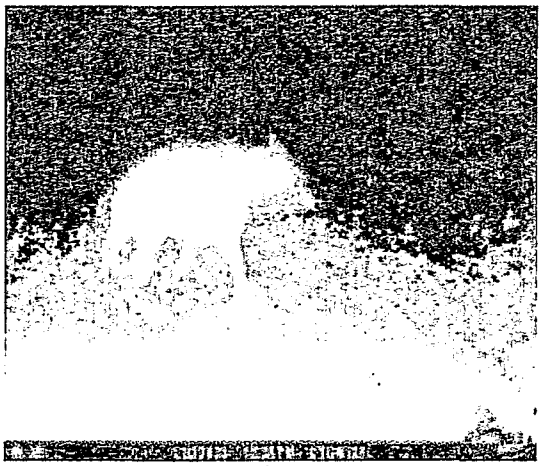
Small Indian civet *(Viverricula indica)*



Common palm civet
(Paradoxurus hermaphroditus)



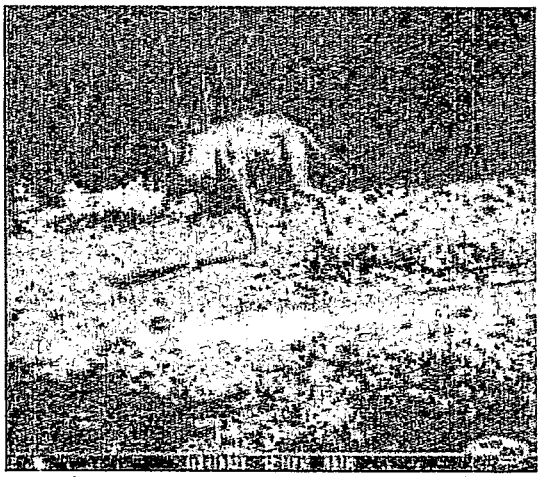
Grey mongoose *(Herpestusedwardsi)*



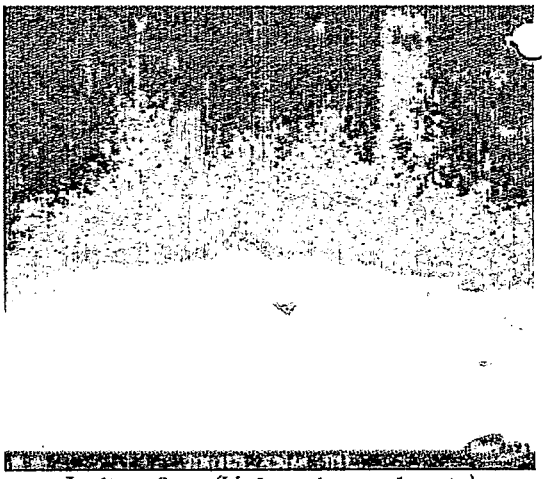
Striped hyena *(Hyaena hyaena)*



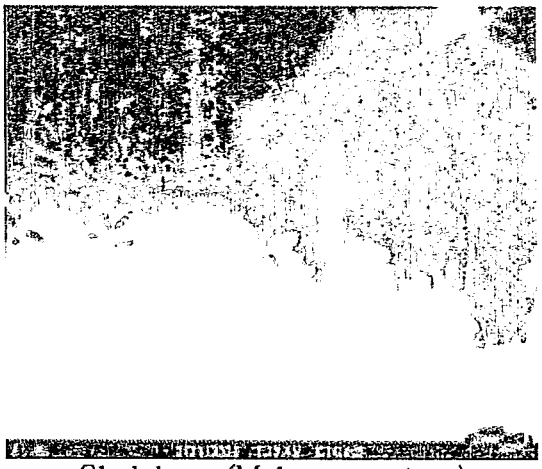
Golden jackal *(Canis aureus)*



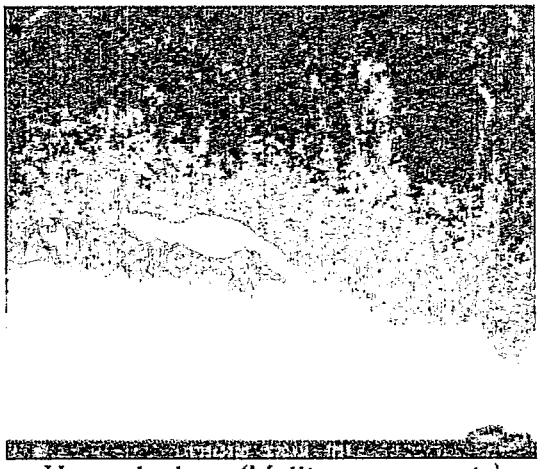
Indian grey wolf *(Canis lupus)*



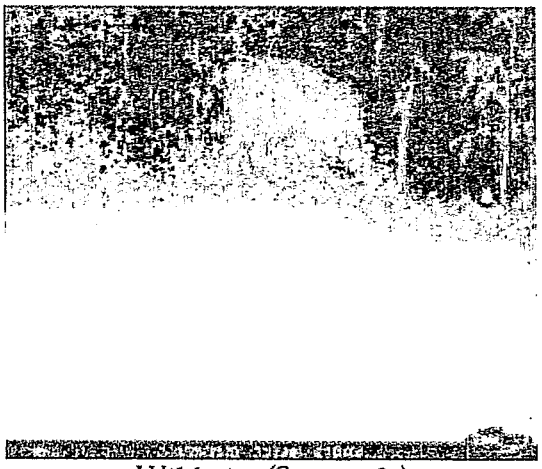
Indian fox *(Vulpes bengalensis)*



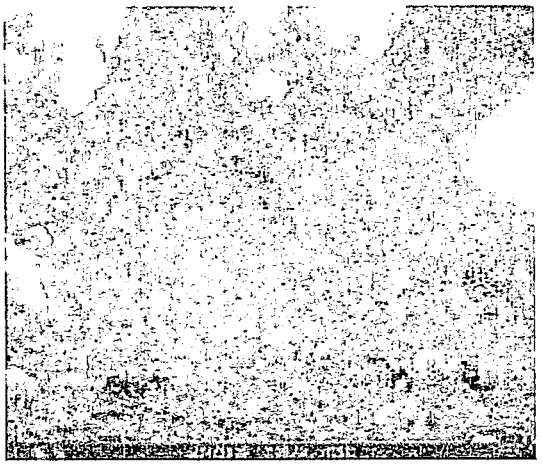
Sloth bear *(Melursus ursinus)*



Honey badger *(Mellivora capensis)*



Wild pig *(Susscrofa)*



Four-horned antelope
(Tetracerus quadricornis)

Plate 5.1: Mammalian species recorded during the survey and pictured in the camera trap in Hasdeo-Arand Coalfield falls within Surguja, Surajpur and Korba districts, Chhattisgarh

CHAPTER-6

STATUS OF AQUATIC DIVERSITY

6.1 BACKGROUND AND SCOPE OF THE STUDY

This chapter provides a comprehensive three season baseline data on biodiversity of aquatic fauna, bio-monitoring of water quality of the headwater streams traversing the core/buffer zones of the proposed/active coal blocks in the forested areas of the entire Hasdeo-Arand Coalfield (HAC) in Surguja, Surajpur and Korba districts of Chhattisgarh state. The impacts on the aquatic habitat and consequent biological water quality due to mining and allied activities are discussed in detail with indicative measures and integrated management plans.

6.2 RIVER AND DRAINAGE SYSTEM

The area under HAC is mainly part of the Mahanadi River middle sub-basin and a lesser extent at the NE is part of the Son River sub-basin of the lower Ganges basin. The Hasdeo-Arand Coalfield (HAC) is drained by mainly four river systems having sub-dendritic drainage pattern with upto 6^{th} order stream (Figure 6.1 and 6.2). The area experiences subtropical climate characterized by three seasons namely hot summer, monsoon and dry & cold winter.

The Hasdeo River basin occupies a larger chunk of the area under HAC. The Hasdeo-Bango Dam is built across the Hasdeo River in 1990 for hydropower and irrigation purposes. The reservoir spreads over an area of 88 sq.km with a storage capacity of 3417 MCM. It is one of the prominent water harvesting structure existing in the area and its main input water source is the drainages originating from HAC. The major drainages in the HAC are Hasdeo-River (N-S), Atem Nadi (north central to north), Chornai Nadi (E-W) with one of its important tributaries - the Rapta Nala (SE-W) and the Rehar River (NE), which is one of the tributaries of Son River.

(1) **Rehar River:** The area under HAC at NE is drained by Rehar River that flows towards north. It is part of the Son River sub-basin of the lower Ganges basin.

(2) **Atem Nadi:** North central part of the HAC is drained by Atem Nadi that flows towards north to join the Hasdeo River and finally drains into the Hasdeo-Bango reservoir.

(3) **Chornai Nadi:** South, SE and central part of HAC is drained by ChornaiNadi. It has relatively a larger network of water courses and is the largest source of water for the Hasdeo-Bango reservoir.

(4) **Rapta Nala:** It is a major tributary of Chornai Nadi that drains a larger portion on the south of HAC to join the main water course at Lemru and finally into the Hasdeo-Bango reservoir.

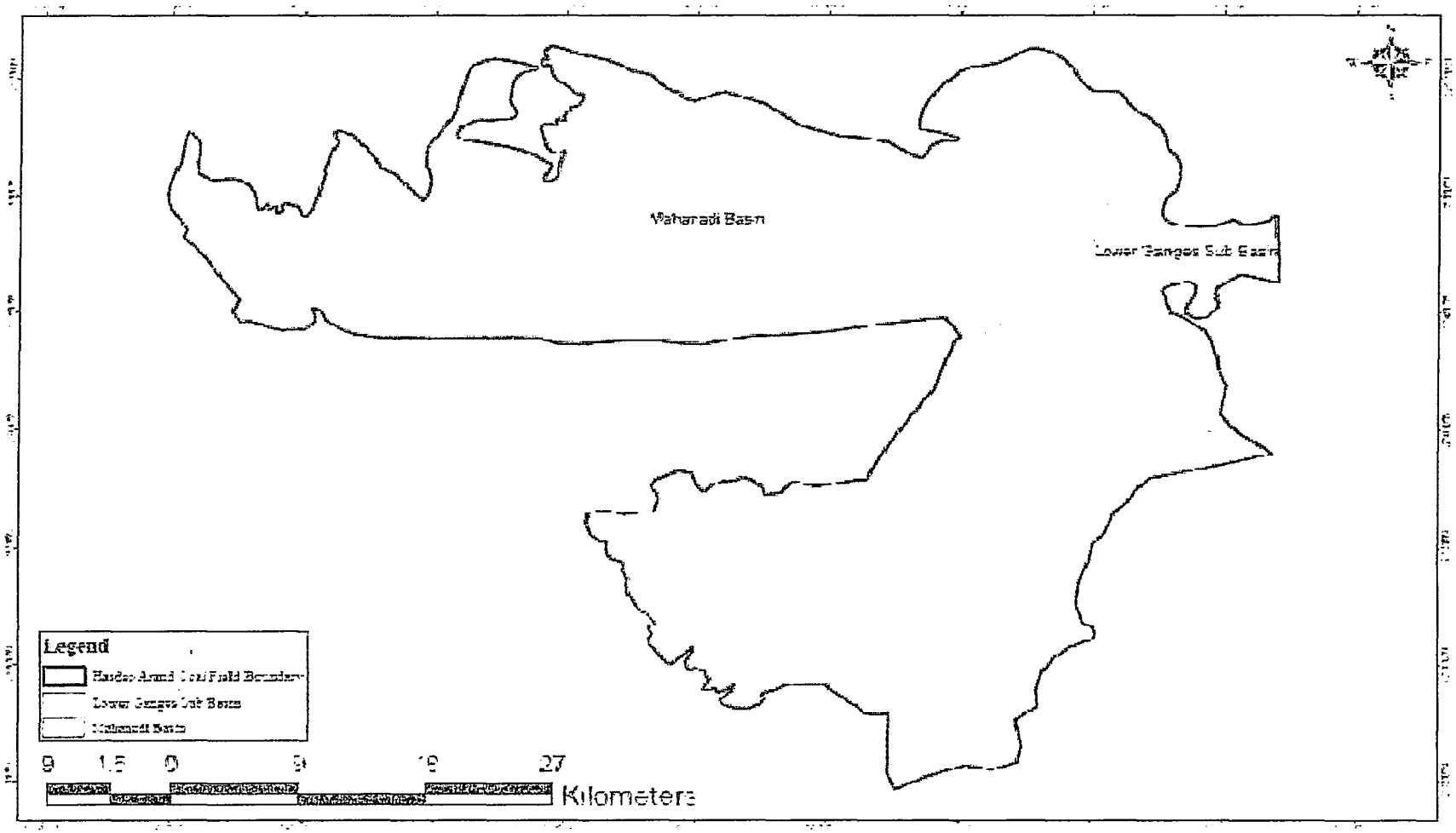


Figure 6.1: Map showing the delineation of the two major river basins (Mahanadi and Lower Ganges) in the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

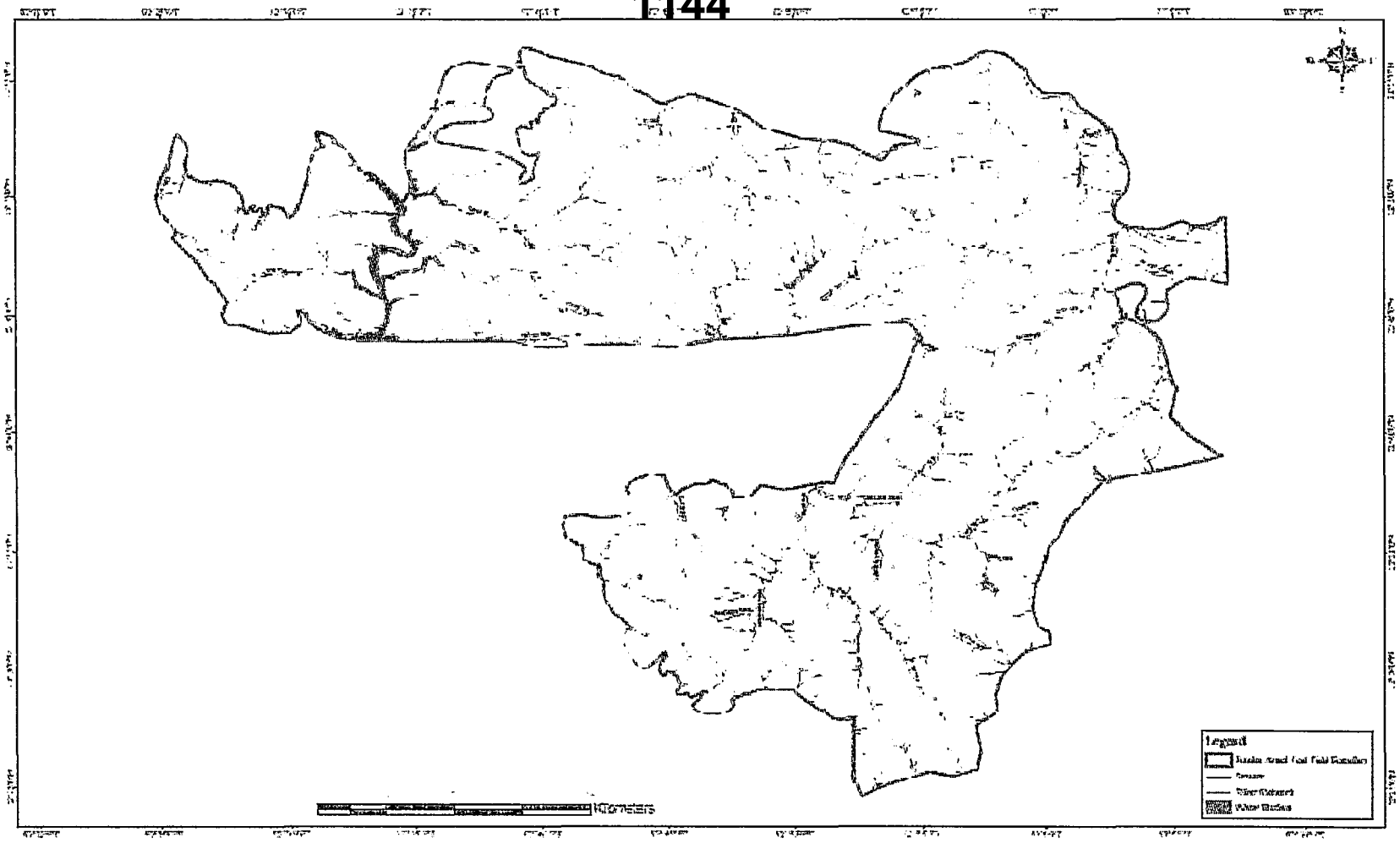


Figure 6.2: Map showing the drainage systems of the rivers of two major river basins (Mahanadi and Lower Ganges) in the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

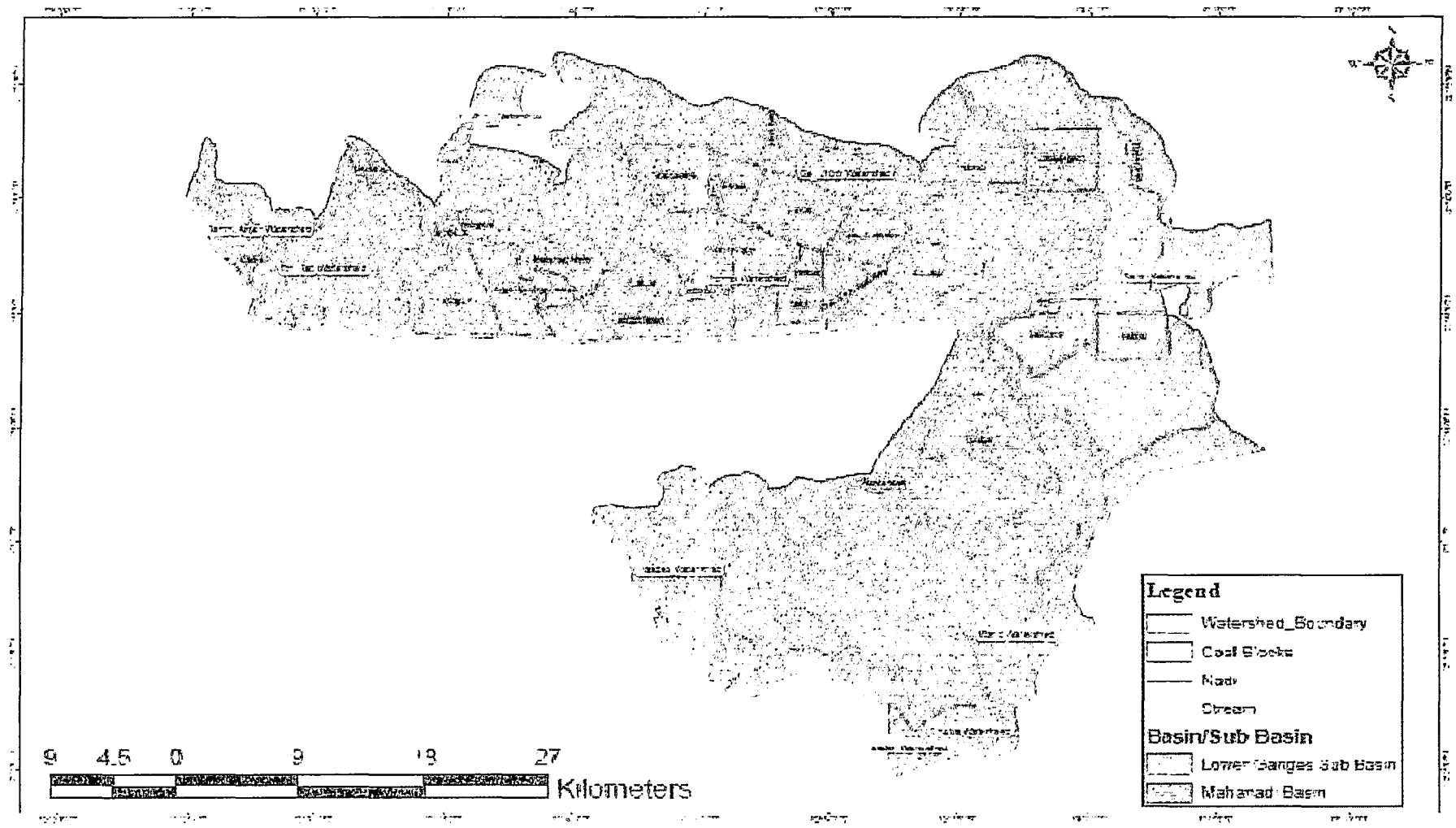


Figure 6.3: Map showing the delineation of the Coal Blocks within the watersheds, sub-watersheds of the two major river basins of the whole Hasdeo-Arand Coalfieldthat falls in Surguja, Surajpur and Korba districts of Chhattisgarh

In terms of drainage network within the area under Coal Blocks in the whole HAC (operating, allotted and identified), Hasdeo River covers the maximum followed by Rehar River as given under:

- Hasdeo River and its headwater streams drain the buffer/core zone of the Coal Blocks Nos. 1-20 and SW part of Coal Block No. 21.
- Rehar River drains the Coal Block Nos. 22 & 23 and remaining portion of the Coal Block No. 21 (Figure 6.3).

The important drainage systems falling within the core/buffer areas of the proposed/active (operating) coal blocks in the whole HAC are as follows:

i) **Atem Nadi:** The Atem river course drains the border of northern and central part of the HAC. It is joined by two prominent streams *viz.*, *Salhi Nala* and *Garjan Nala*. The entire stream forms part of core and buffer zone for the Coal Blocks 12-15, 20 and SW part of 21.

A significant part of the catchments of these streams are under severe land use land cover changes mostly due to human settlements, deforestation due to agriculture and forest degradation. The stream is mostly flowing through open areas with the feeder streams blocked/diverted/modified for subsistence agriculture resulting in habitat modifications along the stream bed. The quantity of water flowing through the stream is observed to be highly fluctuated seasonally with the monsoon rain being the major contributor of the river flow in full strength. The river during rest of the seasons, most often, remain in semi-dried condition with full of sandy substratum at the bottom, which leaves no scope for natural diversification in the form of riffles, pools, cascades, etc., throughout the river water course and therefore, organic matter settlement seldom occurs at the river bottom. Hence, colonization of flora and fauna in the aquatic ecosystem is characteristics to the above-mentioned physiographic features/status of the area.

a) **Salhi Nala** – From its origin, the stream drains the area such as Basen, Chakeri, Sarma, Sanibarra, Phungi, Laxmangarh, Ramgarh P.F., *etc.*, (core/buffer of 20-21) and Baigapara, Kete, Ghatbarra, Kantaroli, Fattepur, Tara, Premnagar, Hariharpur, *etc.* It joins the Atem Nadi at Shivnagar (core/buffer of 13-15).

- The area under the currently operating Coal Block - No. 14 (PEKB) is drained by this stream and therefore, the coal mine is observed to exert significant influence on the main water course of Atem Nadi through Salhi Nala.
- The primary/secondary feeder streams of the Salhi Nala that drains the core/buffer area of the active coal block No. 14 (PEKB) as well as upto Kete, Basen, Ghatbarra, *etc.*, has now been modified/diverted largely due to change in land use land cover pattern resultant of mining in the area.

- The Salhi Nala is being influenced by the area under as many as 06 (Six) proposed coal blocks *viz.*, Nos. 12-15, 20 and SW part of 21 in the HAC, in addition to that of the active Coal Block– the PEKB (14).

b) Garjan Nala: This stream drains the core/buffer area of the proposed coal block No. 15 (Tara) as well as along Tara, Janardanpur, Kantaroli, *etc.*, and joins the Atem Nadi near Chandan Nagar.

- The catchment of this stream is relatively plain with mostly open forests of mixed species where deforestation and forest degradation is prevalent. Similar to Salhi Nala, that river bed occupation for subsistence agriculture is quite prevalent and mostly the areas adjacent to river water course are occupied by seasonal paddy cultivation and other agriculture/horticulture crops.
- In these perennial water courses during the lean period, both permanent and temporary water harvesting structures are being actively employed by the locals for retention of water for their domestic purposes. Water harvesting of this kind is observed to cause reduced flow towards downstream and that mostly results in reduction of aquatic biodiversity and thereby the river water continuum.

ii) Chornai Nadi: It is a sixth order stream and an important drainage system in HAC. It spreads across almost half the area of the entire HAC and that of the active/proposed coal blocks. Primarily, it is fed by two important fifth order streams (i) the Chornai Nala with its network of streams spread across N-NE-E of the HAC near Pindarkhi pass through near Surve; and (ii) the Rapta Nala, with its network spread across S-SE-E of the HAC near Nakiya and pass through Lemru. Both the streams join together to form the Chornai Nadi near Nawapara. In addition to these two streams, there are as many as four secondary/tertiary streams that drain the peaks and valleys in between Pindarkhi and Lemru.

a) Chornai Nala: The two known major feeder streams of the water course are Dhohka Nala with its tributary the Rumbrabahar Nala from Gidmudi and Bagbahar Nala from Parogia, besides several other primary/secondary/tertiary streams. The stream together with its network of headwater feeder streams that are located at a relatively higher elevation in the upper reaches carry significant amount of water towards downstream. The area upstream to the stream water course especially in and around 'Pahadkorja' is relatively undisturbed, owing to the dense forest vegetation cover and is relatively intact due to its elevation gradients and therefore, protected from anthropogenic disturbances that generally prevail in the low lying areas.

- The area under this stream falls within the influence zone of as many as 12 coal blocks *viz.*, Nos. 7-8 and 12-21 in the HAC, out of which one coal block - the PEKB (Phase-I of mining) is in operation /active at present.

b) Rapta Nala (Lemru): Its network of streams together with that of Chornai Nala form one of the major drainage systems that originate from the whole

HAC and it occupies nearly one fourth of the whole HAC at S-SE-E direction. The proposed Coal Block (No. 1 – Nakiya) falls within the area under its catchment. This fifth order stream at Lemru (running from Rapta to Devpahari water fall) that carries water downstream to the main Chornai Nadi is one of the major water courses of its kind in terms of its overall dimension and quantity of water that carries in the whole HAC. The main portion of the stream is primarily formed by two fourth order streams – the Gandher Nala and Rapta Nala and another fourth order stream that joins the Rapta on the left bank downstream near Kuturuwan.

Both the Gandher Nala and Rapta Nala together with their numerous stream networks namely Lamti Nala and Bimalta Nala are falling within the influence zone of the proposed Coal Block - the Nakiya (No. 1). Human habitation and other disturbances due to developmental activities in this area are comparatively sparse owing to highly undulating terrain with dense forest vegetation cover intersected by numerous seasonal/perennial stream channels. Therefore, the area is characterized by significant wildlife movement particularly of elephants, which prompted the concerned State authorities to declare a significant portion in this area to be protected as 'Lemru Elephant Reserve'.

iii) **Bisrar Nala:** It is a relatively small water course and flows through the area from Uchalenga, Arisiya, Paturiyadand through Morga to Dhajak and finally drains in to the main Hasdeo River water course at N-NW of the HAC.

- Primarily, the stream water course forms the core/buffer areas of as many as five proposed coal blocks *viz.*, Nos. 4, 3, 7, 8, 9 and 11. Its catchments are characterized by relatively higher proportion of open/degraded forests towards upstream that mostly located in plains where human habitation is more; while its lower reaches particularly the surrounding area of Dhajak are occupied by more dense forest cover.

iv) **Bamni Nala:** It drains the area that are slightly higher in elevation than that of the Bisrar Nala and joins the main Hasdeo River at N-NW of the HAC. Joining together with Mahasi Nala from west of Tara, the stream drains the area *viz.*, Paturiyadand, Madanpur, Puta, *etc.*

- The core /buffer areas of the four proposed coal blocks *viz.*, Nos. 9, 10, 15 and 16 falls within the influence zone of the stream Bamni Nala. The catchments of the stream are dominated by predominantly open/degraded forests towards upstream.

v) **Khadpadi and Parla Nala:** The Khadpadi Nala is located north of Chotia Coal Block, draining relatively a small hill range lying N-S and flows towards east (through Pondi Khurd) to join the Hasdeo River near Lad. Beyond origin, it is joined by other small streams to form a third order stream before draining into the main River water course (backwaters of Bango dam). Occurrence of dense forest were noticed at its origin and middle part of the stream; further the stream flows

through disturbed and open landscapes where anthropogenic impact is quite evident along most of its catchments. The Parla Nala is located on the south of Chotia Coal Block, originated from S-SE slope of Amatikara hill ranges, where the forest at the catchment is very dense; passing through the midst of Chotia main village human habitations and finally drains into the Bango Dam. Except at its origin, the stream is almost completely flowing through open and much degraded areas.

vi) **Rehar River:** It is a sixth order stream that forms part of the catchments of the Son River – one of the tributaries of the lower Ganges sub-basin.

- It originates near Bhakurma and Kedma, where the proposed two coal blocks *viz.*, Nos. 22 and 23 are located and the river flow towards north. Two out of the three important tertiary feeder streams (Barka Nala) fall within the core zone of the proposed coal blocks.
- In addition to these two coal blocks; nearly half of the area of the coal block No. 21 (Laxmangarh) is drained by one of the second order streams that join the River near Udaipur.

The area falling under whole HAC is characterized by sub-tropical moist deciduous and dry deciduous types of forest cover. Mostly the forests in its northern part are relatively more open than that of all other areas.

- The whole/entire HAC area is presently under minimal influence of land use land cover changes with only two mines that are under operation and hence, the densely vegetated forest areas of the whole HAC is relatively not much impacted by deforestation and forest degradation of specific types related to mining and allied activities.
- However, anthropogenic pressure such as grazing, lopping and illicit felling is widely prominent in fringe forests bordering the open villages/human habitations.
- Subsistence seasonal agriculture mainly paddy cultivation are more prevalent along the river/stream beds as well as catchments of the seasonal/perennial forested streams.
- Drainages that occupy a prominent role in the forested ecosystem of the area have been to some extent, at least in the accessible terrain adjoining the forest fringe villages, modified for the benefit of human habitation including agriculture and water harvesting. This has resulted in loss of riparian forest cover and alteration of habitat suitable for aquatic and semi-aquatic flora and fauna at large.
- Despite these, the cumulative effects of the proposed mining in the 23 coal blocks are likely to cause significant impacts on the forest ecosystem and the drainage of the whole HAC.

6.3 REVIEW OF LITERATURE

The natural watercourses in the study area that supplies water for irrigation, drinking and industrial uses are the lifeline for the community living around. Economic activity and other anthropogenic factors have led to significant contamination of river water resources of the state. In some cities, especially, Korba that rank fifth among the polluted cities in India (CPCB, 2009 and 2010) where the level of contamination is high whereas, across the state the level of contamination has been well within the permissible limits as per CPCB report (2012). Water in some tributaries such as that of Hasdeo River in Korba region is polluted with heavy metals and microbial pollutants (DFID, 2019). There has been great impact on physico-chemical water quality such as DO, BOD and COD that affects every component of ecosystems and such contamination has not only affected the river ecology and ecosystem but, has also affected people depended on the water resources as water from such sources are of limited usage including at times unsuitable for irrigation.

Biological monitoring became one of the most common method for assessment of anthropogenic impacts on aquatic ecosystem (Bunn, 1995), that effectively replacing or as complementary to the traditional method of physico-chemical evaluation of water quality. In the recent past, there has been enormous advancement in bio-monitoring methods and a variety of indices have been developed/recommended/ utilized for the purpose of water quality assessment (Sharma and Moog, 1998; Shah *et al.*, 2011; Abbasi and Abbasi, 2011). Of these indicator organisms, benthic macroinvertebrates are one of the most useful indicator organisms in bio-assessment of aquatic ecosystems (Reshand Rosenberg, 1984; Rosenberg and Resh, 1993; Resh *et al.*, 1995; Barbour *et al.*, 1996; Allan and Castillo, 2007) mainly because of their diverse life skills particularly related to ambient environmental changes.

Biomonitoring of aquatic ecosystem based on Benthic Multimetric Index (BMI) has attained wide acceptance since the beginning of the twentieth century (Cairns and Pratt, 1993; Metcalfe-Smith, 1994 and Bonada *et al.*, 2006) and this method has been reliably tested in both temperate and tropical aquatic ecosystems (Armitage *et al.*, 1983; Sivaramakrishnan *et al.*, 1996; Buss *et al.*, 2015 and Guareschi *et al.*, 2016). Biological monitoring is considered as central to water quality monitoring of aquatic sources and provides an integrated approach to assess the overall environmental quality (Hynes, 1960). The method of biomonitoring underlies the assumptions that modifications/alteration in flow regime, fluvial processes, stream morphology, physico-chemical parameters, riparian vegetation cover, *etc.*, would most likely be manifested in qualitative and quantitative changes of BMIs (Sehgal and Sundar, 1992; Sivaramakrishnan *et al.*, 1996; Joshi *et al.*, 2007; Subramanian and Sivaramakrishnan, 2007b; Sharma and Rawat, 2009 and Shah *et al.*, 2011), which can easily be assessed by their occurrence, richness and abundance.

Aquatic benthic macrofauna perform many important ecological functions. They are considered as central to the recycling of organic matter and by making energy

available to the upper trophic levels, they regulate flow of energy along the aquatic food web and thus, very essential for maintaining overall aquatic environmental health (Wallace and Webster, 1996 and Covich *et al.*, 2004). Because of their varying tolerance to ambient environmental changes, relatively easy and inexpensive method of their collection and analysis and most importantly, their relatively lengthy aquatic life with all morpho-physiological and feeding adaptations, BMI has been used an effective tool for biomonitoring of aquatic ecosystems (Resh and Jackson, 1993; Rosenberg and Resh, 1993; Karr and Chu, 1999; Semwal and Akolkal, 2006; Resh, 2008; Rosenberg *et al.*, 2008; Birk *et al.*, 2012 and Bo *et al.*, 2017). They are known to possess varying degree of resistance to ecosystem pressure of both autochthonous and allochthonous in origin with remarkably high resilience to the changing environments (Voelz*et al.*, 2000). Therefore, they are highly useful in identifying potential sensitive areas in aquatic ecosystems for making management decisions for conservation (Dudgeon, 1994; 1999 and 2000).

Various natural and anthropogenic factors are responsible for conditioning and shaping water quality in stream ecosystems (Hamid *et al.*, 2020). The biodiversity of terrestrial ecosystem, demographics and land use patterns in a catchment area make impacts on the state of headwater streams. Indeed, aquatic resources have an immense social, cultural and economic significance to the places, which they belong. Thus, conservation and management of aquatic ecosystems are integral to the welfare of all human beings. Nevertheless, freshwater habitats are being greatly disturbed world over mainly due to increased anthropogenic interferences manifested by land use land cover changes (Saunders *et al.*, 2002; Dudgeon *et al.*, 2006; Kannel *et al.*, 2007 and Blakely *et al.*, 2014). In most of the South Asian countries, water quality monitoring is principally taking into account the analysis of physico-chemical properties and immense data has already been gathered on the aspect (Sharma *et al.*, 2009). Biological monitoring is a rapidly growing field in India though limited (CPCB, 1999, 2004; Habermann and Reisenberger, 2000; Sharma *et al.*, 2009). Benthic macroinvertebrates are themost popular and commonly used group of freshwater organisms in assessing water quality and offer many advantages in biomonitoring although a practice for well-balanced monitoring programs (Rosenberg and Resh, 1993). In the present study is also confined to Biological monitoring.

Traditional physical and chemical measures of water quality are useful to help determine sources of water contamination, but they only indirectly measure the health of the aquatic ecosystem because they don't look directly at biological responses to pollution. Very few studies on water quality assessment in the Hasdeo River have been reported which are preliminary in nature. Ground water quality in Surguja district (Kumari and Upadhyay, 2013); pond water quality (Kanungo, 2013); water quality parameter in Ambikapur (Gupta *et al.*, 2019); limnological studies in Ghunghutta dam (Baghel, 2017) are the few studies that are specific to particular sites and objectives. Ecosystems are composed of both physical and biological components and the most direct way to understand the health of the organisms in an ecosystem is

to monitor them directly. Aquatic organisms are also useful as indicators because they cope with chemical, physical, and biological influences in their habitat over the course of their entire aquatic lifecycle. Biological communities integrate all of the environmental stresses caused by human and natural activities over a longer period of time. As a result, the numbers and types of organisms present in a water body reflect the quality of their surroundings. No much scientific studies regarding the complete physcio-chemical parameters of water quality, heavy metals are conducted except for few isolated studies in Hasdeo and Korba region (Bhaskar and Dixit, 2015; EIA/EMP, 2018).

6.4 APPROACH AND METHODOLOGY

6.4.1 Benthic Macroinvertebrates

Aquatic fauna (benthic macroinvertebrates) comprising lower aquatic organisms mostly of insect larvae, which are regarded as one of the most prominent indicators of aquatic ecosystem health and water quality were sampled from the perennial/seasonal streams in the core/buffer areas of the active *i.e.*, in operation /proposed coal blocks in the entire HAC which falling within Surguja, Surajpur and Korba districts of Chhattisgarh State. The locations from where aquatic macrobenthic sampling performed are depicted in the Figure 6.4, Plate 6.1. A semi-quantitative sampling was performed using'D-frame' aquatic dip net having mesh size of 200 microns. Benthic macroinvertebrates were collected by vigorously churning the running water in the stream bed immediately above the location where the hand-held net was placed at the bottom vertically using long handle and kick and dislodge off the bottom substrata such as pebbles, broken logs, foliage, *etc.* In case of pools, the net was towed along the bottom as well as vegetated margins. The dislodged organisms along with the debris carried by the running water to the net were then transferred into a sorting tray. After initial sorting the samples were preserved in 70% ethyl alcohol in the field and later sorted in the laboratory, identified up to the lowest taxonomic level possible under stereo-zoom microscope using standard identification manuals. Different kinds of habitats such as pools, riffles and cascades in a sample location were sampled preferably in duplicate to get a uniform representation of the aquatic fauna. This seasonal study using macroinvertebrates as an indicator for monitoring the streams upto the family level was considered rather than species level as many such studies have recommended family level as best resolution for resolving patterns in macroinvertebrate assemblages and assigning appropriate tolerance value for calculating the water quality index.

6.4.2 Water Quality Analysis (physico-chemical parameters)

The ambient physico-chemical parameters *viz.*, Temperature, pH, Electrical Conductivity (EC) and Total Dissolved Solids (TDS) were measured *in-situ* at all sampling locations using a multi-parameter instrument (Eutech) calibrated as per manufacturer's instructions.

6.4.3 Macroinvertebrate Water Quality Index (MWQI)

The qualitative and quantitative data of macroinvertebrates recorded from the sampling locations were used for the assessment of water quality by employing the Macroinvertebrate Water Quality Index (MWQI) developed by Bhat and Pandit (2010). MWQI is superior to all the other kinds of indices used for water quality monitoring because it is simple to use and takes into account the abundance of various macroinvertebrate taxa; shows distinct results for the samples with varying number of individuals of the same taxon; have wide range of applicability and efficacy; is universal and can be used for any pollution sensitivity score system at family, genericor specific level without modification; fulfills all the criteria required of a robust biotic index for use in monitoring of water quality.

The MWQI were calculated using a modified Tolerance Values for the macroinvertebrate's taxa (identified upto the family level) that were adopted from similar kinds of tolerance values for bio monitoring in different geographic regions mainly Asian countries *viz.*, Malaysia, Singapore, Thailand and Vietnam as well as Australia as detailed Annexure 6.1 and as indicated in the Table 6.1.

Table 6.1: Indicative references of Tolerance Scores referred for the present study

S.N.	Geographic Area	Tolerance Scores	References
1	Thailand	BMWP-Thai	Mustow (2002)
2	Australia	SIGNAL2	Chessman (2003)
3	Vietnam	BMWP-Viet	Nguyen *et al.* (2004)
4	Lower Gangetic Plains	HKH Bios	Ofenbock*et al.* (2010)
5	Singapore	Sign-Score	Blakely *et al.* (2014)
6	Malaysia	BMWP-My	Zakaria and Mohamed (2019)

The MWQI was calculated using the following formula:

$$MWQI = \frac{\sum N+1}{(\sum N+1)+(\sum N'+1)}$$

$$N = n_i\,(s_i - m_s) \text{ and } N` = n`_i\,(s`_i - m_s)$$

Where,

N is the multiple product of density of the i^{th} taxon and the positive relative sensitivity score;

N` is the multiple product of density of the i^{th} taxon and the negative relative sensitivity score; n is the density of i^{th} taxon having assigned pollution sensitivity score (s) ≥ median score (m_s) (positive score);

n`$_i$ is the density of i^{th} taxon having assigned pollution sensitivity score (s) < median score (m_s) (negative score);

1 is the constant to account for samples in which taxa having pollution sensitivity score more than the median score may be absent.

A grading of eight index values between 0 and 1 were used to denote the distinct water quality classes with the minimum and maximum representing both the extremes of the defined water quality criteria as detailed in the table below:

The other biotic indices of bio-monitoring generally consider the presence/absence and/or range values of different taxa. This index is a combination of both the abundance and pollution sensitivity scores of the taxa and therefore strongly influenced by the relative abundance of the taxa in a sample. Also, when compared to widely known Hilsenhoff's Family Biotic Index, this index gives distinct results for the samples with different number of individuals of the same taxa (Bhat and Pandit, 2010).

MWQI ranges and details of water quality characteristics assigned

Index range	Water quality	Degree of organic pollution
≥ 0.9000	Excellent	No apparent pollution
≥ 0.7000 - < 0.9000	Very good	Slight organic pollution
≥ 0.6000 - < 0.7000	Good	Some organic pollution
≥ 0.5000 - < 0.6000	Fair	Significant pollution
≥ 0.4000 - < 0.5000	Fairly poor	Significant organic pollution
≥ 0.3000 - < 0.4000	Poor	Very Significant pollution
≥ 0.2000 - < 0.3000	Very poor	High organic pollution
< 0.2000	Worst	Severe pollution

Source: Bhat and Pandit, 2010

6.4.4 Biotic Metrics

The most common biotic metrics such as numerical abundance and richness of macroinvertebrates of both the sampling locations and seasons were calculated. Numerical abundance of the Ephemeroptera, Plecoptera and Trichoptera (EPT richness) were counted as these taxa are relatively less tolerant to pollution and therefore, the metric is often used as an indicator of water quality (Rosenberg and Resh, 1993). Together with this, EPO - 'Odonata' (Shah *et al.*, 2011) were also estimated due to very negligible abundance of the Plecoptera taxa.

6.4.5 Biotic Indices

Biotic indices *viz.*, Taxa Tolerance Score (Sum of the tolerance values of all the individual taxa) and ASPT (Average Score Per Taxon – average of the total scores of all the individual taxa), used as a measure for biological monitoring of water quality were also calculated.

6.4.6 Diversity Indices

The numerical abundance data of the macroinvertebrates were subjected to analysis of the diversity indices *viz.*, Dominance (D), Simpson (1-D), Shannon (H) and Fisher (alpha) by employing the standard software package (PAST, ver. 2.17c, Hammer *et al.*, 2001). Fisher'salpha diversity index were employed for macroinvertebrate diversity comparisons as it is not heavily influenced by sample size (Magurran, 1988).

6.4.7 Abundance and diversity of aquatic macrobenthic invertebrates

A rapid semi-quantitative field sampling of aquatic macroinvertebrates were conducted at different locations falling in eight perennial/seasonal forested headwater streams *viz.*, (1) Atem Nadi, (2) Salhi and Garjan Nala, (3) Bisrar and Maniar Nala, (4) Bamni Nala, (5) Chornai Nadi - Right bank streams, (6) Chornai Nadi - Left bank streams, (7) Khadpadi and Parla (K&P) Nala and (8) Rehar Nadi traversing the core/buffer areas of the proposed/active coal blocks in the whole Hasdeo-Arand Coalfield during three seasons *i.e.*, summer 2019, post-monsoon 2019 and winter 2020 for assess the possible water quality changes and predict the likely impacts of stressors on the aquatic environment (Annexure 6.2). The results of the analysis of aquatic biodiversity and some of the important ambient *in-situ* physico-chemical water quality parameters studied are reported separately to obtain a complete picture of the likely impacts arising out of the scenarios of the Coalfield for making effective management:

- 8 headwater streams covering the core/buffer areas of all the 23 proposed/active Coal Blocks of the whole HAC;
- 4 headwater streams traversing the core/buffer areas of the PEKB cluster of 4 coal blocks *i.e.*, Coal Block Nos. 12 to 15, which is already opened up/in pipeline stage for commencement of mining.

6.4.8 Statistical Analysis

The ambient physico-chemical parameters (Temp., pH, EC and TDS); biotic metrics (abundance and richness) and biotic indices (Tolerance Score and ASPT Score) of macroinvertebrates were analyzed for significance in spatio-temporal variations employing SPSS ver. 17. The data were essentially not normally distributed (The approximate normal distribution of the dependent variables were checked using Shapiro-Wilk Test at $p>0.05$ and visual examination of their histograms, normal Q-Q Plots and box plots with Skewness and Curtosis (somewhere between -1.96 and +1.96) followed by homogeneity of variances by the Levene's test at $p>0.05$) and hence non-parametric statistical tests *viz.*, Kruskal-Wallis and Mann-Whitney-U were performed to analyze the significant differences between variables.

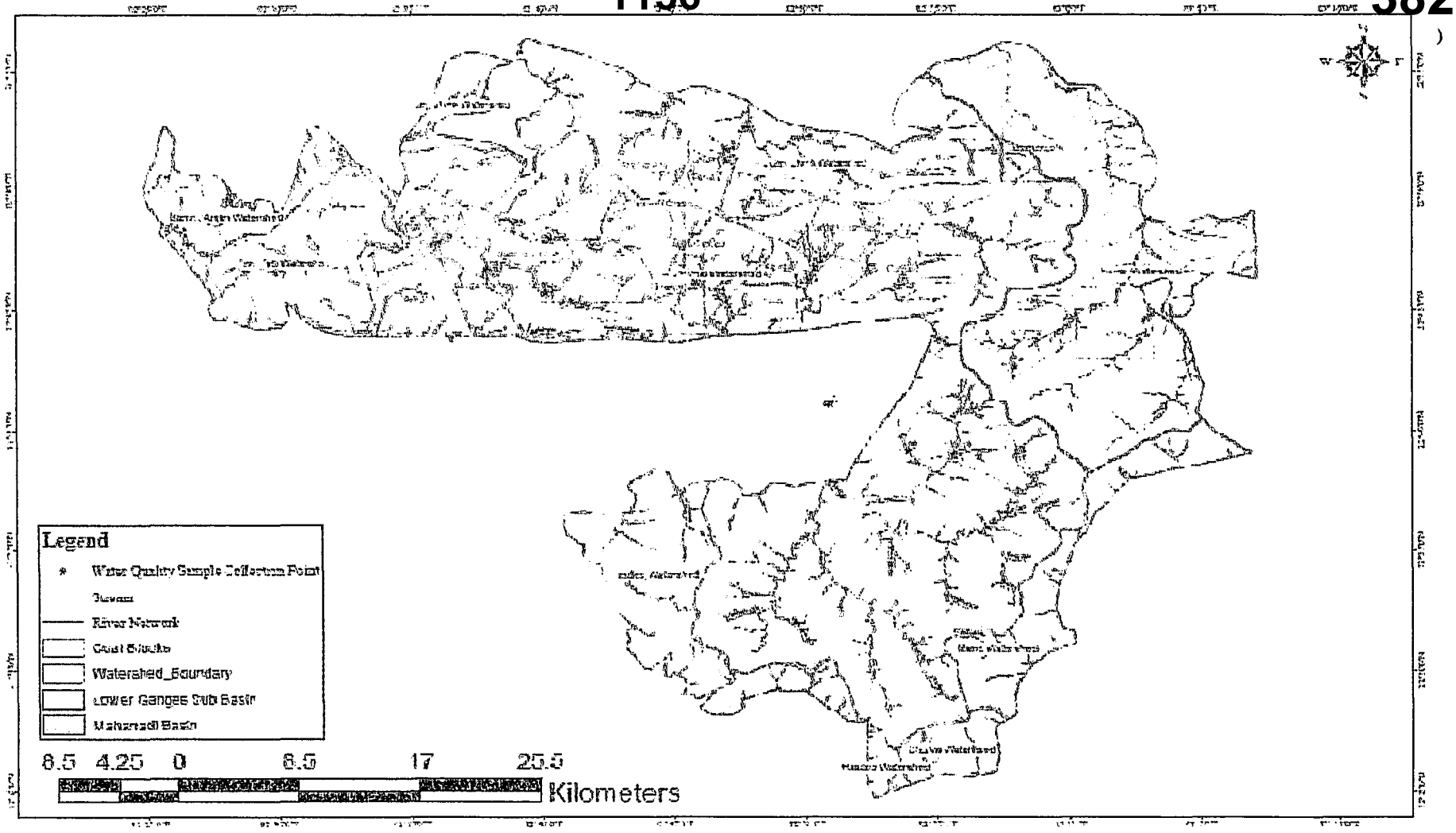


Figure 6.4: Map showing the water quality sampling locations from the drainages of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

6.4.9 Drainage

Generation of drainage map of the study area was carried out by using CARTOSAT DEM of NRSC (ISRO). Also, Remote Sensing and Geographic Information System (GIS) were used for mapping of drainage networks employing CARTOSAT Digital Elevation Model (DEM). Stream orders identification was done by using hydrological tool from spatial analyst Arch toolbox in Arc GIS 10.1v software.

6.5 AMBIENT WATER QUALITY

Physico-chemical properties are the important determining factors of aquatic ecosystem health. The important physico-chemical in-situ ambient water quality parameters viz., temperature, pH, Electrical Conductivity (EC) and Total Dissolved Solids (TDS) recorded from the sampling locations in eight streams traversing the whole HAC during post-monsoon 2019 and winter 2020 are presented in Table 6.2a and Figures 6.5a-b.

6.5.1 Temperature

Temperature variation affects the survival, growth and development of aquatic organisms directly as it controls the metabolic rates of organisms ; and indirectly it is critical in determining both abiotic and biotic system responses (habitat distributions, physiological functions and phenology of aquatic organisms) across a hierarchy of spatial and temporal scales. While temporal variation of temperature in tropical headwater stream is due to diel fluctuation primarily driven by solar radiation (Dudgeon, 2011), spatial variation (local variability) across ecosystem scales is contributed by the effect of landscape topography, geology, stream reach processes, etc., (Jones *et al.*, 2017).

As the data collected during day time, obvious fluctuations in the measurement were noticed according to change in ambient atmospheric temperature. Average ambient water temperature of all the sample location along the eight streams was 31.01 ± 1.60°C (27.30 - 33.90°C) and 21.38 ± 2.17°C (18.10 - 27.70°C) respectively during post-monsoon and winter (Table 6.2b and Figures. 6.5c), while that of the individual streams varied from 29.40 ± 0.98°C at Salhi and Garjan Nala to 32.55 ± 1.48°C at Bamni Nala during post-monsoon and from 19.05 ± 1.34°C at Bisrar and Maniar Nala to 24.15 ± 5.02°C at Atem Nadi during winter.

Table 6.2a: Results of the *in-situ* measurement of spatio-temporal physical water quality parameters recorded from the streams in the core/buffer areas of the proposed/active coal blocks of the whole Hasdeo-Arand Coalfield

Sl. No.	Location Sl.No.		Location indication	Sept., 2019 (Post-monsoon)				Feb., 2020 (Winter)			
				Temp. (°C)	pH	EC (mS/cm)	TDS (ppm)	Temp. (°C)	pH	EC (mS/cm)	TDS (ppm)
1	**18**	**49**	12, 20, 21 Buffer	33.9	7.45	53.4	38	27.7	8.44	59.8	42.5
2	**16**	**48**	20, 21 Buffer	29.9	8.8	59.3	42	20.6	8.52	73.3	52
3	**17**		20 Buffer	31	7.82	54.1	38.4				
4	**19**		21 Core	30.4	7.3	49.1	34.8				
5	**21**	**42**	13, 14, 15, 20, 21 Buffer	28.3	7.85	97.4	69.1	18.7	8.66	194.5	138
6	**22**		15 Buffer	29.7	7.71	71.3	50.7				
7	**39**	**43**	13, 14, 15 Buffer	30.2	8.35	131	93	21.4	8.46	143.3	102
8		**46**	13 Core & 14, 15 Buffer					21.8	8.66	212	151
9		**47**	14 Core					23.2	7.7	120.3	85.2
10	**26**		9 Core & Buffer 7, 8, 16	31.7	7.56	54	38.2				
11	**25**	**58**	11 Core & 3, 7, 8, 9, 16 Buffer	31.5	8.51	55.9	39.6	20	8.61	71.8	51.1
12		**59**	3, 4, 7 Buffer					18.1	8.15	118.9	84.6
13	**23**		11 Core & 9, 10, 15, 16 Buffer	33.6	7.99	68	48.5				
14	**24**	**45**	9 Core & 15, 16 Buffer	31.5	8.42	66.8	47.2	22	7.99	73.7	52.2
15		**44**	16 Core & 15, 10 Buffer					20	7.92	78.9	56.2
16	**40**	**52**	19 Core & Buffer 12, 20, 21	29.9	8.55	66.2	46.4	18.8	8.61	70.9	50.2
17	**34**	**63**	12, 14, 17, 19 Buffer	33.8	8.75	53.1	37.8	22.5	8.77	51.1	36.2
18	**30**		16 Core & 8, 13, 14, 15 Buffer	32.1	7.6	44.1	31.1				
19	**41**	**53**	19 Core	29	7.97	54	38.6	18.9	7.8	65.4	46.1
20	**29**	**60**	7 Buffer	31.1	8.24	125.1	88.7	20.6	8.35	137	97.2
21	**31**	**61**	16, 17, 14 Buffer	32.1	8.1	57.1	40.5	21.6	8.25	59.5	42.5
22		**62**	12, 14, 17, 19 Buffer					23.5	8.33	50.1	35.6
23	**36**	**55**	1 Core	31.6	9.15	50.7	36	22.9	9.55	52.4	37.2
24	**37**	**56**	1 Core	32.2	8.75	58.9	42.2	22.7	8.58	52.1	37
25	**35**	**54**	HAC Buffer	30.4	8.9	130.8	92.7	23.6	9.19	173.2	123
26	**38**	**57**	1 Core	30.9	8.85	119.6	84.8	23.4	8.77	109.8	78.1
27	**27**	**64**	2 Buffer	29.3	9.07	795	564	20.7	9.15	1051	747
28	**28**	**65**	2 Buffer	31.8	8.9	115	82	18.5	8.13	234	166
29	**20**	**51**	21, 22, 23 Buffer	30.8	7.81	60.2	42.8	20.4	9.03	75.5	53.2
30	**32**	**50**	22 Core	27.3	7.99	47.4	33.2	21.6	7.65	51.1	36.4
31	**33**		23 Core	32.2	6.8	53.5	38.2				

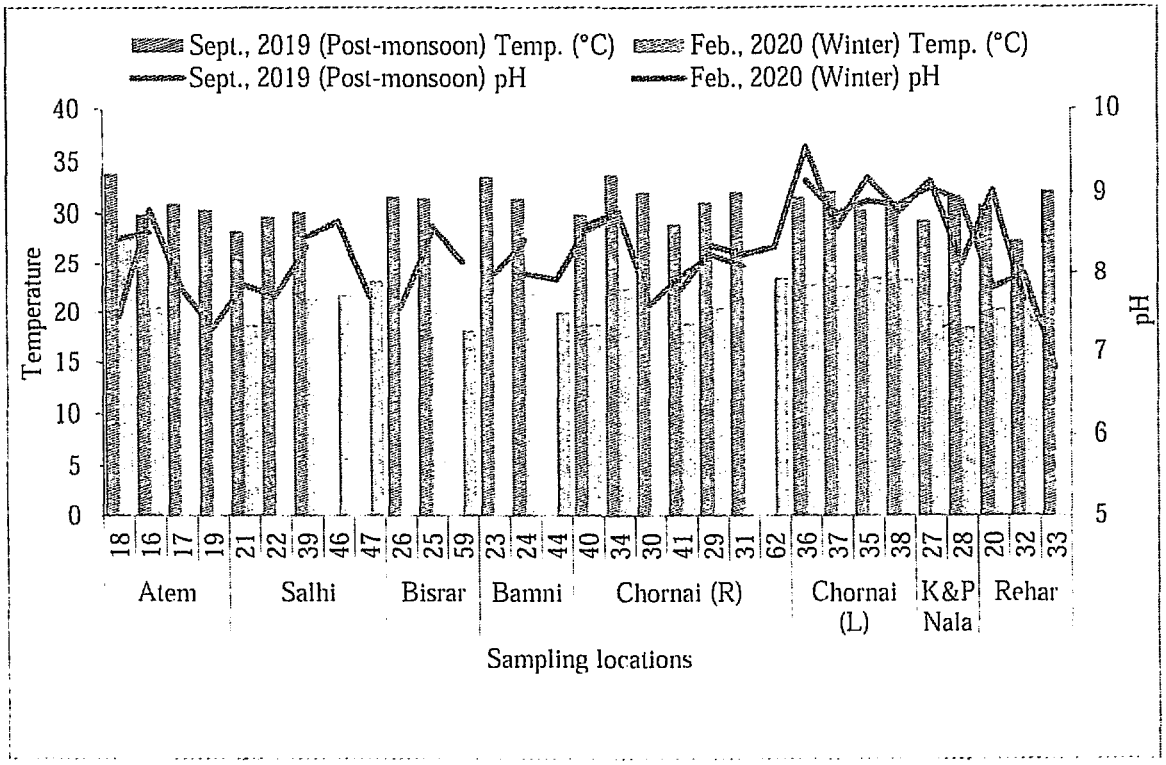


Figure 6.5a: Spatio-temporal *in-situ* temperature and pH recorded from headwater streams in the core/buffer areas of the proposed/active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

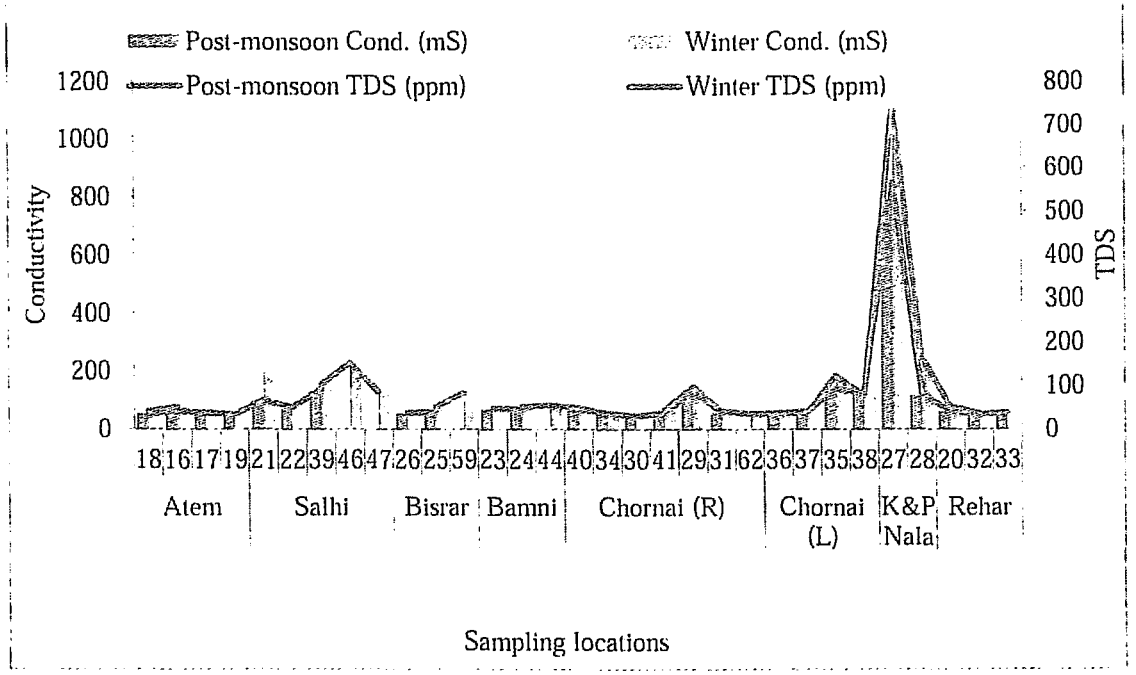


Figure 6.5b: Spatio-temporal *in-situ* electrical conductivity and TDS recorded from headwater streams in the core/buffer areas of the proposed/active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

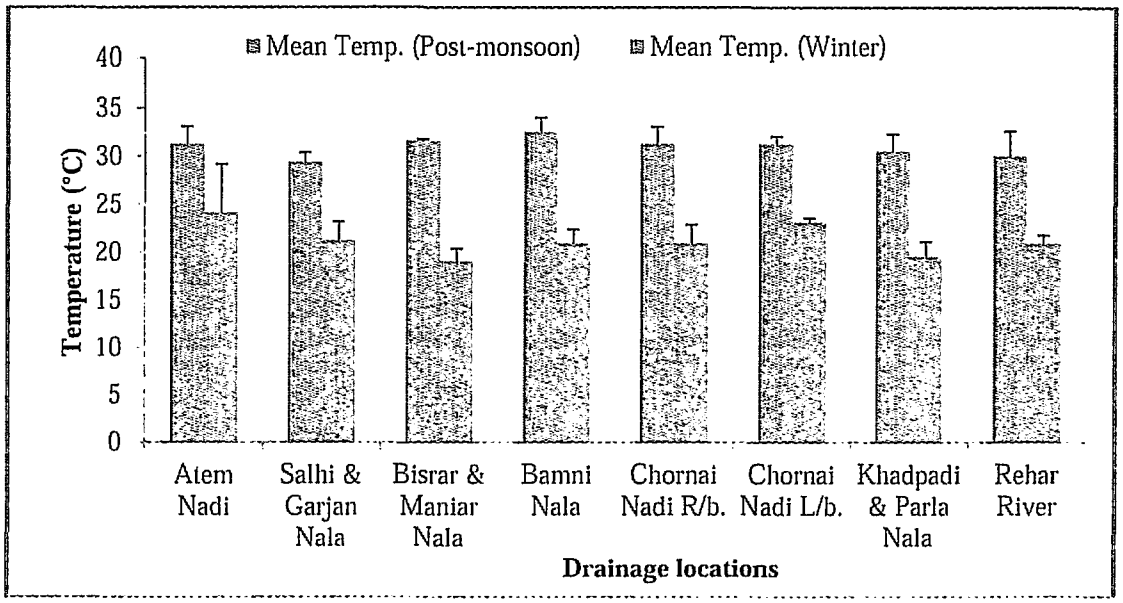


Figure 6.5c: *In-situ* température (Mean±SD) recorded from headwater streams in the core/buffer areas proposed/ active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

- Over all the ambient temperature higher than the total average was recorded from five streams (Atem, Bisrar, Bamni, Chornai Right bank and Chornai left bank streams) during post-monsoon and two streams (Atem and Chornai left bank streams) during winter out of the total of 08 streams.

Kruskal Wallis Test revealed that the ambient temperature did not vary significantly (Chi-Square = 3.32, p = 0.854, df = 7) between the eight streams indicating no evident spatial variation of the parameter (Tables 6.2 c-d). However, temporal (seasonal) variation in ambient temperature was quite evident owing to seasonal fluctuations, Mann-Whitney U Test revealed a significant ($p<0.001$) (Tables 6.2 e-f) variation. It could be due to surface water temperature of stream channels that varied with that of the ambient environment.

Table 6.2b: Summary of descriptive statistics of spatio-temporal physico-chemical parameters recorded from different headwater streams in core/buffer areas of the proposed/active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

Parameters	Location	Season	Range	Mean	Std. Dev.	N
Temperature	Atem	Post-monsoon	29.90-33.90	31.3	1.79	4
		Winter	20.60-27.70	24.15	5.02	2
	Salhi & Garjan	Post-monsoon	28.30-30.20	29.4	0.98	3
		Winter	18.70-23.20	21.28	1.88	4
	Bisrar&Maniar	Post-monsoon	31.50-31.70	31.6	0.14	2
		Winter	18.10-20.00	19.05	1.34	2
	Bamni	Post-monsoon	31.50-33.60	32.55	1.48	2
		Winter	20.00-22.00	21	1.41	2
	Chorani R/B	Post-monsoon	29.00-33.80	31.33	1.72	6
		Winter	18.80-23.50	20.98	1.91	6

Parameters	Location	Season	Range	Mean	Std. Dev.	N
	Chornai L/B	Post-monsoon	30.40-32.20	31.28	0.79	4
		Winter	22.70-23.60	23.15	0.42	4
	Khadpadi & Parla	Post-monsoon	29.30-31.80	30.55	1.77	2
		Winter	18.50-20.70	19.6	1.56	2
	Rehar	Post-monsoon	27.30-32.20	30.1	2.52	3
		Winter	20.40-21.60	21	0.85	2
	Total	**Post-monsoon**	**27.30-33.90**	**31.01**	**1.6**	**26**
		Winter	**18.10-27.70**	**21.38**	**2.17**	**24**
pH	Atem	Post-monsoon	7.30-8.80	7.84	0.67	4
		Winter	8.44-8.52	8.48	0.06	2
	Salhi & Garjan	Post-monsoon	7.71-8.35	7.97	0.34	3
		Winter	7.70-8.66	8.37	0.46	4
	Bisrar & Maniar	Post-monsoon	7.56-8.51	8.04	0.67	2
		Winter	8.15-8.61	8.38	0.33	2
	Bamni	Post-monsoon	7.99-8.42	8.21	0.3	2
		Winter	7.92-7.99	7.96	0.05	2
	Chorani R/B	Post-monsoon	7.60-8.75	8.2	0.41	6
		Winter	7.80-8.77	8.35	0.33	6
	Chornai L/B	Post-monsoon	8.75-9.15	8.91	0.17	4
		Winter	8.58-9.55	9.02	0.43	4
	Khadpadi & Parla	Post-monsoon	8.90-9.07	8.99	0.12	2
		Winter	8.13-9.15	8.64	0.72	2
	Rehar	Post-monsoon	6.80-7.99	7.53	0.64	3
		Winter	7.65-9.03	8.34	0.98	2
	Total	**Post-monsoon**	**6.80-9.15**	**8.2**	**0.61**	**26**
		Winter	**7.65-9.55**	**8.47**	**0.48**	**24**
EC	Atem	Post-monsoon	49.10-59.30	53.98	4.18	4
		Winter	59.80 73.30	66.55	9.55	2
	Salhi & Garjan	Post-monsoon	71.30-131.00	99.9	29.93	3
		Winter	120.30-212.00	167.53	42.91	4
	Bisrar & Maniar	Post-monsoon	54.00-55.90	54.95	1.34	2
		Winter	71.80-118.90	95.35	33.3	2
	Bamni	Post-monsoon	66.80-68.00	67.4	0.85	2
		Winter	73.70-78.90	76.3	3.68	2
	Chorani R/B	Post-monsoon	44.10-125.10	66.6	29.53	6
		Winter	50.10-137.00	72.33	32.69	6
	Chornai L/B	Post-monsoon	50.70-130.80	90	41.04	4
		Winter	52.10-173.20	96.88	57.66	4
	Khadpadi & Parla	Post-monsoon	115.00-795.00	455	480.83	2
		Winter	234.00-1051.00	642.5	577.71	2
	Rehar	Post-monsoon	47.40-60.20	53.7	6.4	3
		Winter	51.10-75.50	63.3	17.25	2
	Total	**Post-monsoon**	**44.10-795.00**	**99.65**	**144.61**	**26**
		Winter	**50.10-1051.00**	**140.82**	**201.48**	**24**
TDS	Atem	Post-monsoon	34.80-42.00	38.3	2.95	4
		Winter	42.50-52.00	47.25	6.72	2
	Salhi & Garjan	Post-monsoon	50.70-93.00	70.93	21.21	3
		Winter	85.20-151.00	119.05	30.64	4
	Bisrar & Maniar	Post-monsoon	38.20-39.60	38.9	0.99	2
		Winter	51.10-84.60	67.85	23.69	2
	Bamni	Post-monsoon	47.20-48.50	47.85	0.92	2

Parameters	Location	Season	Range	Mean	Std. Dev.	N
		Winter	52.20-56.20	54.2	2.83	2
	Chorani R/B	Post-monsoon	31.10-88.70	47.18	20.93	6
		Winter	35.60-97.20	51.3	23.18	6
	Chornai L/B	Post-monsoon	36.00-92.70	63.93	28.96	4
		Winter	37.00-123.00	68.83	40.96	4
	Khadpadi & Parla	Post-monsoon	82.00-564.00	323	340.83	2
		Winter	166.00-747.00	456.5	410.83	2
	Rehar	Post-monsoon	33.20-42.80	38.07	4.8	3
		Winter	36.40-53.20	44.8	11.88	2
	Total	**Post-monsoon**	**31.10-564.00**	**70.71**	**102.59**	**26**
		Winter	**35.60-747.00**	**100.02**	**143.22**	**24**

Table 6.2c: Mean ranks of the Kruskal Wallis Test (Non-parametric) on spatial physical water quality parameters of sampling locations in the core/buffer areas of the proposed/active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

Location	N	Mean Ranks			
		Temp.	pH	EC	TDS
Atem	6	30.92	19.00	16.50	16.08
Salhi & Garjan	7	19.57	21.50	40.00	40.00
Bisrar & Maniar	4	22.25	21.63	23.88	23.63
Bamni	4	27.50	17.75	28.75	28.75
Chorani R/B	12	25.38	23.17	19.08	19.21
Chornai L/B	8	29.75	42.63	24.88	25.00
Khadpadi & Parla	4	21.00	39.00	45.75	45.75
Rehar	5	25.40	15.60	14.90	15.10
	50				

Table 6.2d: Results of the Kruskal Wallis Test (Non-parametric) on spatial physical water quality parameters of sampling locations in the core/buffer areas of the proposed/active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

	Temperature	pH	EC	TDS
Chi-Square	3.324	20.229	22.166	22.205
df	7	7	7	7
Asymp. Sig.	**0.854**	**0.005**	**0.002**	**0.002**

Table 6.2e: Mean rank of the Mann-Whitney U Test (Non-parametric) on temporal physical water quality parameters of sampling locations in the core/buffer areas of the proposed/active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

Parameters	Season	N	Mean Rank	Sum of Ranks
Temperature	Post-monsoon	26	37.46	974.00
	Winter	24	12.54	301.00
	Total	50		
pH	Post-monsoon	26	22.69	590.00
	Winter	24	28.54	685.00
	Total	50		
EC	Post-monsoon	26	21.58	561.00
	Winter	24	29.75	714.00

Parameters	Season	N	Mean Rank	Sum of Ranks
	Total	50		
TDS	Post-monsoon	26	21.58	561.00
	Winter	24	29.75	714.00
	Total	50		

Table 6.2f: Results of the Mann-Whitney U Test (Non-parametric) on temporal physical water quality parameters of sampling locations in the core/buffer areas of the proposed/active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

	Temperature	pH	EC	TDS
Mann-Whitney U	1.000	239.000	210.000	210.000
Wilcoxon W	301.000	590.000	561.000	561.000
Z	-6.040	-1.418	-1.981	-1.981
Asymp. Sig. (2-tailed)	**0.000**	**0.156**	**0.048**	**0.048**

6.5.2 pH

pH is a measure of free hydrogen ions in the water and its amount in stream water usually varies between 6 and 9 indicating slightly alkaline in nature and therefore, it affects the availability of some of the important mineral ions very essential for the shelled aquatic organisms. The average ambient water pH of all the eight streams varied between 8.20 ± 0.61 (6.80 - 9.15); 8.47 ± 0.48 (7.65 - 9.55) and respectively during post-monsoon and winter (Table 6.2b and Figure. 6.5d). The average ambient water pH among different stream locations varied from 7.53 ± 0.64 (Rehar River) to 8.99 ± 0.12 (Khadpadi and Parla Nala) and from 7.96 ± 0.05 (Bamni Nala) to 9.02 ± 0.43 (Chornai Nadi - Left bank Nala) during post-monsoon and winter respectively. The ambient pH was either higher than or equal to that of the total average recorded from four streams during post-monsoon and three streams during winter out of the total of eight streams.

Kruskal Wallis Test revealed that the ambient pH varied significantly (Chi-Square = 20.23, $p<0.05$, df = 7) between the eight streams indicating significant spatial variation (Tables 6.2c-d). While observing the mean ranks of pH for different locations (Table 6.2c) it is evident that of Chornai Nadi (Left bank Nala) and Khadpadi and Parla Nala recorded high *i.e.*, 42.63 and 39.00 respectively indicating significant variation for the parameters from that of the others. The results of the Mann-Whitney U Test for seasonal variation revealed that the parameter did not vary significantly between the two sampling seasons (U = 239, p = 0.16) (Tables 6.2e-f). With few exceptions of high value at two locations, the spatio-temporal average of the ambient pH was within the limits (6.5-8.5) prescribed for the drinking water standards as per BIS.

- It was observed that the value pHtends to vary towards higher side in forested headwater streams, where the influence of organic matter decomposition is relatively high.

- A significant seasonal variation in pH especially during winter with relatively higher values was recorded.
- Relatively high alkaline pH in the forested headwater streams compared to that of lower reach of the water courses is in complete disagreement with that of the studies from tropical Asian streams (studies reported by Nguyen and Cai, 2019).

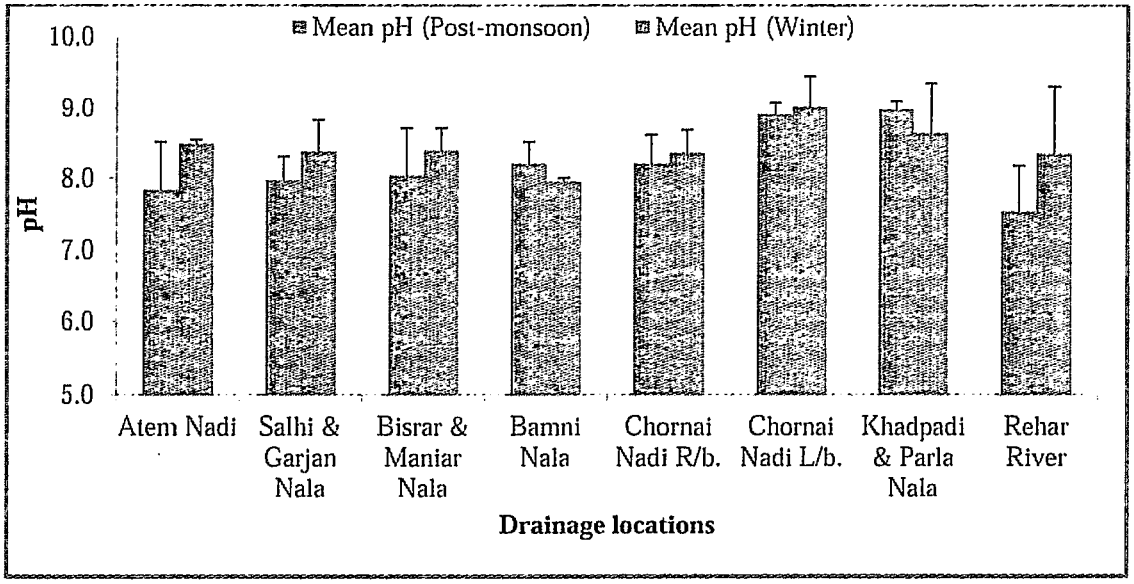


Figure 6.5d: *In-situ* pH (Mean ±SD) recorded from headwater streams in the core/buffer areas proposed/ active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

6.5.3 Conductivity

The average ambient conductivity of all the eight streams varied between 99.65 ± 144.61 µS/cm (44.10 - 795.00 µS/cm) and 140.82 ± 201.48 µS/cm (50.10 - 1051.00 µS/cm) respectively during post-monsoon and winter (Table 6.2b and Figure 6.5e). Between the streams, the averages conductivity varied from 53.70 to 455.00 µS/cm during post-monsoon and from 63.30 to 642.50 µS/cm during winter respectively at Rehar River and Khadpadi and Parla Nala.

- Overall, the ambient conductivity relatively higher than that of total average was recorded from two streams (Khadpadi and Parla Nala and Salhi and Garjan Nala) both during post-monsoon and winter.
- During winter, relatively higher conductivity was recorded from Salhi and Garjan Nala (99.90 - 167.53 µS/cm) and Chornai Nadi – Left bank streams (90.00 – 96.88 µS/cm); Bisrar and Maniar Nala (95.35 µS/cm) other than that of the Khadpadi and Parla Nala from where highest EC was recorded.

Kruskal Wallis Test revealed that the ambient conductivity varied significantly (Chi-Square = 22.17, $p<0.05$, df = 7) between the eight streams indicating spatial variation (Tables 6.2c-d). While observing the mean ranks of conductivity (Table

6.2c) it revealed that of Khadpadi and Parla Nala as well as Salhi and Garjan Nala observed the highest indicating significant variation from that of the others. Mann-Whitney U Test for seasonal variation revealed significant variation (U = 210, p = 0.048) and was substantiated with the variation in Mean Ranks for both the seasons (21.58 and 29.75 for Post-monsoon and winter) respectively (Figure 6.5e-f). With the exception of high value of the parameter at one location (Khadpadi and Parla Nala), (795.00 - 1051.00 µS/cm), the ambient conductivity was within the limits (1000 µS/cm) prescribed for the drinking water as per BIS standards.

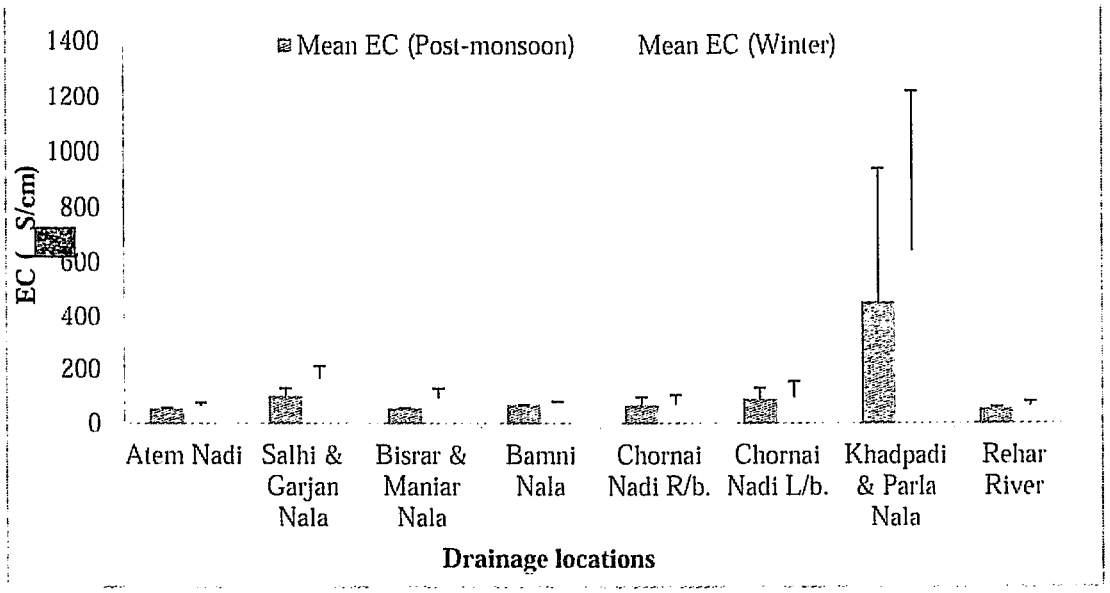


Figure 6.5e: *In-situ* Electrical Conductivity (Mean ±SD) recorded from headwater streams in the core/buffer areas proposed/ active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

6.5.4 Total Dissolved Solids (TDS)

Conductivity and Total Dissolved Solids (TDS) are the measure of the total dissolved ions and salts in water (salinity) are closely related and important parameters in aquatic ecology (Davie, 2008). A study conducted in Central Appalachian coalfield streams reported elevated levels of TDS with dominant components of sulfate (46% by weight, mean), bicarbonate (26%), and calcium (13%) as one of the important stressors to aquatic life and that increasing TDS significantly correlated ($p<0.05$) negatively with several biotic measures of benthic macroinvertebrates (Timpano *et al.*, 2010). The parameters are interdependent, they reflect similar patterns in aquatic environment (Thirumalini and Joseph, 2009). It is generally reported that high values of these parameters may cause potential deterioration in water quality leading to unfavorable environment for aquatic organisms.

Average ambient TDS of all the eight streams varied between 70.71 ± 102.59 ppm (31.10 - 564.00 ppm) and 100.02 ± 143.22 ppm (35.60 - 747.00 ppm) respectively during post-monsoon and winter (Table 6.2b and Figure 6.5f), while that of the

individual streams, varied from 38.07 to 323.00 ppm during post-monsoon and from 44.80 to 456.50 ppm during winter respectively each at Rehar River and Khadpadi and Parla Nala.

- Overall, the ambient TDS relatively higher than that of the total average was recorded from two streams Salhi and Garjan Nala and Khadpadi and Parla Nala both during post-monsoon and winter.

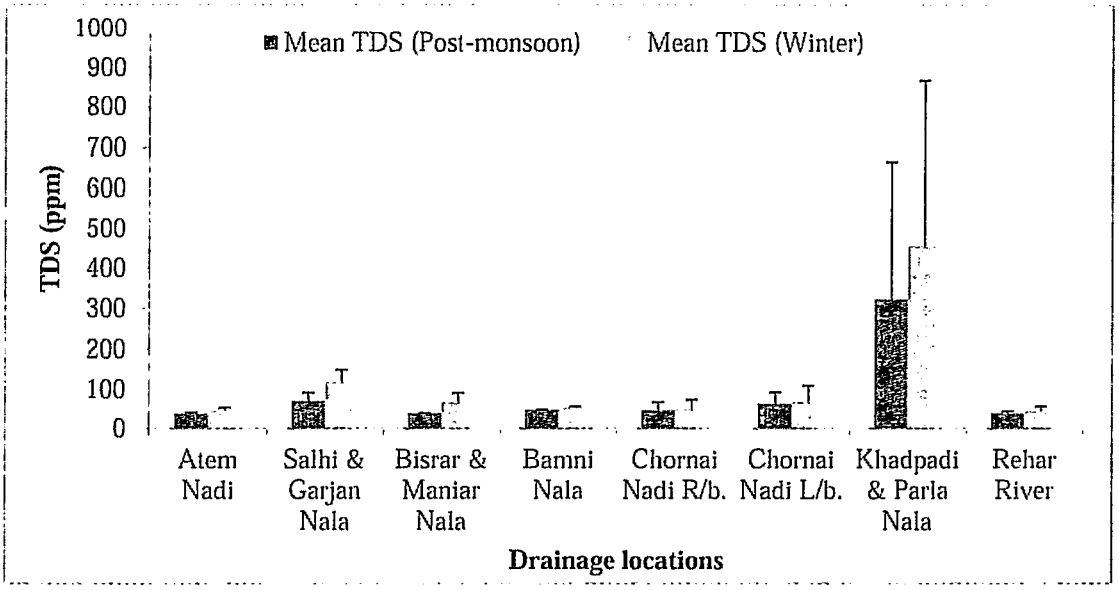


Figure 6.5f: *In-situ* Total Dissolved Solids (Mean±SD) recorded from headwater streams in the core/buffer areas proposed/ active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

Kruskal Wallis Test revealed that the ambient TDS varied significantly (Chi-Square = 22.21, $p<0.05$, df = 7) between the eight streams indicating evident spatial variation (Tables 6.2c-d). While observing the mean ranks of TDS for different locations (Table 6.2c), it was evident that Khadpadi and Parla Nala; and Salhi and Garjan Nala recorded highest indicating significant variation from that of the others. Mann-Whitney U Test for seasonal variation revealed significant variation (U=210, $p=0.048$) which was substantiated with evident variation in Mean Ranks for both the seasons (21.58 and 29.75 for Post-monsoon and winter respectively) (Tables 6.2e-f). With the exception of high value at one location (Khadpadi and Parla Nala-564.00 - 747.00 S/cm), the ambient TDS was within the limits (500 S/cm) prescribed for the drinking water as per BIS standards.

The water quality of the headwater streams is primarily influenced by geo-morphological changes such as erosion, sedimentation, reduction in rainfall *etc.*, as well as by anthropogenic characteristics such land use land cover changes and forest degradation, which include agriculture, illicit felling, *etc.*, due to human settlements and related developmental activities.

- The physico-chemical water quality parameters of the streams in the Hasdeo-Arand Coalfield revealed that temperature, pH, conductivity and TDS varied within their expected natural ranges with exception of an unusual observation of higher conductivity and TDS at one location (Khadpadi and Parla Nala), which is an undesirable quality in terms of both drinking water standards as well as aquatic toxicological view.
- Relatively higher values of pH, conductivity and TDS were recorded during winter compared to that of the post-monsoon and therefore, the variation between seasons was significant. The stream from where the exceptional high values of both conductivity and TDS reported is perennial in nature with undulating rocky peaks of medium elevation, while banks at valley are characterized by patchy outcrops of exposed coal. Significant area at its catchment and the stream bed in plains is occupied by seasonal paddy cultivation.
- The stream locations *viz.*, Salhi and Garjan Nala, Bisrar Nala and both right and left bank streams of Chornai Nadi had registered relatively higher values of conductivity and TDS during both the sampling seasons. The changes might be due to the influence of activities related to human habitation/developmental works.
- It was reported by a similar kind of study in coalfield streams that elevated TDS rarely occurs independent of other stressors and that acidic pH, toxic metals, sedimentation, in-stream and riparian habitat degradation, trophic structure alteration, and hydrologic modification are potential TDS covariates in coalfield streams (Timpano *et al.*, 2010). High concentrations of dissolved solids together with some individual dissolved constituents, such as chloride, sulfate, nitrate, and nitrite, which have their own water-quality concerns and specific standards for maximum concentrations in surface water, carry concerns for human as well as ecosystem health as it can collectively render water unfit for drinking and for supporting aquatic life.

The sampling location forms part of the upper sub-basin of the Hasdeo River which is the relatively less impacted forest tract available in the entire River basin. No relevant data with regard to the water quality parameters of the forested streams of this sub-basin are available; however few such studies on water quality changes due to industrial pollution like that of Vaishnav *et al.* (2014); Upadhyay and Bareth (2014) both from Champa-Jangir; Bhaskar and Dixit (2015); Thakur and Yadav (2019) both from near Manikpur Coal Mine area; Vaishnav and Sahu (2006); Bhaskar *et al.* (2020) both from Hasdeo River at Korba are available from the more polluted stretch of the river (Page No.6, Report on *Water Resource Management for Improved Climate Resilience in Chhattisgarh part of Mahanadi River Basin*), which are lower in the Hasdeo River relative to the present location.

6.6 MACROINVERTEBRATE DIVERSITY

The spatio-temporal abundance and richness of macroinvertebrate taxa recorded from the eight important headwater streams during three seasons are provided in Tables 6.3a-b and Figures 6.6a-b.The total abundance of macroinvertebrates recorded were 2340 (24%), 1167 (12%) and 6417 (65%) respectively during summer, post-monsoon and winter, while the corresponding richness were 46 each during summer and post-monsoon and 57 during winter out of the total abundance of 9924 individuals and the total richness of 72 taxa respectively.

A total number of 9924 individuals of macroinvertebrates belonging to 4 phyla (Platyhelminthes, Annelida, Arthropoda and Mollusca), 6 classes (Rhabditophora, Clitellata, Insecta, Malacostraca, Gastropoda and Bivalvia), 19 orders and 61 families were identified. The taxonomic classification of the macroinvertebrate assemblages from the sampling location is provided as Annexure 6.3. Diptera was the dominant taxa with a relative abundance of 30.40% (mostly contributed by an unusual abundance of the taxa Diptera: Simuliidae at BisrarandManiarNala) followed by Trichoptera with 27.52%, Ephemeroptera with 16.22%, Molluscs with 9.20%, Odonata with 8.82%, Coleoptera with 2.52% and Tricladida, Annelida and Hemiptera with a relative abundance between 1.0 - 2.0% and Plecoptera, Lepidoptera, Megaloptera and Decapoda with a relative abundance less than 1.0% (Figure 6.6a).

The insect orders comprising of Diptera and Odonata both with 8 families each, Coleoptera and Hemiptera both with 7 families each, Ephemeroptera and Trichoptera both with 6 families each and Plecoptera, Lepidoptera and Megaloptera with one family each were dominant in invertebrate assemblage followed by Molluscs with 7 families, Annelids with 5 families, Decapods with 3 families and Platyhelminthes with 1 family out of the total richness of 61. In general, insect taxa with a relative abundance of 86.82% and a total richness of 45 families constitute the most dominant taxonomic group in macroinvertebrate assemblages of the entire sampling location.

Table 6.3a: Abundance and Richness (Biotic Metrics) of macrobenthic invertebrate collected from headwater streams in the core/buffer areas of the proposed/active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

S.N.	Order/Taxa	Family/Taxa	Species/ Taxa	Seasonal Abundance			Total Abundance
				Summer	Post-monsoon	Winter	
1	Tricladida	Dugesiidae				154	154
2	Arhynchobdellida	Erpobdellidae		20	3	19	42
3	Rhynchobdellida	Glossiphoniidae			3	21	24
5	Oligochaeta	Naididae				18	18
6	Oligochaeta	Tubificidae				2	2
7	Oligochaeta	Oligochaeta		47	3		50
8	Diptera	Athericidae		2	27	57	86
9	Diptera	Ceratopogonidae				6	6
10	Diptera	Chironomidae		62	90	295	447
11	Diptera	Culicidae		4	9	2	15

S.N.	Order/Taxa	Family/Taxa	Species/ Taxa	Seasonal Abundance			Total Abundance
				Summer	Post-monsoon	Winter	
12	Diptera	Simuliidae		1	33	2299	2333
13	Diptera	Stratiomyidae	Larva	4			4
14	Diptera	Tabanidae		22	4	52	78
15	Diptera	Tipulidae	*Hexatoma* sp.	4	13	5	22
16	Diptera	Tipulidae			4	22	26
17	Coleoptera	Dytiscidae	Cybister	26			26
18	Coleoptera	Dytiscidae	Larva	3			3
19	Coleoptera	Dytiscidae	Adult	20		4	24
20	Coleoptera	Dytiscidae	*Hydaticus* sp.	2			2
21	Coleoptera	Elmidae	Larva	9	2	27	38
22	Coleoptera	Gyrinidae	Adult	4		2	6
23	Coleoptera	Gyrinidae	Larva	2	2		4
24	Coleoptera	Hydraenidae	Larva	12			12
25	Coleoptera	Hydrophilidae	Adult	53	10	20	83
26	Coleoptera	Hydrophilidae	Larva	7		10	17
27	Coleoptera	Lampyridae	Larva			1	1
29	Ephemeroptera	Baetidae		227	186	373	786
30	Ephemeroptera	Caenidae		186	7	103	296
31	Ephemeroptera	Ephemerellidae		6	93	70	169
32	Ephemeroptera	Ephemeridae				14	14
33	Ephemeroptera	Heptageniidae			5	10	15
34	Ephemeroptera	Leptophlebidae		15	77	238	330
35	Plecoptera	Perlidae			4	1	5
36	Trichoptera	Hydropsychidae		291	328	1229	1848
37	Trichoptera	Leptoceridae		26	2	631	659
38	Trichoptera	Limnephilidae				2	2
39	Trichoptera	Odontoceridae		53			53
40	Trichoptera	Philopotamidae		50	8	100	158
41	Trichoptera	Rhyacophilidae			9	2	11
42	Lepidoptera	Pyralidae			15	3	18
43	Megaloptera	Corydalidae			4	2	6
44	Hemiptera	Belostomatidae	*Lithocerus indicus*	2		1	3
45	Hemiptera	Belostomatidae				1	1
46	Hemiptera	Corixidae		7	1		8
47	Hemiptera	Gerridae			2	12	14
48	Hemiptera	Naucoridae		3	3	1	7
49	Hemiptera	Nepidae	*Laccotrephes* sp.	33	1	23	57
50	Hemiptera	Nepidae	*Ranatra* sp.	4			4
51	Hemiptera	Notonectidae	*Enithares* sp.	7	1		8
52	Hemiptera	Notonectidae				1	1
53	Hemiptera	Pleidae				1	1
54	Odonata	Aeshnidae			1	1	2
55	Odonata	Calopterygidae			5		5
56	Odonata	Coenagrionidae		135	8	73	216
57	Odonata	Cordulidae		7			7
58	Odonata	Gomphidae		55	37	91	183
59	Odonata	Lestidae		34	11	17	62
60	Odonata	Libellulidae		198	53	141	392
61	Odonata	Macromiidae		3	2	3	8
62	Decapoda	Atyidae			1		1
63	Decapoda	Gecarcinucidae		7	17	1	25
64	Decapoda	Palaemonidae	*Macrobrachium* sp.	1	32	18	51

S.N.	Order/Taxa	Family/Taxa	Species/ Taxa	Seasonal Abundance			Total Abundance
				Summer	Post-monsoon	Winter	
65	Basommatophora	Ancylidae	*Ferrissia* sp.			42	42
66	Basommatophora	Lymnaeidae		285	1	34	320
67	Basommatophora	Planorbidae		291	6	41	338
68	Mesogastropoda	Thiariade	*Melanoides tuberculata*	60	36	6	102
69	Mesogastropoda	Thiariade	*Thiara scabra*		1		1
70	Mesogastropoda	Viviparidae	*Bellamya* sp.	10	3	1	14
71	Unionoida	Unionidae				5	5
72	Venerioda	Pisidiidae		40	4	47	91
Abundance				**2340**	**1167**	**6417**	**9924**
Richness				**46**	**46**	**57**	**72**

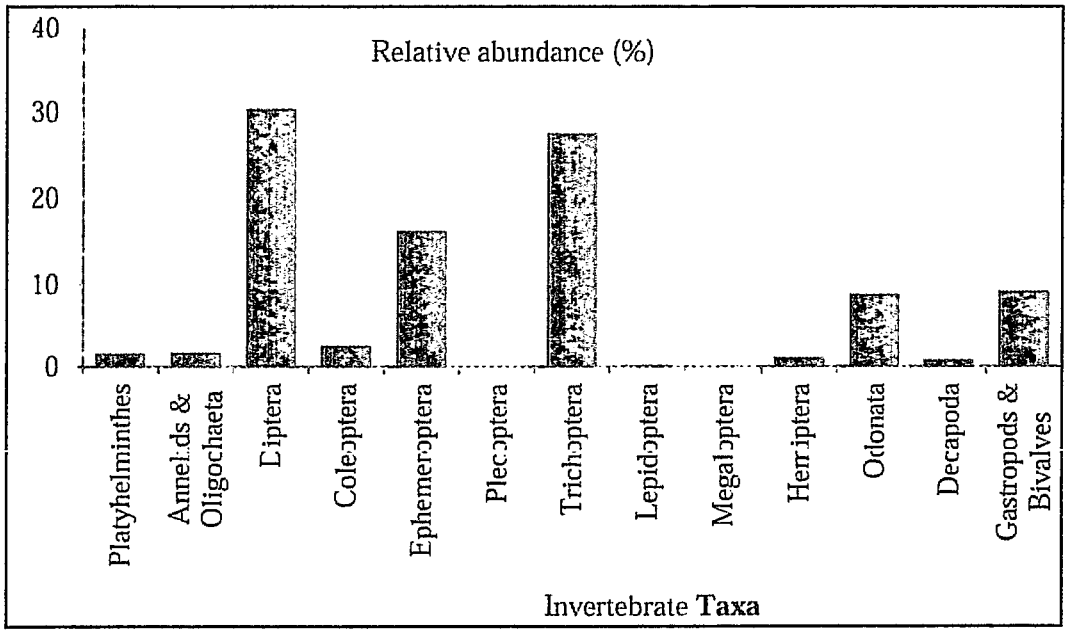


Figure 6.6a: Total relative abundance of macroinvertebrates of the streams in core/buffer areas of the proposed/active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

6.6.1 Ephemeroptera, Plecoptera and Trichoptera/Odonata (EPT/O)

The pollution sensitive EPT (Ephemeroptera, Plecoptera and Trichoptera) taxa were represented with 13 families with a total relative abundance of 43.79%; of which maximum abundance was contributed by Trichoptera followed by Ephemeroptera and the least by Plecoptera (Figures 6.6a-b). The relative abundance of Plecoptera among the EPT taxa was hardly to a maximum of 0.1% recorded from both Chornai Nadi-Right and left bank streams. However, Shah *et al.* (2011) from Nepal (lake aquatic ecosystem) have considered EPO instead of EPT by replacing the Trichoptera with Odonata.

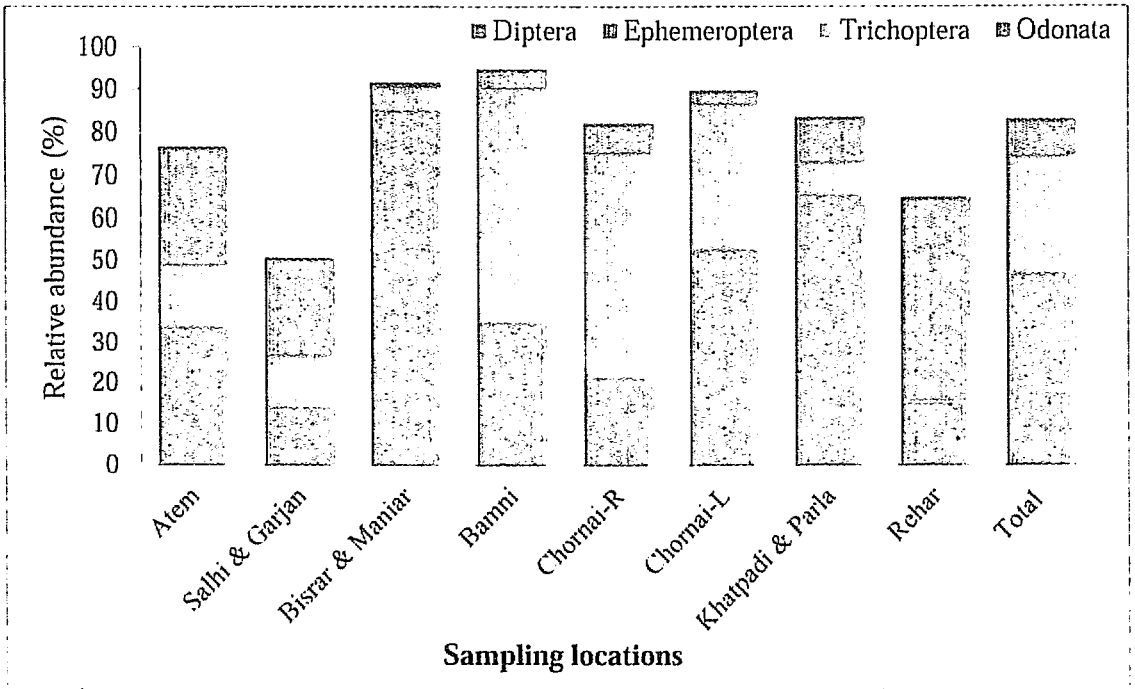


Figure 6.6b: Total relative abundance of Ephemeroptera, Trichoptera, Diptera and Odonata of the streams in core/buffer areas of the proposed/active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

Table 6.3b: Relative abundance of macrobenthic invertebrates collected from headwater streams in the core/buffer areas of the proposed/active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

Taxa	Relative abundance of taxa (%) at sampling locations								Total (%)
	1	2	3	4	5	6	7	8	
Platyhelminthes	--	--	--	--	3.48	3.16	--	--	**1.55**
Annelids & Oligochaeta	2.25	3.60	1.22	3.81	1.11	1.94	0.84	0.56	**1.65**
Diptera	13.48	2.20	79.60	27.14	10.40	17.93	35.71	11.11	**30.40**
Coleoptera	9.47	5.92	0.44	0.48	1.65	3.50	1.68	1.67	**2.52**
Ephemeroptera	20.39	11.83	5.58	7.86	10.90	34.70	29.74	3.89	**16.22**
Plecoptera	--	--	--	--	0.04	0.22	--	--	**0.05**
Trichoptera	14.93	12.65	5.32	55.00	53.75	33.65	7.33	0.56	**27.52**
Lepidoptera	0.32	0.46	--	--	0.25	0.11	--	1.67	**0.18**
Megaloptera	--	--	--	--	--	0.33	--	--	**0.06**
Hemiptera	5.62	3.25	0.22	0.24	0.47	0.67	0.42	3.33	**1.05**
Odonata	27.93	24.13	1.13	4.76	6.99	3.39	10.68	49.44	**8.82**
Decapoda	0.48	2.78	0.04	--	0.61	0.17	0.52	13.33	**0.78**
Gastropods & Bivalves	5.14	33.18	6.45	0.71	10.36	0.22	13.09	14.44	**9.20**
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

(1). Atem Nadi, (2). Salhi & Garjan Nala, (3). Bisrar & Maniar Nala, (4). Bamni Nala, (5). Chornai Nadi-R/b streams, (6). Chornai Nadi-L/b streams, (7). Khadpadi & Parla Nala, (8). Rehar River

The macroinvertebrates taxa in Atem Nadi were represented predominantly by Odonata (27.93%), Ephemeroptera (20.39%) and Trichoptera (14.93%) followed by Diptera (13.48%), Coleoptera (9.47%), Gastropods and Bivalves (5.14), *etc.*, while

that of Salhi and Garjan Nala were represented predominantly by Odonata (24.13%), Trichoptera (12.65%) and Ephemeroptera (11.83%) followed by Gastropods and Bivalves (33.18%), Coleoptera (5.92%), Annelids and Oligochaets (3.60%), *etc.* In Bisrar and Maniar Nala, the dominant taxa were Ephemeroptera (5.58%), Trichoptera (5.32%) and Odonata (1.13%) followed by Diptera (70.60%), Gastropods and Bivalves (6.45%), Annelids and Oligochaetes (1.22%), *etc.* The sampling location at BamniNala was dominated mostly by Trichoptera (55.00%), Ephemeroptera (7.86%) and Odonata (4.76%) followed by Diptera (27.14%), Annelids and Oligochaetes (3.81%), *etc.* The most abundant taxa at Chornai Nadi-Right bank streams were Trichoptera (53.75%), Ephemeroptera (10.90%), Odonata (6.99%) and Plecoptera (0.04%) followed by Diptera (10.40%), Gastropods and Bivalves (10.36%), Platyhelminthes (3.48%), *etc.*, and that of Chornai Nadi-Left bank streams were mostly by Ephemeroptera (34.70%), Trichoptera (33.65%), Odonata (3.39%) and Plecoptera (0.22%) followed by Diptera (17.93%), Coleoptera (3.50%), Platyhelminthes (3.16%), *etc.* The Khadpadi and Parla Nala was dominated by Ephemeroptera (29.74%), Odonata (10.68%) and Trichoptera (7.33%) followed by Diptera (35.71%), Gastropods and Bivalves (13.09%), Coleoptera (1.68%), *etc.* In Rehar River, the dominant taxa were Odonata (49.44%), Ephemeroptera (3.89%) and Trichoptera (0.56%) followed by Gastropods and Bivalves (14.44%), Decapods (13.33%), Diptera (11.11%), *etc.* Among all the taxa, Plecoptera and Platyhelminthes were present only in both the sampling locations of Chornai Nadi and Megaloptera was only from Chornai Nadi-Left bank streams.

- The EPT/O taxa accounted for nearly more than half (52.61%) of the abundance of all taxa based on their total relative abundance accordingly the sampling locations are arranged in decreasing order as follows: **71.96%** (Chornai Nadi-Left bank streams) >71.67% (Chornai Nadi-Right bank streams) >67.62% (Bamni Nala) >63.24% (Atem Nadi) >53.89% (Rehar River) >48.61% (Salhi and Garjan Nala) >47.75% (Khadpadi and Parla Nala) >12.03% (Bisrar and Maniar Nala).

- In general, both right and left bank headwater streams of the Chornai Nadi had relatively high abundance of EPT/O taxa compared to that of the other streams.

6.6.2 Abundance of Macroinvertebrates

The total number of all macroinvertebrates represents the abundance and richness equals the total number of taxa represented however, richness does not represent how common or rare the taxa are. A healthier community will have greater number of taxa within it. Species Richness increases with increasing habitat diversity, suitability, and water quality (Plafkin *et al.* 1989). Both the biotic metrics are very important as a measure of diversity, which is a community attribute related to stability, productivity, trophic structure and migration.

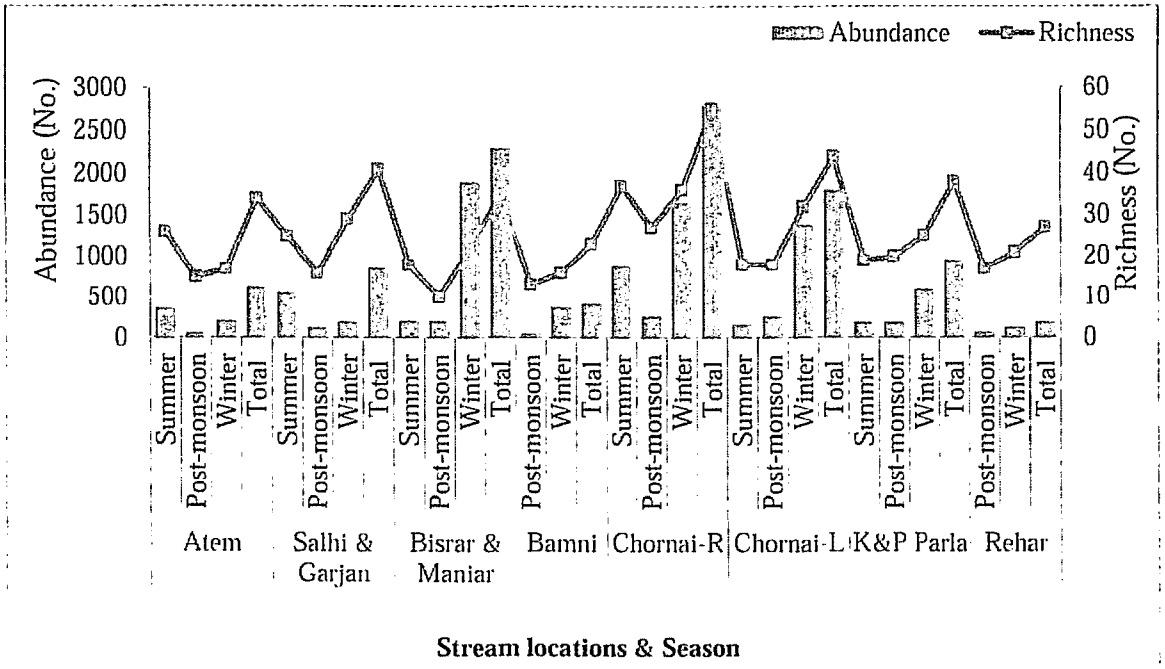


Figure 6.7a: Summary of spatio-temporal Biotic Metrics of macroinvertebrates collected from the headwater streams in the core/buffer areas of the proposed/active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

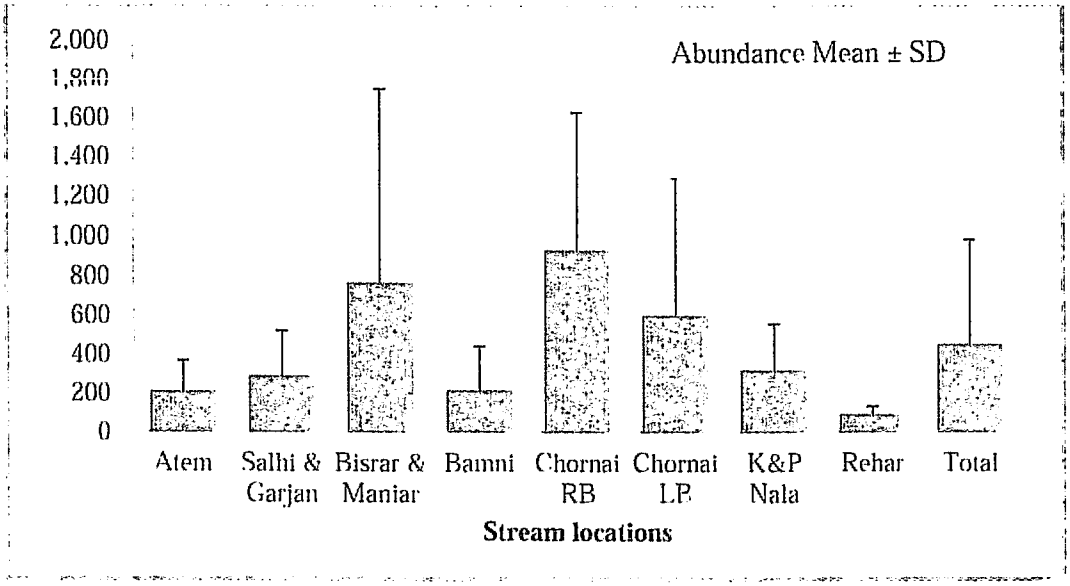


Figure 6.7b: Mean abundance of macroinvertebrates collected from the headwater streams in the core/buffer areas of the proposed/active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

The abundance of macroinvertebrates recorded at Atem Nadi varied from 52 during post-monsoon to 370 during summer with a total and mean of 623 and 208 ±159 respectively (Table 6.4 and Figures 6.7a-b); that Salhi and Garjan Nala varied from 118 to 553 respectively during post-monsoon and summer with the total and mean of 862 and 287 ± 233 respectively.

Table 6.4: Summary of spatio-temporal Biotic Metrics and Biotic Indices of macrobenthic invertebrates collected from streams in the core/buffer areas of the proposed/active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

Sl. No.	Drainage Locations	Season	Abundance	Richness	Taxa Tolerance Score	ASPT
1	Atem Nadi	Summer	370	26	95	3.65
		Post-monsoon	52	15	56	3.73
		Winter	201	17	67	3.94
		Total	623	34	133	3.91
		Mean ± SD	208 ±159	19 ± 6	73 ± 20	3.77 ± 0.15
2	Salhi & Garjan Nala	Summer	553	25	88	3.52
		Post-monsoon	118	16	66	4.13
		Winter	191	29	108	3.72
		Total	862	41	157	3.83
		Mean ± SD	287 ± 233	23 ± 7	87 ± 21	3.79 ± 0.31
3	Bisrar & Maniar Nala	Summer	196	18	56	3.11
		Post-monsoon	196	10	61	6.10
		Winter	1902	22	105	2.90
		Total	2294	35	149	8.51
		Mean ± SD	765 ± 985	17 ± 6	74 ± 27	4.04 ± 1.79
4	BamniNala	Post-monsoon	47	13	55	4.23
		Winter	373	16	73	4.56
		Total	420	23	104	4.52
		Mean ± SD	210 ± 231	15 ± 2	64 ± 13	4.40 ± 0.23
5	ChornaiNadi (Right Bank Nala)	Summer	888	37	147	3.97
		Post-monsoon	255	27	134	4.96
		Winter	1646	36	170	4.72
		Total	2789	55	243	4.42
		Mean ± SD	930 ± 696	33 ± 6	150 ± 18	4.55 ± 0.52
6	Chornai Nadi (Left Bank Nala)	Summer	153	18	69	3.83
		Post-monsoon	257	18	101	5.61
		Winter	1391	32	166	5.19
		Total	1801	44	204	4.64
		Mean ± SD	600 ± 687	23 ± 8	112 ± 49	4.88 ± 0.93
7	Khadpadi & ParlaNala	Summer	180	19	64	3.37
		Post-monsoon	180	20	95	4.75
		Winter	595	25	106	4.24
		Total	955	38	155	4.08
		Mean ± SD	318 ± 240	21 ± 3	88 ± 22	4.12 ± 0.70
8	Rehar River	Post-monsoon	62	17	66	3.88
		Winter	118	21	85	4.05
		Total	180	27	112	4.15
		Mean ± SD	90 ± 40	19 ± 3	76 ± 13	3.97 ± 0.12

IN THE HON'BLE NATIONAL GREEN TRIBUNAL

PRINCIPAL BENCH

AT NEW DELHI

ORIGINAL APPLICATION NO. 59 OF 2024

IN THE MATTER OF: -

HASDEO ARRAND BACHAO SANGHRSH SAMITI ... INTERVENOR

Versus

In the Suo motu matter of-

NEWS ITEM TITLED "DEFORESTATION FOR MINING RESUMES IN HASDEO LOCALS ACTIVISTS ALLEGE DETETION''APPEARING IN THE HINDU DATED 22.12.2023

Next Date 03.07.2024

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SI. NO	PATICULARS	PAGE NO
1.	**ANNEXURE A– 2** Copy Of the Bio- Diversity Assessments Study Executive Report prepared by ICFRE in Consultation With Wildlife Institute of India along with main Report.	401 -600

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Date : 12.06.2024

Place:Delhi

Both *Atem Nadi* as well as *Salhi and Garjan Nala* watercourses assume greater importance in terms of impacts arising out of mining as they fall in the core/buffer areas of the already opened up coal block (CB No. 14 - PEKB). Bisar and Maniar Nala recorded the total and mean abundance of respectively 2294 and 765 ± 985 with a variance of 196 during both summer and post-monsoon and 1902 during winter. The exceptionally high abundance recorded during winter at this location was due to relatively high number of one particular taxon (Simuliidae of Order Diptera). In Bamni Nala, the abundance recorded was varied from 47 to 373 respectively during post-monsoon and winter with a total of 420 and mean of 210 ± 231. In case of Chornai Nadi, the abundance from Right bank streams varied from 255 during post-monsoon to 1646 during winter with a total and mean of respectively 2789 and 930 ± 696, which is the highest mean abundance of all the sampling locations and that of left bank streams varied from 153 during summer and 1391 during winter with a total and mean of respectively 1801 and 600 ± 687.

It was observed that both the right and left bank streams of Chornai Nadi together accounted for the highest mean abundance of macroinvertebrates of all the sampling locations. Khadpadi and Parla Nala recorded a total abundance of 955 which varied from 180 during both summer and post-monsoon and 595 during winter with a mean of 318 ± 240. The abundance at Rehar River varied from 62 during post-monsoon to 118 during winter with a total and mean of respectively 180 and 90 ± 40, which is the smallest mean abundance among all the locations of the area.

In general, compared to the abundance recorded at Chornai-Right and Left bank streams, that of all the other stream locations sampled were low. Both Atem Nadi and Salhi and Garjan Nala had more or less same kinds of abundance, which was not as bad as that of any other locations in the area (except the two locations *i.e.*, both the Chornai Nadi locations).

6.6.3 Richness of Macroinvertebrates

The richness of macroinvertebrate taxa recorded such as Atem Nadi varied from 15 to 26 during post-monsoon and summer respectively with a total and mean of respectively 34 and 19 ± 6; Salhi and Garjan Nala varied from 16 to 29 during post-monsoon and winter with a total and mean of 41 and 23 ± 7 respectively (Table 6.4 and Figures 6.7a and 6.7c). Both the Atem and Salhi water courses recorded relatively similar richness of taxa. Bisrar and Maniar Nala accounted for a total taxa richness of 35 and the same varied from 10 to 22 respectively during post-monsoon and winter with a mean of 17 ± 6. Bamni Nala recorded a total taxa richness of 23, which varied from 13 to 16 respectively during post-monsoon and winter with a mean of 15 ± 2. The total and mean richness recorded at Chornai Nadi Right bank stream were 55 and 33 ± 6 respectively with the variance from 27 to 37 respectively during post-monsoon and summer, while that of at Chornai Nadi Left bank streams were 44 and 23 ± 8 respectively with a variance from 18 each during summer and post-monsoon to 32

during winter. Khadpadi and Parla Nala recorded a total and mean richness of 38 and 21 ± 3 respectively with the variance from 19 to 25 respectively during summer and winter.

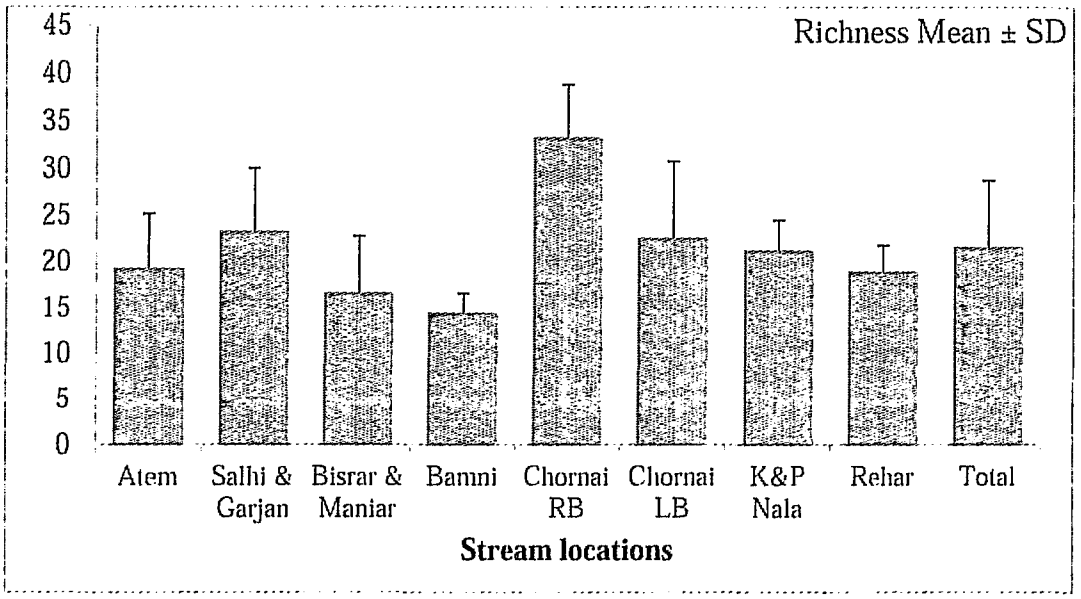


Figure 6.7c: Mean richness of macroinvertebrates collected from the headwater streams in the core/buffer areas of the proposed/active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

At Rehar River, the richness of taxa recorded varied from 17 to 21 respectively during post-monsoon and winter with a total and mean of 27 and 19 ± 3 respectively. In general, Chornai Nadi-Right bank streams recorded the highest mean richness of taxa followed by the respective left bank streams and the Salhi and Garjan Nala, while the lowest richness of taxa was recorded at Bamni Nala. To sum up, the Chornai Nadi-Right bank streams, (reference location), had the highest mean richness of taxa and the remaining sampling locations including that of Atem and Salhi and Garjan Nala was more or less at par with each other.

The results of Kruskal Wallis (Non-parametric) statistical test revealed that both abundance (Chi-Square = 7.19, p = 0.41, df = 7) and richness (Chi-Square = 10.73, p = 0.15, df = 7) did not vary significantly, however temporal variation in abundance was significant (Chi-Square = 6.86, $p < 0.05$, df = 2) and the corresponding variance in richness was barely significant (Chi-Square = 6.07, p = 0.05, df = 2) (Table 6.5a-d). Both the abundance and richness observed to vary in post-monsoon season from that of the other seasons. The rank statistic of spatial abundance and richness revealed evident differences between many sampling locations indicating that both the parameters had varied representation from the sampling locations worth noting.

Table 6.5a: Mean rank of the Kruskal Wallis Test (Non-parametric) on spatial Biotic Metrics and Biotic Indices of macroinvertebrates in the core/buffer areas of the proposed/active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

Nala	N	Ranks			
		Abundance	Richness	Taxa Tolerance Score	ASPT
Atem	3	9.67	8.83	8.00	7.33
Salhi	3	10.17	13.00	12.17	7.67
Bisrar	3	14.33	8.00	7.50	8.33
Bamni	2	8.50	3.25	5.50	15.00
Chornai RB	3	17.67	20.33	20.33	15.67
Chornai LB	3	13.33	12.67	15.00	16.33
Parla	3	11.00	12.83	11.83	12.00
Rehar	2	3.75	9.75	8.75	10.50
Total	22				

Table 6.5b: Results of the Kruskal Wallis Test (Non-parametric) on spatial Biotic Metrics and Biotic Indices of macroinvertebrates in the core/buffer areas of the proposed/active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

	Abundance	Richness	Taxa Tolerance Score	ASPT
Chi-Square	7.187	10.728	10.556	6.538
df	7	7	7	7
Asymp. Sig.	0.410	0.151	0.159	0.479

Table 6.5c: Mean rank of the Kruskal Wallis Test (Non-parametric) on temporal Biotic Metrics and Biotic Indices of macroinvertebrates in the core/buffer areas of the proposed/active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

Season	N	Ranks			
		Abundance	Richness	Taxa Tolerance Score	ASPT
Summer	6	12.50	13.92	10.33	5.50
Post-monsoon	8	6.94	7.00	8.50	15.38
Winter	8	15.31	14.19	15.38	12.13
Total	22				

Table 6.5d: Results of the Kruskal Wallis Test (Non-parametric) on temporal Biotic Metrics and Biotic Indices of macroinvertebrates in the core/buffer areas of the proposed/active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

	Abundance	Richness	Taxa Tolerance Score	ASPT
Chi-Square	6.861	6.067	4.758	8.045
df	2	2	2	2
Asymp. Sig.	0.032	0.048	0.093	0.018

6.6.4 Cluster Analysis

The degree of similarities between the macroinvertebrate abundance and the classification of eight stream sampling locations were defined on the basis of Bray-Curtis method and a hierarchical cluster analysis. The ensuing dendrogram showing clusters of similarity in locations are provided in Figure 6.8.

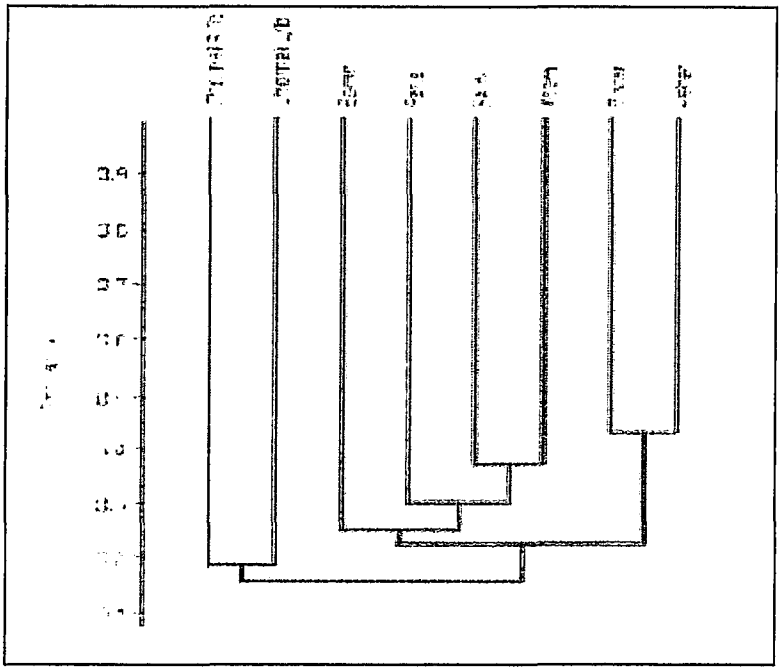


Figure 6.8: Dendrogram of the cluster analysis (UPGMA: Bray Curtis) on the abundance of macroinvertebrates of sampling locations in the streams in core/ buffer areas of the proposed/active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

The geometry of dendrogram indicated that in terms of abundance of macroinvertebrates, both the Chornai Nadi-Right and Left bank streams are most similar to each other compared to that of all the other locations, which is further divisible into two groups consisting of 4 locations *viz.*, Bamni Nala, Khadpadi and Parla Nala, Salhi and Garjan Nala and Atem Nadi similar to each other and the other one consisting of 2 locations *viz.*, Bisrar and Maniar Nala and Rehar River similar to each other. Among the four locations, both Atem Nadi and Salhi and Garjan Nala are more similar to each other compared to the other two, which in turn form two distinct locations in comparison with the other two because of not being similar in abundance of macroinvertebrates.

6.7 BIOTIC INDICES OF MACROINVERTEBRATES

In order to make easier to understand the complex biological data with regard to the indicator organisms monitored in the aquatic ecosystem, various 'biotic indices' have been developed based on the assumptions that biological communities are a product of their environment and that different kinds of organisms have different habitat

preferences and pollution tolerances, which make them to respond differently to different kinds of environmental stressors. Hence, more intolerant organisms are likely to either reduce in numbers or disappear as pollution increases in a water course, while more tolerant ones increase in number.

6.7.1 Taxa Tolerance Score

Macroinvertebrate based tolerance score systems have been used to represent water quality indices world over. Most biomonitoring methods of water quality in streams and rivers involve Tolerance values (TVs) for benthic macroinvertebrates based on their pollution sensitivity (Chang *et al.*, 2013). It provides single values ranges from 0-10 for the family level representative of the organism's tolerance to pollution. The TVs would be high for the pollution intolerant organisms and lower for the tolerant ones. The Tolerance Values assigned to each taxa was summed up to obtain the Taxa Tolerance Score (TTS) of a sampling location. The scale of criteria for water quality characteristics based on the Taxa Tolerance Score is given as under:

Taxa Tolerance Score	Category	Interpretation
0 - 10	Very Poor	Heavily Polluted
11 - 40	Poor	Polluted or Impacted
41 - 70	Moderate	Moderately Impacted
71 - 100	Good	Clean, but Slightly Impacted
> 100	Very Good	Unpolluted, Un-impacted

For assessing water quality, the Average Score Per Taxon (ASPT), which is obtained by dividing the TTS by the total number of taxa (families) in the sample is taking into consideration together with the TTS. This is to reduce the effects of sample size, sampling effort and sampling efficiency on the results obtained by TTS alone as the taxa richness (number of taxa present) is indicative of the diversity of the community. In general, a TTS greater than 100, together with an ASPT value greater than 4 would indicate a good quality water source.

The Taxa Tolerance Score of Atem Nadi varied from 56 during post-monsoon to 95 during summer with the total and average of 133 and 73 ± 20 respectively and that of Salhi and Garjan Nala varied from 66 during post-monsoon to 108 during winter with the total and average of 157 and 87 ± 21 respectively (Table 6.4 and Figures. 6.9 a-b). Both the locations, Atem Nadi and Salhi and Garjan Nala fall under 71-100 TTS having the water quality category 'Good' (Clean, but slightly impacted). The TTS at Bisrar and Maniar Nala varied from 56 during summer to 105 during winter with a total and mean of 149 and 74 ± 27 respectively. Bamni Nala recorded a mean TTS of 64 ± 13 with variance from 55 during post-monsoon and 73 during winter together accounted for a total of 104. In case of Chornai Nadi-Right bank streams, the TTS varied from 134 during post-monsoon to 170 during winter with a total and mean of 243 and 150 ± 18 respectively.

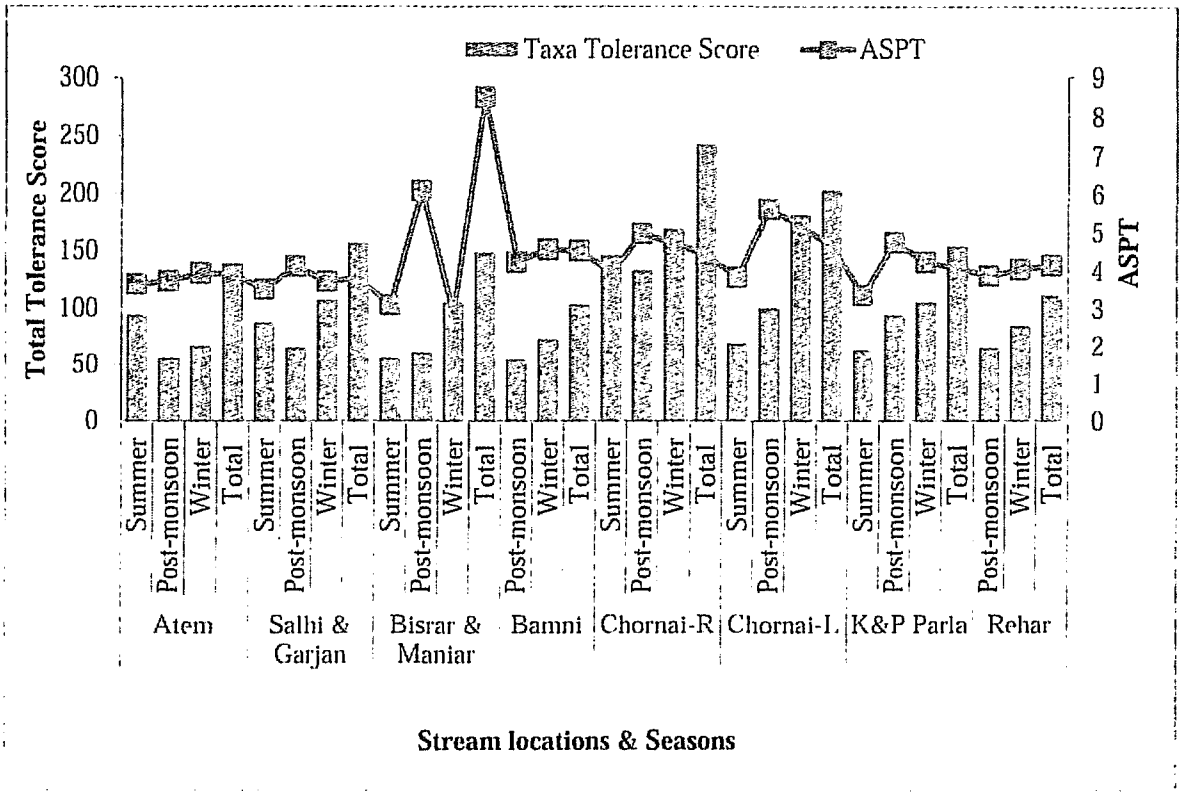


Figure 6.9a: Summary of spatio-temporal Biotic Indices of macroinvertebrates collected from the headwater streams in the core/buffer areas of the proposed/ active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

The TTS in Chornai Nadi-Left bank streams differed from 69 during summer to 166 during winter with a total and mean of 204 and 112 ± 49 respectively. Khadpadi and Parla Nala recorded a total and mean TTS of respectively 155 and 88 ± 22 with a variance from 64 during summer and 106 winters. At Rehar River, the TTS recorded varied from 66 during post-monsoon to 85 during winter with a total and mean of 112 and 76 ± 13respectively.

In summary, both Chornai Nadi-Right and Left bank streams recorded high value of TTS (>100) having the water quality category 'Very Good' (Un-polluted, Un-impacted) followed by all the other locations, which fall under the TTS range of 71-100 with water quality category 'Good' (Clean, but Slightly Impacted) except the Bamni Nala, which fall under the 41-70 TTS range with water quality category 'Moderate' (Moderately Impacted). Relatively high mean values of TTS at Chornai Nadi-Right and Left bank streams rank them standalone locations compared to that of others. Also, the TTS recorded at Atem and Salhi and Garjan Nala were on par with that of other remaining locations for comparison.

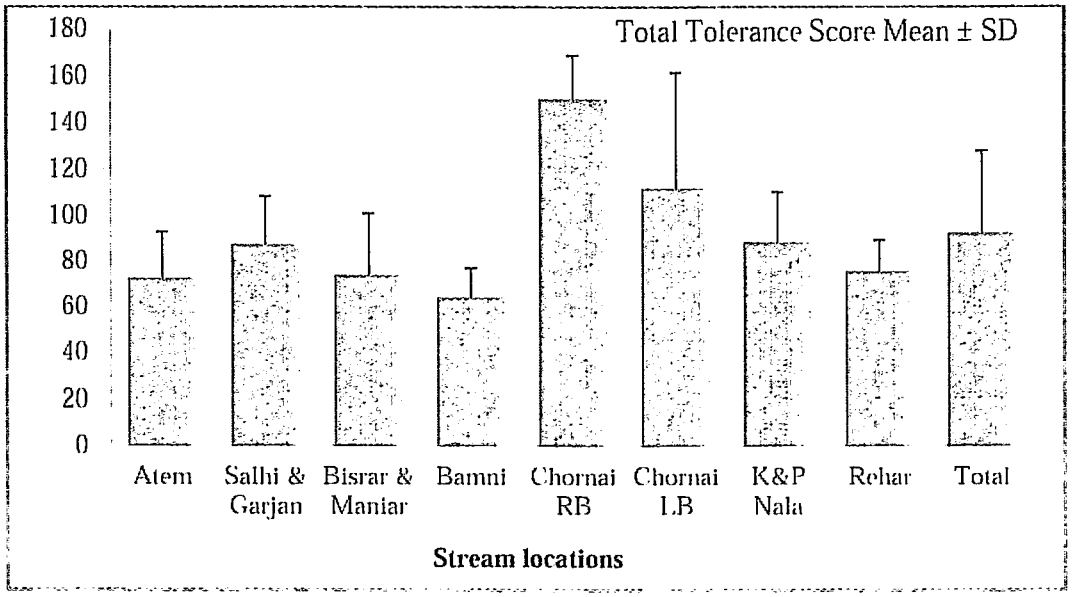


Figure 6.9b: Mean Taxa Tolerance Score of macroinvertebrates collected from the headwater streams in the core/buffer areas of the proposed/active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

6.7.2 Average Score per Taxon (ASPT)

The average tolerance score of all taxa within the community was calculated by dividing the tolerance scores by the number of families represented in the sample (Armitage *et al.*, 1983; Friedrich *et al.*, 1996; Mackie, 2001).

ASPT Range	Water Quality Assessment
≥ 5.0	Excellent
> 4.0 - < 5.0	Good
≥ 3.0 - < 4.0	Moderate
> 2.0 - < 3.0	Poor
≤ 2.0	Very Poor

The resultant average value of a particular sampling location was matched with the range matrix of the index (detailed below) for assessment of probable water quality. The total ASPT of macroinvertebrates recorded at Atem Nadi was 3.91 with the corresponding mean of three sampling seasons was 3.77 ± 0.15 (3.65-3.94) and that of Salhi and Garjan Nala was 3.83 with a mean of 3.79 ± 0.31 (3.52-4.13) (Table 6.4 and Figures 6.9a and 6.9c). At Bisrar and Maniar Nala, the ASPT recorded was 8.51 with a mean of three sampling seasons of 4.04 ± 1.79 that varied from 2.90 during winter to 6.10 during post-monsoon, which observed to be highest among all due to unprecedented number in abundance contributed by the Dipteran larva - Simuliidae. The ASPT at Bamni Nala varied from 4.23 to 4.56 respectively during post-monsoon and winter with a total and mean of 4.52 and 4.40 ± 0.23 respectively. Both Chornai Nadi Right and Left bank streams recorded a total and mean of ASPT values of 4.42 and 4.55 ± 0.52 (3.97-4.96) respectively at the former and 4.64 and 4.88 ± 0.93 (3.83-

5.61) respectively at the latter locations. Khadpadi and Parla Nala had the ASPT total and mean of 4.08 and 4.12 ± 70 (3.37-4.75) respectively. At Rehar River, the total and mean values of ASPT respectively were 4.15 and 3.97 ± 0.12 (3.88-4.05).

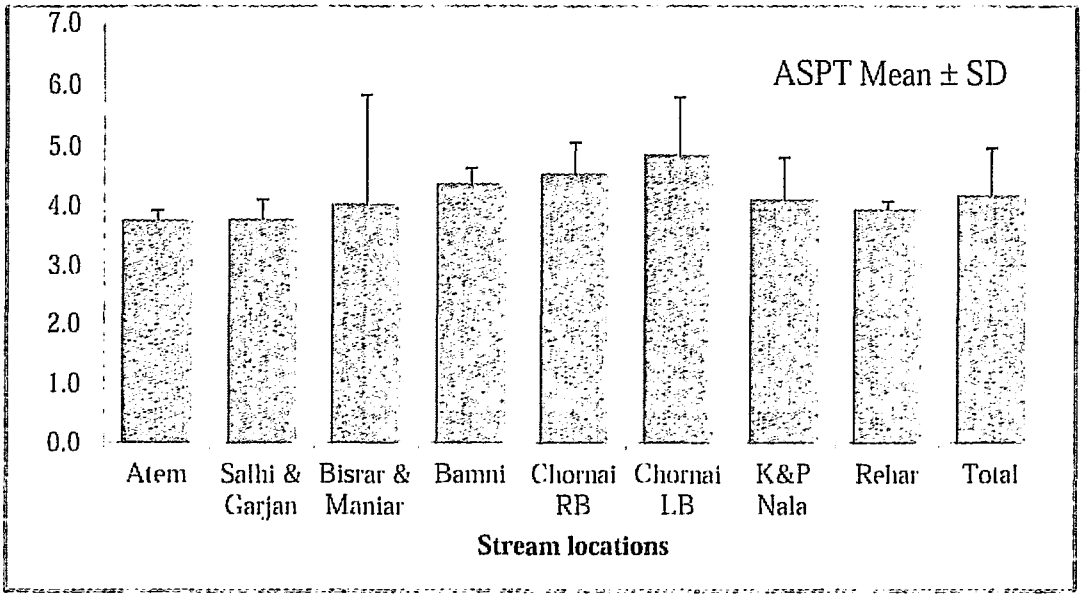


Figure 6.9c: Mean ASPT of macroinvertebrates collected from the headwater streams in the core/buffer areas of the proposed/active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

In general, the index values calculated for the sampling locations indicated that five out of the eight locations (Bisrar and Maniar Nala, Bamni Nala, Chornai Nadi-Right and Left bank streams and Khadpadi and Parla Nala) fall under the ASPT range of 4-5 representing 'Good' water quality and other three locations (Atem Nadi, Salhi and Garjan Nala and Rehar River) fall under the index range of 3-4 representing 'Moderate' water quality.

The results of Kruskal Wallis (Non-parametric) statistical test revealed that spatial variation in both Taxa Tolerance Score (Chi-Square = 10.56, p = 0.16, df = 7) and ASPT (Chi-Square = 6.54, p = 0.48, df = 7) was not significant (Table 6.5a-d). Also, the temporal variation in TTS was not significant (Chi-Square = 4.76, p = 0.09, df = 2), however the variance in richness was significant (Chi-Square = 8.05, $p < 0.05$, df = 2). Although not significant, the rank statistic of spatial abundance and richness as well as that of temporal TTS revealed evident differences indicating that the parameters had different representation from the sampling locations worth noting.

6.7.3 Diversity Indices of Macroinvertebrates

A number of indices for measuring diversity of flora and fauna have been developed for use in ecological and bio-geographic studies. Diversity indices are important tools for biologists to understand the community structure. The diversity index will reveal structural aspects (not functioning of a community) of the assemblage of organisms

and therefore, different indices are useful for comparing different assemblages, which will indicate specific structural differences. It is very well possible that two assemblages will have a similar diversity, despite having a completely different mechanism of their structures. For calculating the diversity indices, three components of community structure *viz.*, species richness (number of species present), evenness (uniformity of distribution of species in a site) and abundance (total number of individual) are taking into consideration and thus diversity indices provide important information about rarity and commonness of species in a community. In biomonitoring, the diversity indices often used to assess the impact of stressors on the biological community.

6.7.4 Dominance (D)

Both dominance and evenness are often considered as two sides of the same coin in community ecology and hence, their measures are complementary. While similarity of abundances of co-occurring species refers to evenness, unevenness in abundances of one or a few species is indicated by dominance (Magurran 2004). For ecologists, both evenness and dominance are properties of the entire community (Hooper *et al.* 2005, Hillebrand *et al.*, 2008), so, as dominance increases, diversity (in the sense of evenness) decreases. The dominance ranges from 0 (all taxa are equally present) to 1 (one taxon dominates the community completely).

The Dominance index of macroinvertebrates was calculated both for the sampling seasons as well as for total of the respective sampling locations (Table 6.6 and Figure 6.10a). Among all the sampling locations, total dominance index of macroinvertebrate assemblage varied from 0.07 (0.10-0.16) to 0.62 (0.22-0.89) respectively at Atem Nadi and Bisrar and Maniar Nala. The relatively high dominance value recorded for the macroinvertebrate abundance at Bisrar and Maniar Nala was due to excessive number in abundance contributed by the Dipteran larva - Simuliidae. The total dominance index calculated for the macroinvertebrate abundance at Salhia nd Garjan Nala was 0.08 with variance from 0.10 to 0.16, that of Bamini Nala was 0.31 (0.23-0.38), that of Chornai Nadi-Right bank streams was 0.15 (0.11-0.22), that of Chornai Nadi-Left bank streams was 0.13 (0.13-0.21), that of Khadpadi and Parla Nala was 0.14 (0.16-0.29) and that of Rehar River was 0.12 (0.14-0.19).

Table 6.6: Summary of spatio-temporal Diversity Indices of macrobenthic invertebrates collected from headwater streams in the core/buffer areas of the proposed/active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba district of Chhattisgarh

S.N.	Drainage Locations	Season	Dominance (D)	Simpson's Index (1-D)	Shannon (H)	Fisher's alpha
1	Atem Nadi	Summer	0.10	0.90	2.57	6.38
		Post-monsoon	0.16	0.84	2.19	7.06
		Winter	0.10	0.90	2.53	4.43
		Total	**0.07**	**0.93**	**2.88**	**7.72**
2	Salhi &	Summer	0.12	0.88	2.48	5.39

S.N.	Drainage Locations	Season	Dominance (D)	Simpson's Index (1-D)	Shannon (H)	Fisher's alpha
	Garjan Nala	Post-monsoon	0.16	0.84	2.20	4.99
		Winter	0.10	0.90	2.71	9.51
		Total	**0.08**	**0.92**	**2.91**	**8.96**
3	Bisrar & Maniar Nala	Summer	0.22	0.78	1.94	4.83
		Post-monsoon	0.33	0.67	1.37	2.23
		Winter	0.89	0.11	0.38	3.49
		Total	**0.62**	**0.38**	**1.09**	**5.66**
4	Bamni Nala	Post-monsoon	0.23	0.78	1.94	5.95
		Winter	0.38	0.62	1.44	3.40
		Total	**0.31**	**0.69**	**1.73**	**5.23**
5	Chornai Nadi (Right Bank Nala)	Summer	0.15	0.85	2.47	7.80
		Post-monsoon	0.11	0.89	2.59	7.63
		Winter	0.22	0.78	2.05	6.50
		Total	**0.15**	**0.85**	**2.56**	**9.71**
6	Chornai Nadi (Left Bank Nala)	Summer	0.13	0.87	2.41	5.30
		Post-monsoon	0.21	0.79	2.00	4.41
		Winter	0.14	0.86	2.37	5.84
		Total	**0.13**	**0.87**	**2.56**	**8.14**
7	Khadpadi & Parla Nala	Summer	0.16	0.84	2.20	5.36
		Post-monsoon	0.17	0.83	2.13	5.76
		Winter	0.29	0.71	1.95	5.28
		Total	**0.14**	**0.86**	**2.47**	**7.92**
8	Rehar River	Post-monsoon	0.14	0.86	2.30	7.73
		Winter	0.19	0.81	2.27	7.43
		Total	**0.12**	**0.88**	**2.60**	**8.81**

6.7.5 Simpson's Index of Diversity (1-D)

Simpson's index is based on the probability of any two individuals drawn at random from an infinitely large community belonging to the same species. Simpson index is usually reported as its complement 1-Dominance and it measures the 'evenness' of the community. The Simpson's index of diversity ranges between 0 and 1 and a greater value indicates higher level of sample diversity to a maximum of 1-1/s. This index places relatively more weight on more abundant species than the rare species in a sample (Krebs, 1994) and therefore, the addition of rare species to a sample causes only small changes in the value of D.

The index for total and seasonal abundance of macroinvertebrates among the sampling locations varied from 0.38 (0.11-0.78) to 0.93 (0.84-0.90) respectively at Bisrar and Maniar Nala and Atem Nadi (Table 6.6 and Figure 6.10a). The relatively low dominance value recorded for the macroinvertebrate abundance at Bisrar and Maniar Nala was due to excessive number in abundance contributed by the Dipteran larva – Simuliidae. The Simpson's index calculated for the macroinvertebrate abundance at Salhi and Garjan Nala was 0.92 with variance from 0.84 to 0.90, that of Bamini Nala was 0.69 (0.62-0.78), that of Chornai Nadi-Right bank streams was 0.85

(0.78-0.89), that of Chornai Nadi-Left bank streams was 0.87 (0.79-0.87), that of Khadpadi and Parla Nala was 0.86 (0.71-0.84) and that of Rehar River was 0.88 (0.81-0.86).

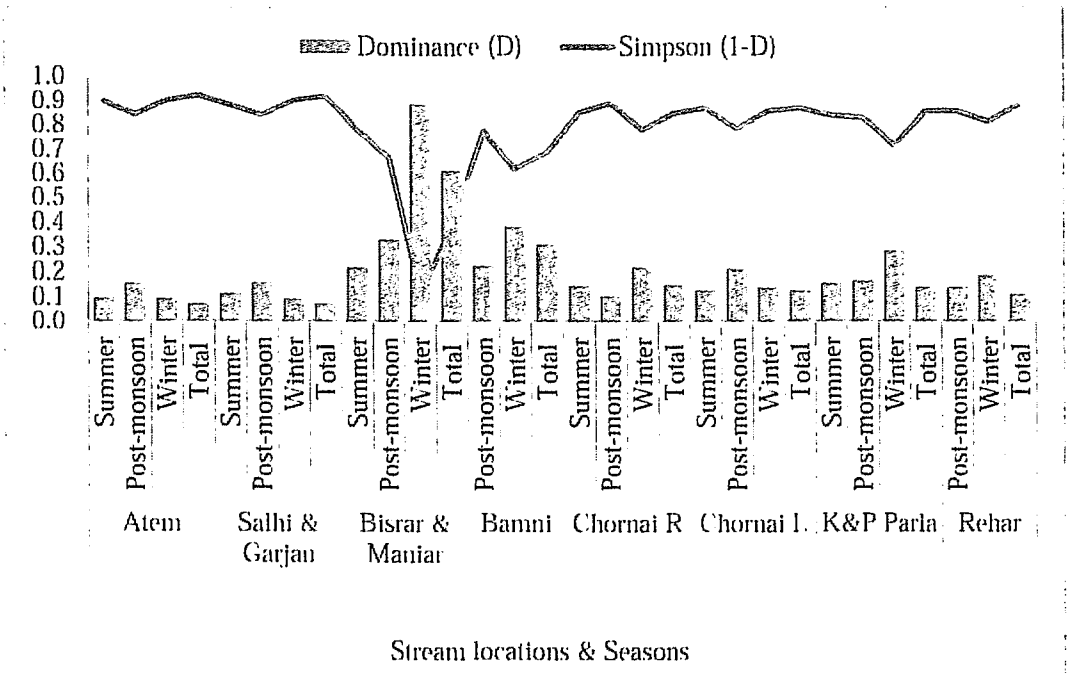


Figure 6.10a: Summary of spatio-temporal Biotic Indices (Dominance and Simpson) of macroinvertebrates collected from the headwater streams in the core/buffer areas of the proposed/active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

6.7.6 Shannon Index (H)

The Shannon-Wiener Diversity index (H) is commonly used as a measure of aquatic biodiversity as the index has best applied to situations of varying pollution which impose general stress on the organisms. The index value ranges from 0, indicating a low level of diversity, to a maximum of 1 1/s. In most ecological studies, the index typically ranges between 1.5 and 3.5 and is rarely greater than 4. So, a value between 3 and 4 indicates clean water and 1 indicates polluted water (Wilhm, 1970). This index is a quantitative measure that reflects the diversity and simultaneously takes into account evenness among the species (Shannon and Wiener 1949) and that places more weight on common species relative to rare species (Krebs 1994). The Shannon index increases as both the richness and the evenness (biotic diversity) of the community increase. The index incorporates both components of biodiversity and hence it is strong because it provides a simple, synthetic summary as well as it is weak because comparing communities that differ greatly in richness is difficult.

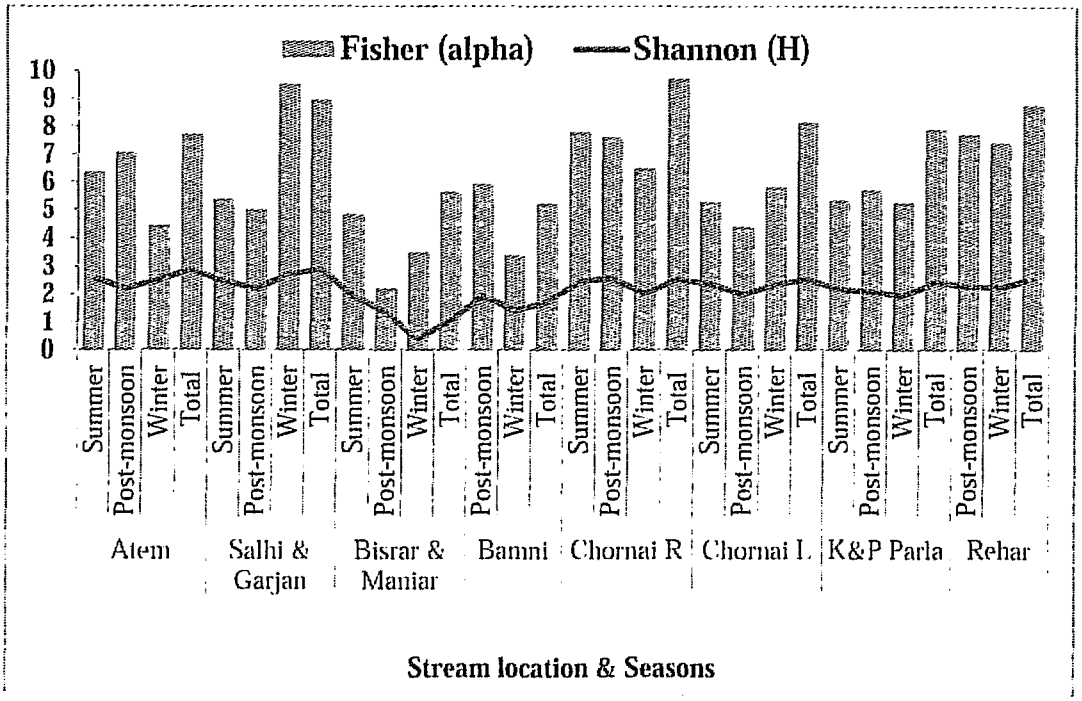


Figure 6.10b: Summary of spatio-temporal Biotic Indices (Fisher's alpha and Shannon) of macroinvertebrates collected from the headwater streams in the core/buffer areas of the proposed/active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

The Shannon Index values for total and seasonal abundance of macroinvertebrate among sampling locations varied from 1.09 (0.38-1.94) to 2.91 (2.20-2.71) respectively at Bisrar and Maniar Nala and Salhi and Garjan Nala (Table 6.6 and Figure 6.10b). The relatively low value of Shannon Index recorded for the macroinvertebrate abundance at Bisrar and Maniar Nala was due to excessive number in abundance contributed by the Dipteran larva - Simuliidae. The Shannon index calculated for the macroinvertebrate abundance at Atem Nadi was 2.88 with variance from 2.19 to 2.57, that of Bamini Nala was 1.73 (1.44-1.94), that of both Chornai Nadi-Right and Left bank streams were 2.56 each with variance from 2.05 to 2.59 and from 2.00 to 2.41, that of Khadpadi and Parla Nala was 2.47 (1.95-2.20) and that of Rehar River was 2.60 (2.27-2.30).

6.7.7 Fisher's alpha

It is a parametric diversity index used to measure diversity within population and it assumes that the species abundance follows log series distribution (Fisher *et al.*, 1943). Fisher's alpha is a satisfactory scale-independent indicator of biodiversity. Several authors have highly recommended use of the Fisher's alpha for measuring diversity in ecological and bio-geographic studies (Taylor 1978; Magurran 1988) because of its following characteristics *viz.*, low sensitivity to sample size (Kempton and Taylor, 1974; Magurran, 1988), good discriminant ability (Kempton and Wedderburn, 1978; Taylor, 1978), robustness (Magurran, 1988), suitability in a variety of ecological applications (Southwood, 1978), application in describing dispersal of individual organisms in space (Southwood, 1978) *etc.*

The Fisher's alpha index values for total and seasonal abundance of macroinvertebrate among sampling locations varied from 5.23 (3.40-5.95) to 9.71 (6.50-7.80) respectively at Bamni Nala and Chornai Nadi-Right bank Nala (Table 6.6 and Figure 10b). The index calculated for the macroinvertebrate abundance at Atem Nadi was 7.72 with variance from 4.43 to 7.06, that of Salhi and Garjan Nala was 8.96 (4.99-9.51), that of Bisrar and Maniar Nala was 5.66 (2.23-4.83), that of Chornai Nadi-Left bank Nala was 8.14 (4.41-5.84), that of Khadpadi and Parla Nala was 7.92 (5.28-5.76) and that of Rehar River was 8.81 (7.43-7.73). The relatively low value of the index at both Bisrar and Maniar Nala and Bamni Nala as well as relatively high value at both Chornai Nadi-Right bank streams and Salhi and Garjan Nala was on par with each other at the respective level and that of the other sampling locations *viz.*, Atem Nadi, Chorai Nadi-Left bank streams, Khadpadi and Parla Nala and Rehar River was more or less similar.

6.7.8 Summary of Diversity Indices

Barring the exceptions at two locations (Bisrar and Maniar Nala and Bamni Nala), the Dominance and Simpson's diversity index values varied uniformly. The Shannon and Fisher's alpha values also observed to vary among the sampling locations in a more or less similar way as that of the Dominance and Simpson's index. A relatively high diversity was observed at the two locations (Chornai Nadi-Right bank streams and Salhi and Garjan Nala) and so also a low diversity at other two locations (Bisrar and Maniar Nala and Bamni Nala). However, the diversity recorded from the rest of the locations (Atem Nadi, Chornai Nadi-left bank streams, Khadpadi and Parla Nala and Rehar River) was intermediary to that of the high and low diverse locations. It is to note that Salhi and Garjan Nala followed by Atem Nadi which are in the core/buffer area of the active coal block in the HAC, were one among the relatively good/moderate diverse locations in terms of aquatic invertebrates. On the contrary, the Taxa Tolerance Score and ASPT indices ascertained that these locations ranked relatively below in terms of the abundance of pollution sensitive aquatic organisms. The results indicated that unless it is conclusively interpreted based on the related biotic indices, diversity indices alone signify no conclusive results.

6.7.9 Macroinvertebrate Water Quality Index (MWQI)

The MWQI was calculated for the seasonal sampling in eight stream locations of the core/buffer areas of the proposed/active coal blocks in whole HAC (Table 6.7). Among all the sampling locations, the MWQI at Salhi and Garjan Nala was calculated to 0.3052 representing 'Poor' water quality with 'Very significant pollution', while those at the three locations *viz.*, Chornai Nadi-Right and Left bank streams as well as Khadpadi and Parla Nala was respectively calculated to 0.8185, 0.8701 and 0.7405 representing 'Very good' water quality with 'Slight organic pollution' followed by the index calculated to 0.4313 representing 'Fairly poor' water quality with 'Significant organic pollution' at Rehar River, both 0.5492 and 0.5211 representing 'Fair' water quality with 'Significant pollution' respectively at Atem Nadi and Bisrar and Maniar

Nala and 0.6964 representing 'Good' water quality with 'Some organic pollution' at Bamni Nala.

Table 6.7: Summary of spatio-temporal Macroinvertebrate Water Quality Index (MWQI) of the headwater streams in the core/buffer areas of the proposed/active coal blocks of the whole Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

S.N.	Drainage Locations	Season	MWQI	Water Quality	Degree of organic pollution
1	Atem Nadi	Summer	0.4601	Fairly poor	Significant organic pollution
		Post-monsoon	0.5526	Fair	Significant pollution
		Winter	0.7000	Very good	Slight organic pollution
		Total	**0.5492**	**Fair**	**Significant pollution**
2	Salhi & Garjan Nala	Summer	0.1712	Worst	Severe pollution
		Post-monsoon	0.6879	Good	Some organic pollution
		Winter	0.5435	Fair	Significant pollution
		Total	**0.3052**	**Poor**	**Very significant pollution**
3	Bisrar & Maniar Nala	Summer	0.1034	Worst	Severe pollution
		Post-monsoon	0.6328	Good	Some organic pollution
		Winter	0.7527	Very good	Slight organic pollution
		Total	**0.5211**	**Fair**	**Significant pollution**
4	Bamni Nala	Post-monsoon	0.6452	Good	Some organic pollution
		Winter	0.5726	Fair	Significant pollution
		Total	**0.6964**	**Good**	**Some organic pollution**
5	Chornai Nadi (Right Bank Nala)	Summer	0.6026	Good	Some organic pollution
		Post-monsoon	0.4947	Fairly poor	Significant organic pollution
		Winter	0.9293	Excellent	No apparent pollution
		Total	**0.8185**	**Very good**	**Slight organic pollution**
6	Chornai Nadi (Left Bank Nala)	Summer	0.6188	Good	Some organic pollution
		Post-monsoon	0.6455	Good	Some organic pollution
		Winter	0.6765	Good	Some organic pollution
		Total	**0.8701**	**Very good**	**Slight organic pollution**
7	Khadpadi & ParlaNala	Summer	0.4828	Fairly poor	Significant organic pollution
		Post-monsoon	0.8777	Very good	Slight organic pollution
		Winter	0.7960	Very good	Slight organic pollution
		Total	**0.7405**	**Very good**	**Slight organic pollution**
8	Rehar River	Post-monsoon	0.6296	Good	Some organic pollution
		Winter	0.3333	Poor	Very significant pollution
		Total	**0.4313**	**Fairly poor**	**Significant organic pollution**

The index calculated among three seasons varied from 0.4601 representing 'Fairly poor' water quality with 'Significant organic pollution' to 0.7000 representing 'Very good' water quality with 'Slight organic pollution' respectively during summer and winter at Atem Nadi, from 0.1712 representing 'Worst' water quality with 'Severe pollution' to 0.6879 representing 'Good' water quality with 'Some organic pollution' respectively during summer and post-monsoon at Salhi and Garjan Nala, from 0.1034 representing 'Worst' water quality with 'Severe pollution' to 0.7527 representing

'Very good' water quality with 'Slight organic pollution' respectively during summer and winter at Bisrar and Maniar Nala, from 0.5726 representing 'Fair' water quality with 'Significant pollution' during winter to 0.6452 representing 'Good' water quality with 'Some organic pollution during post-monsoon at Bamni Nala, from 0.4947 representing 'Fairly poor' water quality with 'Significant organic pollution' during post-monsoon to 0.9293 representing 'Excellent' water quality with 'No apparent pollution' during winter at Chornai Nadi-Right bank streams, from 0.4828 representing 'Fairly poor' water quality with 'Significant organic pollution' during summer to 0.7960 and 0.8777 both representing 'Very good' water quality with 'Slight organic pollution' respectively during winter and post-monsoon at Kahdpadi and Parla Nala and from 0.3333 representing 'Poor' water quality with 'Very significant pollution' during winter to 0.6296 representing 'Good' water quality with 'Some organic pollution' during post-monsoon at Rehar River, while the index calculated for seasonal sampling at Chornai Nadi-Left bank streams varied respectively during summer and winter from 0.6188 to 0.6765 both representing 'Good' water quality with 'Some organic pollution'.

In summary, the sampling locations based on the water quality characteristics and degree of organic pollution excerpted from the MWQI calculated may be arranged in the decreasing order as **Very good** (Chornai Nadi-Left bank streams, Chornai Nadi-Right bank streams and Khadpadi and Parla Nala) > **Good** (Bamni Nala) > **Fair** (Atem Nadi and Bisrar and Maniar Nala) > **Fairly Poor** (Rehar River) > **Poor** (Salhi and Garjan Nala).

6.8 CONCLUSION

The aquatic macroinvertebrates a well-defined and widely used community of indicator organisms of stream water quality was collected from the headwater streams of core/buffer areas of the proposed/active (21 proposed/ 2 active) coal blocks of whole HAC and assessed for predicting the probable biological water quality of the sampling locations by employing the biotic metrics, biotic indices, diversity indices and Macroinvertebrate Water Quality Index. The probable impacts of the proposed mining on aquatic ecosystem and resultant water quality changes were assessed by conducting extensive field visits to the individual coal blocks as well as physical observations of the physiographic status of the area including the adjoining stream channels.

Sl.No.	Sampling Locations
1	AtemNadi
2	Salhi and GarjanNala
3	Bisrar and ManiarNala
4	BamniNala
5	ChornaiNadi-Right bank streams
6	ChornaiNadi-Left bank streams
7	Khadpadi and ParlaNala
8	ReharNadi

Sl. No.	Biotic Metrics	Biotic Indices	Diversity Indices
1	Abundance	Taxa Tolerance Score	Dominance (D)
2	Richness	ASPT	Simpson's Index (1-D)
3	EPT/O Taxa	Macroinvertebrate Water Quality Index	Shannon Index (H)
4			Fisher's alpha

The water quality of the headwater streams in the area is observed to primarily influence from geo-morphological changes such as erosion, sedimentation, reduction in rainfall *etc.*, as well as from anthropogenic characteristics such as landuse land cover changes and forest degradation, which include agriculture, illicit felling, *etc.*, due to human settlements and related developmental activities. The physico-chemical water quality parameters of the streams in the area revealed that temperature, pH, Conductivity and TDS varied within their expected natural ranges with exception of an unusual observation of higher Conductivity and TDS at one location than expected. A total number of 9924 individuals of macroinvertebrates belonging to 4 phyla (Platyhelminthes, Annelida, Arthropoda and Mollusca), 6 classes (Rhabditophora, Clitellata, Insecta, Malacostraca, Gastropoda and Bivalvia), 19 orders and 61 families were identified. The total seasonal abundance of macroinvertebrates recorded were 2340 (24%), 1167 (12%) and 6417 (65%) respectively during summer, post-monsoon and winter, while the taxa richness was 46 each during summer and post-monsoon and 57 during winter.

Insect taxa with a relative abundance of 86.82% and a total richness of 45 families constitute the most dominant taxonomic group in macroinvertebrate assemblages of the entire sampling location. The EPT/O taxa, one of the pollution sensitive taxa, accounted for nearly more half (52.61%) of the abundance of all taxa in the sampling locations. In general, the abundance, richness, Taxa Tolerance Score, ASPT, diversity indices and MWQI calculated for the macroinvertebrates revealed that the water quality and likely impacts of various natural and anthropogenic stresses on aquatic resources at the two most abundantly forested stream locations *viz.*, the Chornai Nadi-Right and Left streams were not so significant. However, the two prominent sampling locations core/buffer to the active mining areas (Chotia and PEKB) *viz.*, Atem Nadi and Salhi and Garjan Nala were more or less similar in all respects of aquatic macroinvertebrate biodiversity and water quality and that that varied from other sampling locations. Also, the results of the study revealed that the MWQI represented more reliable details of the water quality characteristics of the locations than the other biotic indices such as Taxa Tolerance Score and ASPT. The results conclusively revealed that highly degraded locations in all respects most probably tended to degrade aquatic biodiversity and stream water quality.

The water sources in the area forms the important sub-basins of Hasdeo-River (a tributary of River Mahanadi) as well as the immediate upstream feeder streams of the Hasdeo-Bango Dam built for both irrigation and hydro power. Rehar River is part of

the Son River sub-basin of the lower Ganges basin. The biodiversity and water quality assessment of the area is particularly important in the wake of it being diverted for mining of coal from as many as 23 identified coal blocks of which a two are being operated. The whole coalfield area, except the hilly slopes towards S-SE particularly the right and left bank catchments of the Chornai Nadi, forest degradation and land use land cover changes on account of human settlement and the consequent cultivation along the banks of water courses are rampant resulting in state of a biodiversity relatively low. Barring the first/second order forested headwater streams located in the hilly tracts, all other larger water course in plain areas are mostly observed flooded with heavy deposition of coarse sand, which observed to not only restrict replenishment of river bottom with the adequate organic matter deposits, but also alter the river geo-morphological dynamics together rending the locations with poor habitat diversity for aquatic organisms including fish and other higher vertebrates. The plain areas in North and NE of the whole coalfield mostly as well as wherever human habitation located, forest is under immense pressure from degradation due to encroachments and illicit felling.

6.9 ICHTHYOFAUNAL DIVERSITY

The aquatic ecosystem of the study area encompasses mainly of 3rd to 6th order seasonal/perennial hill streams traversing primarily the upland *Sal* dominating forested ecosystem and draining into the Hasdeo-Bango reservoir. The major drainages in the study area are Hasdeo-River along N-S, Atem Nadi on northern central to north, Chornai Nadi and one of its important tributary the Rapta Nala respectively along E-W and SE-W, while the Rehar River, which is one of the tributaries of Son River at the North draining the area from S-N along the eastern side of the Hasdeo-Arand Coalfield. Hasdeo-Bango is the major recipient of all drainages from the area and is being utilized for both hydropower generations as well as for irrigation.

6.9.1 Catch per Unit Effort (CPUE)

Fishery resources in these upland forested streams are therefore not prominent enough to the level of commercial utilization, while cultivation and harvest is being done in the reservoir waters. It is to note that organized full time fishing is seldom operated in these streams; instead, seasonal fishing is prevailing mostly during lean period and summer months employing country made fishing gears such as cast nets, stake nets, gill nets, scoop nets, various kinds of fish traps made of bamboo/twigs, *etc*. Various kinds of artisanal fishing methods employing country made crude fishing gears and the corresponding catch obtained in the study area are shown in Plate 6.2.

A rapid market survey in the area could yield a very little information about the indigenous fish species availability in the region as has been reported earlier by Bhadbhade *et al.* (2017). In most of the observations, an individual or group of individuals engaged in fishing a day could hardly obtain fish from a few grams to 1-2

kg. It is therefore perceived that bare minimum quantity of catch fished from the streams is most often utilized for individual consumption and is seldom having any marketable potential involving cash transactions. Often the fishing activity in lean period/summer season involves the whole village upto few tens of individuals including women and children, despite the quantum of fish catch obtained is not enough to share among the participants. All kinds of fishing gears like bag nets and traps for collection by filter trapping and scoop nets for collection by picking are used.

6.9.2 Fish Diversity

Various study reports pertaining to fish and fisheries potential particularly that of Mahanadi river basin have been reported by Pathak *et al.*, (2007) and Mishra *et al.*, (2018). The major fishery resource and utilization constituted mainly of major Carps (Catla, Rohu and Mrigal) followed by common Carp, other Cyprinid verities, *etc.*, besides miscellaneous species like, Murrels (3 Channa species), Catfishes like *Wallgo attu*, *Clarias* spp., *etc*. As many 85 fish species predominantly Catfishes followed by Minnows, miscellaneous and major Carps from the upper part of Mahanadi River basin has been reported by Pathak *et al.* (2007). A FAO report (Sugunan, 1995) detailing the fish production trends from reservoirs in Madhya Pradesh mentioned that the Hasdeo-Bango Dam reservoir, which extends over an area of 2510 ha recorded a production of 5.68 tonnes at the rate of 2.26 kg per ha.

A rapid observation of fish species from the catch of artisanal fisher folk in action in some of the water courses of the study area could record as many as 13 common indigenous fish species (Table 6.8) and 02 introduced exotic fish species *viz.*, *Cyprinus carpio carpio* (Common carp) and *Oreochromis mossambicus* (Tilapia), apart from few crustaceans that include prawns and crabs (Plate 6.3).

Snake heads (*C. gachua* and *C. punctata*) are common inhabitants of almost all types of freshwater bodies including foul ditch waters. These fish species were recorded from left bank streams leading to Chornai Nadi falling under coal blocks (CB Nos. 8 and 12-19). Although caught from wild and consumed widely at the villages, their contribution as food fish is relatively very small. *Nemacheilus denisoni/Schistura dayi* usually occurs in fast flowing streams and having ornamental potential. These are quite ambiguous in taxonomic distinctness and believed to share the present sampling area shared by both of the species. The fish species was recorded from almost all forested streams in the study area. *Lepidocephalichthys guntea* of minor food value is a commonly occurring species in streams and rivers. The fish species was recorded from left bank streams leading to Chornai Nadi falling under coal blocks (CB Nos. 8 and 12-19).

Garra mullya inhabits along the bottom of streams attached to rocks and other hard substratum and feed by scavenging. It prefers relatively shallow and clear water. The fish species was recorded from left bank streams leading to Chornai Nadi falling

under coal blocks (CB Nos. 8 and 12-19). Though represent very few in the catch, the fish is being consumed in this area.

All the barb fishes such as *Pethia (Puntius) ticto, Puntius amphibius* and *Puntius sophore* are very common in almost all kinds of freshwater sources. These are one of the widely consumed common freshwater fishes in this region and are having very small scale marketable potential among the local populace. These fish species were recorded from almost all sampling locations in the study area.

Danio rerio is widely occurring in almost all kinds of water bodies and it is a common inhabitant of the streams in the study area. The fish species was recorded from almost all sampling locations in the study area. It has very good potential as ornamental fish.

Glossogobius giuris occurs in almost all water courses and is also widely consumed as food fish in the region. The fish species was recorded from almost all sampling locations in the study area.

Coal Block Nos. 22 & 23 and remaining portion of the Coal Block No. 21

Glyptothorax telchitta a sisorid catfish is reported from Rehar River, which is part of the Ganga basin through Son River. The fish species was recorded from Rehar River and perhaps available in the streams associated with the river (CB Nos. 22 and 23). It is considered as a food fish in this region and is often caught in fish catches by various gears. The fish is considered as vulnerable as per the NBFGR Report of the Threatened Fishes of India (Lakra *et al*. 2010)

Cirrhinus reba is considered as minor carp. The species is occurring in the area in open ponds and flood waters paddy fields. Although a potential food fish, no commercial cultivation practice and stocking are done. The species are harvested from the wild for consumption, which is suspected to be a threat to its population. The fish species was recorded from an open water course in a paddy field associated with Atem Nadi (CB No. 15). As it has a good prospect for commercial production, aquaculture trials may very well be possible in the open water sources of this region.

Table 6.8: Fish diversity in streams/ water bodies of Hasdeo-Arand Coalfield, Chhattisgarh

S. No.	Order and Family	Genera and Species	IUCN Status	*CAMP, 1998	Locations spotted	Importance
1	Cypriniformes Cobitidae	*Lepidocephalichthys guntea*	LC	--	All streams	Food
2	Cypriniformes Balitoridae	*Nemachcilus denisoni (Schistura dayi)*	LC	--	All streams	Ornamental
3	Cypriniformes Cyprinidae	*Garra mullya*	LC	VU	All streams	Food
4	Cypriniformes Cyprinidae	*Cirrhinus reba*	LC	VU	Atem Nadi	Food
5	Cypriniformes Cyprinidae	*Pethia ticto*	LC	LRnt	All streams	Food
6	Cypriniformes Cyprinidae	*Puntius amphibius*	LC	--	All streams	Food
7	Cypriniformes Cyprinidae	*Puntius sophore*	LC	LRnt	All streams	Food
8	Cypriniformes Cyprinidae	*Barilius bendelisis*	LC	LRnt	Atem Nadi	Food and Ornamental
9	Cypriniformes Cyprinidae	*Danio rerio*	LC	LRnt	All streams	Ornamental
10	Perciformes Channidae	*Channa punctata*	LC	LRnt	Chornai Nadi	Food
11	Perciformes Channidae	*Channa gachua*	LC	VU	Chornai Nadi	Food
12	Perciformes Gobidae	*Glossogobius giuris*	LC	--	Chornai Nadi	Food
13	Siuriformes Sisoridae	*Glyptothorax telchitta#*	LC	LRnt	Rehar River	Food

*Conservation Assessment and Management Plan (CAMP) Workshop Report, 1998.
Vulnerable as per the NBFGR
LC-Least Concern; DD-Data Deficient; VU=Vulnerable; LRnt-Low risk near threatened

Barilius bendelisis is a potential ornamental and food fish of greater importance especially for local populace in India (Kumar *et al.*, 2013). It inhabits in shallow, clear and cold water of streams and rivers along base of hills. In the present observation, the species has been recorded from upper stretches of Atem Nadi (CB Nos. 12-15 and 20-21) where clean and plenty of flowing water was available and moreover, the species of very common occurrence in most of the fish catches in this area. Kumar and Singh (2019) and Mir *et al.* (2015) identified two distinct stocks of *Barilius bendelisis* and reported significant phenotypic heterogeneity in populations between the geographically isolated regions of Central Indian Himalaya owing to the influence of local ecological conditions. In rivers having marked environmental and altitudinal variations, hindrance in flow regime due to construction of barrages/dam might lead to potential isolation in distribution of stocks of *Barilius bendelisis* as reported by Panda *et al.*, (2019) from Teesta, Kameng and Myntudu Rivers of North East India in Indo-Burma Biodiversity Hotspot.

Srivastav and Singh (2017) reported 21 fish species belonging to four orders from Hasdeo River near Khatgora. As many as six species are common among the report and the present record. Bhadbhade *et al.* (2017) reported that based on the observations of local fisherman, *Salmophasia bacaila/Oxygaster bacaila* is almost disappeared from the Hasdeo-River and that *Wallgo attu*and *Cirrhnus cirrhosus* inhabiting the River are respectively Vulnerable and Threatened category of fishes as per IUCN. However, *Oxygaster bacaila* is reported to occur in the river as per the report of Srivastav and Singh (2017). Therefore, it is understood that, there is no specific information about the fishery potential as well as aquatic biodiversity of the area.

Among the species recorded from the study area, three fish species are categorized under Vulnerable (VU) and six species under Lower Risk near threatened (LRnt) category of conservation status (CAMP, 1998). However, like any other native fish species, their population is suspected under threat mainly attributable to over exploitation, wide spread habitat destruction and land use land cover changes. Hence, suitable conservation measures are needed to protect the populations of the native fish species from local extinction from streams and rivulets of the Hasdeo River upstream of the barrage.

6.9.3 Importance of Fishery

A reasonably good amount of food fishes of commercial origin mainly comprises of carps and other cat fishes were observed to be sold in the weekly markets in HAC area. Their exact origin such as from the state or outside side could not be ascertained. The indigenous fish caught in plenty during the season were observed to value added in the form of sun dried/smoke-dried and sold in the local markets in a very limited scale by native individuals (Plate 6.4). Other than these, no mode of utilization of fish resources of the HAC area is observed to have commercial importance.

6.9.4 Problems and Prospects

6.9.4.1 Problems

Except the forested hills in the HAC , the water courses at large are devoid of much diversified habitats as the sandy substratum is uniformly occupying everywhere in the stream channels preventing organic matter deposition, which is very important for the fish species as well as aquatic biodiversity. Pathak *et al.*, (2007) studied the Mahanadi area and reported that sediment in the streams constituted predominantly by sand (85.8 to 97.5%) having poor to moderate organic carbon, poor available nutrients and near neutral to alkaline pH. Epiphytic and other river bed rooted vegetation growth are relatively poor owing to the excessive spread of sandy substratum; however, the banks are often colonized by aquatic weeds particularly *Ipomea carnea* plants. In general, geo-morphological features and climatic variability contributes to the seasonal variability of flow regimes which is the major drivers that control the aquatic biodiversity in the stream channels of the area (Pathak *et al.*, 2007). More recently the environmental flow which is a function of quantity, timing, and quality of water flows to sustain the downstream ecological process and the livelihood needs of the dependent of human beings is mandatory to maintain the environmental stability. The forested hill streams in the HAC area are under immense pressure such as land use land cover changes and forest degradation owing to anthropogenic influence. A study conducted on the environmental flow reported that the Hasdeo-Bango barrage has regulated the seasonal flow of the river and considerable reduction in the downstream flow together with sediments (Bhadbhade *et al.*, 2017).

6.9.4.2 Prospects

The prospects for potential indigenous food fish like *Cirrhinu sreba, Barilius bendelisis*, etc., through aquaculture shall be explored. The seedlings propagated elsewhere shall be released in to the local waters especially large water bodies for enriching their population and for utilization as food fish. Intensive cultivation can be attempted in appropriate area and season when water is available in plenty in association with State Fisheries Department.

6.9.5 Impact Assessment

Mining in forested landscape involves significant land use changes that mostly likely lead to geo-morphological changes in the river water courses. The stream networks in the area are unique to the extent that it carries a lot of downstream flow during the rainy season and maintains the minimum flow during the lean period. The aquatic biodiversity of the area is observed to be shaped by such features like moderate-dense forest vegetation cover intersected numerous networks of streams that predominate in the area. The likely changes in flow regimes, geo-morphological and physico-chemical characteristics of the stream water courses further influence availability of aquatic and riparian habitat, freshwater biodiversity, *etc.*, and thereby associated

ecosystem processes and functions such as nutrient cycling, sediment redistribution and overall ecosystem productivity.

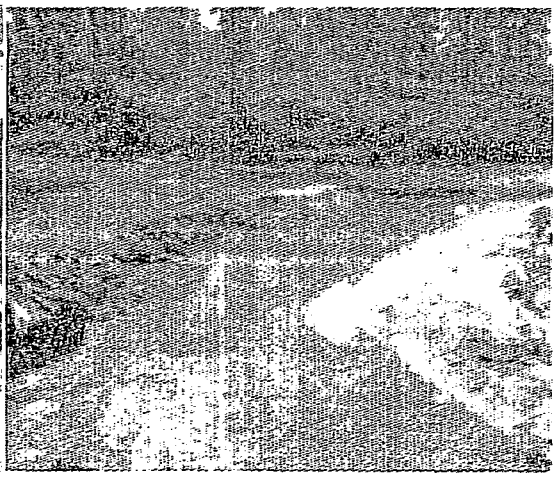
- The stream that originates from Ghatbarra and flowing along S-N across the PEKB coal block (14) is one of the primary feeder streams of Salhi Nala. This has been channelized as Catch Water Drain along the active margin of the mine pit (First Phase of the PEKB) from S-SE to S-SW to facilitate the flow of water along the lease boundary. The primary/secondary feeder streams once existed in the core area of the coal block and that drained the area up to Kete, Basen, Ghatbarra, *etc.*, have been modified/diverted due to ongoing mining/dumping and the resultant changes in the land use land cover pattern. Fragmentation of primary feeder streams or loss of connectivity along the length from the source is most likely to have significant reduction in the stream flow. The minimum required stream flow directly influences stream water quality and physical habitat characteristics thereby maintaining the habitat diversity required to support native biotic communities and ecosystem functions.
- The mine under operation (Coal Block 14) and the proposed mines (coal block 15 and 12) are of open cast type that involves activity from forest clearing for mining and other infrastructure facilities to excavation, loading and surface transportation of waste and coal. Therefore, mining will result in land use land cover changes that lead to alteration in hydrological regime by way of reduced stream water flow, increased erosion that leads to increased sediment deposition on the river bed and related environmental issues.
- The aquatic biodiversity and biological water quality assessment study has identified the likely water quality characteristics in Salhi Nala and Atem Nadi adjoining the active mining areas as not within the ambient quality compared to that of the other stream locations. In the light of the above, it is presumed that the water quality may get further vary when all the mines (coal block 12, 13 and 15) and other contiguous coal blocks) commence operation especially during monsoon when the flow is relatively high due to high rainfall. In addition to the above streams, the Chonai Nadi that receives significant water flow from its feeder streams that fall within the core/buffer area of the coal blocks 7, 8, 15, 16, 17, 18, 19 & 12, is also likely to be influenced by mining in its forested watershed areas.
- In the present scenario, mining is being done in a relatively small geographical area as compared to the extent of the all the coal blocks allotted/re allotted and identified (23 coal blocks as on with the study) in the entire HAC; yet its impacts both direct and indirect are quite evident and significant from the observable changes in the forest cover and natural drainages. Deterioration in the quality and quantity of surface water is an important issue and is likely to increase further with the expansion of mining. Majority of the drainage that fall within the core and buffer zone of the coal blocks are of primary and

secondary feeder streams and therefore, they will be greatly affected due to retention, flow restriction, low discharge, reduced channel morphology, etc.

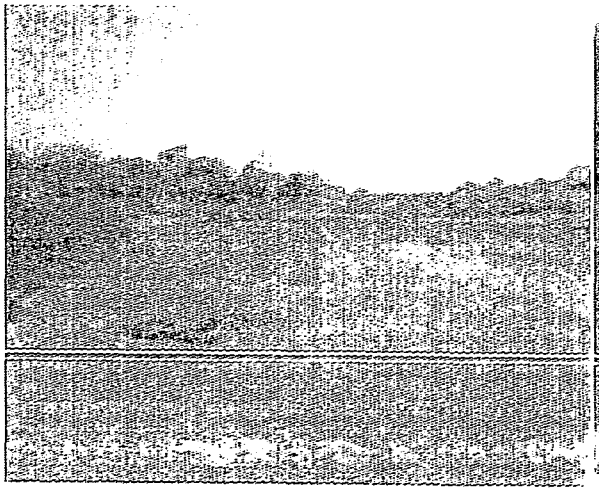
- Alteration of riparian forest cover along the catchment of streams and resultant of habitat degradation, loss of biodiversity, changes in flow dynamics, changes in stream channel morphology and substratum composition through run off, *etc.*, are being evidently seen in most of the forested hill streams. Subsistence seasonal paddy cultivation depending on water availability along the stream beds, slash and burn agriculture along the slopes, etc., are the quite prominent agriculture activity prevalent in the area that affect the quality and quantity of stream water flow.
- The aquatic sources and its forested headwater streams in the core/buffer areas *viz.*, that of Atem Nadi, Salhi and Garjan Nala, Ghatbarra Nala, *etc.*, have largely been modified/diverted both due to various pressures from anthropogenic origin mostly due to stream bed agriculture.



1. Atem Nadi near Basen (12, 20, 21 Buffer) Comp. No. P2103, Udaipur, Surguja



2. Atem Nadi u/s (20, 21 Buffer) Comp. No. P2059, Udaipur, Surguja



3. Atem Nadi near Salhi village (13, 14, 15, 20, 21 Buffer) Comp. No. P2014, Udaipur, Surguja



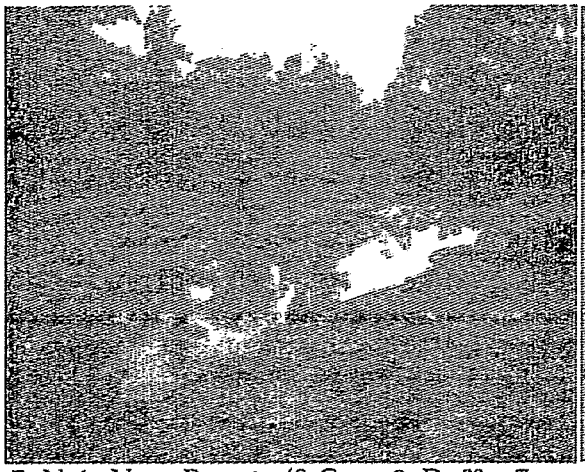
4. SalhiNala near AtemNadi (13, 14, 15, 20, 21 Buffer), Shivnagar, Ramanuj Nagar, Surajpur



5. ChornaiNadi Pindraki (19 Core & Buffer 12, 20, 21), Comp. No. P2125, Udaipur, Surguja



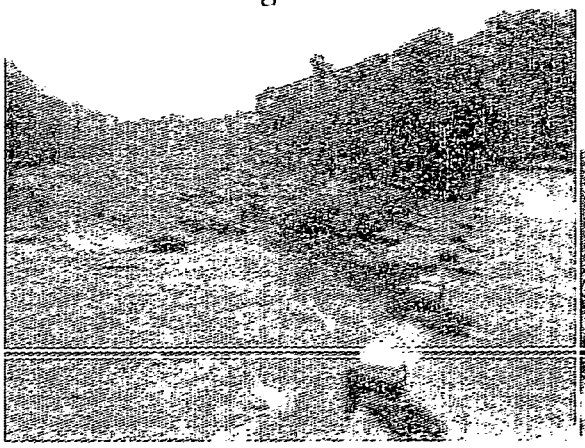
6. Nala near Parogia (12, 14, 17, 19 Buffer), Parogia, Udaipur, Surguja



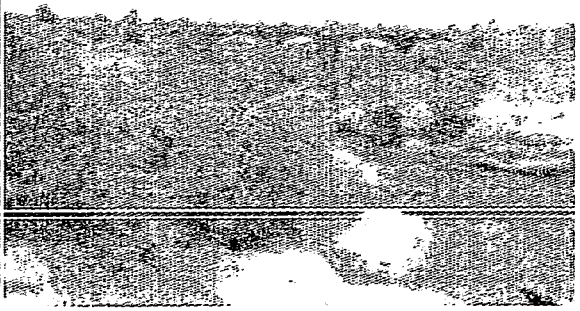
7. Nala Near Paturia (9 Core & Buffer 7, 8, 16), Comp. No. P366, Kendai, Katghora



8. Nala near Gidmuri (16 Core & 8, 13, 14, 15 Buffer), Comp. No. P434, Kendai, Katghora



9. Dhajak Nala (11 Core & 3, 7, 8, 9, 16 Buffer), Comp. No. P372, Kendai, Katghora



10. Chotia Khadpadi Nala (2 Buffer), PondiKhurd Village, Kendai, Katghora



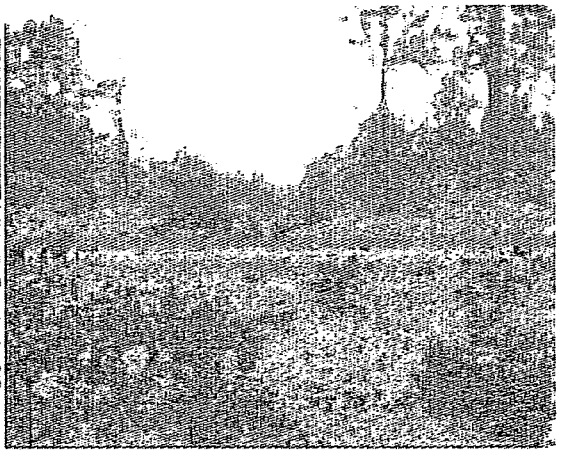
11. Khuji Chornai u/s (19 Core), Comp. No. P2135, Udaipur, Surguja



12. Nakiya Chornai u/s (1 Core Nakiya), Comp. No. OA1199, Lemru, Korba



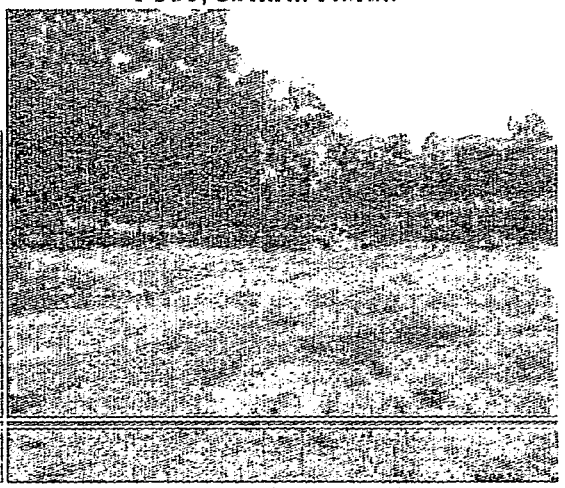
13. Nakiya - LamtiNala (1 Core Nakiya), Rapta Village, Lemru, Korba



14. Nakiya (1 Core Nakiya), Comp. No. P901, Lemru, Korba



15. Tara Central - GarjanNala (15 Buffer) Comp. No. P1993, Ramanuj Nagar, Surajpur



16. Atem Nadi u/s (20 Buffer), Comp No. P2100, Udaipur, Surguja



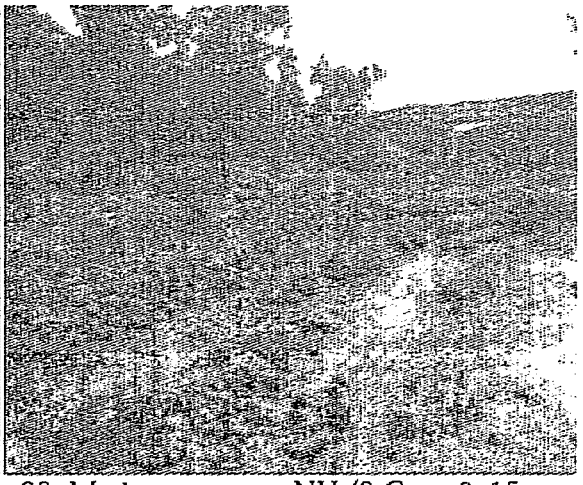
17. Nala near Laxmangarh (21 Core), Comp. No. P2062, Udaipur, Surguja



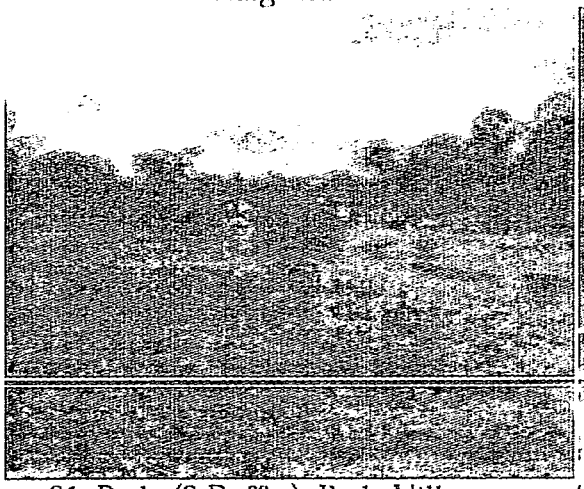
18. Ren Nadi (21, 22, 23 Buffer), Narkola Village, Udaipur, Surguja



19. Madanpur South (11 Core & 9, 10, 15, 16 Buffer), Comp. No. P363, Kendai, Katghora



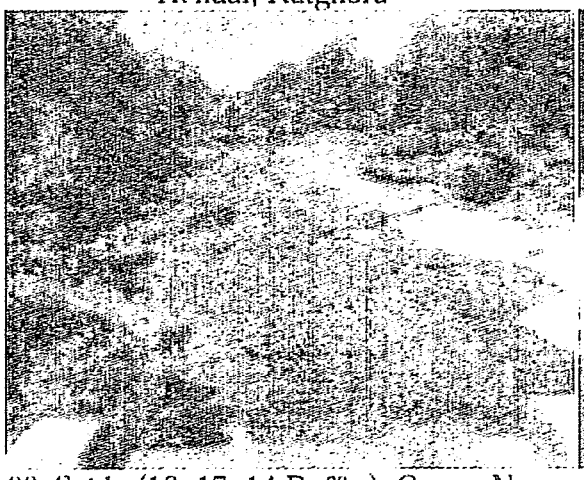
20. Madanpur - near NH (9 Core & 15, 16 Buffer), Comp. No. P387, Kendai, Katghora



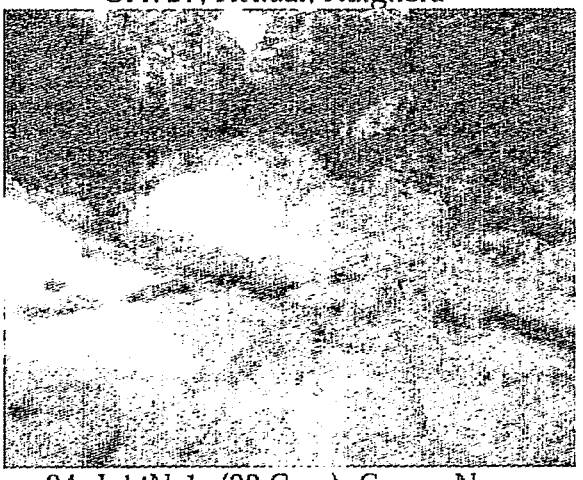
21. Parla (2 Buffer), Parla Village, Kendai, Katghora



22. Arisiya (7 Buffer), Comp. No. Arisiya OA727, Kendai, Katghora



23. Saidu (16, 17, 14 Buffer), Comp. No. P440, Kendai, Katghora



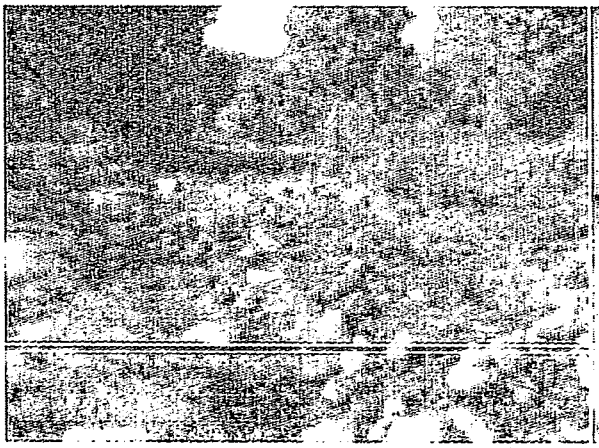
24. JokiNala (22 Core), Comp. No. P2188, Udaipur, Surguja



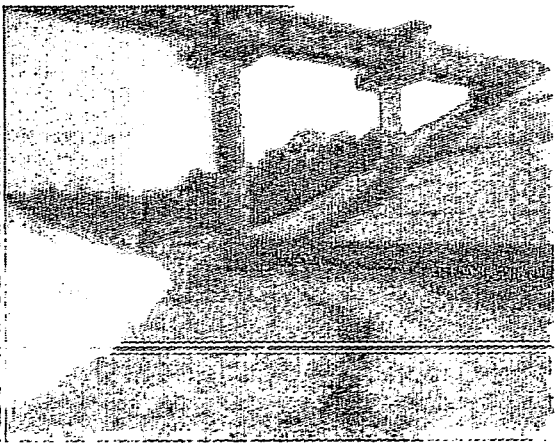
25. Kedma (23 Core), Comp. No. P2175, Udaipur, Surguja



26. Near Bakoi – GandherNala (HAC Buffer), Comp. No. OA1186, Lemru, Korba



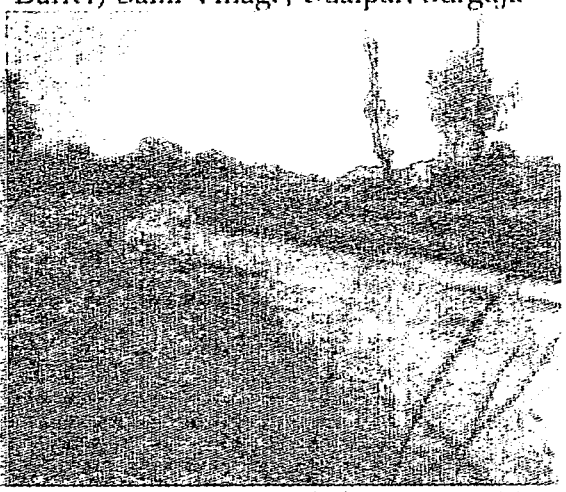
27. Nakiya – Binalta (1 Core Nakiya), Comp. No. OA1196, Lemru, Korba



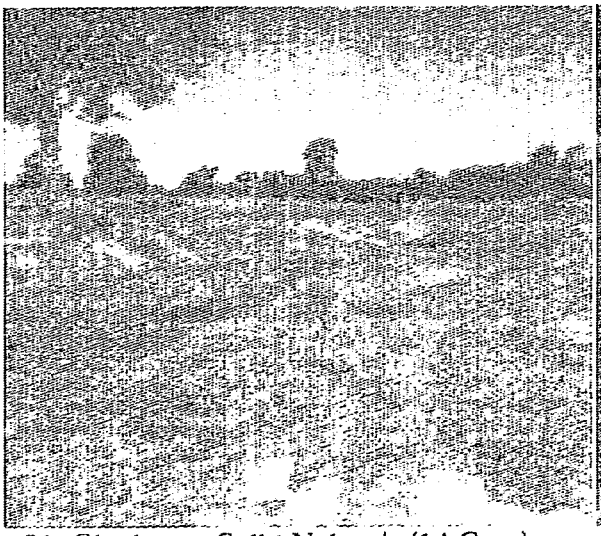
28. PEKB Salhi Nala u/s (13, 14, 15 Buffer) Salhi Village, Udaipur, Surguja



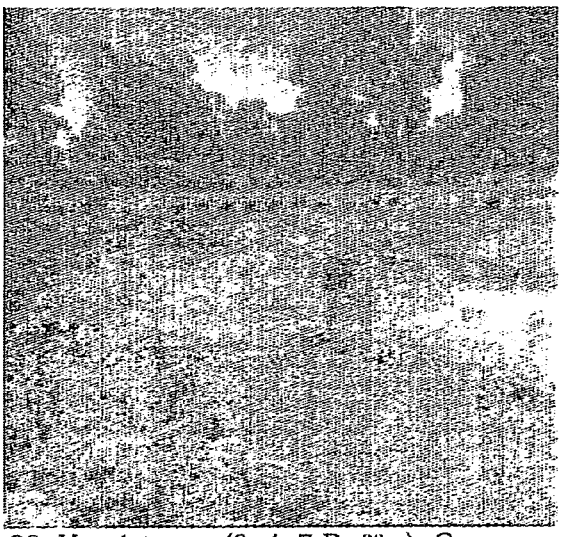
29. Puta Nala – Near NH (16 Core & 15, 10 Buffer), Comp. No. OA724, Kendai, Katghora



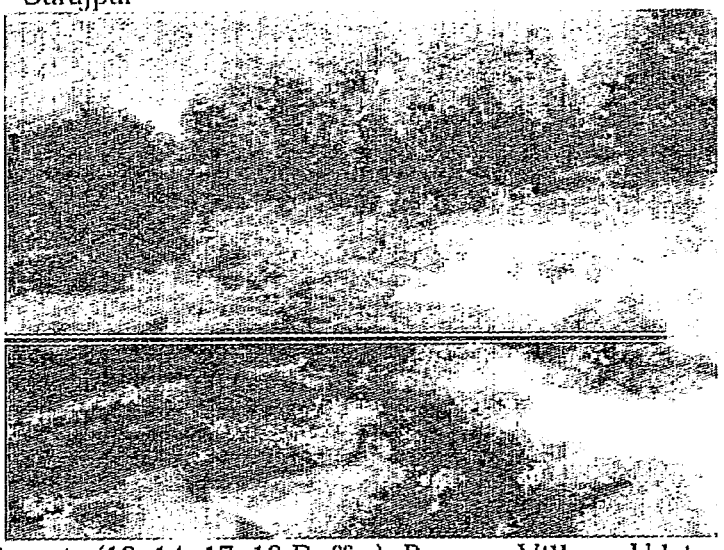
30. PEKB Salhi Nala u/s (13 Core & 14, 15 Buffer), Salhi Village, Udaipur, Surguja



31. Ghatbara - Salhi Nala u/s (14 Core), Ghatbara Village, Ramanuj Nagar, Surajpur



32. Kendai area (3, 4, 7 Buffer), Comp. No. OA726, Kendai, Katghora



33. Near Parogia (12, 14, 17, 19 Buffer), Parogya Village, Udaipur, Surguja

Plates 6.1: Images of sampling locations for aquatic macro-invertebrates in the core/buffer areas of the active/proposed coal blocks in whole Hasdeo-Arand Coalfield, Surguja, Surajpur and Korba, Chhattisgarh



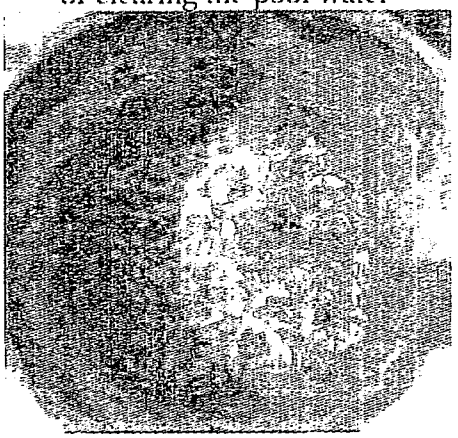
Fishing is being done in the temporary pools by handpicking after clearing water



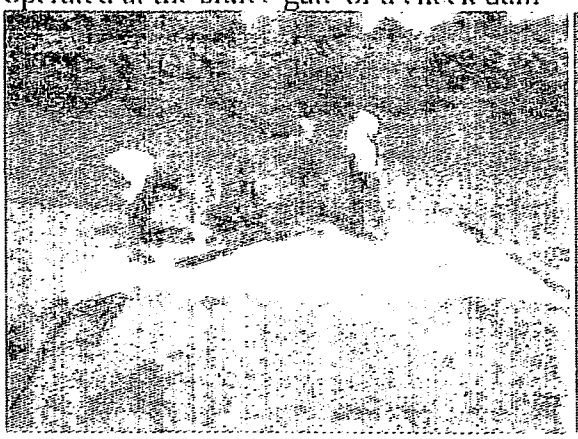
Fish catch obtained by hand picking out of clearing the pool water



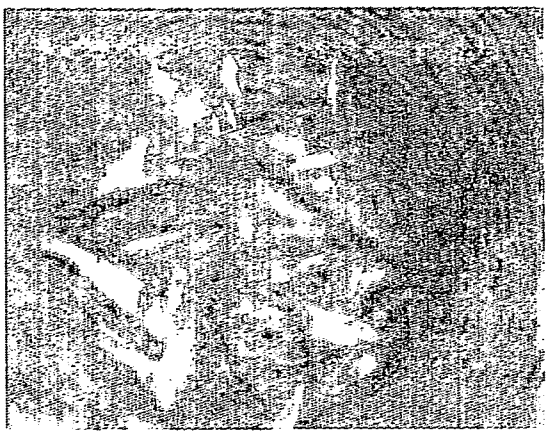
Bagnet (very small mesh size) is being operated at the sluice gate of a check dam



Fish catch obtained by bagnet fishing



Stake net haul is being spread on the shore



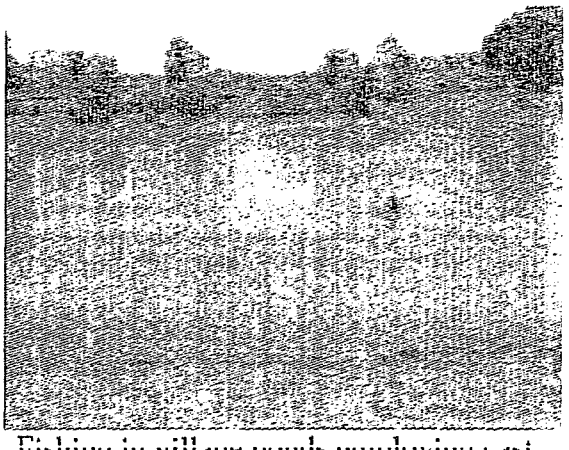
Fish catch obtained by stake net operation



Cast net operation in pool water



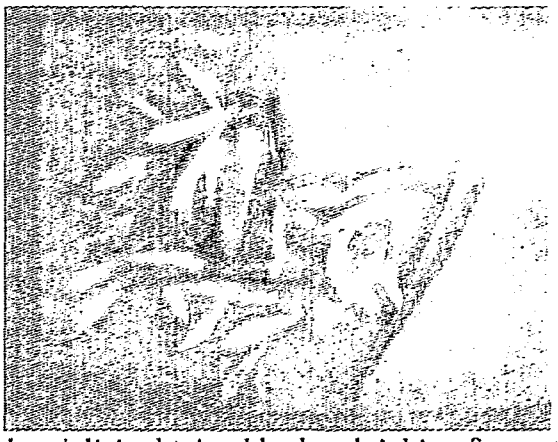
A catch obtained by cast net in pool water



Fishing in village ponds employing cast net/gill net



A catch of *Cyprinus carpio carpio* from the village pond

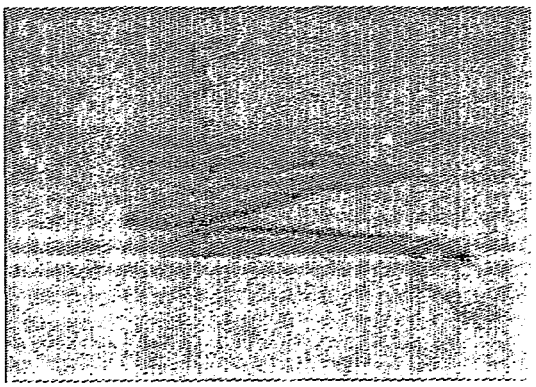


A catch of *Barilius bendelisis* obtained by handpicking from streams during post-monsoon

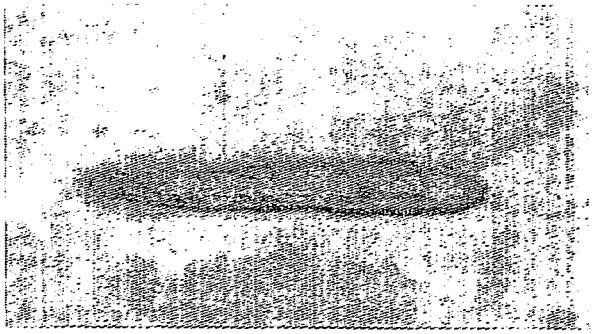
Plate 6.2: Artisanal fishing by employing country made crude fishing gears from the water resources in Hasdeo-Arand Coalfield



Lepidocephalichthysguntea



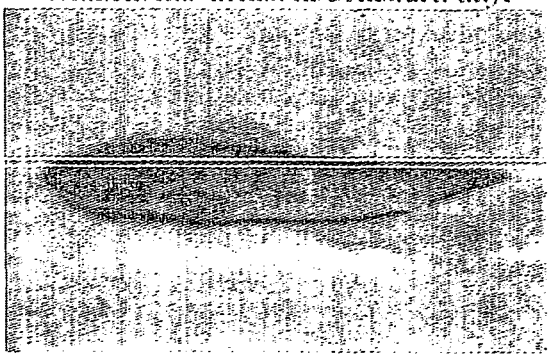
Glossogobius giuris



Nemacheilus denisoni/Schistura dayi



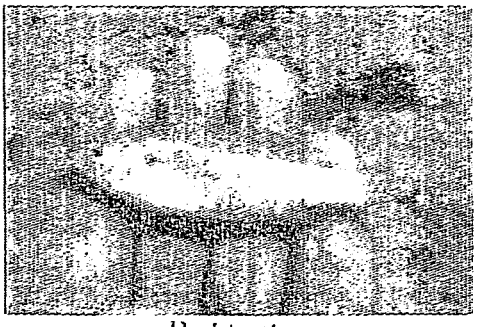
Glyptothoraxtelchitta



Channa punctata



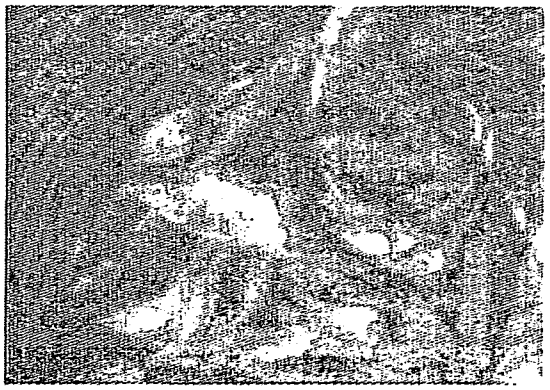
Channa gachua



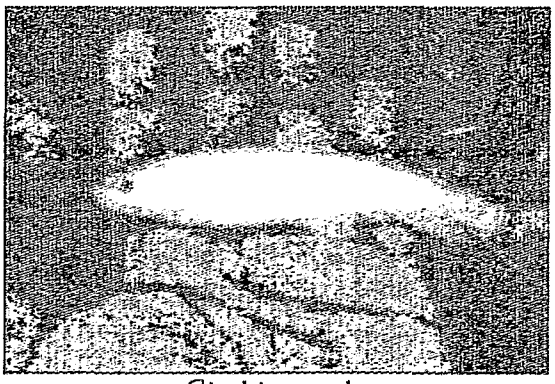
Pethia ticto



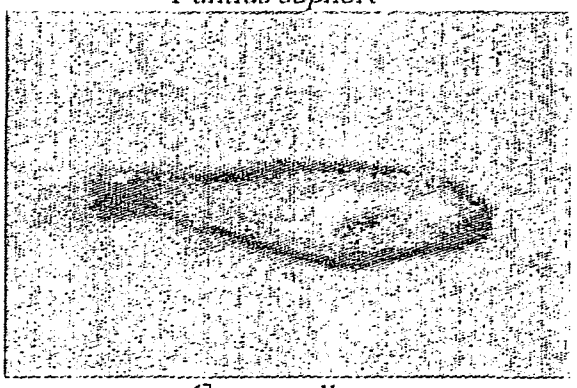
Puntius ambhibius



Puntius sophore



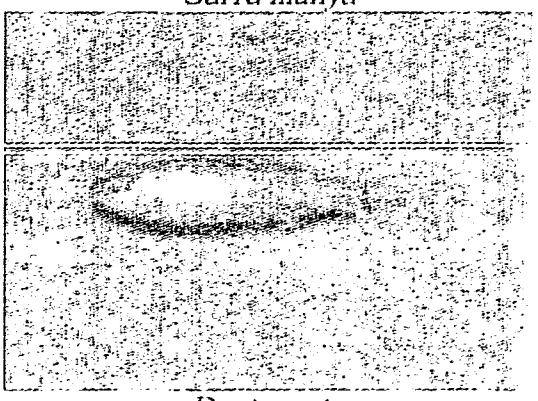
Cirrhinus reba



Garra mullya



Barilius bendelisis



Danio rerio

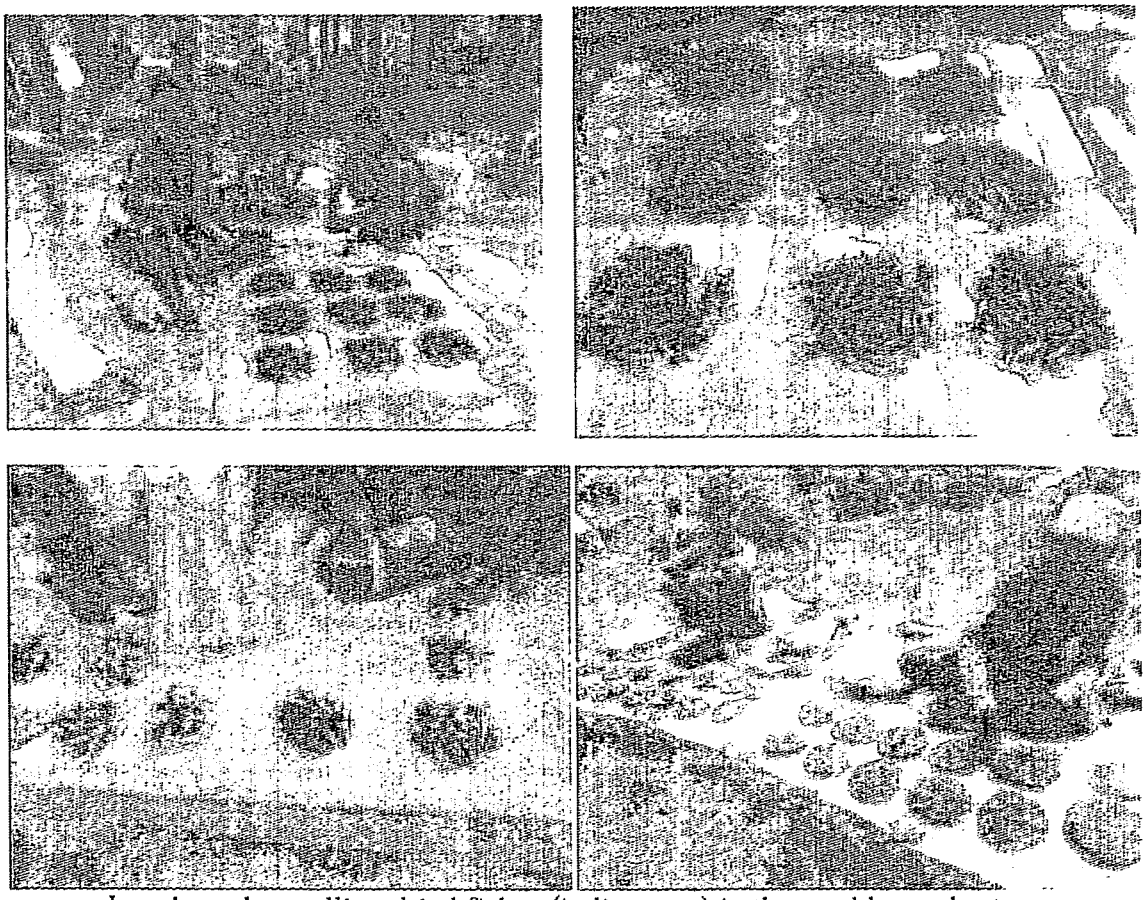


Oreochromis mossambica



Macrobrachium sp.

Plate 6.3: Most common fish species regularly being caught by the artisanal fishing using country made gears from the streams of Hasdeo-Arand Coalfield



Local vendors selling dried fishes (indigenous) in the weekly markests

Plate 6.4: Fishery resource utilization in the Hasdeo-Arand Coalfield – Smoked & sun dried fish is being sold in the weekly markets

CHAPTER- 7

SOCIO-ECONOMIC *VIS-A-VIS* BIODIVERSITY VALUES OF HAC

7.1 SCOPE OF THE STUDY

This chapter provides details on the socioeconomic values of villages and households in the entire Hasdeo-Arand Coalfield (HAC) and in the 23 coal blocks falling within the HAC located in Surguja, Surajpur and Korba districts of Chhattisgarh state.

7.2 STUDY AREA- HASDEO-ARAND COALFIELD (HAC)

The HAC lies partly in Udaipur, Lakhanpur tehsils/community development (CD) blocks of Surguja district; Korba and Poundi-Uproda tehsils/CD blocks of Korba district and Premnagar tehsil/CD block of Surajpur district in Chhattisgarh state. Under the provisions of the 5th Schedule of Constitution of India, the entire Hasdeo-Arand coalfield (HAC) region is a notified Scheduled Area. The Schedule provides a framework for local self-governance, enactment of PESA and upheld the rights of local communities for self-governance through local institutions and functionaries with the gram sabha to manage local plans and natural resources. There are 142 revenue villages belonging to 92 Gram Panchayats (Census of India, 2011; Socioeconomic and Caste Census, 2011) exists within HAC. These villages are located in the fringes of the protected/reserve forests under Kendai and Atmanagar forest ranges of Kathghora Forest Division; Udaipur forest range of South Surguja Forest Division; Ramanujnagar forest range of Surajpur Forest Division and Lemru, Balco, Pasarkhet and Kudmura forest ranges of Korba Forest Division (Figure 7.1 & 7.2) (Annexure 7.1 Table 1) and on which local communities have primary dependency for livelihoods and subsistence agricultural farming. The forest fringe villages falling within the core zone of mine lease area and buffer zone of 2 km radius from the boundary of the 23 coal blocks were considered for sample survey.

7.3 APPROACH AND METHODOLOGY

The approaches adopted include procurement of various documents, desk review of the documents /published reports /data, delineation of the HAC, identification of the villages and framing of questionnaire.

7. 3.1 Desk Review

Desk review of published data (District Census Statistical Handbooks 2011, Socioeconomic and Caste Census Report, 2011, 20th Livestock Census Report, 2019, Agricultural Census, 2015-16 and other relevant reports) was made for generating data. In addition the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) reports of Parsa East and Kanta Basan (PEKB), Parsa, Chotia-2B coal mine projects, mining plan and mine closure plan documents of

PEKB, Parsa, Tara, Chotia mine projects, pre-feasibility reports of Kente Extension, Gidmuri and Paturia, Madanpur South, Chotia-2B projects, social impact assessment report of Madanpur South project and rehabilitation and resettlement (R&R) plan, corporate social responsibility (CSR) reports of PEKB mine project and available other study reports and documents were reviewed for designing the questionnaire.

7. 3.2 Questionnaires

Structured questionnaire was framed to collect (1) household and (2) village data/ details (Annexure 7.3). List of villagers and key resource persons interviewed are given in Annexure 7.2 Table 1-2.

7.3.3 Sampling Design

The populations within the HAC were of homogenous in nature with the social structure (population predominated with scheduled tribes to the extent of 70-80%); occupation (about 80% practice agriculture) and literacy rate (36-68%). Therefore, simple random sampling design at village and household level were considered (Figure 7.3). The sample size and sampling intensity considered for the villages were n=35 and 24.65%; and for the household were n=4 and 1.56% respectively. The household survey for primary baseline data was made during June, 2019, Sept., 2019 and Feb., 2020. The questionnaires were tested during resonance survey to standardize before conducting the comprehensive survey.

Stratified random samplings were employed to identify the villages that are close to forest and households. Dependencies on forest in terms of quantity of fodder collected or mostly grazed, fuelwood and major NTFP's *etc* were identified as variables. The villagers sell the crop produce, left after their captive consumption, and buy items for daily needs from the local markets. The weekly markets (n=8) locally known as '*Weekly Haats*' which play an important role in satisfying the consumer needs of the villagers and provides them with an opportunity to sell their crops produce, forest produce and handicrafts. Focused group discussions in the form of Participatory Rural Appraisal (PRA) were conducted. The list of villagers and key resource persons interviewed are given in (Annexure 7.2 and Table 1-2).

7.3.4 Estimation of dependency on forests

The dependencies of the inhabitants of the HAC on forest resources for food, energy and health security were estimated from the household and local market survey. The dependency of communities living in proximity to forests on forest produce such as fuel wood, fodder and NTFPs (mainly Tendu, Mahua) were quantified from the removals. The value of those produce was arrived from both the respondent and from the current market value. Similarly, the income from agriculture, forest produce and livestock were also captured.

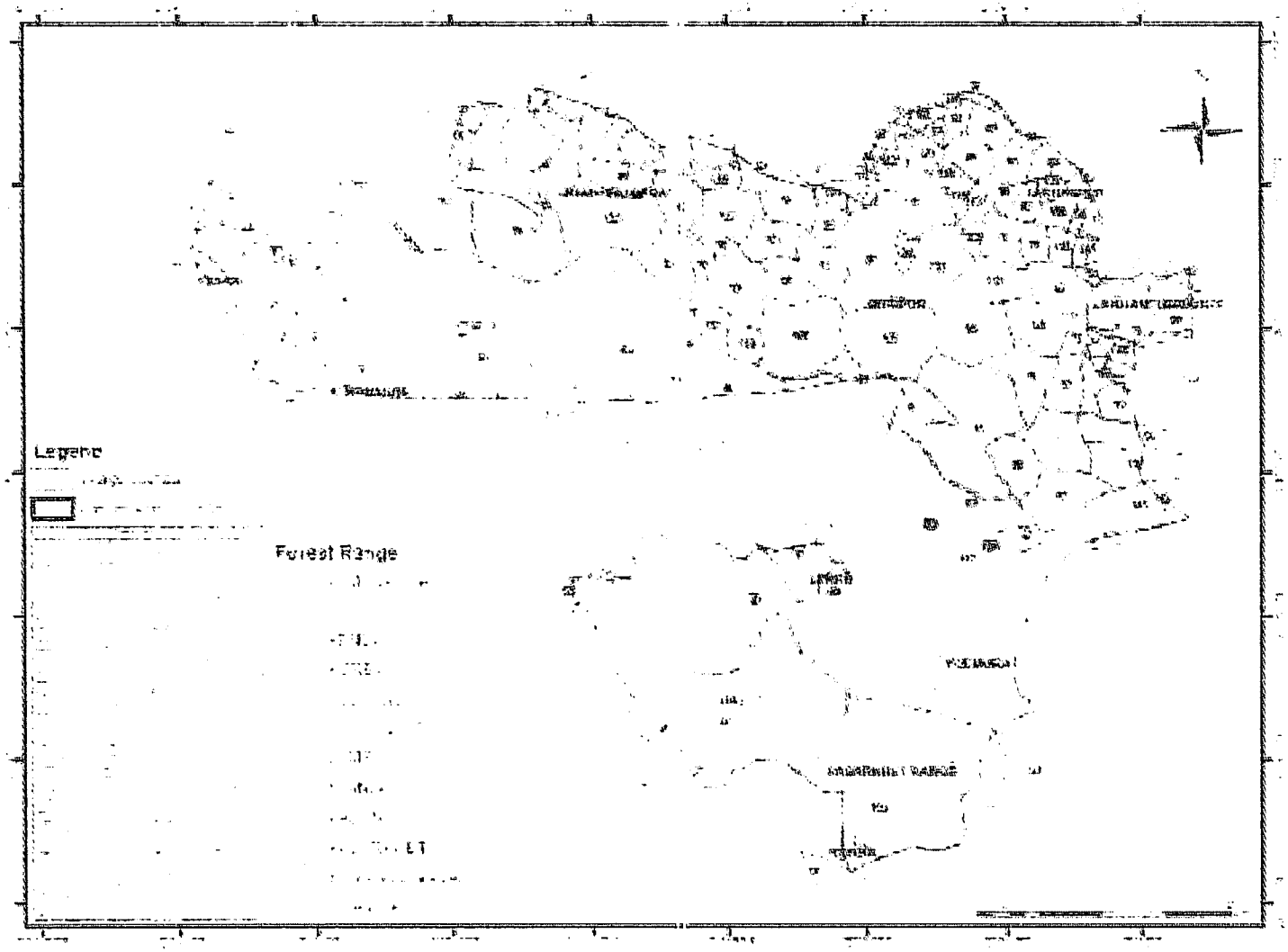


Figure 7.1: Map showing the administrative revenue villages in Hasdeo-Arand Coalfield that fall in Korba, Surguja and Surajpur districts of Chhattisgarh

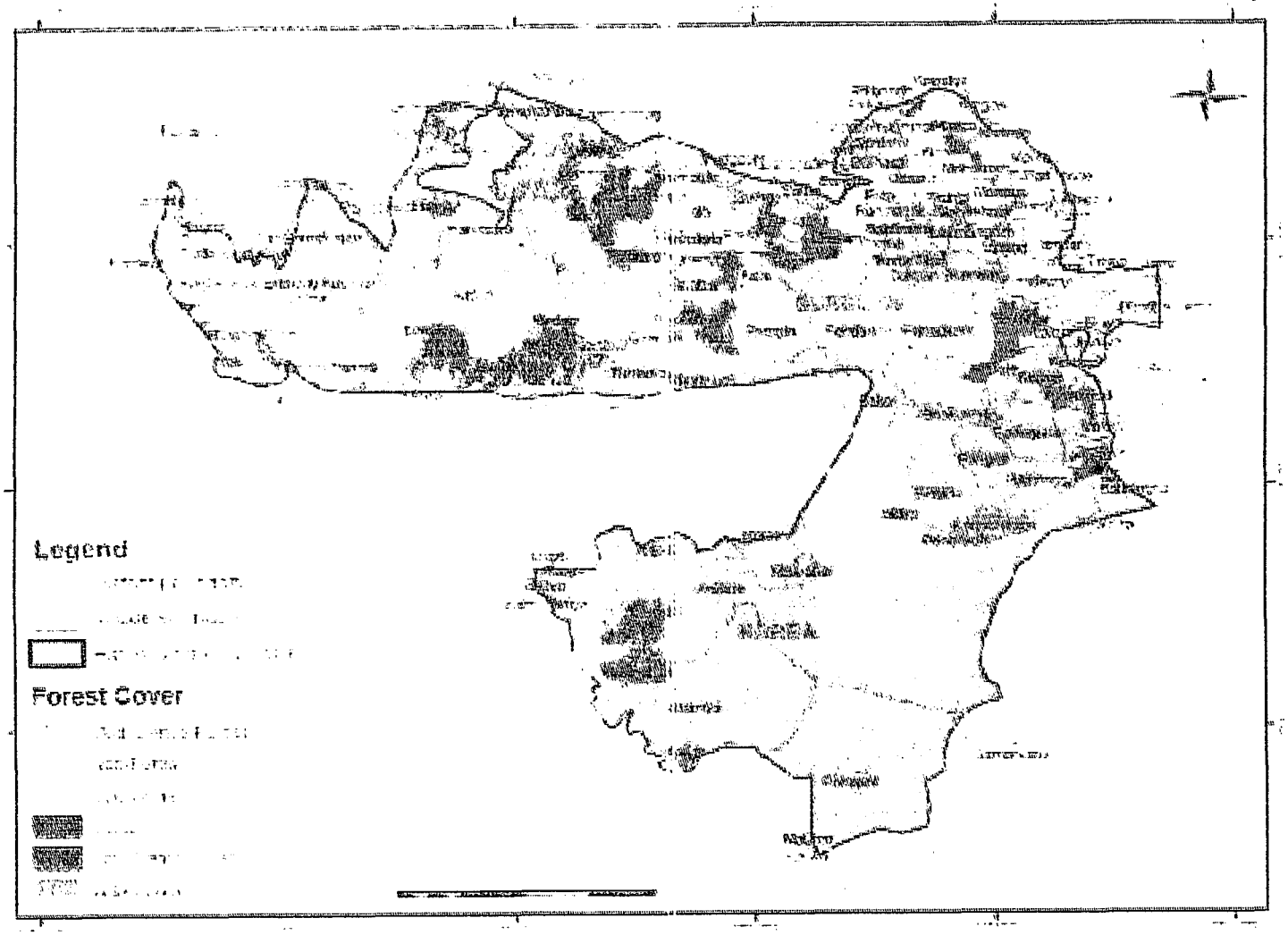


Figure 7.2: Map showing villages considered as forest fringe villages in Hasdeo-Arand Coalfield area that fall in Korba, Surguja and Surajpur districts of Chhattisgarh

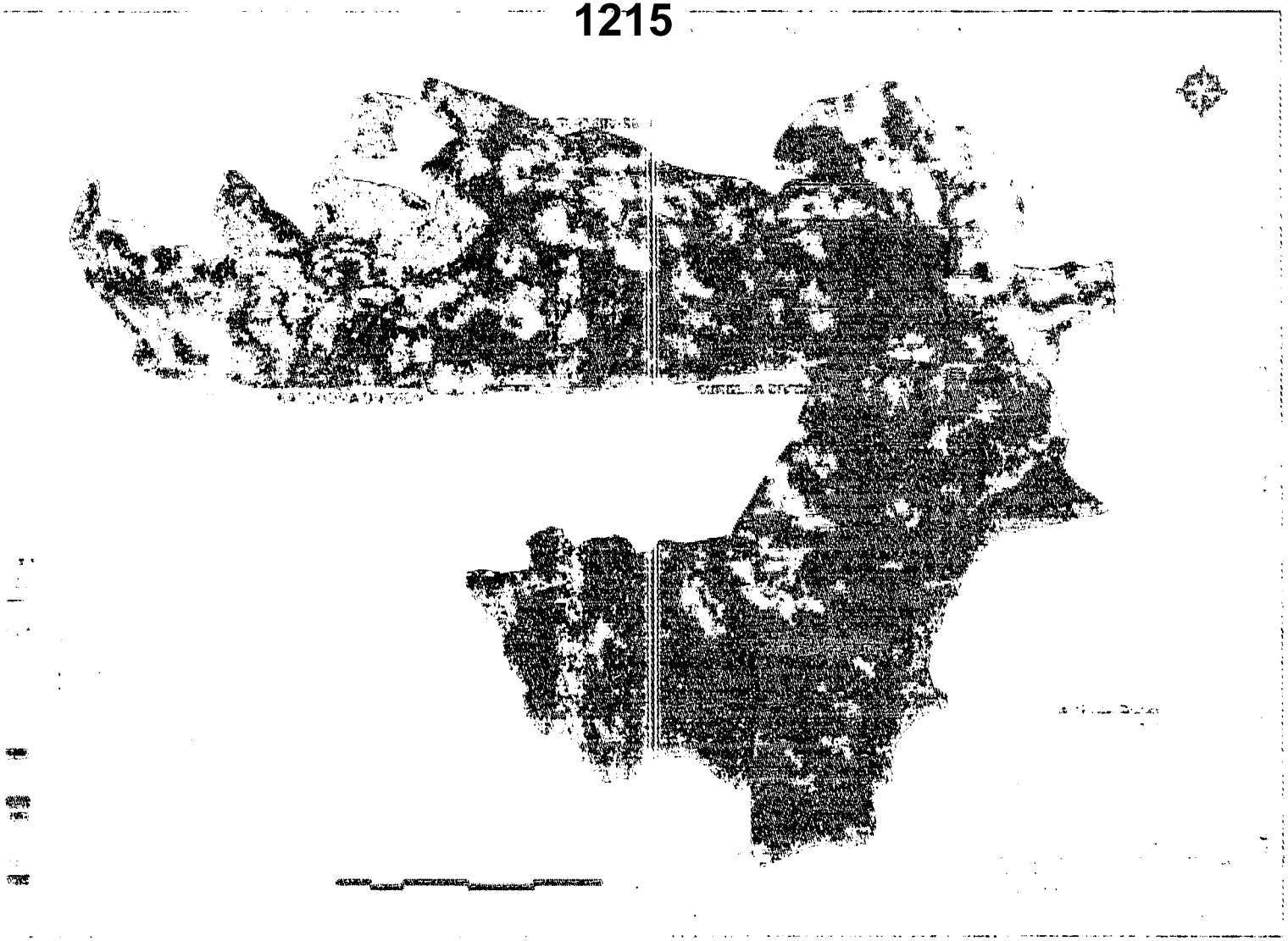


Figure 7.3: Map showing location the PRA conducted in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

The questionnaire was designed in such a way to verify the information provided by the respondents through triangulation process for the variable *i.e.*, the income from various sources to arrive at individual family income by cross checking with production from land, if available; forest produce and others. Few families, however, declined to accept the income calculated from agriculture and therefore considered nil. Semi-structured interviews were also conducted with the key resource persons *i.e.*, project officials, health workers, teachers and community members, forest field staff and their responses were recorded for triangulation of desired variables.

7.4 SOCIOECONOMIC STATUS OF THE VILLAGES IN HAC

7. 4.1 Demographic Profile

The HAC has 142 revenue villages that falls in Surguja, Surajpur, Korba districts of Chhattisgarh inhabited with 124948 population belonging to 28948 households (Census of India, 2011) that are sparsely/randomly distributed (average population density of 95 persons per sq.km) (Table 7.1). The average sex ratio is 981 with nuclear family structure having the average family/household size of 4.32 individuals.

7.4.2 Social Structure

The society is dominated with scheduled communities to the extent of 73.66% of total population comprising of scheduled tribes (69.74 %) and scheduled castes (3.92 %). Due to preponderance of scheduled population, HAC is notified as *Scheduled Area* as per the provisions of 5th Schedule of the Constitution of India. Other backward class (OBC) and general community constitute only 26.34 % of total population (Table 7.2).

Cultural diversity is represented with ethnic groups of different religious, social and cultural backgrounds. Amongst the notified forty two (42) scheduled tribe (ST), forty four (44) scheduled caste (SC) and 87 other backward class (OBC) communities in Chhattisgarh state, population in HAC is dominated with scheduled communities comprising of ST and SC followed by OBC and general communities. An account on the ethnic groups reported (Census, 2011) from HAC is given in Table 7.3 & Figure 7.4a. Each ethnic group has their own traditions, beliefs, customs, culture, festivals.

Hinduism is predominant (93.7%) religion among the tribes of the Chhattisgarh state followed by Christianity (4.7%), other religion (1.4 %) and Islam (0.1 %). Surgujia is the dominant first language in the Surguja (spoken by 56.72% population) and Surajpur (spoken by 81.3% population) districts, while Chhattisgarhi (spoken by 82.68% population) is spoken in Korba district besides Kurukh, Hindi and Sadri.

Table 7.1: Distribution of population in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

District	CD Block	No. of Gram Panchayat	No. of revenue villages	% of total villages	Village area (sq.km)	% of total village area	No. of HHs	% of total HHs	Population			% of total popu.	Sex Ratio	Av. HH size	Av. Popu. Density
									Total	Male	Female				
Surguja	Lakahnpur	13	17	11.97	152.72	11.58	087	14.12	17933	8959	8974	14.35	1002	4.39	117
	Udaipur	31	60	42.25	775.23	58.79	1523	39.81	51044	25790	25254	40.85	979	4.43	66
Surajpur	Premnagar	10	15	10.56	70.01	5.31	993	13.79	17256	8733	8523	13.81	976	4.32	246
Korba	Korba	10	19	13.38	55.04	5.04	374	8.20	9147	4582	4565	7.32	996	385	166
	Poundi-Uproda	17	31	21.83	265.72	19.28	971	24.08	29568	15016	14552	23.66	969	4.24	114
HAC		**81**	**142**	**100**	**1318.72**	**100**	**23948**	**100**	**124948**	**63080**	**61868**	**100**	**981**	**4.32**	**95**

Source- Extracted from Census of India, 2011

Table 7.2: Social structure in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

District	CD Block	Population			SC Population			ST Population			Total SC & ST Population			Others including OBCs Population		
		No.	%	Sex Ratio	No.	%	Sex Ratio	No.	%	Sex Ratio	No.	%	Sex Ratio	No.	%	Sex Ratio
Surguja	Lakahnpur	17933	14.35	1002	789	4.40	1013	12870	71.77	1002	13659	76.17	1003	4274	23.83	998
	Udaipur	51044	40.85	979	2245	4.40	964	33962	66.53	987	36207	70.93	985	14837	29.07	965
Surajpur	Premnagar	17256	13.81	976	421	2.44	914	11244	65.16	994	11665	67.60	991	5591	32.40	946
Korba	Korba	9147	7.32	996	326	3.56	979	8203	89.68	1008	8529	93.24	1007	1317	14.40	951
	Poundi-Uproda	29568	23.66	969	1121	3.79	922	20860	70.55	979	21981	74.34	975	6888	23.30	947
HAC		**124948**	**100**	**981**	**4902**	**3.92**	**957**	**87139**	**69.74**	**990**	**92041**	**73.66**	**988**	**32907**	**26.34**	**961**

Source- Extracted from Census of India, 2011

Table 7.3: Distribution of Ethnic/Tribal groups in Hasdeo-Arand Coalfield area that fall in Korba, Surguja and Surajpur districts of Chhattisgarh

District	CD Block	Tribal group	Villages
Korba	*Poundi-Uproda*	Agariya Baiga. Bharia Bhumia. Bhuinhar Bhumia. Bhumiya Bharia. Pando. Binjhwar. Birhul. Birhor. Dhanwar. Gond. Cherwa. Kawar. Kanwar. Tanwar. Khairwar. Kondar Kharia. Korwa. Kodaku. Majhwar. Munda. Oraon. Dhanka. Dhangad	Arisiya. Baniya. Bhujung kachhar. Chotiya. Dhajak. Ghatbarra. Ghunchapur. Gidmuri. Kapanapara. Kendai. Ketma. Khirti. Khotkhuri. Lalpur. Lamna. Madanpur. Morga. Parla. Paturiyadand. Puta. Rode. Thrriama. Uchalenga.
	Korba	Agariya. Andh. Baiga Bhaina. Bharia Bhumia. Bhuinhar Bhumia. Bhumiya Bharia. Paliha. Binjhwar. Damor. Damaria. Dhanwar. Gond. Koya. Kucha Maria. Maria. Kawar. Kanwar. Tanwar. Korku. Korwa. Majhi. Majhwar. Pardhi Bahelia. Chita Pardhi. Langoli Pardhi. Phans Pardhi. Shikari. Takankar. Takia Parja. Saonta. Saunta. Sawar. Sawara	Bimalta. Nakiya. Rapta. Pendradih.
Surguja	*Udaipur*	Agariya. Baiga. Bharia Bhumia. Bhuinhar Bhumia. Bhumiya Bharia. Pando. Binjhwar. Gond. Arakh. Moghya. Kawar. Kanwar. Tanwar. Korwa. Majhi. Majhwar. Nagesia. Oraon. Dhanka. Dhangad	Badegaon. Bakoi. Bangru. Basen. Bhakurma. Bule. Chakeri. Dawa. Fattepur. Ghatbarra. Pendarkhi. Gumga. Hariharpur. Jagga. Jhirmiti. Kedma. Keshma. Kete. Khondhala. Khujhi. Kumdeva. Kundeli. Lalpur. Laxmangarh. Mahespur. Manoharpur. Manpur. Mareya. Matringa. Mohanpur. Mudgaon. Pahadkorja. Palka. Pandripani. Pangoti. Parogia. Parsa. Pendarkhi. Phungi. Puta. Ramnagar. Saidu. Salhi. Sanibarra. Sarma. Sayar. Sitkalo. Sonatrai. Suskam. Tendu Tikra. Udaipur.
	Lakhanpur	Agariya Kanwar. Majhi. Majhwar. Dhanwar. Oraon. Dhanka. Dhangad	Jiwaliya
Surajpur	*Premnagar*	Agariya. Pando. Binjhwar. Oraon. Dhanka. Dhangad. Dhanwar. Gond. Majhwar. Nagesia. Oraon. Dhanka. Dhangad	Hariharpur. Janardanpur. Tara. Kantaroli. Mendra.

Sources : Extracted from Census of India, 2011

7.4.3 Particularly Vulnerable Tribal Groups (PVTGs)

There are five (05) Particularly Vulnerable Tribal Groups (PVTGs) reported from Chhattisgarh state (tribal.nic.in/ST/state wise PVTGs list-Pdf) of which two are i.e., **Pahari Korwa** and **Birhore** are reported from HAC (Figure 7.4b). These tribes are reported to live in isolation in remote inaccessible hills, forest areas and therefore are archaic, vulnerable, deprived, backward and most disadvantaged among other tribals. Their livelihood is vulnerable because over the years, the more dominant tribal and non-tribal groups have encroached upon the resources on which they originally controlled and accessed for their survival. **Pahari Korwa** a sub tribe of **Korwa tribe** and **Birhore tribe** have their habitation in Korba and Poundi-Uproda CD blocks of Korba district and Udaipur CD block of Surguja district.

- ***Birhors*** (man of the forest) are a special backward tribe of Chhattisgarh with a population of 3104 constituting of 1526 male and 1578 female and literacy of 39.0% with male literacy of 49.6% and female literacy of 28.7%. These tribes are reported to be distributed in 34 villages with 353 HHs and 1294 population in Poundi-Uproda CD block of Korba district. **Within HAC this tribe is reported from Lalpur village of Lalpur Gram Panchyat of Poundi-Uproda CD block, Korba district** (Census of India, 2011).There are two types of Bihore tribes of which one is the nomadic Bihore (*Uthalu*), who makes temporary habitats, roam around the hills for hunting and fishing during the rainy season. They also cultivate. The other is *Jaghich Birhor*. The principal deity is Sun (Surya) and Budhi Mai, Mary Mai, Ancestor Mountains, trees etc. and they believe in ghosts, black magic *etc*. Other considers the Birhors to specialize in sorcery. **Birhor tribe dance like Karama, Fagua, and Bihav dance** *etc.* and **the folk songs include Karama songs, Fagua songs, and marriage songs**. Their major musical instruments are mandar, dhol, dhaffli, timki etc.

- ***Pahari Korba*** **tribe** with population of more than 40 thousand and literacy rate of *11 percent* is reported to reside in Surguja and Korba and other districts of Chhattisgarh state. Pahari Korwa community is reported in 140 villages *in Surguja* district and 33 villages in Korba district representing 2374 HHs and 9509 population and 610 HHs and 2397 population (2011 Census). **Pahari Korwa is reported to be inhabited in Kadamjheriya village, a solely Pahrai Korwa inhabited tribal village (Figure 7.4b).** These tribes inhabit the mountain, the houses are made of wood, bamboo, clay, thatch and roof made of local tile. Their staple food is Kodo, Kutki, Godali Page, sometimes rice, wild root vegetables, seasonal vegetables, all kinds of birds, hens, fish, crab, goat, deer, pig etc. Make and drink wine from Mahua. Presently, permanent residents have started cultivation of Kodo-Kutki, Godali, Paddy, Maize, Black gram, Green pulse, Kulathi *etc*. Due to lack of irrigation and rocky land, the production is very less; those who have less agricultural land have started to work in the fields of other tribes.

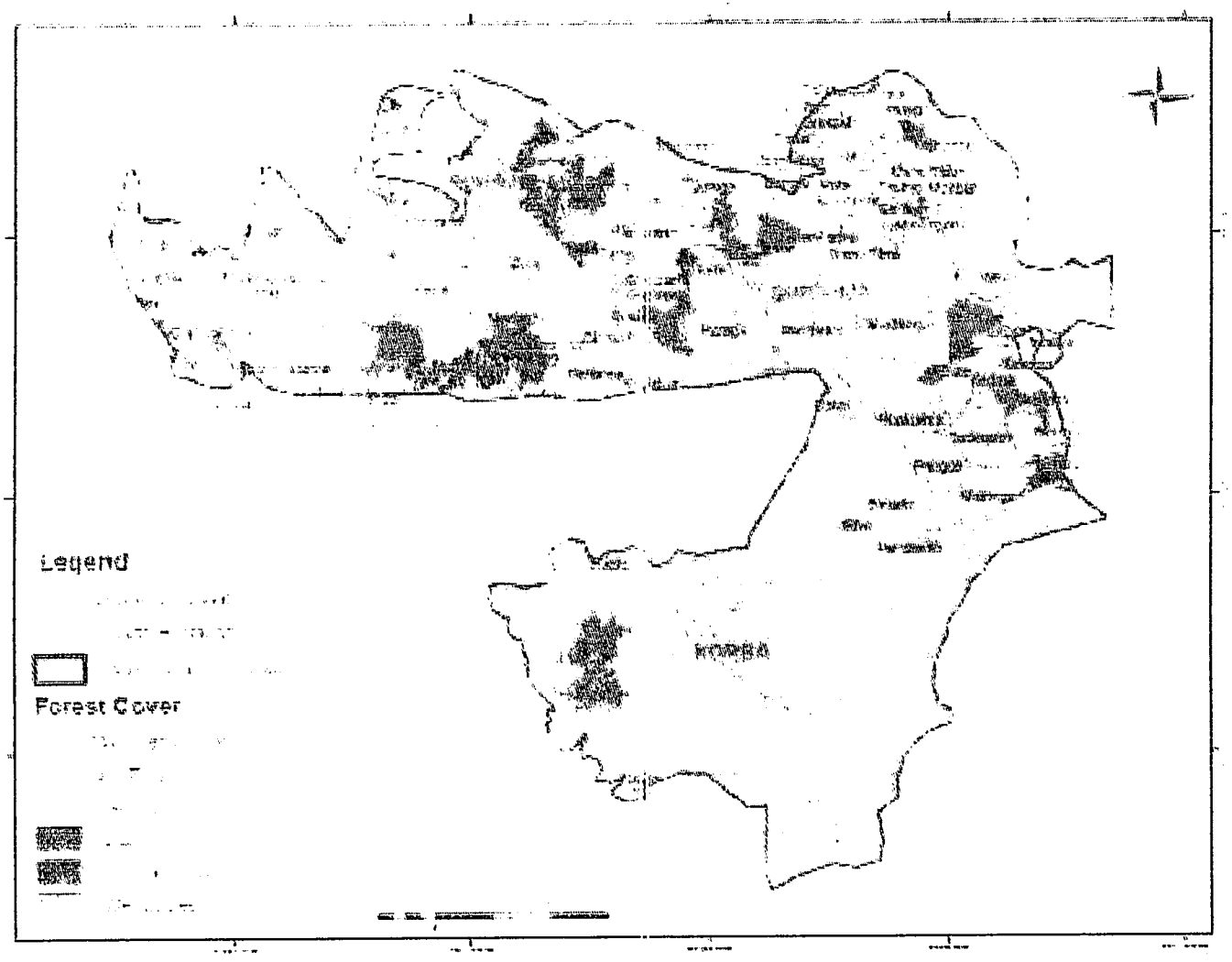


Figure 7.4a: Map showing villages inhabited by Ethnic/tribal groups in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

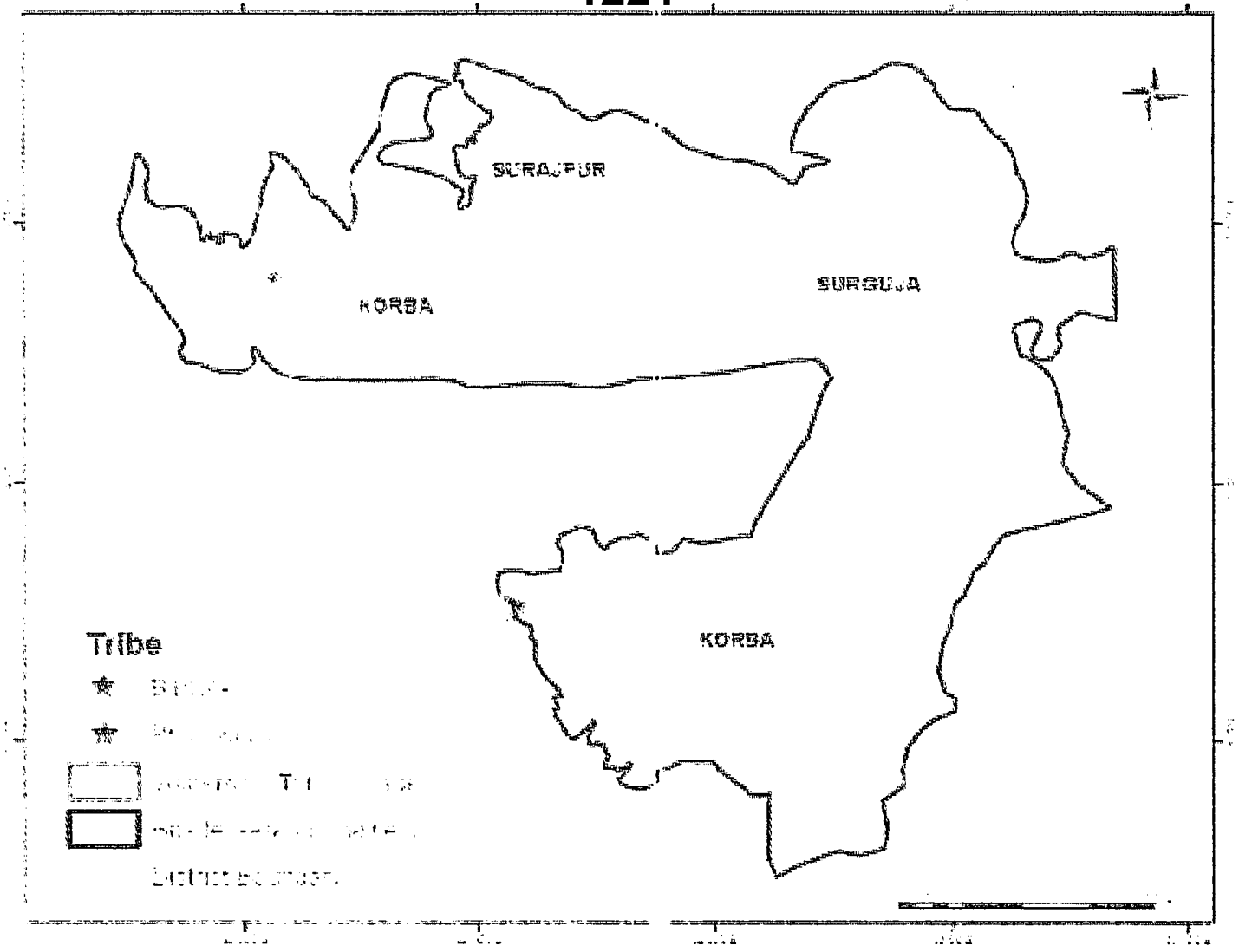


Figure 7.4b: Map showing vulnerable Tribal village locations in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

Kandamul, Bhaji, Mahua, Char, Gum, Tendu patta, Honey, Amla *etc.* are collected from wild, of which, Gum, Tendu patta, Char, Honey and Amla are sold in local markets. Men and children hunt birds with arrows and bows; catch fish, crab, and snail from small river/rivulets during rainy season and other seasons for self-consumption.

Pahari Korwa hunt, collect forest produce and practice dahiya farming. The hunters and forest dwellers wander from one mountain to another. Gotrihar, Hasda, Aidme, Farma, Samurahla, Gonu, Banda, Idinwar, Sonwani, Bhudivar, Birbani etc., are the gotras found in Pahari Korwa tribe.

Their main deities are Thakurdev, Khuriarani, Sheetala mata, Dulhadeva *etc.* In addition, snakes, tigers, trees, mountains, sun, moon, earth, river *etc.* are also considered as deities. On worship, they sacrifice the chicken and offers liquor. The major festivals are Dussehra, Nawakhani, Diwali, Holi etc. They also believe in witchcraft, black magic and ghosts. The person who knows the mantra or magic is called Devar Baiga.The people of this tribe dance Karama, Bihava, Parghni, Rahas *etc.* Karama songs, Bihav songs, Phags *etc.* are prominent in folk songs, which has its own specific dialect called "Korwa dialect".

7.4.4 Literacy

The literacy in HAC region is 53.38% and the female literacy is reported to be 44.91% (Table 7.4). The primary level educational institutions (278 schools) are well distributed in the HAC region with average availability of 02 primary schools per village followed by middle (104 schools), secondary (19 schools) and senior secondary (11 schools) level educational institutions in descending order with average availability of middle, secondary and senior secondary school in the order for 1.36, 7.47 and 12.90 villages sharing respectively making students to travel long distances for higher education. There are only three (03) degree colleges One (01) Medical college and three (03) polytechnic Colleges and 02 vocational training institutes in the HAC region (Table 7.5 & 7.6).

Table 7.4: Literacy status in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

CD Block	Literates			Illiterates			Literacy rate (%)		
	Total	M	F	Total	M	F	Total	M	F
Lakhanpur	6943	4137	2806	10990	4822	6168	46.73	55.51	37.89
Udaipur	24369	14171	10198	26675	11619	14968	57.11	65.70	48.33
Premnagar	7990	4742	3248	9266	3991	5275	55.46	65.19	45.53
Korba	3777	2307	1470	5370	2275	3095	49.28	59.83	38.59
Poundi Uproda	13949	8453	5496	15619	6563	9056	51.23	66.70	44.85
HAC	**57028**	**33810**	**23218**	**67920**	**29270**	**38562**	**53.38**	**64.00**	**44.91**

Source: Extracted from Census of India, 2011

Table 7.5: Educational infrastructure primary institutions in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

Coalfield Area Community Development Block (Distt.)	Pre-Primary School			Primary School			Middle School			Secondary School			Sr. Secondary School		
	Govt.	Private	Total	Govt.	Private	Total	Govt.	Private	Total	Govt.	Private	Total	Govt.	Private	Total
Poundi-Uproda	0	2	2	47	2	49	21	2	23	1	1	2	0	1	1
Korba	0	0	0	29	1	30	5	0	5	1	0	1	1	0	1
Premnagar	0	1	1	42	2	44	17	1	18	3	1	4	2	1	3
Udaipur	0	5	5	117	3	120	42	3	45	10	1	11	5	0	5
Lakhanpur	0	1	1	34	1	35	12	1	13	1	0	1	1	0	1
HAC	**0**	**9**	**9**	**269**	**9**	**278**	**97**	**7**	**104**	**16**	**3**	**19**	**9**	**2**	**11**
Source- Extracted from Census of India, 2011															

Table 7.6: Educational infrastructure higher institutions in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

Coalfield Area Community Development Block (Distt.)	Arts & Science Degree College		Engineering College		Medicine College		Management Institute		Polytechnic		Vocational Training School/ITI		Non Formal Training Centre		School for disabled		Others	
	Govt.	Private	Govt.	Private	Govt.	Private	Govt.	Private	Govt.	Private	Govt.	Private	Govt.	Private	Govt.	Private	Govt.	Private
Poundi-Uproda	1	1	0	0	0	1	0	0	1	1	1	1	0	0	0	0	0	0
Korba	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Premnagar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Udaipur	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Lakhanpur	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
HAC	2	1	0	0	0	1	0	0	2	1	1	1	0	0	0	0	7	0
Source- Extracted from Census of India, 2011																		

7.4.5 Occupations

Overall 89.32% of total working populations are engaged in agricultural related activities, 9.46% as other workers and 1.22% as household and industrial workers (Table 7.7- 7.8). Working population consists of 52.82% and dependent population is 47.18% of the total population in HAC. Females constituted 48.79 % of working population and 51.19% are dependent population. Agricultural labors dominated the working population followed by cultivators with 49.21% and 40.18% of working population respectively.

Main workers (having 6 months or more working period) constituted 50.44% and marginal workers (having less than 6 months working period) 49.34% of working population. Females constituted 31.66% among main worker and 68.34% among marginal workers (Table 7.8). Cultivators (56.08%) dominated main workers followed by agricultural laborers (30.53%), other workers (12.38%) and household (HH) industrial workers (1.45%). In terms of economic activity, overall 86.61% of main workers population is engaged in agriculture in HAC (Table 7.9 & 7.10); among the main workers females accounted for 43.93% as cultivators, 41.31% as agricultural laborers followed by other workers (12.38%) and HH industrial workers (1.45%). However, agricultural laborers (68.31 %) dominated marginal workers followed by cultivators (23.93%), other workers (6.47%) and HH industrial workers (0.99%). Overall 93.11% of marginal workers were engaged in agriculture related economic activities in HAC. Female marginal workers accounted for 67.81% as agricultural laborers followed by cultivators (25.59%), other workers (5.55%) and HH workers (1.06%) Table 7.11.

7.4.6 Amenities/Infrastructure Facilities

7.4.6.1 Healthcare Facilities

Major health related issues reported in the HAC are common diseases and the patients suffering from such common ailments are treated at the Primary Health sub Centers, Primary Health Centers, Community Health Centers available in the HAC. However, for acute and chronic cases people go to the nearest district hospital and super specialty hospital located at Ambikapur, Bilaspur, Korba, Raipur *etc.*

The primary health sub centers are available in 32 villages, primary healthcare centers in 5 villages and community healthcare center in 01 village in the HAC (Table 7.12). Child nutritional care units as Anganwadi Centre are available in 140 villages and other nutritional centres in 142 villages while Accredited Social Healthcare Activist (ASHA) workers are available for 139 villages (Table 7.13)

Table 7.7: Occupational status of total workers and non-workers in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

District	CD Block	Working Popu. (%)			Dependent Popu. (%)		
		Total	M	F	Total	M	F
Korba	Poundi-Uproda	49.73	56.17	43.07	50.27	43.83	56.93
Korba	Korba	48.20	58.6	37.68	51.80	41.31	62.32
Surajpur	Premnagar	51.056	55.6	52.45	45.94	44.37	47.55
Surguja	Udaipur	55.68	57.71	53.53	44.31	42.21	46.43
	Lakhanpur	50.96	55.01	46.91	49.04	44.99	53.09
Hasdeo-Arand Coalfield		**52.82**	**56.71**	**48.79**	**47.18**	**43.22**	**51.19**
Source- Extracted from Census of India, 2011							

Table 7.8: Occupational status of main and marginal workers in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

District	CD Block	Main Workers Popu. (%)			Marginal Workers Popu. (%)		
		Total	M	F	Total	M	F
Korba	Poundi-Uproda	52.71	69.19	30.54	47.29	30.81	69.46
Korba	Korba	32.16	37.22	24.24	67.84	62.77	75.75
Surajpur	Premnagar	58.80	86.85	28.32	41.20	13.15	71.68
Surguja	Udaipur	48.18	61.79	33.55	51.30	37.58	66.45
	Lakhanpur	54.07	71.35	33.85	45.93	28.65	66.15
Hasdeo-Arand Coalfield		50.44	66.40	31.66	49.34	33.33	68.34
Source- Census of India, 2011							

Table 7.9: Economic activity wise occupation status of total workers in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

District	CD Block	Working Popu. (%) of cultivators			Working Popu. (%) of agri lab.			Working Popu. (%) of HH workers			Working Popu. (%) of other workers		
		Total	M	F	Total	M	F	Total	M	F	Total	M	F
Korba	Poundi-Uproda	33.03	42.68	19.88	56.15	44.3	71.25	1.86	1.64	2.15	8.96	10.63	6.72
	Korba	22.59	32.61	6.92	61.62	52.0	76.51	0.91	1.00	0.76	14.88	14.28	15.81
Surajpur	Premnagar	61.30	71.72	49.98	31.58	19.1	44.81	1.17	1.03	1.32	5.95	7.84	3.89
Surguja	Udaipur	36.40	42.03	30.85	51.34	45.5	57.84	1.11	1.16	1.07	11.30	12.24	10.24
	Lakhanpur	50.32	58.66	40.55	43.43	33.4	55.37	0.73	0.83	0.62	5.52	7.26	3.47
Hasdeo-Arand Coalfield		40.18	47.81	31.39	49.21	40.2	59.42	1.22	1.20	1.25	9.46	10.73	7.94
Source-Extracted from Census of India, 2011													

Table 7.10: Economic activity wise occupational status of main workers in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

District	CD Block	Working Popu. (%) of Cultivators among main workers			Working Popu. (%) of agri. lab. among main workers			Working Popu. (%) HH ind. workers among main workers			Working Popu. (%) other workers among main workers		
		Total	M	F	Total	M	F	Total	M	F	Total	M	F
Korba	Poundi-Uproda	32.28	36.70	38.30	34.3[illegible]	29.[illegible]8	48.96	1.72	1.78	1.52	11.64	11.77	11.23
	Korba	34.77	42.36	16.55	46.3[illegible]	39.[illegible]6	63.79	1.90	2.10	1.44	17.00	16.48	18.23
Surajpur	Premnagar	70.01	76.98	46.76	19.3[illegible]	13.[illegible]8	38.31	1.48	1.00	3.08	9.15	8.34	11.85
Surguja	Udaipur	49.68	53.23	41.97	34.6[illegible]	31.[illegible]9	41.09	1.43	1.35	1.59	15.31	15.22	15.34
	Lakhanpur	70.45	73.38	63.23	20.9[illegible]	18.[illegible]7	27.79	0.91	0.91	0.91	7.69	7.54	8.07
Hasdeo-Arand Coalfield		56.08	60.82	43.93	30.53	26.[illegible]3	41.31	1.45	1.36	1.66	12.38	12.07	13.10

Source-Extracted from Census of India, 2011

Table 7.11: Economic activity wise occupational status of marginal workers in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

District	CD Block	Working Popu. (%) Cultivators amongst marginal workers			Working Popu. (%)Agri. Labourers amongst marginal workers			Working Popu. (%) HH workers amongst marginal workers			Working Popu. (%) other workers amongst marginal workers		
		Total	M	F	Total	M	F	Total	M	F	Total	M	F
Korba	Poundi-Uproda	11.56	11.20	11.78	80.44	79.42	81.05	2.01	1.31	2.43	5.98	8.08	4.73
	Korba	16.82	26.84	3.84	68.87	59.83	80.58	0.43	0.36	0.54	13.87	12.97	15.04
Surajpur	Premnagar	48.87	36.93	51.25	49.02	57.28	47.38	0.73	1.25	0.62	1.38	4.54	0.75
Surguja	Udaipur	23.93	23.63	25.24	67.03	68.19	66.30	0.82	0.84	0.80	7.54	7.34	7.66
	Lakhanpur	26.61	22.03	28.94	69.91	70.75	69.48	0.52	0.64	0.47	2.95	6.59	1.11
Hasdeo-Arand Coalfield		23.93	21.90	25.59	68.31	69.17	67.81	0.99	0.87	1.06	6.47	8.06	5.55

Source- Extracted from Census of India, 2011

Table 7.12: Health care infrastructure in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

District	CD Block	Availability of Health care infrastructure (No. of villages)																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	A	B
Korba	Poundi-Uproda	0	1	6	0	0	0	0	0	0	0	0	0	0	0	0	2	6	11	1	0
	Korba	0	1	2	1	0	0	0	1	0	0	0	1	0	0	1	0	2	0	1	0
Surajpur	Premnagar	0	1	8	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Surguja	Udaipur	1	1	11	4	0	0	0	1	2	0	0	1	0	0	1	2	22	129	3	0
	Lakhanpur	0	1	5	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0
Hasdeo-Arand Coalfield		1	5	32	12	0	0	0	2	3	0	0	2	0	0	2	5	30	140	5	0

Source- Extracted from Census of India, 2011

1	Community Health Centre	11	Family Welfare Centre
2	Primary Health Centre	12	Non-Government Medical Facilities Out Patient
3	Primary Health Sub Centre	13	Non-Government Medical Facilities in And Out Patient
4	Maternity And Child Welfare Centre	14	Non-Government Medical Facilities Charitable
5	TB Clinic	15	Non-Government Medical Facilities Medical Practitioner with MBBS Degree
6	Hospital Allopathic	16	Non-Government Medical Facilities Medical Practitioner with other Degree
7	Hospital Alternative Medicine	17	Non-Government Medical Facilities Medical Practitioner with no Degree
8	Dispensary	18	Non-Government Medical Facilities Traditional Practitioner and Faith Healer
9	Veterinary Hospital	A	Non-Government Medical facilities Medicine Shop
10	Mobile Health Clinic	B	Non-Government Medical facilities Others

Table 7.13: Child nutritional care infrastructure facilities in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

District	CD Block	Nutritional Centres-ICDS	Nutritional Centres-Anganwadi Centre	Nutritional Centres- Others	ASHA	Community Centre with/without TV
Korba	Poundi-Uproda	6	31	31	29	2
	Korba	1	19	19	18	1
Surajpur	Premnagar	0	14	15	15	0
Surguja	Udaipur	2	59	60	60	3
	Lakhanpur	4	17	17	17	3
Hasdeo-Arand Coalfield		13	140	142	139	9

Source- Extracted from Census of India, 2011

Table 7.14: Drinking water sources in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

District	CD Block	Tap water							Well					Hand Pump		Tubewell/ Bore wells			Springs			River/ Canal			Tank/ Pond/ Lake					
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Korba	Poundi-Uproda	3	3	3	4	2	3	0	0	0	28	24	24	31	29	29	3	2	2	5	5	5	11	6	6	19	10	10	0	0	0
	Korba	0	0	0	0	0	0	1	1	1	19	16	16	19	19	19	1	0	0	0	0	0	8	6	6	10	4	4	0	0	0
Surajpur	Premnagar	0	0	0	0	0	0	0	0	0	15	6	[illegible]	15	15	15	7	7	7	0	0	0	4	3	3	11	7	7	0	0	0
Surguja	Udaipur	0	0	0	12	10	10	1	0	0	60	34	34	69	59	59	8	6	6	5	5	5	32	9	8	56	25	25	0	0	0
	Lakhanpur	0	0	0	2	1	1	1	1	1	17	13	13	17	16	16	4	4	4	1	1	1	15	6	6	10	2	2	0	0	0
Hasdeo-Arand Coalfield		3	3	3	18	13	14	3	2	2	139	93	93	142	138	138	23	19	19	11	11	11	70	30	29	106	48	48	0	0	0

Source- Extracted from Census of India, 2011

1	Tap Water-Treated source of drinking water	9	Uncovered Well
2	Tap Water-Treated Functioning All-round the year	11	Uncovered Well Functioning All-round the year
3	Tap Water-Treated Functioning in Summer months (April-September)	12	Uncovered Well Functioning in Summer months (April-September)
4	Tap Water Untreated source of drinking water	13	Hand Pump
5	Tap Water Untreated Functioning All-round the year	14	Hand Pump Functioning All-round the year
6	Tap Water Untreated Functioning in Summer months (April-September)	15	Hand Pump Functioning in Summer months (April-September)
7	Covered Well	16	Tube Wells Borehole
8	Covered Well Functioning All-round the year	17	Tube Wells Borehole Functioning All-round the year
9	Covered Well Functioning in Summer months (April-September)	18	Tube Wells Borehole Functioning in Summer months (April-September)
19	Spring	25	Tank Pond Lake
20	Spring Functioning All-round the year	26	Tank Pond Lake Functioning All-round the year
21	Spring Functioning in Summer months (April-September)	27	Tank Pond/Lake Functioning in Summer months (April-September)
22	River Canal	28	Others
23	River Canal Functioning All-round the year	29	Others Functioning All-round the year
24	River Canal Functioning in Summer months (April-September)	30	Others Functioning in Summer months (April-September)

7.4.6.2 Drinking Water facilities

The villagers fetch water from the facilities either located in their village or within 500 m to 1 km distance. Hand pump is the main sources for drinking water in HAC available in all 142 villages however these are functional round the year in only 138 villages; followed by uncovered wells in 139 villages, but are functional round the year in 93 villages (Table 7.14). Drinking water from tube well/bore well is available in 23 villages and functional round the year in only 19 villages; tap water from treated source and functional round the year in 03 villages. Tap water from untreated sources is available in 18 villages but functional round the year only in 13 villages. Drinking water is also sourced from springs with availability in 11 villages and the dependence of households from 51 villages; river/canal in 70 villages having dependence of households from 30 villages; and tank/pond/lake in 106 villages with round the year and dependence of households from 48 villages (Table 7.14). Overall 56.83% of household in HAC are dependent on hand pump for drinking water followed by well (24.75 %), tap water (5.23%), River/canal (5.06%), springs (4.12%) and minimum (0.56%) on tanks/ponds/ lake (Table 7.15)

Table 7.15: Dependency rate of households on different sources of drinking water in Hasdeo-Arand Coalfield area, Chhattisgarh

Source of drinking water	Dependency rate (%)
Hand pump for drinking water	56.83
Well (covered & uncovered) for drinking water	24.75
Tap water (treated & untreated) for drinking water	5.23
River /canal for drinking water	5.06
Springs for drinking water	4.12
Other	2.56
Tube well/ bore well for drinking water	0.89
Tank/Pond/Lake for drinking water	0.56

Source: Based on Census of India, 2011

7. 4.6.3 Road Network

The National Highway (NH) 130 passes through the HAC and providing connectivity to 06 villages falling along right and left sides of NH 130. State highway provided connectivity to 16 villages. Out of 142 villages 134 villages have connectivity through gravel (kuchha road) and 96 villages have all weather road connectivity.

The private bus transport facilities are available in 73 villages followed by cart driven by animals in 67 villages. The Kedma, Bhakurma and Nakiya villages in the HAC situated at 25-30 km away from NH 130, are connected through link road from Udaipur to Matringa and Udaipur via Lemru to Korba with daily bus service respectively. Status of availability of road connectivity and transportation facilities is given in Table 7.16-7.17

Table 7.16: Road connectivity in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

District	CD Block	1	2	3	4	5	6	7	8	9	10
Korba	Poundi Uproda	6	5	14	15	24	28	18	23	10	1
	Korba	0	0	5	11	13	18	11	14	4	1
Surajpur	Premnagar	0	2	7	9	11	14	10	13	0	0
Surguja	Udaipur	0	8	11	42	10	58	37	32	0	0
	Lakhanpur	0	1	6	7	15	16	10	14	0	0
Hasdeo Arand Coalfield		6	16	43	84	73	134	86	96	14	2

Source: Extracted from Census of India, 2011

1	National Highway	6	Gravel (kuchha) Roads
2	State Highway	7	Water Bounded Macadam
3	Major District Road	8	All Weather Road
4	Other District Road	9	Navigable Waterways (River/Canal)
5	Black Topped (pucca) Road	10	Footpath

Table 7.17: Transportation facilities in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

District	CD Block	1	2	3	4	5	6	7	8	9	10	11
Korba	Poundi Uproda	0	14	1	0	1	5	9	7		16	0
	Korba	0	10	0	4	4	0	1	1	0	3	4
Surajpur	Premnagar	0	9	0	0	0	0	2	0	0	6	0
Surguja	Udaipur	0	26	0	0	0	1	20	3	0	32	0
	Lakhanpur	0	14	0	0	0	2	7	3	0	10	0
Hasdeo Arand Coalfield		0	73	1	4	5	8	39	14	0	67	4

Source: Extracted from Census of India, 2011

1	Public Bus Service	7	Tractors
2	Private Bus Service	8	Cycle pulled Rickshaws (manual driven)
3	Railway Station	9	Cycle pulled Rickshaws (machine driven)
4	Auto/Modified Autos	10	Carts Driven by Animals
5	Taxi	11	River/Ferry Service
6	Vans		

7.4.6.4 Communication facilities

The HAC was having services of 09 post offices, 06 sub post offices, and 03 private courier service providers. About 16 villages have landlines network and 64 villages under mobile network coverage (Table 7.18). The credit facilities included three commercial banks, eight Co operative and agricultural credit societies each (Table 7.19).

There are 134 SHGs, 21 regular markets, 18 weekly markets and 12 agricultural marketing societies in HAC for procurement of paddy, other agricultural crops, horticultural, forest and animal husbandry produce. Facilities for extracurricular and entertainment are available in 42 villages, public reading rooms in 63 villages and newspaper supply in 71 villages. Birth and death registration office was available in 96 villages (Table 7.20).

Table 7.18: Postal and communication network connectivity in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

District	CD Block	Postal				Telephony			
		1	2	3	4	5	6	7	8
Korba	Poundi-Uproda	2	1	1	2	5	4	3	1
	Korba	0	0	0	0	1	0	1	0
Surajpur	Premnagar	1	0	0	0	1	1	7	0
Surguja	Udaipur	4	3	0	1	6	3	40	2
	Lakhanpur	2	2	0	0	3	3	13	1
Hasdeo Arand Coalfield		9	6	1	3	16	11	64	4

Source: Extracted from Census of India, 2011

1 Post Office
2 Sub Post Office
3 Post and Telegraph Office
4 Private Courier Facility
5 Telephone (landlines)
6 Public Call Office /Mobile
7 Mobile Phone Coverage
8 Internet Cafes / Common Service Centre (CSC)

Table 7.19: Credit and marketing facilities in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

District	CD Block	Credit			Marketing				
		1	2	3	4	5	6	7	8
Korba	Poundi Uproda	1	1	2	30	19	15	6	8
	Korba	0	1	0	19	6	0	2	0
Surajpur	Premnagar	2	2	2	15	9	0	4	2
Surguja	Udaipur	0	4	3	53	29	2	4	1
	Lakhanpur	0	0	1	0	0	0	0	0
Hasdeo Arand Coalfield		3	8	8	134	76	21	18	12

Source: Extracted from Census of India, 2011

1 Commercial Bank
2 Cooperative Bank
3 Agricultural Credit Societies
4 Self Help Group (SHG)
5 Public Distribution System (PDS) Shop
6 Mandis/Regular Market
7 Weekly Haat
8 Agricultural Marketing Society

Table 7.20: Facilities for extracurricular and entertainment in Hasdeo Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

District	CD Block	1	2	3	4	5	6	7
Korba	Poundi Uproda	4	1	1	1	20	13	24
	Korba	6	1	1	2	3	4	10
Surajpur	Premnagar	5	0	0	3	6	4	10
Surguja	Udaipur	18	1	2	0	21	39	35
	Lakhanpur	9	3	3	1	13	11	17
Hasdeo Arand Coalfield		42	6	7	10	63	71	96

Source: Extracted from Census of India, 2011

1 Sports Field
2 Sports Club/Recreation Centre
3 Cinema/Video Hall
4 Public Library
5 Public Reading Room
6 Daily Newspaper Supply
7 Birth and Death Registration Office

7.4.7 Agricultural and horticultural crop diversity and productivity

HAC falls partly in sub humid and Chhattisgarh/Mahanadi basin J3 (Cd/Cm)5 agro-ecological zone and northern hill zone of Chhattisgarh and Eastern Plateau & hill agro-climatic zone. Annual normal rainfall varies between 1192.3 mm to 1400 mm.

Major agricultural/horticultural crops grown in HAC are presented in Table 7.21 and cropping cycle in Table 7.22.

Table 7.21: Major agricultural/horticultural crops grown in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

Crop type	Scientific Name	Family	Common Name
Fruits	*Mangifera indica* L	Anacardiaceae	Mango
	Musa paradisiaca L	Musaceae	Banana
	Carica papaya L	Caricaceae	Papaya
	Artocarpus heterophyllus Lam	Moraceae	Jackfruit
	Anacardium occidentale L	Anacardiaceae	Cashew nut
	Annona reticulata L	Annonaceae	Custard apple
	Litchi chinensis Sonn.	Sapindaceae	Litchi
	Citrullus lanatus (Thunb) Matsum & Nakai	Cucurbitaceae	Watermelon
	Cucumis melo L	Cucurbitaceae	Musk melon
	Punica granatum L	Lythraceae	Pomegranate
	Pyrus communis L	Rosaceae	Pear
	Citrus aurantium L	Rutaceae	Sour Orange
	Zizyphus mauritiana Lam	Rhamnaceae	Ber
	Phyllanthus emblica L	Phyllanthaceae	Amla
	Psidium guajava L	Myrtaceae	Guava
	Citrus limon (L.) Osbeck	Rutaceae	Lemon
	Citrus sinensis (L.) Osbeck	Rutaceae	Orange
Cereals	*Oryza sativa* L	Poaceae	Rice
	Sorghum bicolor (L.) Moench *subsp. bicolor*	Poaceae	Jowar
	Pennisetum glaucum (L.) R. Br	Poaceae	Millets
	Zea mays L	Poaceae	Maize
	Triticum		Wheat
Pulses	*Cajanus cajan* (L.) Huth	Fabaceae	Pigeon pea
	Cicer arietinum L	Fabaceae	Gram
	Vigna radiata (L.) R. Wilczek *var. radiata*	Fabaceae	Green Gram
	Lablab purpureus (L.) Sweet	Fabaceae	Sloth Gram
	Macrotyloma uniflorum (Lam.) Verdc	Fabaceae	Horse Gram
	Glycine max (L.) Merr	Fabaceae	Soybean
	Pisum sativum L	Fabaceae	Peas
	Lens culinaris Medik	Fabaceae	Lentils
	Lathyrus sativus L	Fabaceae	Lathyrus
Oilseeds	*Brassica campestris* L	Brassicaceae	Rapeseed/Mustard
	Linum usitatissimum L	Linaceae	Alsi, Linseed
	Arachis hypogaea L	Fabaceae	Groundnut
	Sesamum orientale L	Pedaliaceae	Sesamum
	Glycine max (L.) Merr	Fabaceae	Soyabean
	Helianthus annuus L	Asteraceae	Sunflower
	Carthamus tinctorius L	Asteraceae	Safflower/Niger
Vegetables	*Solanum lycopersicum* L	Solanaceae	Tomato
	Solanum melongena L	Solanaceae	Brinjal
	Abelmoschus esculentus (L.) Moench	Malvaceae	Bhindi
	Brassica oleracea L *var. capitata* L	Brassicaceae	Cabbage
	Brassica oleracea L *var. botrytis* L	Brassicaceae	Cauliflower
	Lagenaria siceraria (Molina) Standl	Cucurbitaceae	Bottle gourd
	Vigna unguiculata (L.) Walp	Fabaceae	Cowpea
	Phaseolus vulgaris L	Fabaceae	Beans
	Solanum tuberosum L	Solonaceae	Potato
	Allium cepa L	Amaryllidaceae	Onion
	Pisum sativum L	Fabaceae	Green Peas
	Raphanus sativus subsp. *Sativus*	Brassicaceae	Radish

Crop type	Scientific Name	Family	Common Name
Cash Crops	*Saccharum officinarum* L.	Poaceae	Sugarcane
	Capsicum frutescens L.	Solonaceae	Chilli
	Zingiber officinale Roscoe	Zingiberaceae	Ginger
	Curcuma longa L.	Zingiberaceae	Turmeric
	Allium sativum L.	Amaryllidaceae	Garlic
	Brassica rapa L. subsp. *dichotoma* (Roxb.) Hanelt	Brassicaceae	Toria

About 89.39% working population in HAC are engaged in agriculture related activities out of which 40.18% are cultivators and 49.21% are agricultural labourers. Cultivation/agriculture is largely practiced by marginal and small lands that are under rain fed conditions with single crop production. About 57.90% HHs are having marginal and 22.60% small operational land holdings.

Table 7.22: Cropping seasons of major agricultural/horticultural crops grown in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

Cereals		Pulses		Oilseeds	
Kharif	**Rabi**	**Kharif**	**Rabi**	**Kharif**	**Rabi**
Rice	Wheat	Pigeon Pea	Peas	Rapeseed Mustard	Rapeseed Mustard
Jowar		Gram	Lentils	Linseed	
Millets		Green gram	Lathyrus	Groundnut	Groundnut
Maize		Sloth gram		Sesamum	
		Horse gram		Soya bean	
		Moong		Sun flower	Sun flower
		Soybean		Niger/safflower	
Vegetables		**Cash crop**		**Horticultural crops**	
Kharif	**Rabi**	**Kharif**	**Rabi**	**Kharif**	**Rabi**
Tomato	Potato	Sugarcane	Garlic	Mango	Sour Orange
Brinjal	Onion	Chilli	Toria	Banana	Ber
Bhindi	Green Peas	Zinger		Papaya	Amla
Cabbage	Radish	Turmeric		Jackfruit	Guava
Leafy veg.	Others			Cashew nut,	Lemon
Cauliflower				Custard apple	Orange
Bottle guard				Litchi	
Cow peas				Watermelon	
Beans				Musk melon	
Others				Pomegranate	
				Pear	

Estimated net sown area is 234 sq km out of which about 97% is rain fed with average land holding of 1.6 ha. Kharif is main cropping season, however, crops were also grown during Rabi season in irrigated areas (1.5 sq km) particularly in low lying and natural drainage areas having sufficient soil moisture.

Paddy is grown as major cereal crop in HAC, wheat and maize as minor cereal crops. The production is only for self-consumption, however, the surplus paddy and other crops produced are sold in cooperative society. The average productivity of cereals as reported in HAC is given in Figure 7.5.

Sloth gram, Pigeon peas, Horse gram, Lathyrus, Pea are the major pulses grown only for self-consumption in the HAC and the average productivity as reported is given in Figure 7.6. Groundnut, Seasmum, Sunflower, Rape seed– Mustard, Linseed, Niger, Soybean are prominent oilseeds grown only for self-consumption in the area and their average productivity as reported is shown in Figure 7.7. Cauliflower, Cabbage, Brinjal, Tomato, Bhindi, Cowpea, Bottle Guard, Leafy Veg., Chilli, Potato, Green Pea, Radish, Onion are the major vegetables and grown only for self consumption; and the average productivity as reported are shown in Figure 7.8. Sugarcane is the major cash crop.

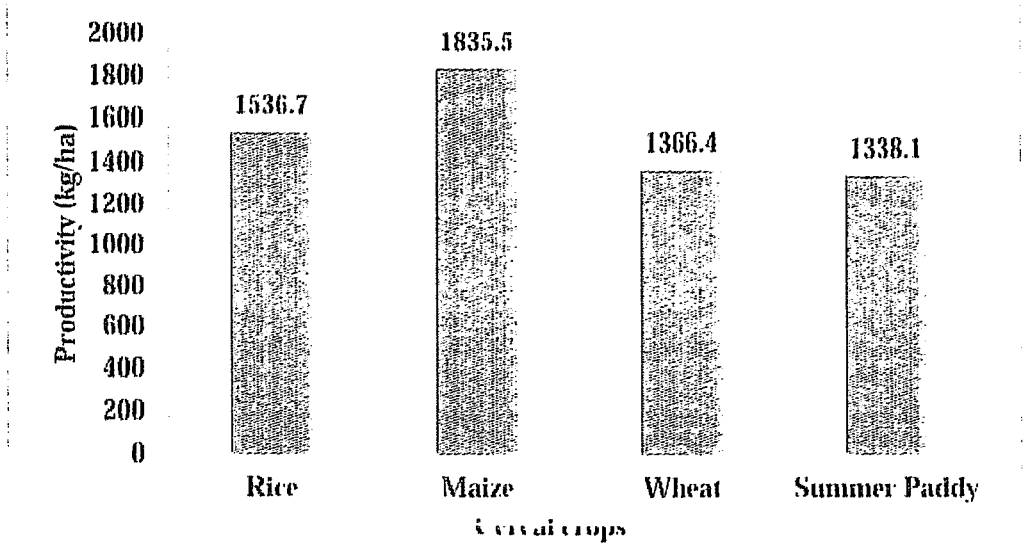


Figure 7.5: Average productivity of cereal crops during 2013-17 in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh (Source http://agriportal.cg.nic.in/PortHi/)

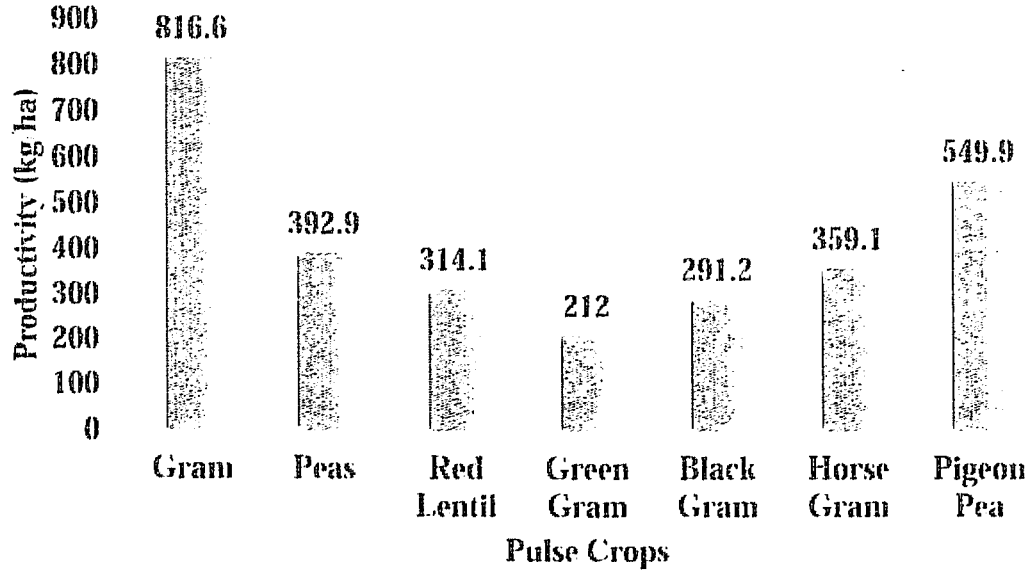


Figure 7.6: Average productivity of pulses during 2013-17 in the study area of Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh (Source-http://agriportal.cg.nic.in/PortHi/)

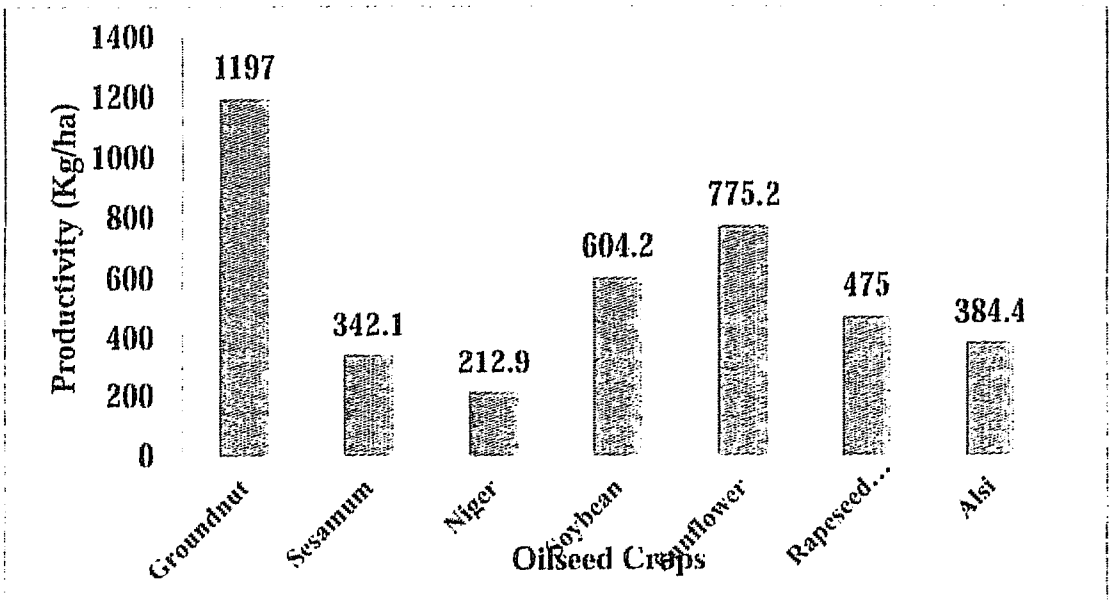


Figure 7.7: Average productivity of oilseed crops during 2013-17 in the study area of Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

Common upland crop weeds are *Ageratum conyzoides, Celosia argentea, Echinochloa* spp., *Euphorbia hirta, Eclipta alba, Panicum* spp., *Cyperus* spp., *Cynodon dactylon, Achyranthes aspera, Amaranthus* spp., *Anagallis arvensis, Argemone mexicana, Avena fatua, Dactyloctenium aegyptium, Saccharum spontaneum, Tribulus terrestris* while low land crop weeds are *Echinochloa, Cyperus, Eichhornia crassipes, Oxylis*, etc.

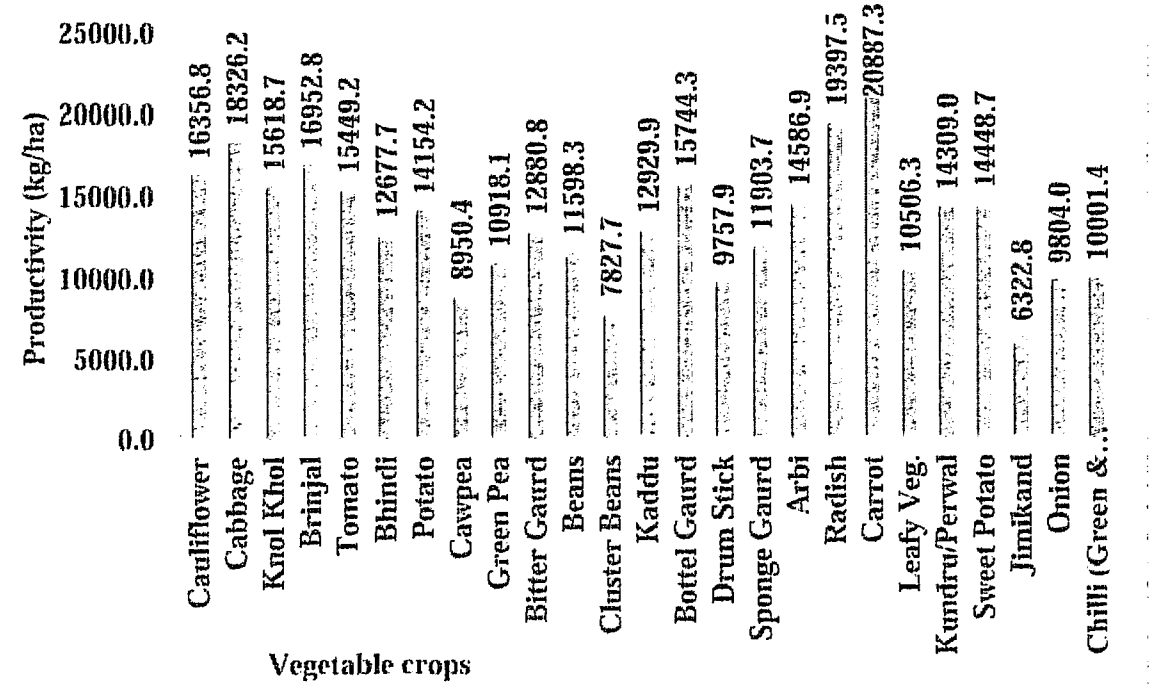


Figure 7.8: Average productivity of vegetable crops during 2014-15 to 2018-19 in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh (Source-http://agriportal.cg.nic.in/Portlii/)

Among horticultural crops Mango, Banana, Papaya, Jackfruit, Cashew nut, Custard apple, Litchi, Watermelon, Muskmelon, Pomegranate, Pear, Sour Orange, Ber, Aonla, Guava, Lemon and Orange are the major fruit crops grown in home gardens, only for self-consumption and their average productivity in shown in Figure 7.9.

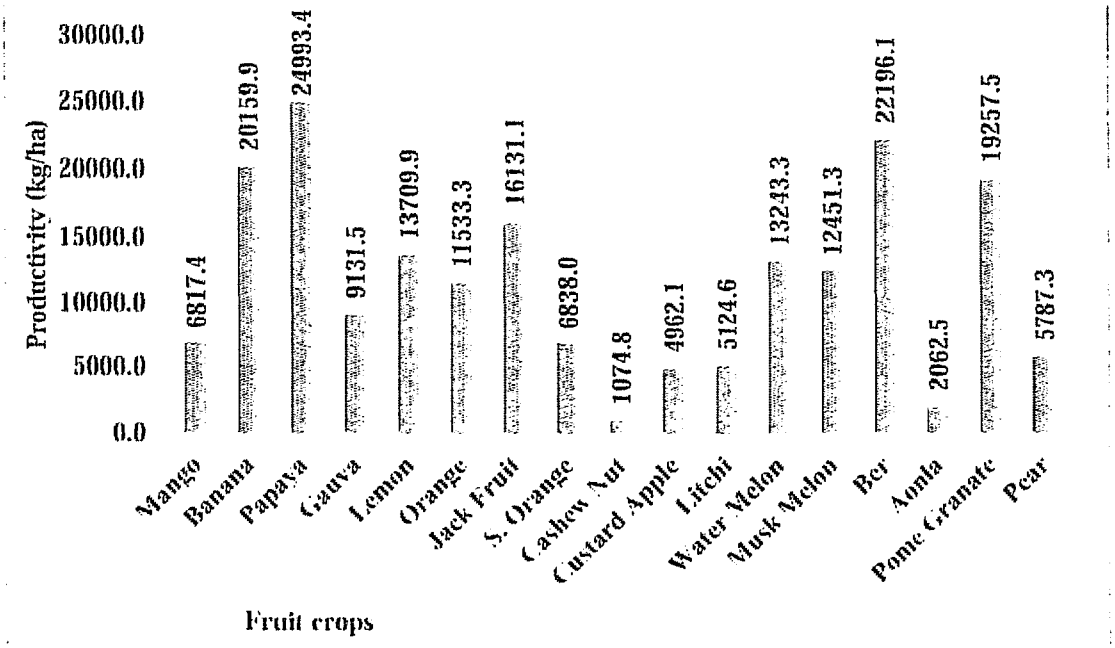


Figure 7.9: Average productivity of fruit crops during 2014-15 to 2018-19 in Hasdeo Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

(Source: Sample survey in Gare Pe)

7.5 SOCIOECONOMIC STATUS OF THE HOUSEHOLDS

Sample household (n=153) survey was done in selected villages (n=35) at random to understand the present state of social, economic and cultural settings of the households in the HAC.

7.5.1 Family structure/Demography

Household (HH) survey revealed that average family size is 6.12 with proportion of adult population to the extent of 64 percent of surveyed population.

The life expectancy is 70-75 years. Sex ratio is 975. As per SECC (2011) HH population of 6-15 years age group dominated in the HAC region followed by 16-25 years age group. HH working population is about 60 percent and 40 percent was dependent population (Figure 7.10).

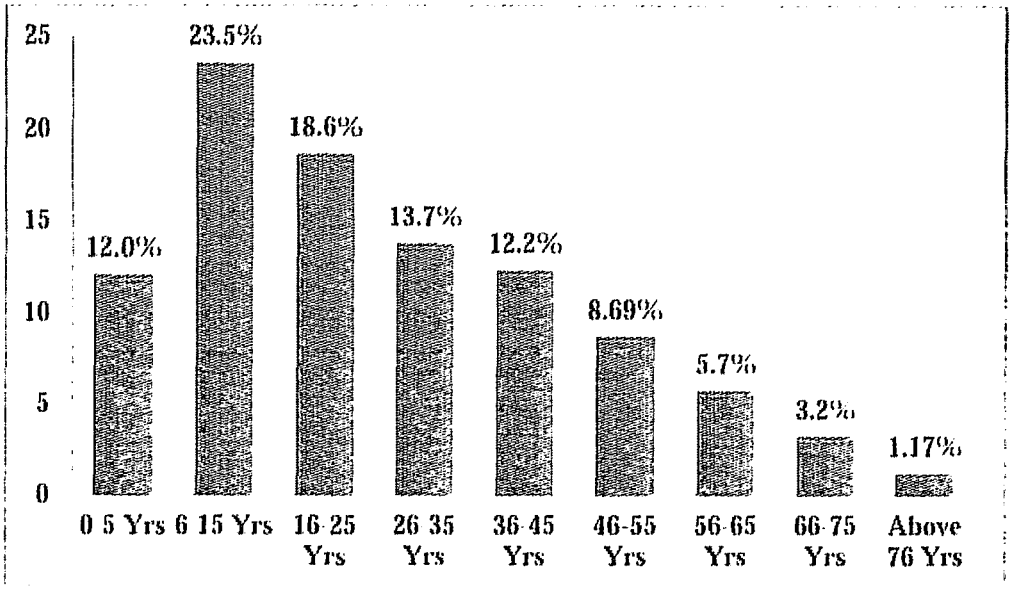


Figure 7.10: Distribution of age group wise population in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh
(Source- SECC, 2011)

7.5.2 Literacy

Overall literacy rate of respondents is 57.30%, which comprised of secondary (30.3%) followed by primary education (20.4%), senior secondary education (4.6 %), graduate (1.3%) and post graduate (0.7%). As per SECC, 2011 literacy rate in HAC was 51% out of which 2% had completed primary or below primary level education while 49% population was illiterate (Figure 7.11).

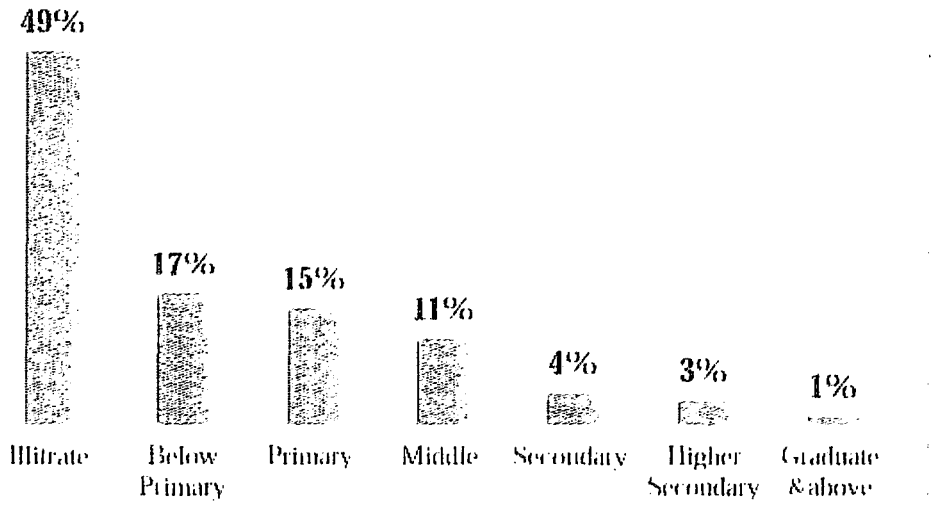


Figure 7.11: Population by highest education level completed in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh
(Source- SECC, 2011)

The primary schools are available in all 35 surveyed villages, middle schools in 12 villages; secondary schools in 10 villages and senior secondary school in 03 villages

(Table 7.23). Students from villages travel 2-10 km distance for middle, secondary and senior secondary education. Students either stay or travel to Korba, Ambikapur, Katghora or Raipur for their higher education in Degree/Professional Colleges. The limited facilities in terms of middle, secondary, senior secondary schools and institutions of higher education besides cost involved in study in higher classes at distant places may be one of the reasons for low literacy rate in the HAC.

Table 7.23: Existence of schools in the surveyed villages in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

S.no	Schools	Villages
1	Middle Schools	Ghatbarra, Salhi, Phulchhati, Lalti, Basan, Manpur, Mahespur, Jiwaliya, Ban kesma, Lalpur, Kesma, Badegaon
2	Secondary Schools	Parsa, Sonatrai, Phulchhati, Lalti, Rikhi, Lakshmangarh, Khudarbasar (mission school), Kedma, Nakiya, Mareya
3	Senior Secondary School	Udaipur, Dadgaon, Lemru

Source: HH Survey

7.5.3 Land holding

The HH land holding varied between 0.1 ha to 8.89 ha. The survey revealed that among the operational land holder's majority (57 HHs) had marginal land holdings, followed by small (27 HHs), semi medium (13 HHs) medium (12 HHs). There were 06 HHs which were landless.

As per SECC, (2011) in terms of the proportion of number of operational land holdings, 58% of HHs have marginal land holdings followed by small land holdings (23%) and both constituted 81% of HHs in HAC (Figure 7.12).

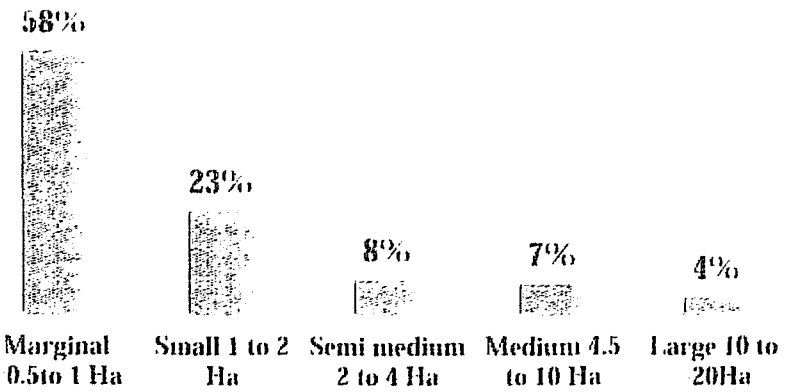


Figure 7.12: Proportion of number of operational land holdings in Hasdeo-Arand Coalfield within Korba, Surguja and Surajpur districts of Chhattisgarh
(Source: SECC, 2011)

In terms of land holdings area marginal and small land holdings comprised of 19% and 25% respectively; followed by semi medium and medium and the large land holding (5%) was minimal (Figure 7.13).

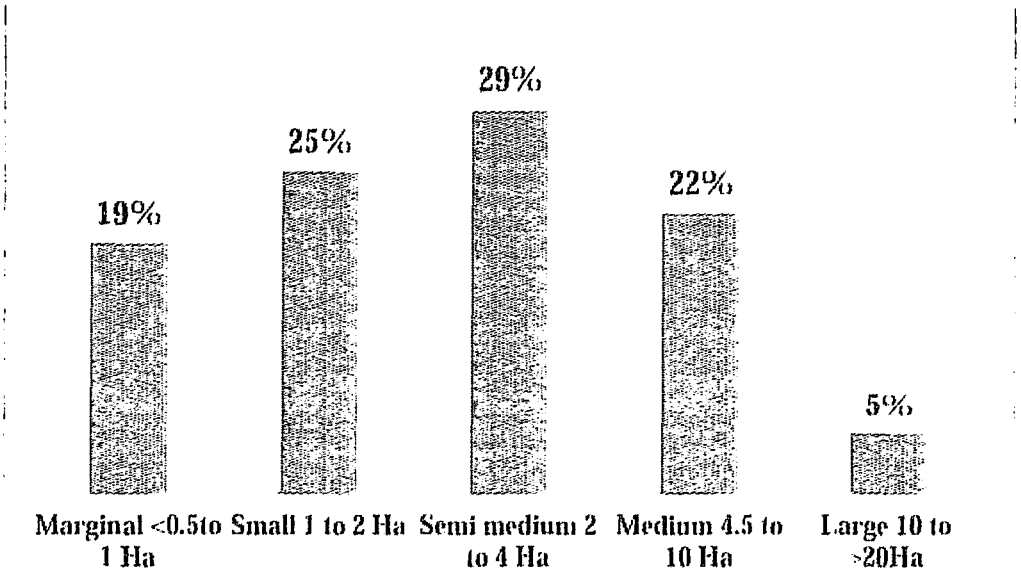


Figure 7.13: Proportional area of operational land holdings in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

7.5.4 Occupation

Household surveys revealed that majority (96.7%) of surveyed households practice subsistence agriculture and are engaged in agriculture either as cultivators or agricultural labour. Only 30 HHs family members are engaged in services (govt and mine), business etc.

7.5.5 Dependence on livestock

The livestock population in surveyed HHs is dominated by cattle (463) followed by goat (383) and buffalo (111); 95.8% villages are dependent on buffalo for milk purposes; and 34.5% on goat and 34.5% on Pigs as source of income. Poultry, pigs, and goat are also reared for captive consumption. However, at hard times these are sold based on their body weight for meat. Goat meat cost @ Rs. 400-500/kg, Poultry meat @ Rs. 80-120/kg and Pig meat @ Rs. 250-300/kg. Cow and buffalo milk are sold at an average price of Rs. 40-50/lit. *Due to lack of records for triangulation and validation of recall data on number of milch animals, pigs, goats and poultry sold by respondents this component has not been included in estimation of annual income.*

7.5.6 Dependence on Agriculture

The land holding pattern of the HHs in HAC are of mainly marginal and small and have mainly opted for single crop Paddy cultivation under rain fed conditions and double crop under irrigated and low lying areas only to a limited extent as shown in

the sampled villages (Figure 7.14). Average household paddy production was estimated to be 1576.75 kg and average paddy productivity was 13 quintal/ha in the rain fed areas; and 15 quintal/ha in the irrigated areas. The minimum support price for Paddy for the year 2019 was Rs. 2500/quintal. Maize grown during Kharif season, with an average productivity of 18 quintal/ha which fetched Rs. 18-19/kg @ market rate in 2019.

Wheat is cultivated in the fields having irrigation facilities and in the low lying areas along Rehar River. The average productivity of 13 quintal/ha were recorded and sold in the market @ rate Rs. 22 per kg in 2019. Other cultivated crops included Harhar, Seasame and seasonal vegetables.

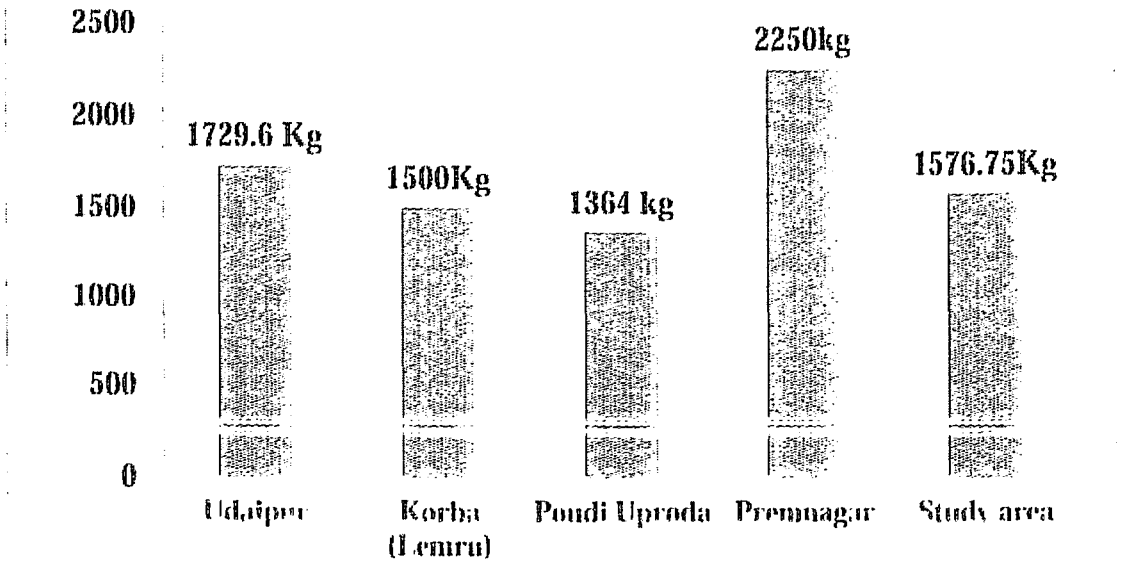


Figure 7.14: House hold average paddy productions (kg) in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

Based on National Food Security Act (NFSA), 2013 and its amendments as implemented by Chhattisgarh State Govt., the ration at subsidised rates is also provided through Targeted Public Distribution System (TPDS) to priority and Antodaya (poorest of poor) households as identified under sub section (1) of section 10 of the act. There are about 25,494 priority and 9,831 (https://dfpd.gov.in/nfsa-data/publications/Publications/EC_PDPoorPriorityHouseholdsAsWPWeb.aspx) Antodaya ration card holders in the HAC eligible for subsidized ration as per provisions of NFSA, 2013.

7.5.7 Dependence on Forest

The HAC is dominated with forestland use with estimated forest cover of 151.85 sq km (80.64% of total HAC). The Sal forest vegetation is dominant to the extent of 80 percent and mixed forest vegetation to 20 percent. A total of 142 forest fringe villages having 28,948 households (HHs) and 1.25 million population (Census of India, 2011);

1,28,455 Adult Cattle Units (20th Livestock Census 2019) are dependent on forest for fuelwood, small timber, NTFPs and fodder needs respectively.

The HAC Scheduled Area, majority of the inhabitants are Scheduled Tribes, Scheduled Caste and all are forest dwelling communities dependent on forest produce and agriculture cultivation for their livelihood. The forest is also the watershed of the many rivers, Nadi, Nalas and Hasdeo Bango reservoir.

The scheduled tribe and other forest dwelling communities have rights and privileges, called *Nistar*, to enter the forest, collect dry fuel wood, fodder, minor forest produce for their consumptive use and graze their cattle in natural forest within 5 km radius as per the provisions of Chhattisgarh Grazing Rules, 1986. The Forest Rights Act (FRA) and the Panchyats (Extension to Scheduled Areas) PESA, Act 1996 also grant forest rights. FRA along with rules makes specific provisions on several types of forest rights. The Forest Rights Committee a subcommittee of the Gram Sabha constituted under PESA have the power of Gram Sabha envisaged under PESA. The power of decision making *w.r.t.* to minor forest produces (MFPs) lies with the Gram Sabha and Forest Rights Committee whose actions are subject to approval of Gram Sabha. The right to disposal of MFPs is under sole ownership of Gram Sabha ,auction and disposal can be carried out by the Gram Sabha by itself or authorize the Committee under Rule 4(1) (e) to carry out this function as a delegate of the Gram Sabha and not in its own right. The disposal of MFPs right vested in individual, groups of individuals or family covers the entire gamut of activities as described under Rules 2(1) (d), subject to the powers of Gram Sabha under Section 5 of the Act. As per FRA no produce should go out of the village/community until the needs for the same within the village /community have been satisfactorily met to prevent conversion of MFPs for commercial use at the cost of local needs and to ensure the protection of right of local artisans who use the MFPs as raw material. Collection of MFPs/NTFPs is managed by Village Forest Committee and Forest Protection Committee constituted under Joint Forest Management (JFM) depending up on their availability.

7.5.7.1 Dependence on fuel wood

The forest produce like fuelwood, fodder, small timber and Tendu leaves with removals in regular manner and in large quantities were only considered for estimation of dependence on forest and detailed as below:

Household survey revealed that fuel wood collected from forest was dominant source of energy used for cooking and heating purposes by local communities in the HAC area. LPG connections distributed under Pradhanmantri Ujjwwala Yojna of Govt. of India, however the cost, restricted access to the refilling station and free access to fuel wood from forest made villagers to make limited use of LPG.

Annual household fuel wood removal from forest in surveyed villages is estimated to be 2.47 tonnes with maximum of 4.12 tonnes removal from villagers in Lemru forest

range falling in Korba community development (CD) block; and minimum (1.7 tonnes) by villagers under Udaipur forest range falling in Udaipur CD block (Figure 7.15). The high consumption of fuel wood is due to non-availability of LPG refilling station, remote location of Lemru area and availability of LPG refilling station in Udaipur area were observed to be one of the reasons.

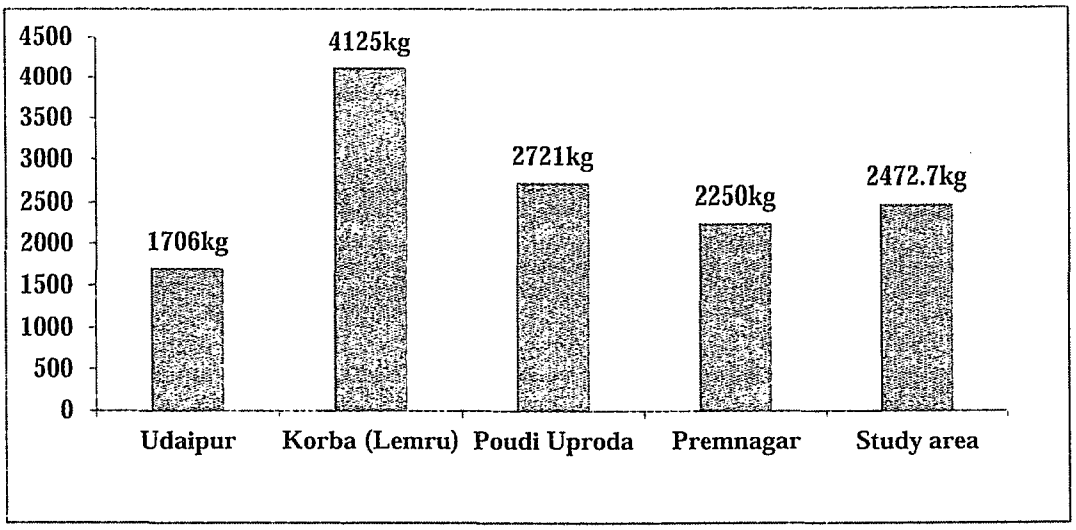


Figure 7.15: Estimated Annual Fuel wood removals from forests (kg)/HH/annum in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

A total of 98.57% of 28948 households (HHs) in HAC use fuelwood as source of energy and estimated annual fuelwood dependence on forest was 0.07 million tonnes (Census, 2011). Forest survey of India (2017) have estimated the average annual fuel wood dependence to be 0.033 million tonnes; and FRI (2017) reported annual fuelwood consumption of 0.97 million tonnes in Surguja and 0.26 million tonnes in Korba districts with 98.85% in Korba and 80.86% in Surguja districts. NSSO (2014) have reported 83.50 % households in India rely on firewood and chips with the per capita consumption of 19 kg per month in rural areas. Overall dependency on forest for fuelwood was high with 98.75% households using fuelwood for cooking and other purposes. List of fuel wood species is given in Annexure 4.8 under Section- of the Chapter 4.

7.5.7.2 Dependence on fodder for livestock (ACUs)

Animal rearing was not a common occupation in the HAC area in the past which has become practice for milk, ploughing agricultural fields, cart pulling and as source of meat in the last decade, and has resulted in increase of livestock. The 20th Livestock Census of India (2019) has estimated cattle population in HAC area to be 76221 followed by Goat (62533), buffalo (14767) and pig (2043) (Figure 7.16).

Total livestock reported in HAC is 1,55,564 equivalents to 1,28,455 ACUs including all major categories of fodder consuming livestock namely cattle, buffalo, goat, sheep.

Livestock was converted into Adult Cattle Units (ACUs) considering one cow = 01 ACU, one bullock = 1.5 ACU, one buffalo = 1.37 ACU, young stock of buffalo/cow = 0.75 ACU and sheep or goat = 0.15 ACU (Yang, 1971).

Grazing of cattle, goat and sheep is a common way of rearing livestock in HAC area from 9 AM to 5 PM in nearby pasture and forest land particularly during cropping season and in fallow agricultural fields after crop harvest. List of major fodder species is given in Annexure 4.7. Cattle grazing and paddy straw stack for stall feeding in HAC are shown in Plate 7.12 and 7.13.

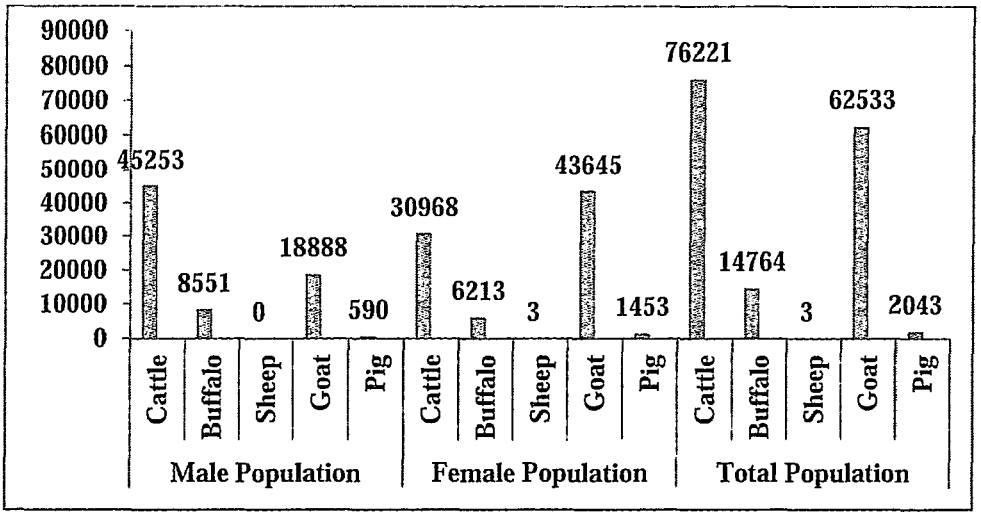


Figure 7.16: Livestock population in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

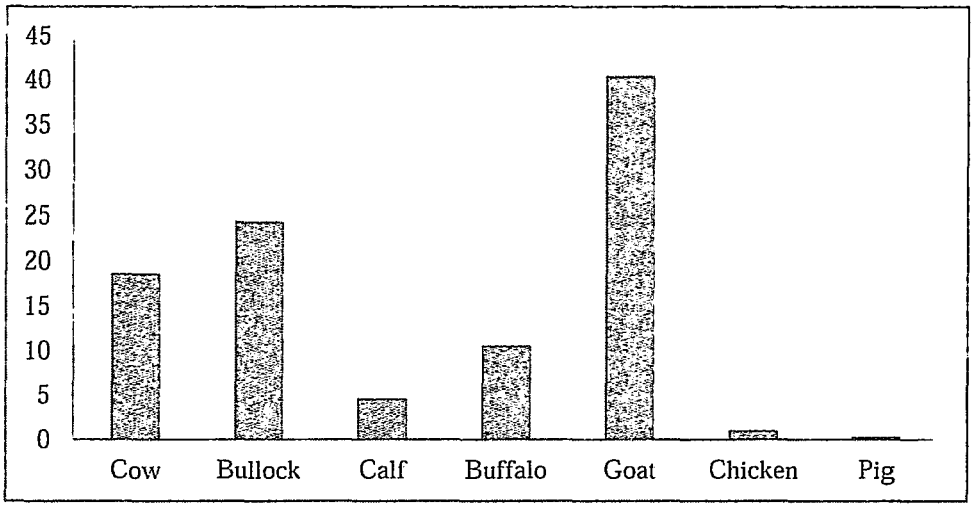


Figure 7.17: Livestock composition in surveyed villages in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

Paddy straw stall feeding was observed, especially during night time or for milch cattle. Grazing rights as determined by Forest Department based on grass productivity, soil conservation, forest type and other factors and limited to 2 ACU/ha in protected forest and 1 ACU/ha of reserve forest. The body weight of 01 ACU in India was considered as 300 kg. Accordingly, with the assumption of 8 kg of green

fodder requirement for ACU of 100 kg body weight fodder requirement estimated to be 24 kg green fodder /ACU. This estimation is based on an underlying presumption of requirement of 24 kg of green fodder per ACU per day (Agricultural Economic Research Review and Tamilnadu Agricultural University). Household survey revealed that livestock composition is dominated with cattle (cows + bullocks) followed by goats and buffalos (Figure 7.17). About 96.70% households grazed their cattle in nearby pasture and forests lands. Estimated annual fodder requirement was about 9.10 tonnes/ACU and annual dependence on fodder from forest was 1.13 million tonnes in 2019-20.

FRI, 2017 has reported annual fodder removal of 6.48 Mt in Surguja and 1.79 Mt in Korba districts. FSI - SFR (2019) has estimated annual fodder removal of 82.77 million tonnes from forest and average annual per capita (ACU) removal of 6.497 tonnes in Chhattisgarh. FSI (2020) estimated about 75.20% fodder requirement of forest fringe villages in Chhattisgarh state is met from forest and 75.30 percent ACUs were partially or completely dependent on forest for fodder. Annual fodder removal in forest fringe villages in Chhattisgarh state was estimated to the tune of 31.093 million tonnes with share of 23.06 Mt/year from forest, community land (1.34 Mt/year), roadside (2.89 Mt/year), private pastures (2.25 Mt/year), own land (0.19 Mt/year) and market (0.77 Mt/year). Forest was reported to be one of the major sources for fodder through grazing and stall feeding. Annual fodder removal through grazing accounted for 27.11 Mt of which forest accounted for 23.06 Mt/year and grazing in agricultural fields, road side accounted for 1.05 Mt/year.

7.5.7.3 Dependence on small timber

Small timber is used in construction of houses (ballies, poles), furniture, agricultural implements and fencing purposes in the HAC area. The annual consumption has been estimated to be 852163.55 cum for forest fringe villages in Chhattisgarh state by FSI (2020). Out of this small timber use as agricultural implements accounts for 14112.91 cum; fencing of house (15551.54 cum), furniture (4876.51 cum) and roof (817622.59 cum). List of major timber species is given in **Annexure 4.5.**

Table 7.24: Estimated annual fuelwood, fodder and small timber household dependence in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

Forest Resource	Annual household dependence within 5 km radius of forest	
	FSI estimated rate in 2019	HAC
Fuelwood	1048.48 kg	0.030 million tonnes
Fodder	19.28 tonnes	5.58 million tonnes
Small timber	0.22 cum	6368.56 cu m

The type of house and timber use in house construction and fencing of homesteads are shown in Plate 7.13 and 7.14 respectively. Estimated annual fuelwood, fodder and small timber household dependence surveyed is given in Table 7.24 and consumption in Table 7.25.

Table 7.25: Estimated annual fuelwood, fodder and small timber consumption by local communities in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

Forest resource	Estimated annual per capita consumption	
	FSI estimated rate in 2019	HAC
Fuelwood	283 kg	0.0354 million tonnes
Fodder	6.50 tonnes	6.05 million tonnes
Small timber	0.067 cum	8371.52 cum

7.5.7.4 Dependence on NTFPs

The collection of NTFPs from forest supplement the livelihood of ethnic, land less and marginal and small farmers and other forest dependent communities in the HAC area.

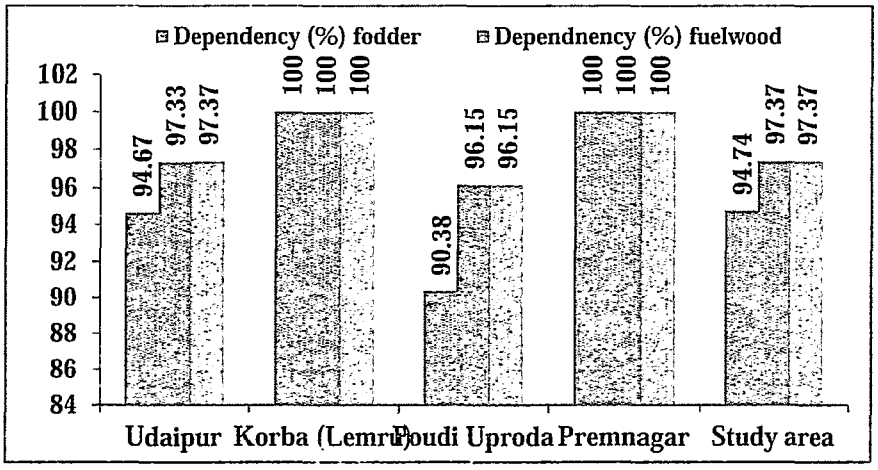


Figure 7.18: Dependency of local communities on forests in surveyed villages Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

Tendu leaves and Mahua flowers and seeds are major NTFPs collected from forest on regular basis in large quantities and hence considered for dependence estimation. Other NTFPs collected in minor quantities include Char seeds, Mahul leaves, Chhind leaves, Phuljharu grass (Hill broom), Harar fruit and Baehra fruit, Dhawai flowers, wild honey, edible wild mushrooms, bamboo shoots, Sal resin, Sal seed, Sal leaves, Chironta seed based on the availability in different seasons. These NTFPs are mainly collected from Parla, Lad, Lam Pahar, Dhajag, Paturia, Fathepur, Pindraki, Matringa, Ghatbara, Puta, Chakeri protected and Pidiya reserve forests falling in HAC area. Mahul patta was mainly collected from Kolargadra, Botopol, Gidmuri, Paturia, Madanpur, Basan, Parogia, Badegaon, Mareya, Ramgarh hill. Lac cultivation and silk worm rearing was also practiced by select villagers in the HAC area. Household dependency on forest for fodder was 94.74 per cent and 97.37 percent each for fuel wood and major NTFPs in surveyed villages of HAC area (Figure 7.18).

Table 7.26: List of Tendu leaves collection centers in the study area of Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

District Union	Primary Co-operative Societies	Collection Center (Phad)		
Surguja	Kedma	Kedma, Kesma, Sitkalo Matringa, Patkura	Jamdara, Biniya Tirkela, Karae, Dhodhakesra	Kudarbaswar, Bhakurma Mareya, Badegaon, Argoti
	Udaipur	Sukhari Bhandar, Jajgi, Laxmangarh, Maheshpur, Manpur, Lipangi	Udaipur, Kumdewa, Sayar, Tendutikra , Puta, Mrigadand	Dumardih Kesganwa, Ramnagar Mohanpur, Sarma, Shanibarra Devtikra
	Dandgaon	Parsa, Parogiya, Suskam, Saidu, Ghatbarra A, Ghatbarra B, Hariharpur, Fatepur	Doulatpur ,Chakeri, Basen, Jarhadand, Pindraki, Pandopara, Salba,Khujhi	Salhi, Dava, Manoharpur, Dandgaon, Gumga,Bakoi,Jhingajhariya
Surajpur	Tara	Tara, Janardanpur, Kantaroli Mendra	Chitkhai, Maheshpur Boirdand, Rijhnabahar	Abhaipur, Pranpathri, Hariharpur Charpara
	Premnagar	Premnagar, Raghunathpur, Kedarpur	Koteya, Mahora, Sarastaal	Kashiyari, Bakirma Baldevnagar Rameshwarnagar
Korba	Vimalata	Vimalata, Nakiya	Munardand, Arsena	Rapta, Dokarmana, Kudarichingar
	Lemru	Aretara, Deopahari, Keubahar, Chhatibahar	Kantaduwari Dindasarai Sonari	Lemru, Badgoan, Kuturuwa, Lampahad
	Morga	Morga, Khirti, Uchglenga, Dhajak	Kendai, Udena, Tihlisarai Bugrabhata	Botopal, Sagbadi Amapani, Ketma
	Madanpur	Puta, Paturiyadand, Gidmuri	Salihapahari, Arsia, Karaihapara	Madanpur, Thhirriama, Bulasibhawana
	Chotia	Chotia, Parla, Kapanawapara	Baniya, Semraha, Lamna	Chordhowa, Harmod

Table 7.27: Villages engaged in Tendu leaves collection in Korba, Surguja and Surajpur districts in Hasdeo-Arand Coalfield areaof Chhattisgarh

District	Village Name				
Surguja	Argoti	Dhodha Kesra	Keshma	Mohanpur	Salhi
	Badegaon	Dumardih	Khujhi	Mudgaon	Sanibarra
	Bakoi	Fattepur	Kumdewa	Pandripani	Sarma
	Basen	Ghatbarra	Laxmangarh	Parogia	Sayar
	Bhakurma	Gumga	Lipangi	Parsa	Sitkalo
	Biniya	Jajga	Maheshpur	Patkura	Sukhari Bhandar
	Chakeri	Jamdara	Manoharpur	Pendarkhi	Suskam
	Dandgaon	Karai	Manpur	Ramnagar	Tendu Tikra
	Daulatpur	Kedma	Mareya	Saidu	Tirkela
	Dawa	Kenapara	Matringa	Salba	Udaipur
Surajpur	Abhaypur	Janardanpur	Maheshpur	Premnagar	Rameshwar Nagar
	Hariharpur	Kantaroli	Mendra	Raghunathpur	Tara
Korba	Aretara	Fulsar	Ketma	Madanpur	Rapta
	Arisiya	Gidmuri	Keubahar	Morga	Samarkana
	Bahera	Jajgi	Khirati	Nakiya	Thrriama
	Baniya	Kapana Wapara	Kudrichingar	Parla	Uchalenga
	Chotiya	Kendai	Lamna	Paturiyadand	
	Dhajak	Kerijheriya	Lemru	Puta	

7.5.7.5 Tendu leaves

Tendu (*Diospyros melanoxylon*) leaves; a commodity of nationalized trade is collected by almost all households during third week of April to second week of June of a year. The production was taken as standard bag or manak bora unit equivalent to 1000 bundles containing 50 leaves each bundle. There are three district unions having 10 Primary Co-operative Societies and 129 centers (Phads) for Tendu leaves collection in HAC area (Table 7.26 & 7.27, Figure 7.19-7.21). The collection rate for Tendu patta was Rs. 4000 per standard bag in 2019 season, while it was Rs. 2500/- per bag in 2018 season and Rs. 1800 per bag in 2017 season. Household survey revealed that Tendu leaves collection during 2019 season ranged between 50 to 950 standard bags in surveyed villages Table 7.28. Data on quantity of Tendu leaves collection and value from Kendai forest range Office of Katghora Forest Division at Kathghora; Udaipur Forest range office at Udaipur of South Surguja Forest Division in 2019 season given in Table 7.29 revealed collection of 20003 standard bags collection of Tendu leaves of Rs. 8.0 Crores value in the year 2019 from the HAC area. Tendu stand in Gumga Protected forest is shown in Plate 7.1, sun drying, packaging in Plate 7.2, loading, and transportation of dried Tendu leaves in Plate 7.3.

Table 7.28: Tendu leaves standard bags collected in 2019 season in surveyed villages in the study area of Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

S.N.	Tendu Collection Center	No. of Standard Bags
1	Chotia	220
2	Ghatbarra	950
3	Suskam, Basan, Parsa	250 each
4	Dadgaon, Dalutpur and Gumga	400 each
5	Salab and Manoharpur	200
6	Sani Bara, Lakshmangarh, Sukhri bhandar, Lipingi	125 - 150
7	Domanra, Deogarh, Udaipur, Ramnagar, Mohanpur, Jajgi, Sarma and Tendu Tikra	200 each
8	Kedma	300
9	Badegaon	100-150
10	Kesma	300
11	Sitkalo	100
12	Mareya	200
13	Matringa	50
14	Khudrabasar, Bhakurma	250 each
		Source: HH survey

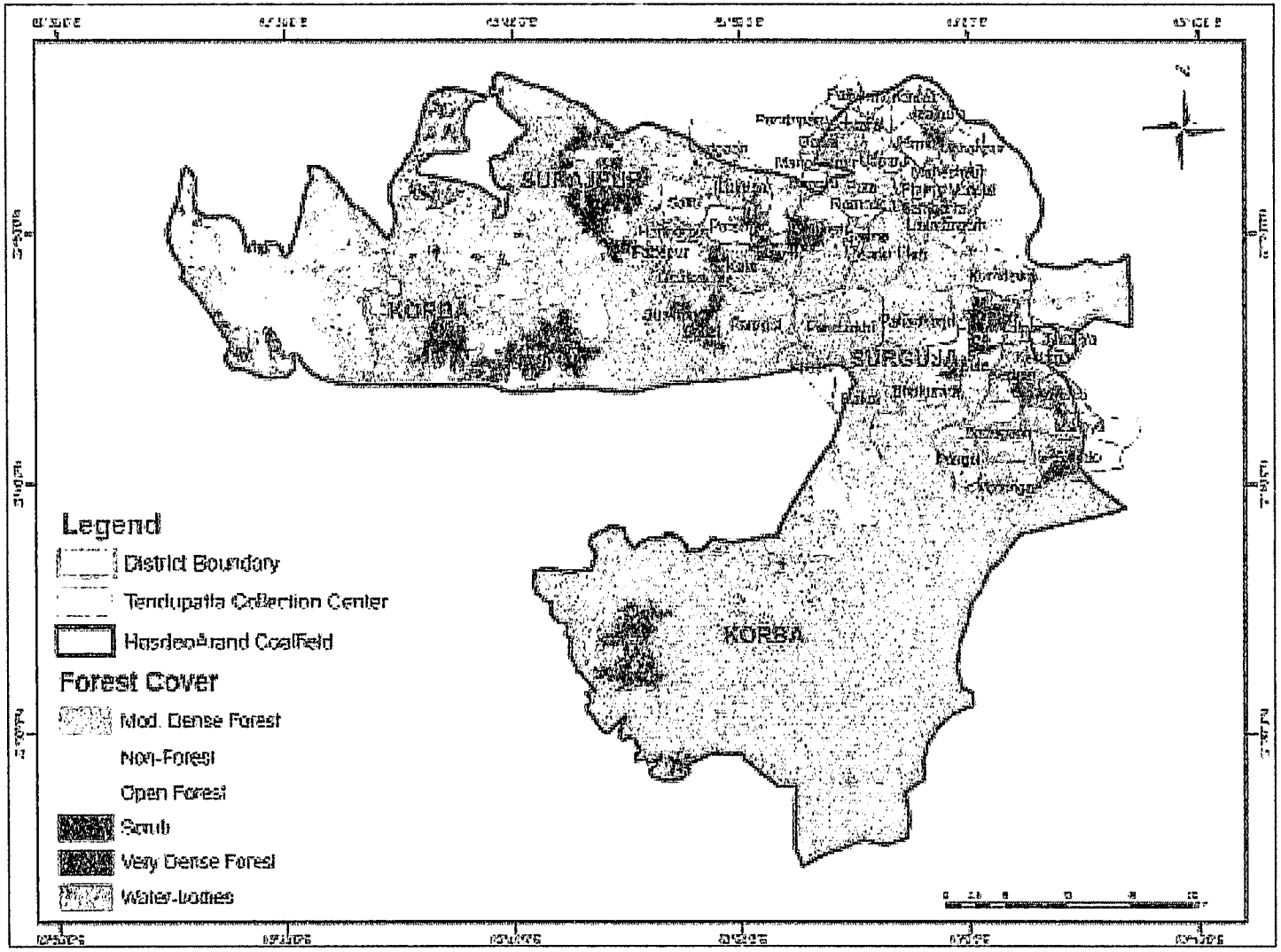


Figure 7.19: Map showing Tendu leaves collecting vilages in Hasdeo-Arand Coalfield area of Surguja district of Chhattisgarh

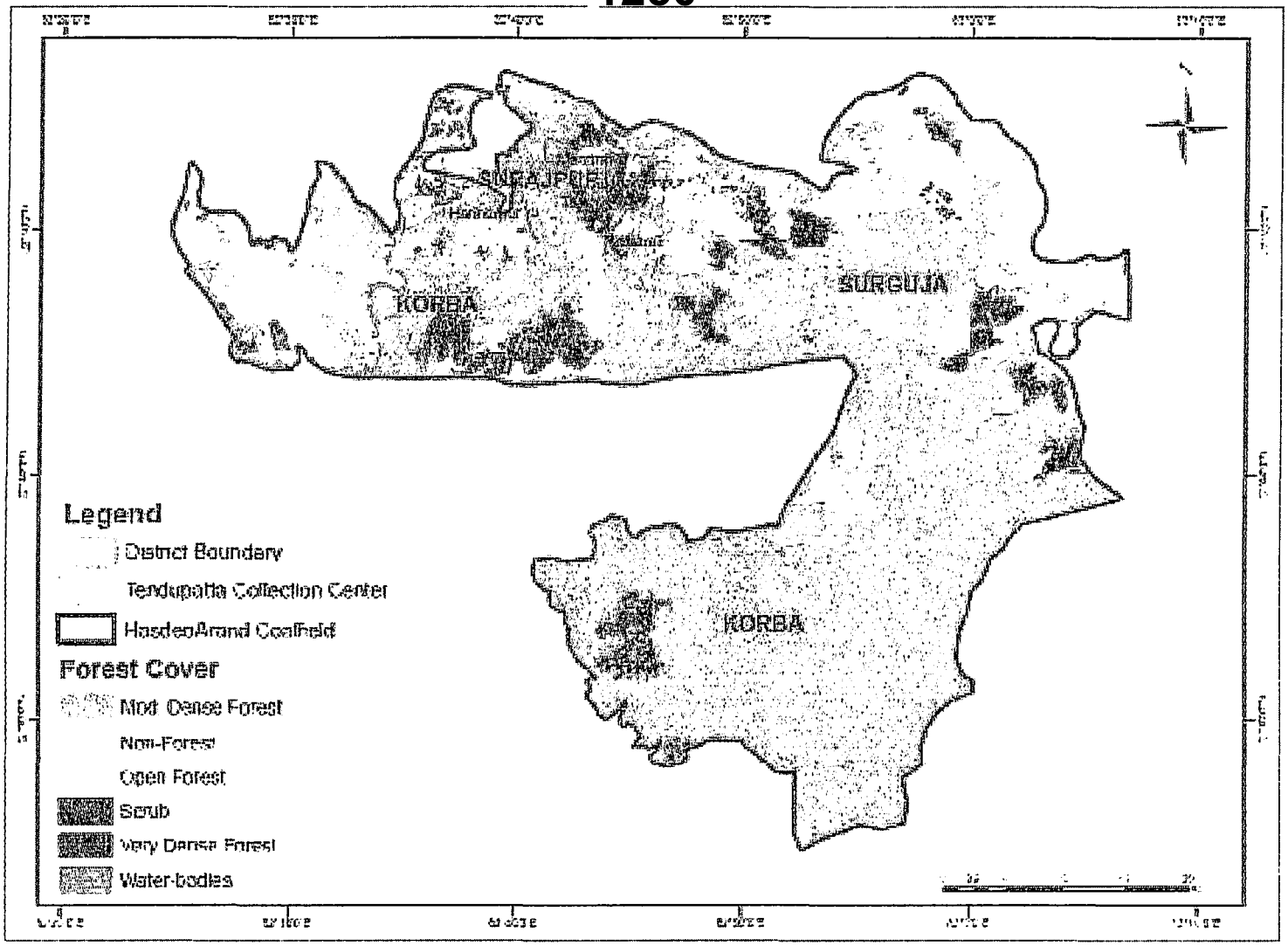


Figure 7.20: Map showing Tendu leaves collecting villages in Hasdeo-Arand Coalfield area of Surajpur district of Chhattisgarh

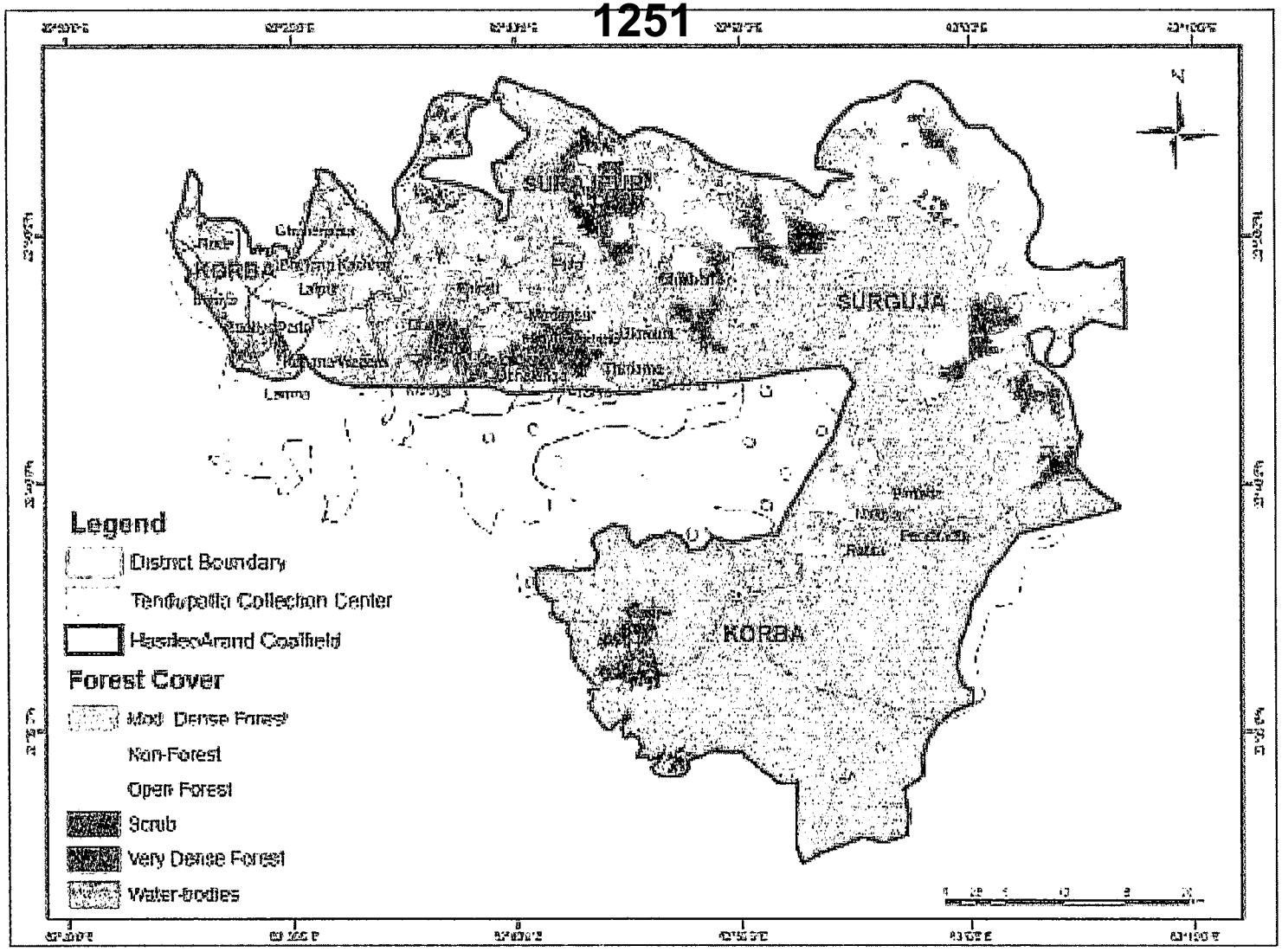


Figure 7.21: Map showing Tendu leaves collecting villages in Hasdeo-Arand Coalfield area of Korba district of Chhattisgarh

Table 7.29: Tendu leaves standard bags and the values from forests under Kendai forest range of Katghora Forest Division and Udaipur Forest range of South Surguja Forest Division in 2019 season

District Union	Samiti	Tendu leaf collection (No. of Standard bag) in 2019 season	Collection value @ Rs 4000/standard bag in 2019 season
Kathgora	Madanpur	2281.50	9126000
	Morga	2057.10	8228400
	Chotia	1686.36	6745440
	Sirmina	2782.50	11130000
	Ladd korbi	2204.95	8819800
	Pali Budapara	780.49	3121960
Surguja	Udaipur	1935.12	7740480
	Dadgaon	2403.70	9614800
	Rikhi	2816.56	11266240
	Kedma	1054.29	4217160
		20002.57 Say 20003 standard bags	80010280 Say Rs. 8.0 crores
Source- Udaipur and Kendai Forest Range Office Records, 2020			

7.5.7.6 Other NTFPs

Unregulated trade of Mahua a commodity is also made by almost all households for self-consumption and the surplus is sold in weekly markets during lean season, which fetches higher price up to Rs. 80-90 /kg of dried flowers as a supplement income.

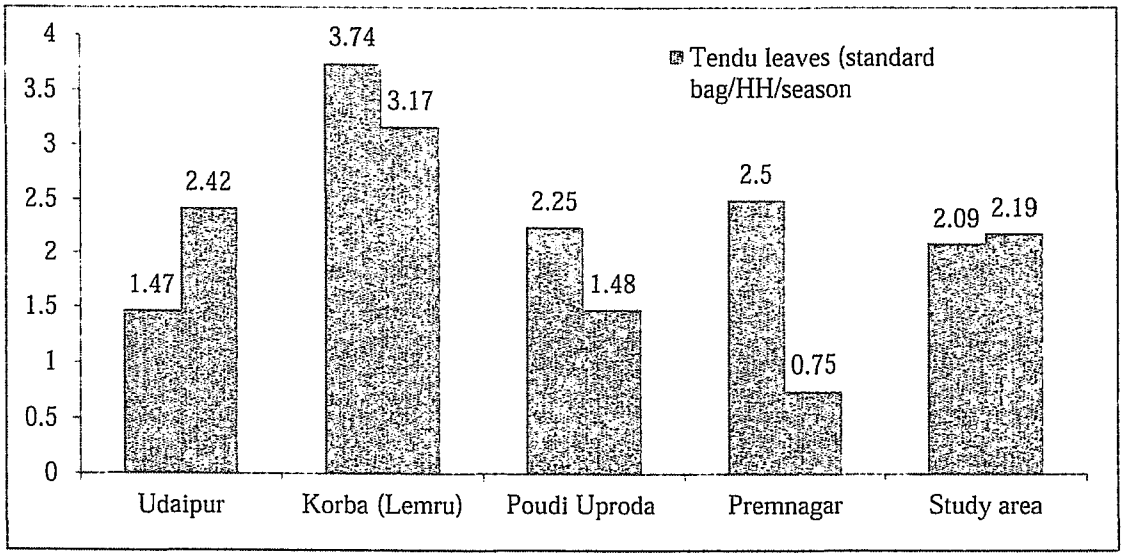


Figure 7.22: Household collection of Tendu leaves and Mahua flowers from the forests by the villagers in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

HH survey revealed that Mahua flower collection varied between 20-1000 kg per HH during 2019 season with average annual household collection of 219 kg. Collection of Chirongi seed and lac was 24 kg and 18 kg respectively. Annual household Tendu leaves and Mahua flowers collected from forest by the household from the surveyed villages is shown in Figure 7.22.

7.5.7.7 Estimated Annual Income

Household survey revealed that 55.76% surveyed HHs having monthly income of less than Rs. 5,000; 37.56% with monthly income between Rs. 5,000/- to less than Rs. 10,000/- and only 6.68% households have monthly income of Rs. 10,000/- or above. Overall 79.97% surveyed HHs have monthly income of less than Rs. 10,000/- and qualifying as a beneficiary under the Below Poverty Line (Figure 7.23). Average annual household income was estimated to be Rs. 86,341/- with contribution of Rs. 17,195/- from forest; Rs. 28,381/- from cultivation and Rs. 40,763/- from secondary sources of income like manual casual labour, jobs and business *etc.*

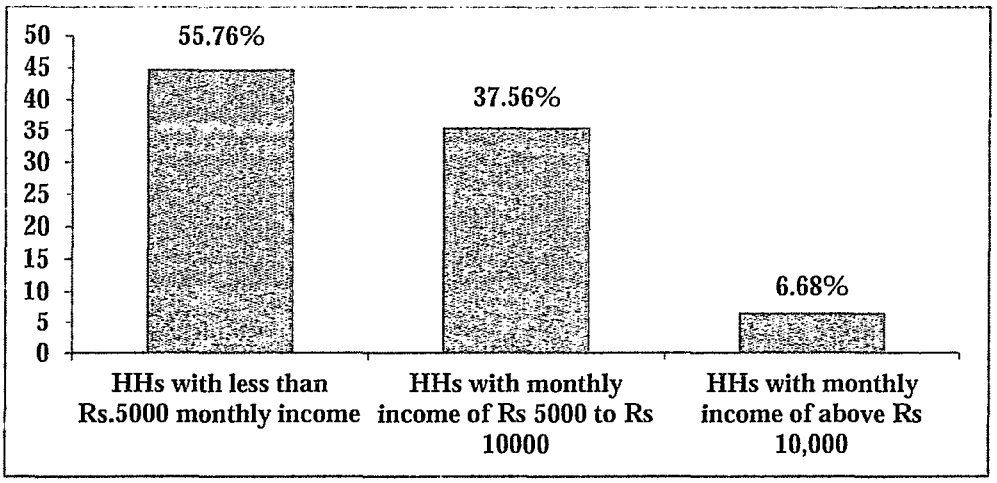


Figure 7.23: Proportion of monthly Household income in sample villages in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

As per SECC, 2011 Casual manual labour is reported to be the main source of income (51.35% HH) followed by cultivation (41.08% HH) in HAC. However, few households had salaried members who work in mining companies, health centers, schools, govt. departments private and domestic (Figure 7.24).

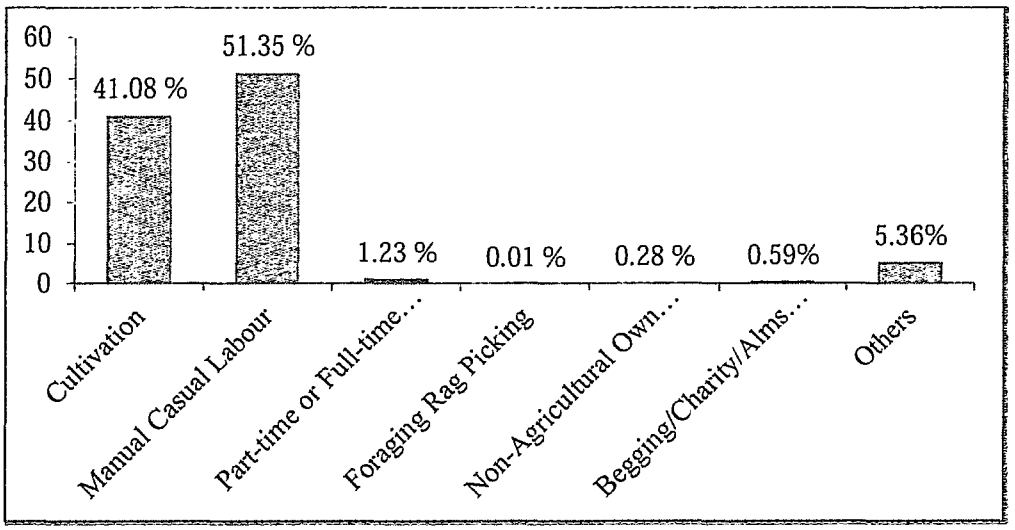


Figure 7.24: Showing the major sources of household income in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

Overall, 93% HHs were estimated to have less than Rs. 5000/- monthly income (**Figure 7.25**) and estimated average annual income of Rs. 39,463/-. HHs with monthly income between Rs. 5000 to Rs. 10000 had average household annual income of Rs. 85569.

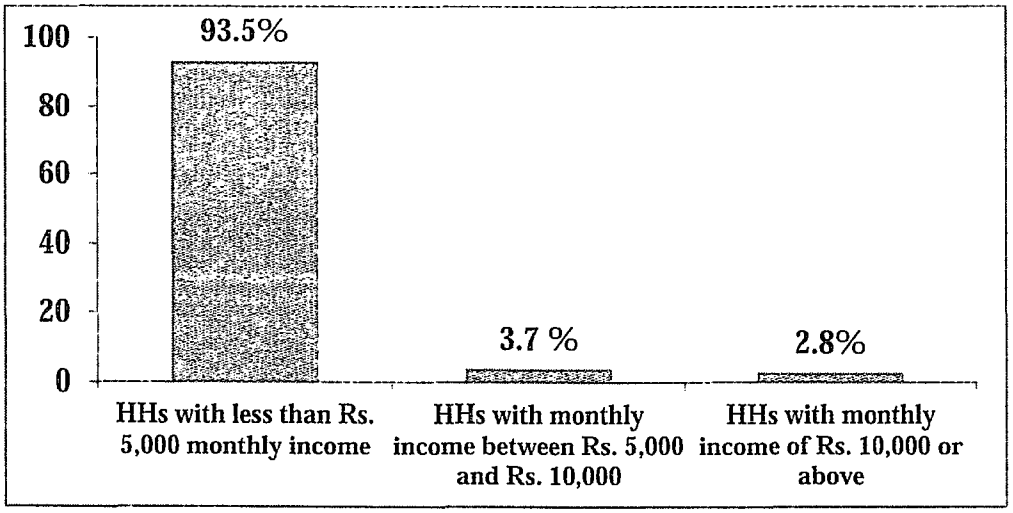


Figure 7.25: Proportion of Household with highest monthly income in Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh (Source- SECC, 2011)

FRI (2017) has reported estimated average annual household income of less than or equal to Rs. 60,000/- @ monthly household income of Rs. 5000/- for about 73.03% forest fringe village households in Korba and 58.81% in Surguja. The annual household income from agriculture with single crop production including seasonal vegetable and fruit crops has been estimated at Rs. 28,382/- with monthly household income contribution of Rs. 2,365/- (Chhattisgarh Krishi portal available at http://www.agriportal.cg.nic.in). Dependency of local communities in surveyed villages of HAC in given in **Figure 7.26**.

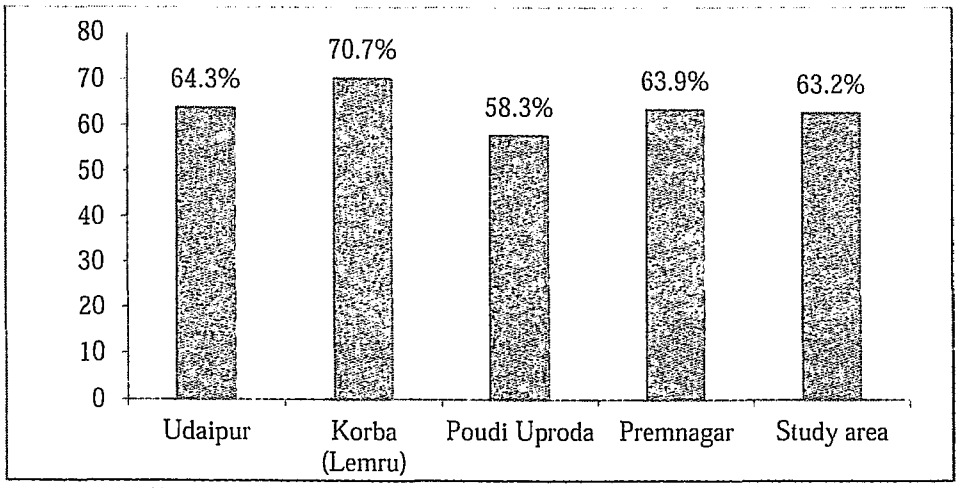


Figure 7.26: Dependency on agriculture by local communities in surveyed villages in the study area of Hasdeo-Arand Coalfield area within Korba, Surguja and Surajpur districts of Chhattisgarh

7.5.8 Infrastructure Facilities

7.5.8.1 Healthcare facilities

Household survey revealed that primary health centres at Korbi, Parla, and Chotia provide health care services to HAC villages under Poundi-Uproda CD block of Korba district. Water borne and skin diseases, malnutrition, bone and teeth deformity were reported as major health problems in this part of HAC area. The public health care facilities are available at Adani Health Centre in Shivnagar, Shivnagar dispensary; primary health centers at Tara, Pindraki, Gidmuri, Paturia, Madanpur, Morga, Ghatbara, Parsa, Dadgaoan, Gumga, Mudgaon, Kathmura, Lalati, Kente, Pindraki, Parogia, Saidu, Morga, Madanpur, Lakshmangarh, Chakeri, Lipingi, Kedma, Mareya, Nakiya villages in the HAC.

7.5.8.2 Drinking Water facilities

Household survey also revealed that drinking water supply is mainly sourced from hand pumps followed by uncovered well, tube well/bore well, river/canal, springs and treated and untreated tap waters, tank/pond/lake in descending order. Besides drinking purposes water for bathing, washing and irrigation is also used from rain water harvesting tanks/ponds lakes constructed by state government in village or cluster of villages and their hamlets. Water from natural rivers/nalas is also used for washing, bathing and irrigation purposes. Water of Bisrar, Dhajag, Manasi and Maniari nala are used by the people of Morga, Khirti, Bhulsbavna para and Pandorama, Khirti, Dhajag villages; Soksi nala water by people of Saidu village; Jhinga nala and Kapanakan nala water by people of Pindraki village for bathing, washing and irrigation purposes. Bar nala and Kiri nala water is used by people of Ghatbara and Suskam villages; Dhek Bahar nala, Kari Keri nala and Atem River water used by Basan and Parsa villages for bathing, washing and irrigation purposes. Salhi nala, Tara nala, Khatkhora nala, Boghra nala, Ramgarh nala and Atem river water is used for washing, bathing and irrigation purposes. Ramgarh nala water was also stored at Salba dam and used for irrigation purposes. Drinking water in Basan, Salhi and Parsa villages is supplied through tankers by PEKB mine authorities besides from bore well, hand pump and solar pump. Water from check dam along Kera jhariya nala at Sukhri bhandar, Rehar river, Khanpari nala and 15-20 talabs in Mahespur, 06 in Manpur, 03 in Phungi and 02 in Paudi villages for rain water harvesting and storage for lean season use for bathing washing and irrigation purposes. Irrigation is also done through tube wells. Bhalu nala water is used for bathing and washing and irrigation by villagers of Pangoti village. Jyoki nala water is used for bathing, washing and irrigation purposes by people of Kedma village. There were two ponds in Bule and five ponds in Kedma villages. Villages in Matringa area make use of Rehar River, Kharpari/ Khurkhuri nala water for bathing and washing purpose.

7.5.8.3 Electricity

Based on primary data from respondents it is revealed that Saidu, Parogia, Badegaon village have only solar lighting, while Nakiya, Bimlata, Rapta, Pindriah, Chakeri, Mareya, Kedma villages has both power supply as well solar lighting. Mobile telephone networks are available in most of the HAC except Nakiya and Pindraki villages and surrounding 10 km area.

7.5.8.4 Weekly markets (Haats)

Weekly Haats' plays an important role in satisfying the consumer needs of the locals in the HAC area and provides an opportunity to sell agricultural, forest produce and handicrafts. The villagers sell surplus produce and buy items of daily needs from these local markets. The surplus NTFPs, agricultural, horticultural and animal husbandry produce and products were sold by locals in weekly markets. Detail of Weekly Haats' is provided below. Glimpse of weekly haats are shown in **Plate 7.4 to 7.9**. The Primary Co-operative Societies loacted at Korbi, Morga, Dadgaon, Dumahea, Udaipur, etc., from farmers of Korbi, Gidmuri, Manpur, Mahespur, Pungi villages procure paddy from the area.

Days	Haat villages
Sunday	Korbi, Gidmuri, Bimlata
Monday	Kedma, Chotia, Lemru
Tuesday	Pindraki, Udaipur, Dokarmana
Wednesday	Morga, Tara
Thursday	Dawa, Pali
Friday	Deogarh Salha, Parsa
Saturday	Kendai , Dadgaon

7.6 CULTURAL HERITAGE

Cultural Heritage is synonymous with the "expression of human values" and has a high social and amenity value of sites, and remains of archaeological, historical, and socio-cultural structures. The important cultural heritage sites are as following:

a) **Ramgarh Hill:** Ramgarh hillock situated on hat (cap) shaped Ramgarh Mountain is the most ancient historical place of Surguja district. The ancient remains and inscriptions clearly indicate "*Natya Shala*" belonging to 3rd century B.C and believed that Sita used to reside in the cave known as *Sita Bengra* during the exile of Lord Rama. Kalidas had composed the great kavya "*Meghdoot*" at this palce (**Plate 7.18**). At the rear end of *Sita Bengra* there is a large tunnel of 181 ft. in length known as "*Hathi Pol*" so named as even an elephant can move through it.

Jogimara caves at geo-coordinates (latitude 22^0 53' 54" N. longitude 82^0 55' 46" E) facing north-east and lies adjacent to the Sita bengra cave to its west. The cave

ceiling bears paintings and an inscription in Brahmi characters of 3rd century B.C. The paintings on the ceiling consist of panels of procession, torana motifs, trees, animal figures, *etc.*, but not in a good state of preservation. It was declared protected area/monument *vide* Notification No. 19.12.1964 and declared of national importance *vide* Gazette of India, SO No. (4271) dated 10.12.1964 under Notification No.F-4/36/64- C.1 dated 19.12.1964. (http://www.asiraipurcircle.in/Monuments_sites_ProtectedMonuments.html)

Sita Bengra caves at geo-coordinates (latitude $22^0 53' 54"$ N, longitude $82^0 55' 46"$ E) locally known as *Natyasala* represents a unique example of early Indian theatre. It is oblong on plan and is accessible through a flight of rock-cut steps. The inscription on the eastern wall in a Asokan Brahmi of 3rd century B.C. records the intimacy between an artist named Devadina (Devadatta) and Devadasi Sutanuka. In the cave there are also two foot prints which are scooped out of the rock. It was declared as protected area/monument *vide* Notification No. 19.12.1964 and declared as of national importance *vide* Gazette of India, SO No. (4271) dated 10.12.1964 under Notification No.F-4/36/64-C.1 dated 19.12.1964. **(Plate 7.16 -7.17).**
(http://www.asiraipurcircle.in/Monuments_sites_ProtectedMonuments.html).

b) **Kendai Waterfall**- Kendai water fall in Kendai village of Poundi Uproda tehsil of Korba district and is situated right side of the Bilaspur-Ambikapur NH-5. It is one of the beautiful picnic spot as lovely waterfall having 75 feet height.

c) **Bango reservoir** on Hasdeo River in the HAC is a water sports, picnic spot, fish angling site and as known as Mauritius of Chhattisgarh (Plate 7.15).

d) *Mahespur Shiva Temple* is 10th Century BC temple spread over in 400 sq meter area is situated on the banks of Rehind river at Mahespur village under Udaipur community development block of Surguja district. It is an excavated archaeological site. There are only remains of the ancient of Shiva and Vishu temples. Only 1-2 feet high and 2 feet radius Shivlinga in Garb Graha is intact in the temple. It is a repository of sculptures of god and goddesses of Shiva, Vishu, Kartikae, Ganesha, Narsingh, Ganga, Jamuna and inscriptions on the stone. Water tank with stone steps in temple complex and remains of ancient habitation are present (Plate 7.19).

Hasdeo Bango Reservoir lies within 10 km aerial distance from the coal blocks boundary of Morga-I, II, III, IV, Chotia 2B, Saidu, Morga South, Puta Parogia, Parogia, Gidmuri, Paturia and Madanpur South & Madanpur North. **Kendai water fall** falls within 10 km aerial distance from the coal blocks boundary of Morga-I & II, Morga South. Ancient of Shiva and Vishu temple, **Mahespur** falls within 10 km aerial distance from the coal block boundary of Laxmangarh. **Sita Bengra & Jogimara caves** falls within 10 km aerial distance from the coal blocks boundary of

Laxmangarh, Sarma, PEKB, Madanpur South (Table 7.30). Considering the importance of the archaeological, historical, and Socio-cultural structures which is falling with in the 10 km from the boundary of above mentioned coal blocks, appropriate precausionary measures are to be takenup to protect these manuments.

Table 7.30: Proximity aerial distance of archaeological/Socio-cultural/tourist sites with the respective coal block in Hasdeo-Arand Coalfield, Chhattisgarh

Sr. No.	Cultural Heritage Sites	Coal block Name/Number	Approx. Aerial Distance (km) from demarcated coal block boundary
1	Sita Bengra & Jogimara caves	Laxmangarh, 21	5.45
		Sarma, 20	2.79
		Tara Central, 15	15.20
		Parsa, 13	12.70
		PEKB, 14	8.91
		Madanpur South, 12	8.80
		Pindraki,19	10.40
2	Shiv Temple Mahespur	Laxmangarh21	1.85
		Sarma,20	11.20
3	Kendai Water Fall	Morga-II,4	0.45
		Morga-I, 3	2.70
		Morga South, 7	6.10
4	Hasdeo Bango Reservoir	Saidu, 18	1.80
		Morga South, 7	1.59
		Puta-Parogia, 16	2.59
		Morga-I, 3	3.59
		Morga-II, 4	0.10
		Morga-III, 5	0.10
		Morga IV, 6	1.22
		Chotia, 2B	0.23
		Parogia, 17	4.47
		Gidmuri, 8	5.37
		Paturia, 9	5.61
		Madanpur South, 11	6.25
		Madanpur North, 10	7.11
Sources : Aerial distance estimated by using google map			

7.7 PUBLIC PERCEPTION ON MINING IN HAC REGION

People's perception in general revealed that, the tribal communities showed high affinity towards forests as reflected in their agricultural, religious and livelihood practices. The respondents reported receiving significant benefits from the forests that include medicinal plants (3%, n = 3), fuel wood (98%, n = 109), food (100%, n = 111), fodder for livestock (19%, n = 21), soil benefits (2%, n = 3) and water as well (1%, n = 1). The majority of respondents (97%) mentioned that conservation of forests is the best way to use the forest produce for their livelihood.

The respondents were not in favour of mining. There was a fear of losing their ancestral property with which they were emotionally attached, their cropland and forest on which they sustain their family in terms of food crops, fuelwood, fodder,

small timber, NTFPs as source of livelihood and income. They were also afraid of losing their way of life and culture. However, young lot had shown interest for jobs in mining companies.

Similarly, people's perception about mining revealed that about 55% (n = 50) respondents having land in the vicinity of mining/ proposed mining sites. About 60% (n = 66) of the respondents mentioned that they have not participated in the public hearing in the past. In general, a majority of respondents (88%, n = 79) were unwilling to give their lands for the purpose of mining. The perceived impacts of mining include loss of agricultural lands that they have nurtured over generations (52%, n = 58), loss of lands in general (67%, n = 75), loss of forests that they are highly dependent on (69%, n = 77), loss of NTFP yields (68%, n = 76) and health deterioration (38%, n = 42).

7.8 LIKELY IMPACTS DUE TO OPERATIONAL/PROPOSED COAL MINING

7.8.1 Loss of land

The Hasdeo-Arand landscape is a notified Scheduled Area, being pre-dominated by socially and economically backward scheduled communities. These communities are highly dependent on forests for fuel wood to meet energy requirements for cooking, NTFPs for self-consumption and supplementary source of income, fodder for livestock grazing, small timber for housing and agricultural land for cultivation. The households of the villages falling within mine lease and surrounding areas are likely to be directly and indirectly affected or susceptible to their livelihood due to diversion of 321.65 sq km forest land, 28.27 sq km permanent pasture and other grazing lands and 48.82 sq km net sown area for food grain production (Table 7.31). Paddy is a major crop with single crop production along with other minor cereals, vegetable and horticultural crops. Their high dependence on agriculture and forest for livelihood and income that are resulting into likely land alienation and landlessness as a major livelihood concern in HAC as majority of the household workers mainly depend on cultivation /agricultural or agricultural labor.

Chhattisgarh is known for rice production. The stream with HAC flowing through open areas with the feeder streams are blocked/diverted/modified for subsistence agriculture by the villagers. Subsistence seasonal agriculture mainly paddy cultivation is more prevalent along the river/streams beds as well as catchments of the seasonal/perennial forested streams. It is obvious from the sampled villages where the wheat is grown in low lying mainly irrigated and the paddy cultivating villages (Figure 7.27-7.28)

- The primary/secondary feeder streams of the Salhi Nala that drain **the core/buffer area of the active coal block No. 14 (PEKB) as well as up to Kete, Basen, Ghatbarra,** *etc.*, has now been modified/diverted largely due to change in land use land cover pattern resultant of mining.

Table 7.31: Showing the coal blocks and the representative villages likely to loss land resources due to operational and proposed coal mining in 23 coal blocks in Hasdeo-Arand Coalfield, Chhattisgarh

SN	Coal Blocks	Likely to be affected village	Forest (ha)	Permanent pastures and other grazing lands (ha)	Net area sown (ha)
1	Morga-I, II, III, IV, Madanpur North	Dhajak	4.08	0.06	1.68
2	Morga-I Madanpur South	Ketma	3.05	0.44	0.56
3	Morga-I, Morga South, Madanpur South, Paturia	Morga	19.75	0.00	1.61
4	Morga South, Paturia	Uchalenga	7.76	0.10	1.24
5	Morga-I, II	Kendai	19.27	0.16	2.45
6	Morga South	Arisiya	11.33	0.03	1.44
7	Morga South	Khirati	7.62	0.05	0.91
8	Paturia, Madanpur North	Madanpur	4.21	0.02	0.82
9	Chotia (2B)	Bhujung Kachhar	1.82	0.05	0.17
10	Gidmuri, Puta Parogia	Gidmuri	1.23	0.00	0.84
11	Saidu	Thrriama	0.74	0.00	0.17
12	Nakiya	Nakiya	0.80	0.00	0.32
13	Tara	Mendra	1.34	0.00	1.29
14	Tara, Parsa	Janardanpur	0.69	0.00	1.30
15	Puta Parogia, Tara	Kantaroli	1.94	0.00	1.13
16	Tara, Parsa	Tara	1.36	0.00	2.11
17	Nakiya	Shivnagar	0.99	0.00	1.49
18	Puta Parogia	Puta	9.88	0.79	2.08
19	Puta Parogia, Parogia, Parsa, PEKB	Ghatbarra	17.71	2.44	3.63
20	PEKB, Kente Extension	Kete	0.80	9.88	1.60
21	Bhakurma- Matringa	Bhakurma	60.09	1.21	1.96
22	Saidu, Parogia, PEKB, Kente Extension, Pindraki	Parogia	39.16	0.00	0.16
23	Saidu, Parogia	Saidu	5.24	0.39	0.39
24	PEKB, Parsa	Salhi	5.11	4.00	2.68
25	PEKB, Parsa	Hariharpur	3.40	0.02	0.74
26	Parsa, Puta Parogia	Fattepur	1.51	2.66	1.18
26	PEKB	Parsa	7.22	1.84	2.81
28	PEKB, Kente Extension	Basen	13.75	0.15	1.00
29	Kente Extension, Pindraki, Sarma	Chakeri	26.82	0.23	3.05
30	Sarma	Sarma	2.00	0.57	1.47
31	Pindraki	Pendarkhi	32.55	1.14	1.86
32	Laxmangarh	Laxmangarh	1.39	0.67	3.56
33	Kedma	Kedma	7.04	1.37	1.12
		Total	321.65	28.27	48.82
					Source- Based of Census of India, 2011
					Note- Repetition of coal block in column is because the many of the coal block falls within same village boundary

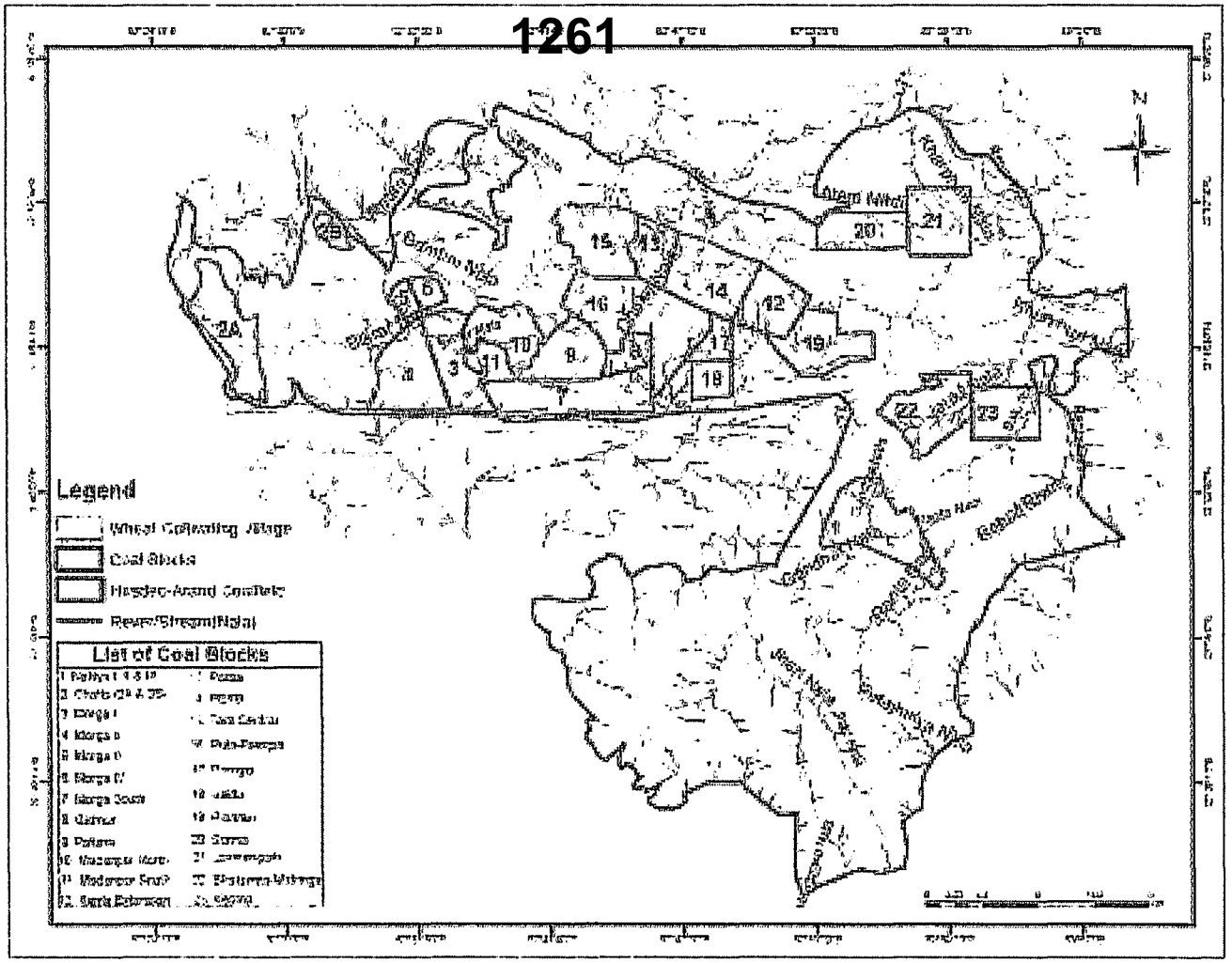


Figure 7.27: Map showing wheat cultivating villages that falls either partially of fully within few coal blocks in Hasdeo-Arand Coalfield, Chhattisgarh

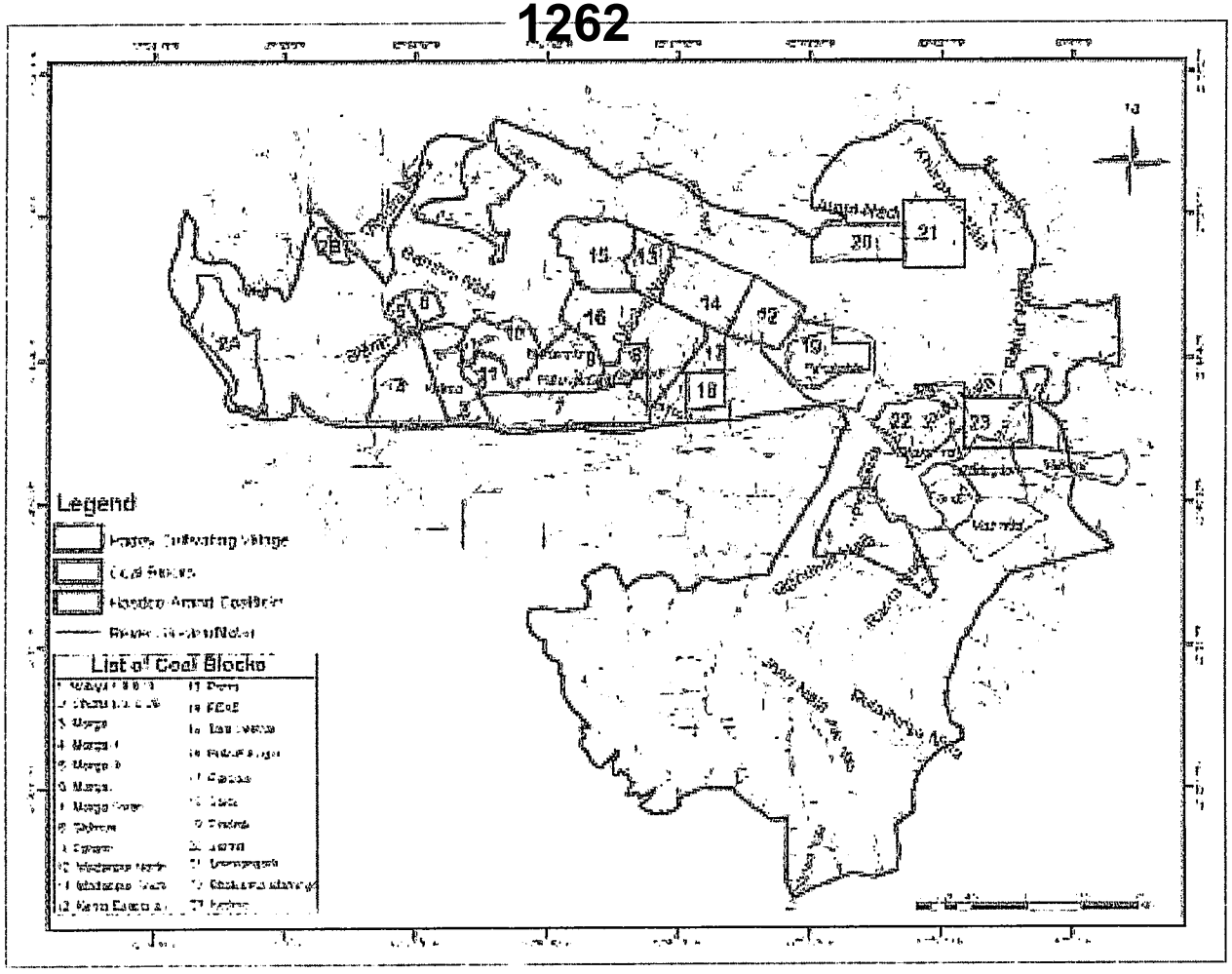


Figure 7.28: Map showing few representative sampled villages cultivating paddy that falls in Hasdeo-Arand Coalfield, Chhattisgarh

- Rehar River is a sixth order stream that forms part of the catchments of the Son River, one of the tributaries of the lower Ganges sub-basin. It originates near Bhakurma and Kedma, where the proposed two coal blocks Bhakurma - Matringa (22); Kedma (23) are located and the river flow towards north. Two out of the three important tertiary feeder streams (Barka Nala) falls within the core zone of the proposed coal blocks. In addition to these two coal blocks; nearly half of the area of the coal block No. 21 (Laxmangarh) is drained by one of the second order streams that join the River near Udaipur. The villages within and surround the coal block 21, 22 and 23 will be likely impacted.
- The open cast mining will have negative impact on the wheat growing villages in low lying area mainly irrigated and other agricultural land including rice because of land use changes.

7.8.2 Loss of forest right

There are 142 revenue villages in the HAC area of which, 61 villages falling within 2 km radius; 81 villages between 2-10 km radius of the 23 coal blocks considered for the study (Table 7.32-7.33). Out of 142 villages a total of 61 villages inhabited by ethnic tribal community are likely to be affected due to operational and proposed coal blocks. These villages are inhabited by 46983 populations in 10,928 households with average household size of 4.30 and population density of 1.40 (Census, 2011).Out of affected/impacted villages 33 villages are falling in core zone of the coal blocks having 6534 HHs that are likely to be affected or displaced either as home oustee or land oustees or both home and land oustees (Table 7.31). Those villages' falls within the mine lease of the coal block would require resettlement & rehabilitation.

- HAC is considered to be one of the last remaining contiguous patches of forests outside the legally recognized Protected Area (PAs) in Central India, in particular between Palamu Tiger Reserve in Jharkhand and Kanha in Chhattisgarh. Most villages in the Hasdeo area are dependent on agriculture and forest produce for their livelihoods.
- The Hasdeo-Arand landscape is dominated by ethnic vulnerable and marginalized scheduled population (75.80%) constituting of ST population (70.31 %) and SC population (5.49%) with overall literacy of 53.38 percent and female literacy of 44.91 percent.
- Also recognizes "habitat rights" of Particularly Vulnerable Tribal Groups (PVTGs).Two PVTGs Pahari Korwa and Birhore are reported from Kadamjheria village along boundary of the HAC land scape in Korba CD block and Lalpur village in Poaudi Uproda CD block of Korba district respectively.
- Birhors (man of the forest) are a special backward tribe of Chhattisgarh. Within HAC this tribes are reported from Lalpur village of Lalpur Gram Panchyat of Poundi-Uproda CD block, Korba district (Census of India, 2011) and the exact population of these within HAC required to be surveyed.

- Chotia coal block and PEKB coal block are the two mines under operation. The forest diversion for PEKB is till been refereed as the case is under sub judicial.
- Forest Rights Act (FRA), 2006 potentially secure the rights of more than 7.4 million STs and Other Traditional Forest-Dwellers (OTFDs) in Chhattisgarh (32% of state population) over at least 3.02 million ha in over 11,500 villages (http://fra.org.in/document/Promise%20and%20Performance%20Report.pdf).
- The FRA (2006) rests on recognizing the rights of the ST, pastoralist communities and OTFD communities to hold and live in forest land guaranteeing them individual, community tenure or both, and engage in cultivation for livelihoods (MoTA, August 7, 2014). The FRA also ensures that the traditional forest dwelling groups have certain rights that ensure control over forest and forest resources, which include the right of ownership, access to collect, use and dispose of MFPs, community rights such as *Nistar,* habitat rights for the members of the Primitive Tribal Groups (PTGs) and pre-agricultural communities, other community rights, the right to protect, manage, conserve and regenerate community forests using traditional protection and conservation techniques for sustainable use (MoTA, August 7, 2014). The Act vested Individual Forest Right (IFR) and Community Forest Rights (CFR)
- Through an order dated January 8, 2016, the district level committee (DLC) under the FRA informed that the CFR holders of Ghatbarra village rights stand cancelled as it was disruptive of mining activity. The district collector, Divisional Forest Officer (DFO) and district level representative of the tribal development department, signed the order. The village had received this CFR title to access 811 hectares of forests. The area overlaps the coal concessions of both the PEKB and the Parsa mine blocks.
- The Ghatbarra CFR recognized three specific rights for the villages: Section 3 (1) (a) community rights such as *nistar,* by whatever name called, including those used in erstwhile princely states, *zamindari* or such intermediary regimes; Section 3 (1) (b) right of ownership, access to collect, use, and dispose of minor forest produce which has been traditionally collected within or outside village boundaries; and rights to grazing (both settled or transhumant) as per Section 3 (1) (c) of the FRA, 2006. Now the Forest Right Committee Ghatbarra Versus Union of India (WPC No.1346 of 2016) is under sub judicial.
- However, on 13th February 2019, Honourable Supreme Court of India ordered the 21 state governments to evict more than a million tribes and forest dwellers and their families whose claims over the forest land had been rejected by the authorities under the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act (FRA), 2006. The said order was, put on hold by the Supreme Court of India on 28 February 2019 after the central government filed a plea seeking modification of the 13th February,2019 order stating that FRA was "beneficial" legislation and that it should be construed liberally to help the tribals and forest dwellers who "are extremely poor and

illiterate people and not well informed of their rights and procedure under the Act and also they live in remote and inaccessible areas of the forest.

Majority of the coal blocks encompasses villages dominated with traditional tribal population. It is essential that the rights of the communities are ensured as the entire landscape is home and the resources provide economic sustenance to the ethnic community.

Table 7.32: List of likely to be affected/impacted villages due to coal mining in Hasdeo-Arand Coalfield that falls within Surguja, Surajpur and Korba Districts of Chhattisgarh

S.N.	Coal Block/Status	Likely to be affected/impacted villages	
A.	**Allotted**		
1.	Chotia (Chotia-2A & 2B coal mines operational)	Bhujung Kachhar (Salaigote, Sakoda para)	Ghunchapur
		Jajgi	Baniya
		Chotia	Rhode
		Lalpur	-
2	Parsa East & Kanta Basan (PEKB) (*PEKB coal mine operational*)	Parsa	Salhi
		Hariharpur	Kete
		Ghatbarra	Basan
		Parogia	-
3	Parsa	Salhi	Hariharpur
		Fattepur	Ghatbarra
		Janardanpur	Tara
4	Kente Extension	Basen	Kete
		Parogia	Chakeri
5	Madanpur South	Morga	Ketma
6	Gidmuri	Gidmuri	Paturiyadand
7	Paturia	Madanpur	Paturiyadand
		Uchalenga	Morga
B	**Not allotted**		
8	Tara	Mendra	Janardanpur
		Tara	Kantaroli
9	Morga IV	Dhajak (Botopal)	-
10	Morga III	Dhajak (Botopal)	-
11	Morga II	Kendai	Dhajak(Sagbar)
12	Morga I	Dhajak	Ketma
		Morga	Kendai
13	Morga South	Morga	Uchalenga
		Arisiya	Khirti
14	Madanpur North	Bhulasbhavna	Madanpur
		Dhajag	-
15	Puta Parogia	Puta	Kantaroli
		Khirati	Gidmuri
		Fattepur	Ghatbarra
		Suskam	-
16	Saidu	Saidu	Parogia/ Thirmana
		Khot Khurri	Suskam
17	Parogia	Saidu	Ghatbarra
		Suskum	Parogia
18	Pindraki	Parogia	Chakeri
		Pendarkhi	Khujhi
19	Sarma	Puta	Sarma
		TenduTikra	Chakeri
		Bangru	-
20	Laxmangarh	Phungi	Maheshpur
		Manpur	Laxmangarh
		Sanibarra	TenduTikra
		Ramnagar	Udaipur
		Puta	Jhirmiti

S.N.	Coal Block/Status	Likely to be affected/impacted villages	
		Mohanpur	Lipangi
21	Bhakurma-Matringa	Pahadkorja	Bule
		Bhakurma	-
22	Nakiya	Nakiya	Bimalta
		Pendradih	-
23	Kedma	Kedma	Keshma
		Badegaon	Bule
		Mareya	-

7.8.3 Loss of forest resources

Tendu leaves, Mahua flowers and seeds are major the NTFPs collected from forest on regular basis in large quantities and hence considered for dependence estimation. Other NTFPs collected in minor quantities include Char seeds, Mahul leaves, Chhind leaves, Phul jharu grass, Harar fruit and Baehra fruit, Dhawai flowers, wild honey, edible wild mushrooms, bamboo shoots, Sal resin, Sal seed, Sal leaves, Chironta seed based on the availability in different seasons. These NTFPs are mainly collected from **Parla, Lad, Lam Pahar, Dhajag, Paturia, Fathepur, Pindraki, Matringa, Ghatbara, Puta, Chakeri protected and Pidiya reserve forests** falling in HAC. Mahulpatta is mainly collected from Kolargadra, Botopol, Gidmuri, Paturia, Madanpur, Basan, Parogia, Badegaon, Mareya, Ramgarh hill. Lac cultivation and silk worm rearing is also practiced by select villagers in the HAC. Household dependency on forest for fodder was 94.74% and 97.37 % each for fuel wood and major NTFPs in surveyed villages of HAC. Household survey revealed that Tendu leaves collection during 2019 season ranged between 50 to 950 standard bags in surveyed villages and sold @ Rs. 2500/- per bag in 2018 season and Rs. 1800 per bag in 2017 season. Over all tendu patta sale from HAC was Rs 8.0 crores @ collection rate for Rs 4000/standard bag during 2019.

Unregulated trade of Mahua a commodity is also made by almost all households for self-consumption and only surplus is sold in weekly markets during lean season, which fetches higher price up to Rs. 80-90 /kg of dried flowers as a supplement income. HH survey revealed that Mahua flower collection varied between 20-1000 kg per HH during 2019 season with average annual household removal of 219 kg. Collection of Chirongi seed and lac were 24 kg and 18 kg respectively.

The HAC contributes to forest-based resources for the community in terms of NTFP, fuel wood and small timber. The coal mining is likely to have impact on the dependence on forest and forest produce on the community livelihood.

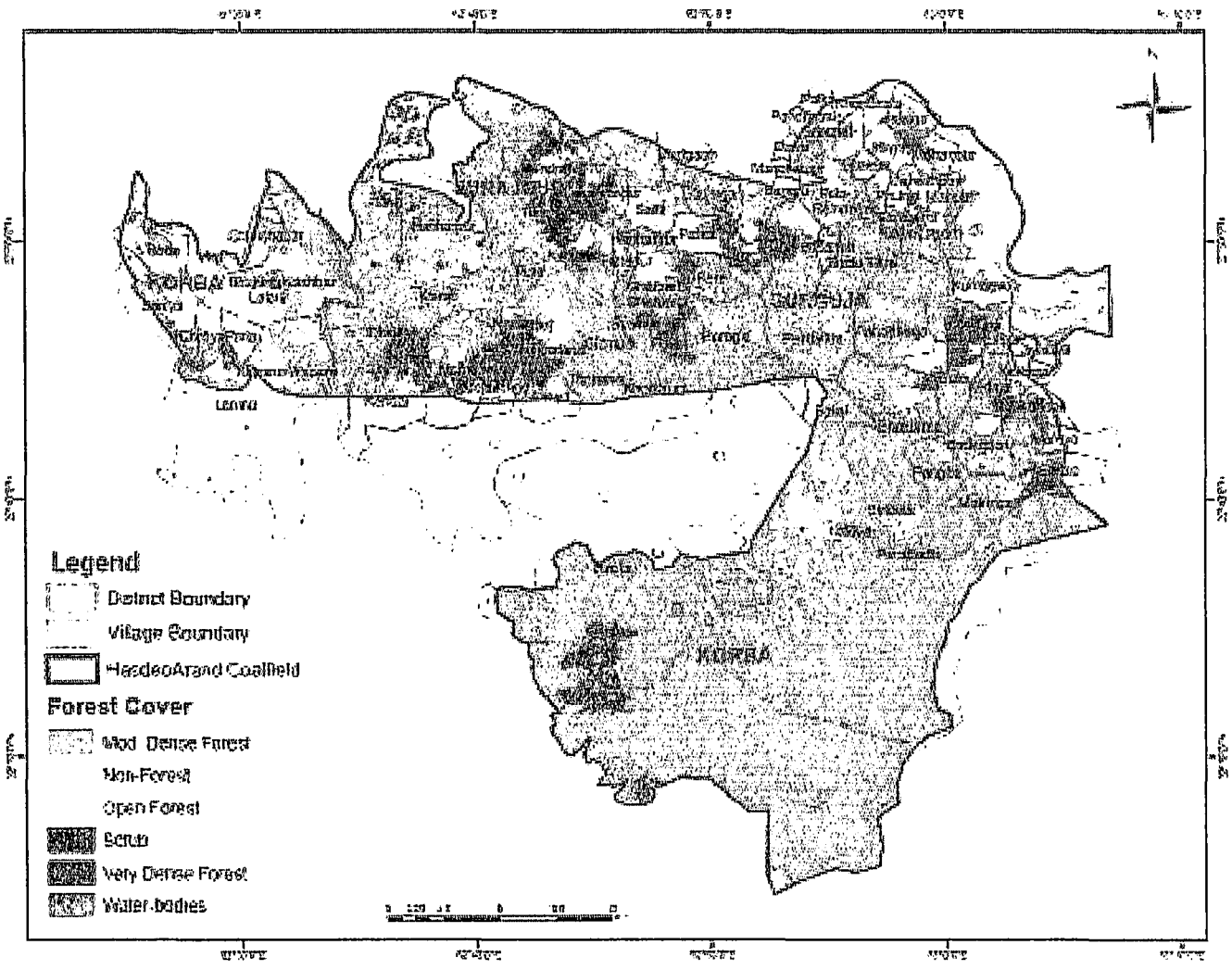


Figure 7.29: Map showing villages in Hasdeo-Arand Coalfield area falling within Korba, Surguja and Surajpur districts of Chhattisgarh

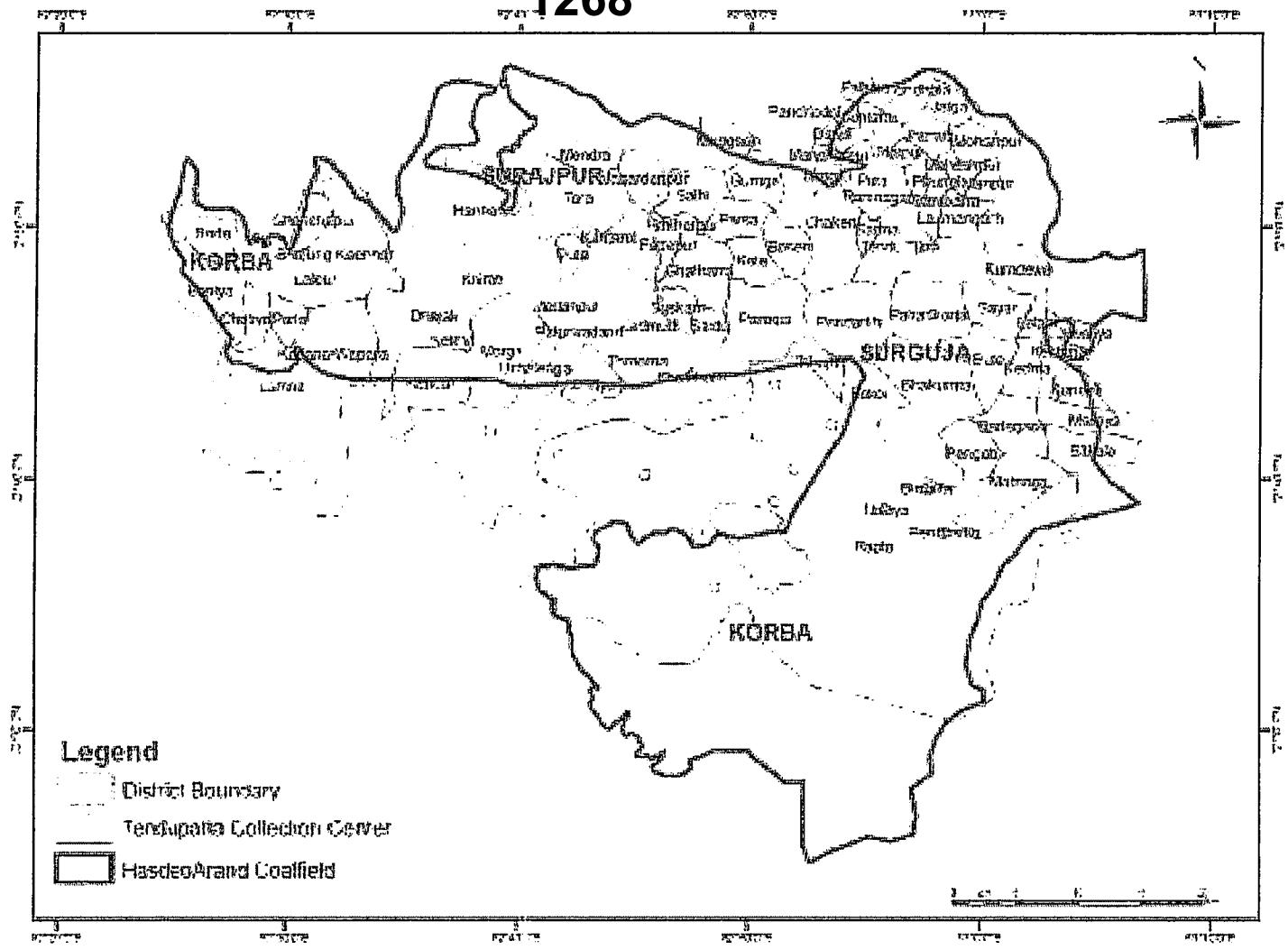


Figure 7.30: Showing the Tendu patta collection centres in Hasdeo-Arand Coalfield area that falls in Surguja, Surajpur and Korba Districts, Chhattisgarh.

7.8.4 Loss of livelihood and sources of income

Majority of the population in the study area is highly dependent on agriculture and forest produce for their livelihood and sources of income.

- The average annual household income of sample households was estimated to be Rs. 86,341/-, of which Rs. 17,195/- from forest; Rs. 28,381/- from cultivation and Rs. 40,763/- from secondary sources of income like manual casual labour in cultivation /agriculture, jobs and business.
- The estimated average monthly income was Rs. 7195/- out of which Rs. 1432/- was from forest, Rs. 2365/- from cultivation and Rs. 3396/- from secondary sources such as labor in cultivation /agriculture etc.

The sources of income from the forest resources will be lost due to loss of forest rights, community rights and diversion of forest land; agriculture resources due to loss of agriculture land/labor *etc.* Overall the livelihood of the community inhabiting in the HAC region and their subsistence will negatively impacted due to loss of forest land, agriculture land and other natural resources.

Table 7.33: Revenue villages likely to be affected due to coal mining in Hasdeo-Arand Coalfield area falling within Korba, Surguja and Surajpur districts of Chhattisgarh

SN	Coal Blocks	Likely to be affected Village	No. of HH	Population			Sex ratio	SC Population			ST Population		
				Total	M	F		Total	M	F	Total	M	F
1	Morga-I, II, III, IV, Madanpur North	Dhajak	363	1425	738	687	931	38	22	16	1107	568	539
2	Morga-I, Madanpur South	Ketma	50	218	108	110	1019	0	0	0	207	102	105
3	Morga-I, Morga South, Madanpur South, Paturia	Morga	396	1771	914	857	938	89	48	41	1286	652	634
4	Morga South, Paturia	Uchalenga	188	743	367	376	1025	0	0	0	682	335	347
5	Morga-I, II	Kendai	609	2467	1277	1190	932	131	69	62	1821	952	869
6	Morga South	Arisiya	256	974	515	459	891	48	25	23	716	379	337
7	Morga South	Khirati	189	753	396	357	902	0	0	0	640	337	303
8	Paturia, Madanpur North	Madanpur	96	363	193	170	881	2	2	0	299	153	146
9	Chotia-2B	Bhujung Kachhar	122	505	253	252	996	0	0	0	470	237	233
10	Gidmuri, Puta Parogia	Gidmuri	138	594	303	291	960	0	0	0	536	276	260
11	Saidu	Thrriama	31	149	70	79	1129	0	0	0	144	68	76
12	Nakiya	Nakiya	120	452	244	208	852	7	4	3	423	229	194
13	Tara	Mendra	146	617	295	322	1092	18	8	10	459	226	233
14	Tara, Parsa	Janardanpur	105	423	218	205	940	19	8	11	396	204	192
15	Puta Parogia, Tara	Kantaroli	122	528	271	257	948	12	5	7	482	249	233
16	Tara, Parsa	Tara	287	1291	641	650	1014	37	19	18	749	357	392
17	Nakiya	Bimlata	92	347	174	173	994	1	0	1	316	157	159
18	Puta Parogia	Puta	300	1267	637	630	989	112	61	51	784	385	399
19	Puta Parogia, Parogia, Parsa, PEKB	Ghatbarra	310	1395	710	685	965	83	34	49	966	499	467
20	PEKB, Kente Extension	Kete	124	561	296	265	895	20	10	10	541	286	255

SN	Coal Blocks	Likely to be affected Village	No. of HH	Population			Sex ratio	SC Population			ST Population		
				Total	M	F		Total	M	F	Total	M	F
21	Bhakurma-Matringa	Bhakurma	323	1235	642	593	924	12	7	5	1135	584	551
22	Saidu, Parogia, PEKB, Pindraki Kente Extension,	Parogia	78	322	155	167	1077	0	0	0	253	125	128
23	Saidu, Parogia	Saidu	31	119	65	54	831	0	0	0	119	65	54
24	PEKB, Parsa	Salhi	300	1315	674	641	951	0	0	0	1154	589	565
25	PEKB, Parsa	Hariharpur	62	298	151	147	974	3	1	2	226	118	108
26	Parsa, Puta Parogia	Fattepur	88	469	238	231	971	0	0	0	423	214	209
27	PEKB	Parsa	262	1085	567	518	914	60	32	28	775	404	371
28	PEKB, Kente Extension	Basen	123	570	304	266	875	0	0	0	516	272	244
29	Kente Extension, Pindraki, Sarma	Chakeri	256	1068	534	534	1000	26	12	14	693	335	358
30	Sarma	Sarma	55	261	134	127	948	0	0	0	211	103	108
31	Pindraki	Pendarkhi	201	841	416	425	1022	5	2	3	713	354	359
32	Laxmangarh	Laxmangarh	370	1518	752	766	1019	33	16	17	527	264	263
33	Kedma	Kedma	272	1126	581	545	938	43	19	24	534	279	255
		Total	6534	27553	14076	13477	957	821	413	408	20741	10578	10163
Source- Based of Census of India, 2011													

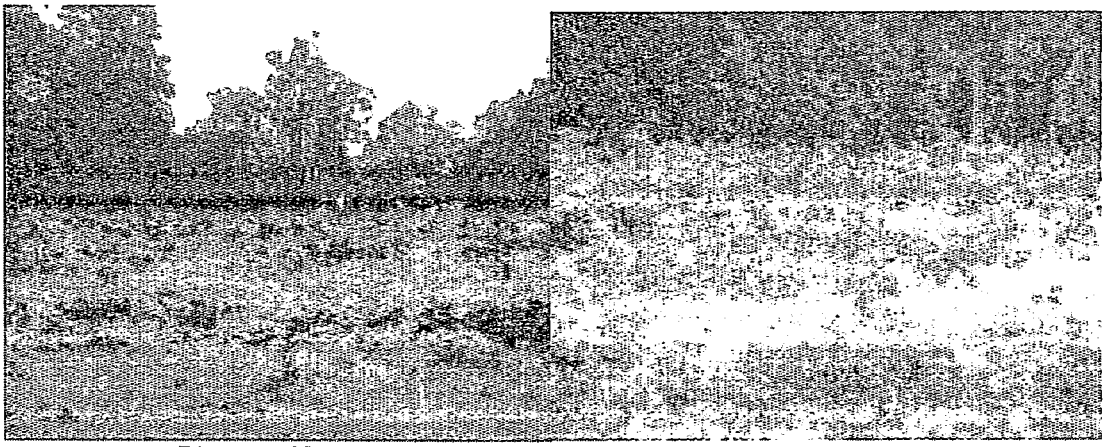


Plate 7.1: Natural Tendu sapling stand in Gumga Protected forest

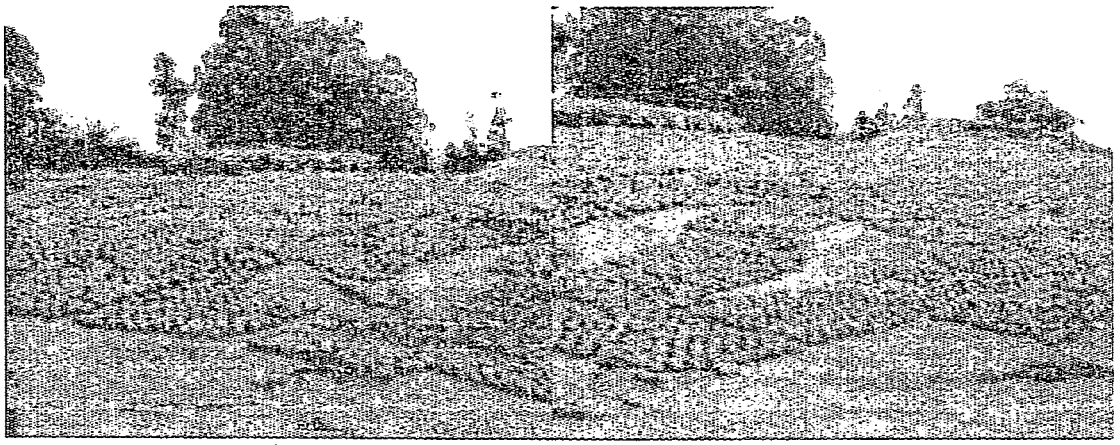


Plate 7.2: Sun drying and packaging of Tendu leaf



Plate 7.3: Loading and transportation of Tendu leaf

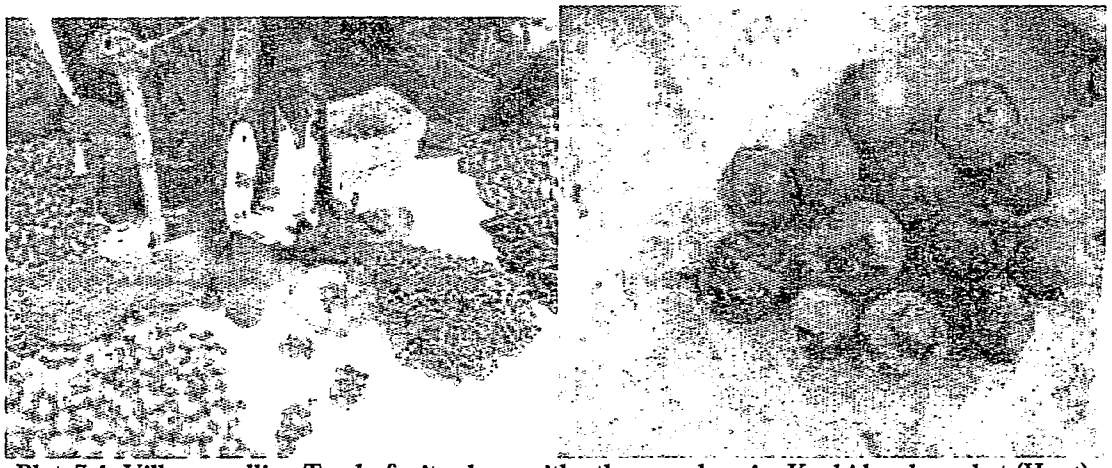


Plate7.4: Villager selling Tendu fruits along with other produce in Korbi local market (Haat)

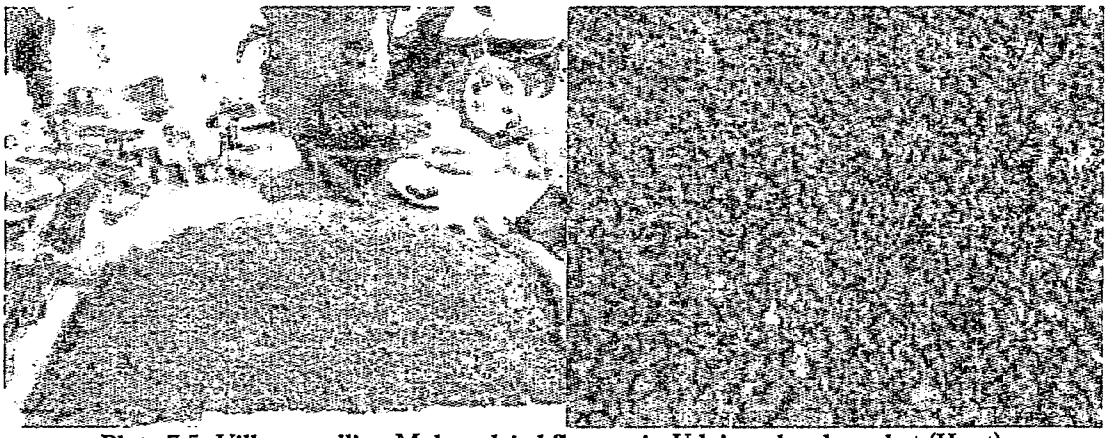


Plate 7.5: Villager selling Mahua dried flowers in Udaipur local market (Haat)

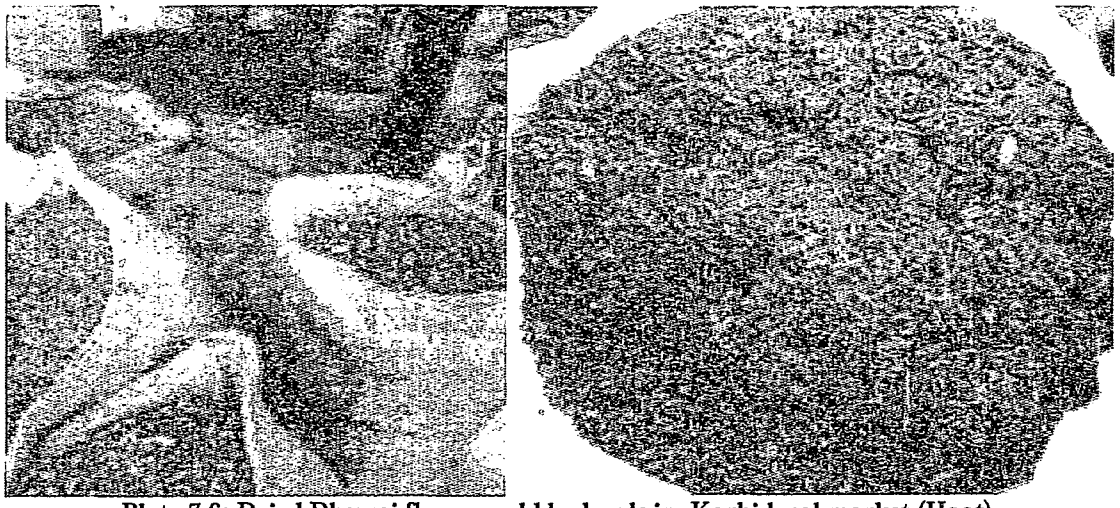


Plate 7.6: Dried Dhawai flowers sold by locals in Korbi local market (Haat)

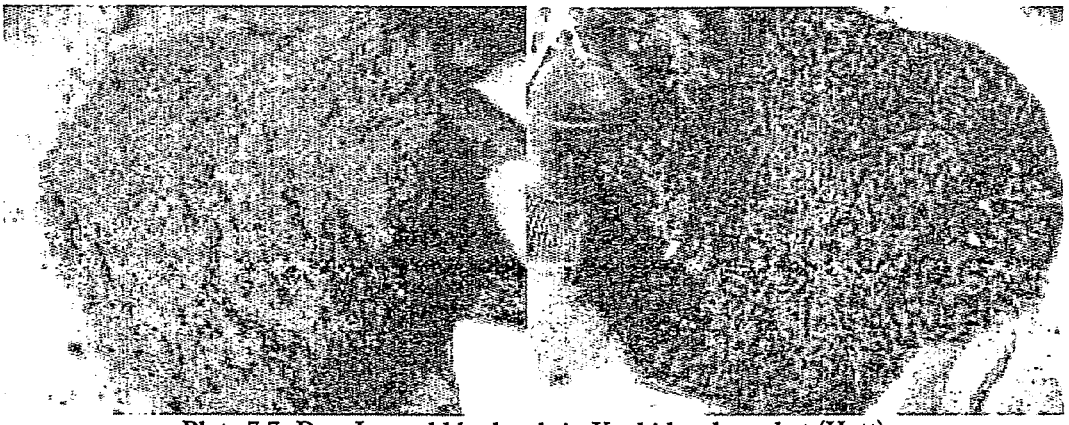


Plate 7.7: Raw Lac sold by locals in Korbi local market (Hatt)



Plate 7.8: Locals selling Bamboo baskets in Korbi local market (Hatt)



Plate 7.9: Wild Mushrooms for sale at Udaipur Haat

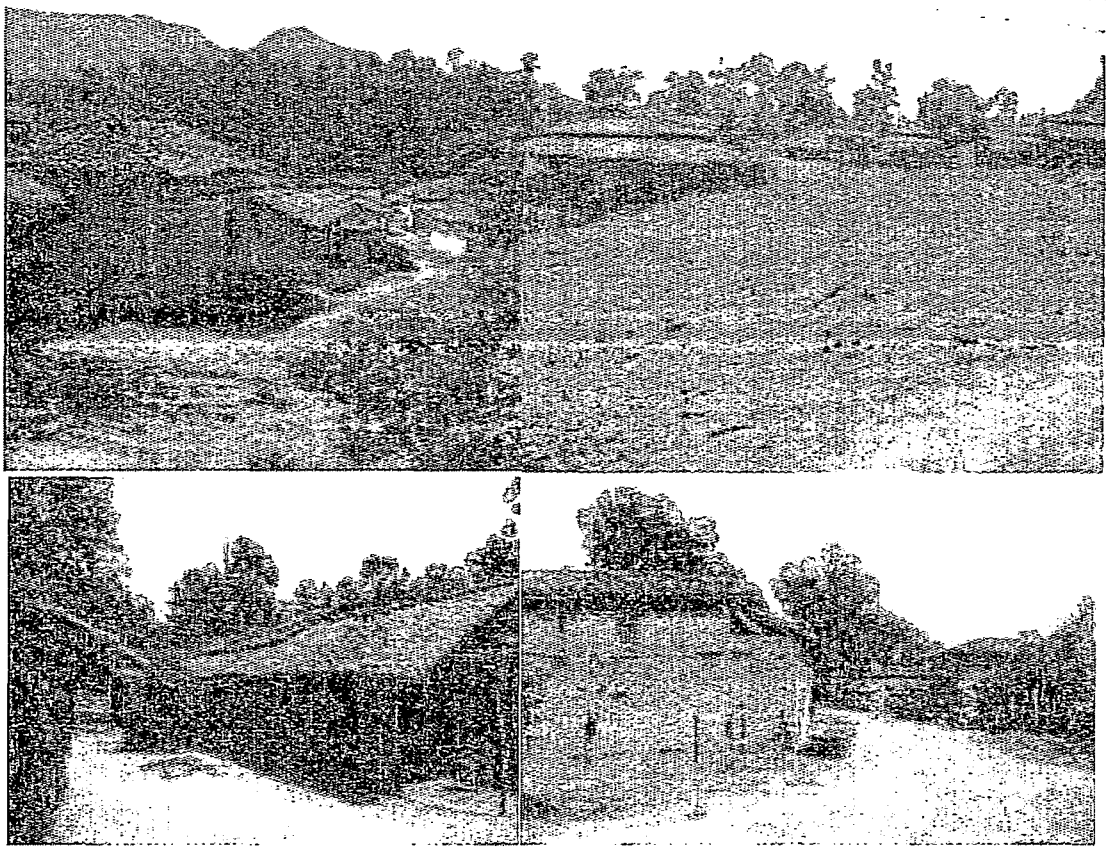


Plate 7.10: House Types in villages in HAC



Plate 7.11: Respondents during Household Survey in Rapta village

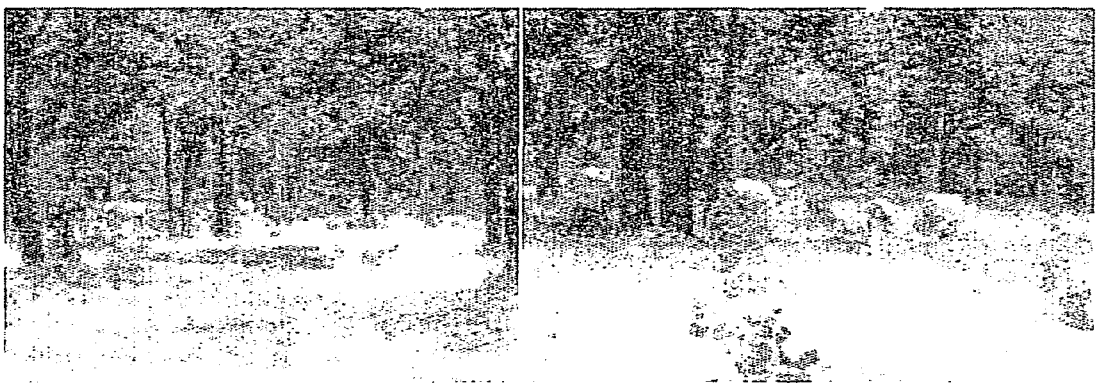


Plate 7.12: Cattle grazing in forests



Plate 7.13: Paddy straw stored for lean season fodder for cattle at Premnagar and Nakiya villages



Plate 7.14: Village house construction and fencing –use of timber mainly Sal (*Shorea robusta*) trees from forests at Premnagar and Salhi villages

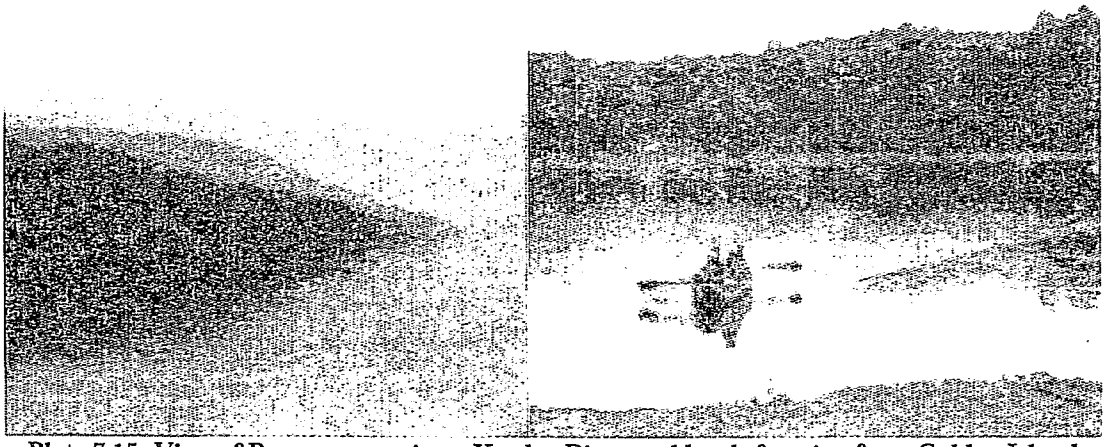


Plate 7.15: View of Bango reservoir on Hasdeo River and locals ferrying from Golden Island



Plate7.16: Sita Bengra Caves and Inscription on caves Ramgarh Hills



Plate 7.17: Rock inscription and Talab at top of Ramgarh Hills

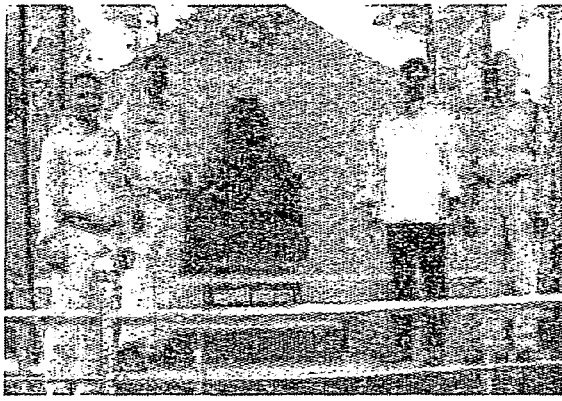


Plate 7.18: Mahakabi Kalidas statue at entrance of Ramgarh Hills

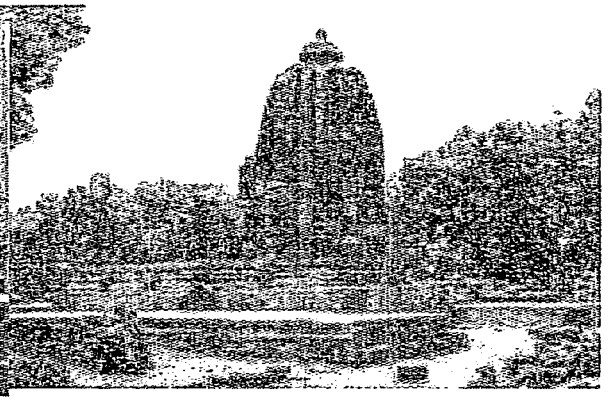


Plate 7.19 Maheshpur Shiva & Vishu Temple ASI Site

CHAPTER-8

EFFICACY OF MINE CLOSURE PLAN & CONSERVATION MEASURES PROPOSED IN OPERATIONAL/UPCOMING COAL BLOCKS

This chapter provides comprehensive observations on the efficacy of the Mine Closure Plan, Progressive Mine Closure Plan, conservation measures adopted as stipulated in the environmental compliance condition and gaps in undertaking the adaptive management measures by operational mines *i.e.*, Parsa East Kanta Basan (PEKB) and Chotia-2A & B coal blocks. The directions of National Green tribunal (NGT) *vide* its judgement dated 24th March 2014 (Annexure 1.3) to the MoEF&CC "*to seek advice or* opinion *on opening of PEKB coal block as per the sequential mining*" has been duly addressed in this chapter. In addition,the observations on the efficacy of reclamation methods undertaken in PEKB, afforestation of the reclaimed areas as well as natural regeneration of the afforested areas are provided as per the ToR. Also, the efficacy of the mine closure for those mines for which documents are available is also provided in this chapter.

Out of the 23 coal blocks identified by CMPDI, four are allotted to different lessees. Two coal blocks *i.e.*, Parsa East Kanta Basan (PEKB- block No. 14) and Chotia (block No. 2) out of the four allotted are in operation and the remaining two blocks i.e., Parsa (13) and Kente Extension (12) are in the processes of obtaining necessary clearances. Detailed information on exploration, mining and mine closure activities envisaged are available for these 04 blocks.

Five (05) coal blocks such as Tara Coal block, Madanpur (North), Madanpur (South), Paturia and Gidmuri coal blocks have only geological, mining and mine closure proposals. Limited information is available for 5 coal blocks such as Morga-II, Morga-III, Morga-IV, Morga South and Saidu; and for the remaining nine coal blocks (Puta-Parogia, Parogia, Pindraki, Sarma, Laxmangarh, Bhakurma-Matringa, Kedma, Morga-I and Nakiya I, II & III) no information are available. Accordingly, observations on efficacy of Mine Closure Plan have been provided in this chapter.

8.1 OBSERVATIONS ON EFFICACY OF MINE CLOSURE PLAN, ENVIRONMENTAL MONITORING & MITIGATION MEASURES, R&R ACTIVITIES OF PARSA EAST KANTA BASAN (PEKB) COAL BLOCK

8.1.1 Exploration & Reserve Estimation

PEKB mining lease area is explored by drilling 196 boreholes for cumulative meterage of 24899.80 m. Intensity of drilling is 8.11 boreholes per sq.km. Exploration established 03 potential coal seams *i.e.* seam VI, V and IV in descending order from surface. Total geological reserves estimated are 516.40 million tonnes. Intensity of

ploration undertaken is in order in respect of lateral spacing of boreholes and drilling depth. Entire coal bearing horizon upto Talchir formation has been explored. Exploration reveals, occurrence of thin coal seam varying thickness from 0.2 m to 0.98 m below the coal seam IV, with parting of about 50 m thick. Mining of such thin coal seam of less than 0.5 m with more than 50 m thick parting may not be economical; therefore, concurrent backfilling of mined out pit will not adversely affect the interest of mineral conservation. The entire block has been fully explored.

8.1.2 Systematic Development of Mine Pit

8.1.2.1 Mine pit development

As proposed in the mining plan, mine pit has been opened all along the strike length of coal seam for a length of 6.12 km along mine surface and 6.04 km along mine floor to facilitate ease to operate more than one section and achieve targeted production of 15 million tonnes per annum. However opening of such a long mine face for extensive mining has serious impact on land degradation. It may be minimized by undertaking intensive mining *i.e.* mining in smaller strike length up to the bottom of the coal body with simultaneous backfilling. Practicing such type of mining shall not expose huge area of land degradation in any given point of time for entire life of the mine.

Three contractors are engaged to work in the entire strike length of coal seams. This has increased the movement of vehicles with in the mine pit and the mine road widths are not sufficient to accommodate the increased traffic. There is no full proof traffic system for dumpers, for haulage of OB and coal. One-way traffic is not provided for all the haul roads. Some part of the road is being used by both light and heavy vehicles including 'U-turns', which is quite unsafe. In pit conveyer belt is under construction at the middle of the mine pit, two external dumps and two internal dumps are planned on eastern and western sides. ***Considering operational convenience and proximate to dumping, coal loading point and to minimize lead distance, it is suggested to operate the mine on the western and eastern end intensively up to bottom of coal seam without opening lengthy mine face with concurrent backfilling and advancing mining operation at the middle of the mine pit, so that land degradation at any point of mining operation is minimized.*** Similarly, the mining operation may be adopted during the IInd phase of the mining, accordingly mine planning needs to be envisaged and implemented.

The approved mining plan and mine closure plan has envisaged cumulative stripping ratio of 4.13 cum/ton up to 8th year of mining. However, it is observed during the survey in September 2020 (9th year of mining operation) the total overburden generated is 146.32 million cum and coal extracted is 63 million tonnes, which amounts to stripping ratio of 2.32 cum/tonnes, *which is much lesser than the envisaged stripping ratio indicating mine development is not commensurate with quantum of extraction of coal as envisaged in the mining plan.* Therefore, it is

suggested that the overburden benches have to be advanced sufficiently to ensure safe, scientific and sustainable mining. *Backfilling of mine pit has not been progressed as indicated 5th year of Mine Stage Plan.*

8.1.2.2 Drilling, blasting and handling of overburden/waste

Drilling and blasting is undertaken for over burden removal. Five Nos. of 160 mm Bore Hole Drills (BHD) of Hitatchi make are deployed in the mine for drilling in O.B. Bench height is maintained 10 m. Since O.B. mostly sandy sandstone & fractured sandstone, sub-grade drilling up to 0.3 m is undertaken, wherever required. Spacing and burden is maintained as 7 - 9 m x 6 – 7 m. Blasted O.B. is excavated by 3 cum and 15 cum shovel along with matching dumpers and dumped in the external dump/ backfilling sites. Blasting is being carried out departmentally (by mine management) as per DGMS permission under the supervision of Blasting officer and in daytime between 1 pm to 2 pm. No secondary blasting is required. Blasting accessories are drawn from explosive magazines; while Site Mixed Emulsion (SME) is supplied by explosive manufactures at blasting site in their pump trucks. Explosive column in blast holes is nearly one third and stemming column is two third of blast depth. Controlled blasting is done through Nonels of different delays. SME with cast boosters are charged optimally to control fly rock and ground vibrations.

8.1.2.3 Coal mining

Coal is excavated by deploying surface miner, an environment friendly mining equipment as it has inbuilt water spraying system which minimize dust at coal cutting site and adjustable teeth for coal cutting of desired size reduce one level crushing and minimize noise. However, ***automatic inbuilt loading facility is not utilized considering huge handling and operational convenience.*** Mined coal gathered and transported to washery deploying by Front End Loader and Dumper combination. It is suggested that the operational convenient alone should not take in to consideration or prioritise in sustainable and environmentally friendly mining. Because, loading through surface miner shall be put into practice on experimental basis and accordingly future planning shall be planned for scientific mining.

8.1.2.4 Coal transportation

Environment clearance was accorded with a condition that "coal transportation in pit by belt conveyor from in pit to pithead coal handling plant, surface to siding by belt conveyor to Pre-weigh Bin and loading at siding by SILO with inbuilt Rapid Loading System". However, in pit belt conveyor is not commissioned and is under advanced stage of its construction (Plate 8.1). Closed conveyer system needs to be completed at the earliest and commissioned, so that vehicle movements in the mine pit kept in minimum level and reduce generation of dust and noise.

8.1.3 Waste Disposal

8.1.3.1 External dumps

Overburden removed is dumped initially in the external dumps located in non-coal bearing area at north-western and north-eastern parts of lease and subsequently backfilled at de-coaled/ mined out area. There are two external OB dumps *viz.*, East and West External OB Dumps spread over an area of 112.98 ha and 25.71 ha respectively. The Eastern part of external OB dump has reached up to 58m height with 3 to 6 terraces/ decks and its slope angle is ranging from 25^0 to 35^0. The West External dump located on the north-western side of the lease has reached 32m height with 2 to 3 terraces/decks and slope angle vary from 25^0 to 35^0.

8.1.3.2 Internal dumps/ backfilling

Waste generated during the course of mining is proposed to be disposed initially in external dumps and subsequently in the internal dumps as back filling of mined out pit. Presently after completion of 8 years of mining operations waste dump have been disposed over an extent of 138.69 ha and 429.43 ha of two external dumps and two internal backfilled dumps respectively (Plate 8.2). Disposal of waste material in the eastern and western external dump is proposed in the approved mining plan till 6^{th} year of mining operations, however part of the eastern external dump is still active during the 9^{th} year of mining operation. Keeping large area under active dumping is not good practice of mining. It is suggested that dumping on eastern external dump has to be completed on priority and after stabilizing scientifically providing proper slope angle and water drains, the area should be reclaimed at the earliest to reduce impact on land degradation.

On examination of internal dumping, stabilization and reclamation activities, it is found that out of 731.50 ha of broken up area, only 429.43 ha of land (58.71%) has been backfilled and remaining 302.07 ha area (41.29%) under active mine pit. In the Progressive Mine Closure Plan, land use of pre-mining, during mining and post mining are envisaged and furnished. As per the proposal at the end 5^{th} year and 10^{th} year of mining operation, area to be excavated is 825.64 ha and 1226.34 ha respectively and area to be backfilled during the same period is 586.87 ha and 957.77 ha respectively (Plate 8.3). The envisaged proposal indicates that 71% to 78% of mined out land has to be backfilled at the end of 5^{th} and 10^{th} year of mining operations. But it is found that during 9^{th} year of mining operation (October 2020), 58.71% of mined out area only backfilled, which is much behind the scheduled proposal. To minimize quantum of land degradation at any given point of time, it is suggested to undertake intensive mining *i.e.* mining in smaller strike length up to the bottom of the coal seam with simultaneous backfilling instead of extensive mining of opening mine pit for longer strike length.

The mine closure plan envisages afforestation of backfilled area and to develop water reservoir to a depth of 30 m from ground level in part of backfilled mine pit. Mining lease area comprises of 701.786 ha of agriculture land, which is about 26% of total mining lease area. Efforts should be made to bring back the mined-out area close to original topography and land use. Accordingly, proposal may be inbuilt in the mine closure plan to bring back some extent of land to fit for farming/cultivation to balance socioeconomic of the region and justifying purpose of developing water reservoir apart from artificial recharge and rainwater harvesting, it may also support cultivation.

8.1.3.3 Retaining Walls and Settling Pits

Proposal has been inbuilt in the mine closure plan providing retaining walls at the toe of dumps and the unstable overburden benches to prevent wash off from dumps and sliding of material from benches and construction of water channels /drains. Even though, retaining walls are provided for the external dumps, which could not prevent sliding and siltation of water drains and on nearby road as their location was far away from the toe of the dump. Water drains provided are not scientifically made in respect of its dimension with reference to catchment area and intensity of rainfall and runoff water. It is suggested that bioengineering structures should be provided taking drainage pattern of the area, intensity of rainfall and run off into consideration.

8.1.3.4 Mine Drainage: Surface Runoff and Ground water Runoff

Mining lease area do not have Perennial River, however 3 first order seasonal streamlets flowing north-easterly, northerly and north-westerly and join into second order stream and flow towards north-western corner of the lease boundary and ultimately join to Salhi Nala, a tributary of Atem Nadi. Hydrogeology study report with mining plan indicate that an average rain fall of the area is 1400 mm whereas monsoon rainfall (June to October) is 1384 mm. Based on this it is estimated that in the PEKB mining block of 27 sq.km area generate about 8.88 million cubic meter water and flow as runoff. More over mining conditions increase percolation of water as well as increase groundwater runoff from 10% to 21% of rainfall.

These groundwater conditions and surface run off are not addressed scientifically to plan garland drains dimension and dumps configuration etc. Increase of surface water runoff in post mining conditions may damage toes of the dumps, if proper drainage channel is not provided. About 60% of annual rainfall is within a period of two months and an average single day rainfall of 100 year's average is 243 mm and mine opening disturb ground water runoff of vibrant streams. To mitigate the impact, as suggested in the ground water study report, garland channel/ drains required size have to be developed, which is capable to flow 76 m^3/sec of water during peak runoff period without any logging and blockage. Accordingly, the study report suggested that channel should be trapezoidal shape having width of 6m and depth of 2m. Garland channels and rainwater drains provided are not meet this specification and ultimately resulted to breaching of dump toes, sliding and siltation.

६.3.5 Management of coal rejects from washery

In the PMCP a proposal has been made to utilize the rejects generated from the washery for generation of FBC based Thermal Power Plant in accordance to EC condition obtained during 2011, however in the EC dated 10.08.2018 indicate that (i) Transportation of raw coal, washed coal and the rejects shall be through rail and (ii) Disposal of washery rejects shall be in accordance with the extant policy and guideline, and environment friendly. Coal mined from seam IV is G 11 quality having 36% to 38% ash content is fed to Jig washery having capacity of 10 MTP, which upgrades the coal to 30% to 31% ash content and this quality of coal contributes 70% of production and weight percentage of the reject generation is 10 to 11 %. Coal extracted from Seam V and VI are G 7 quality with ash content vary from 48 to 52% is fed to Dense Media Cyclone of 5 MTP capacity and upgraded to 31 to 32% ash content, which contributes 30% of production and reject generation is 36 to 37%. Till end of September 2020 total coal reject generated is 10.85 million tonnes. Rejects generated from beneficiation of Raw Coal of Parsa East and Kanta Basan coal mine are disposed off to end user plants with prior approval of Coal Controller's Organization.

8.1.4 Budgetary Support Provided in the Mine Closure Plan

RVUNL has entered into an agreement with the Coal Controller for opening the Escrow Account on 27.11.2013 at United Bank of India, Old Court House Street Branch, Kolkata.

Table 8.1: Details of money deposited in Escrow Account till 2017-18 towards PEKB mine closure activities

Year	Financial Year	Instalment Amount in lakh	Amount Deposited in Rs.	Date
1st	2013-14	796.96	38876000	27.11.2013
			40820000	31.03.2014
2nd	2014-15	389.76	38976389	25.03.2015
3rd	2015-16	1308.36	30000000	2015
			33833623	12.05.2016
			67013755	20.03.2016
4th	2016-17	703.65	37900000	10.03.2017
			32464504	15.03.2018
5th	2017-18	738.82	73882665	31.03.2018
Total		**3937.55**	**393755936**	

Details of money deposited in Escrow Account until 2017-18 towards mine closure activities are provided in Table 8.1. In addition, tentative abandonment Expenditure Proposed in the Mine Closure Plan is given in Table 8.2.

Table 8.2: Tentative Abandonment Expenditure Proposed in the PEKB Mine Closure Plan, Surguja District of Chhattisgarh

Activity	Amount in lakh
Dismantling of Infrastructure (i)Dismantling of workshop (ii)Dismantling of facilities	**1200.00**
Disposal of rehabilitation of mining machinery (i)Dismantling of pumps and pipes (ii)Dismantling of stowing bunker, provisioning of pumps for bore well pumping arrangement (iii) Re-arrangement of water pipe lines to dump top park (iv)Dismantling of Power lines	**5.00**
I. Safety and Security: (i)Barbed wire fencing with masonry pillars, (ii) Concrete wall with masonry pillars around the pit, (iii) Securing air shaft, and installation bore well pump' (iv) Boundary wall around water body (v) Garland drain around the outside boundary wall (vi) Stabilization (*viz.* benching, pitching *etc.*) of side walls of water body (vii) Toe wall around the dump (viii) Garland drain around the dump (ix) Drainage channel from main OB dump to Nala	**50.00**
II. Filling of void	**40.00**
III. Top Soil management	**20.00**
IV. Technical & Biological Reclamation of mined out area	
Quarry	**8510.00**
Terracing, blanketing with soil and vegetation of External dump	**451.00**
Vegetation of infrastructure Road, Rationalization area *etc.*	**230.00**
V. Landscaping & Plantation (i)Peripheral road, gates, view point, cemented steps on bank (ii) Beautification and landscaping over dump and (iii) Plantation	**36.00**
Post Mining water quality and air quality management Other miscellaneous expanses like cost of organization for executives of the closure activities, cost of post project monitoring for three years	**500.00**
Others: (i)Entrepreneurship development (vocational /skill development training for sustainable income affected people (ii)Golden handshake / Retrenchment benefits to 100 employees of OC (iii)Golden Handshake/ Retrenchment benefit to 200 employees of OC (iv) Onetime financial grant to societies/ institutions (v) Provide jobs in other mines of the company	**3610.00**
(vi) Continuation of other services like running of schools etc	**500.00**
(vii)Corpus fund for maintenance of retained facilities	**2000.00**
Total	**17152.00**

As per the advice of coal controller for compliance status of approved Mining Plan and Mine Closure Plan till 31 March 2018 submitted by Indian Institute of Technology (Indian School of Mines), summary of the expenditure done by RVUNL for various Mine Closure Activities upto 31st March 2018 is given Table 8.3.

Table 8.3: Summary of the expenditure done by RVUNL for various PEKB Mine Closure Activities up to 31st March 2018, in Surguja district of Chhattisgarh

Sl.No.	Mine Closure Activities	Rs in lakh
1	Escrow Account to be deposited for 2017-18 as per Mine Closure Plan	738.82
2	Total Amount deposited in Escrow Account till 31st March 2018	3937.56
3	Expenditure done by M/s RVUNL for Mine Closure for 2017-18	2413.16
(i)	Top soil handling and mulching cost	1760.06
(ii)	Plantation cost & Horticulture cost	298.13
(iii)	Fencing Material & erection cost	---
(iv)	Salary & wages cost of Horticulture Department	59.41
(v)	Garland drain cost	295.56

The third-party audit report concluded that M/s. RVUNL has carried out all the activities envisaged under approved mining closure plan till 31st March 2018 and summary of expenditure incurred for FY 2017-18 is amounting to Rs. 24,13,16,126/-. Even though proposed activities of mine closure envisaged in the mine closure plan are undertaken, it effectiveness is not adequate. As mine closure activities are not generalized and it is site specific and characteristics of each parameters such is nature and quality of dump material, competence of rocks, nutrition content in top soil, rain fall of the area, geomorphology of the area *etc.* are need to be considered to make site specific mine closure proposal and Reclamation and Restoration Plan.

8.2 EFFICACY OF THE CONSERVATION MEASURES IN PEKB

The NGT pronounced its judgement on 24th March 2014 (Annexure 1.3) and recommended to the MoEF&CC with direction to seek advice of the FAC within reasonable time and emphasised for answer to the following questions:

1. Opinion about the reclamation methods proposed? And efficacy of the conservation measures *i.e.*, Reclamation and Rehabilitation made.

8.2.1 Statutory Clearances PEKB Coal Block

Clearance Details	Approval Letter Details
EC for a production capacity of 10 MTPA and Pit Head Coal Washery of 10 MTPA over a **total project area of 2711.034 ha** in villages Parsa, Kente, Basan, Salhi, Hariharpur, Ghatbara, Parogia under Udaipur Tehsil of Surguja district, Chhattisgarh state.	No.J-11015/03/2008-IA-II(M) dated 21-12-2011
FC for diversion of **1898.328 ha of forest land** in two phases for PEKB captive coal block opencast mining project in South Surguja Forest Division in Surguja district, Chhattisgarh	F.No. 8-31/2010-FC dated 15-03-2012, which was revalidated on 12-04-2018 to **1871.118 ha** by the revised mining plan.
EC for expansion of production of the PEKB Open Cast Coal Mine from 10 to 15 MTPA as well as Pit Head Coal Washery from 10 to 15 MTPA over a total area of **2682.856 ha** for a period of 34 years in Hasdeo-Arand Coalfield, Surguja district, Chhattisgarh	No.J-11015/03/2008-IA-II (M) dated 10-08-2018.

8.3 LAND USE CHANGES

8.3.1 Pre-Mining

The pre-mining land usage change details within the PEKB Mine Lease area as per the EC dated 10 08-2018 are as follows:

Pre-mining land usage of PEKB	
Land use type	**Area (ha)**
Forest land	1871.118
Tenancy land	701.786
Govt. land	109.952
Total	**2682.856**

8.3.2 Phase-I

The land usage change during the Phase-I of the PEKB Open Cast Coal Mine lease area is as below:

Total area under Phase-I of PEKB		
Land use type	**Area (ha)**	
Mining	866.166	**1049.985**
Infrastructure	183.819	
East External Dump	112.98	**138.69**
West External Dump	25.71	
Total	**1188.675**	

8.3.3 Post-mining

The post-mining land usages within the PEKB Mine Lease area as per the EC dated 10-08-2018 are as follows:

Land use Type	During Mining (ha)	End of life (ha)	Land use (ha)					
			Plantation grass/ Greenbelt	Water body	Public use	Agriculture land	Dismantled	Total
External OB Dump	112.655	112.655	112.655	--	--	--	--	112.655
Top Soil Dump	5.0	5.0	5.0	--	--	--	--	5.0
Excavation Area	2328.247	--	2127.555	260.692	--	--	--	2328.247
i). Backfilled area	--	2157.560	--	--	--	--	--	--
ii). Excavated void	--	230.687	--	--	--	--	--	--
Roads and infrastructure area	137.435	137.435	13.744	--	32.601	--	91.090	137.435
Rationalization area	39.518	39.518	35.931	--	3.588	--	--	39.518
Total	**2682.856**	**2682.856**	**2294.884**	**260.884**	**36.189**	--	**91.090**	**2682.856**

8.3.4 Life of the Mine

The remaining life of the mine (15 MTPA) is 31 years considering the quantity of coal already extracted (11.53 MT) till March, 2016 out of the estimated total mineable coal reserve of 440.93 MT with the corresponding Over Burden (OB) generated 2342.38 MCum at an average Stripping Ratio of 5.31 Tonnes/Cum .

8.4 RECLAMATION AND REHABILITATION

8.4.1 Internal Backfilled Dumps

Out of the total land area broken for mining as on September, 2020 (731.50 ha), a total of 429.43 ha has been backfilled by in-pit dumping in retreating method from bottom to top providing terracing of appropriate height and width. The in-pit dumping/internal backfilling are made in two divisible areas *viz.*, East and West backfilled dumps and the details of backfilled OB dumps are given in Table 8.4.

Table 8.4: Details on the in-pit dumping/internal backfilling areas *viz.*, East and West Backfilled Dumps in Parsa East & Kanta Basan (PEKB) in Hasdeo-Arand Coalfield in Chhattisgarh

Backfilled OB dump	Area in ha (backfilled area)	Top RL (m)	Pit Bottom RL (m)	Surface RL (m)	Height of the dump (m)	No. of terraces
East Backfilled OB dump	156.27	540	475	530-553	65	6-7
West Backfilled OB dump	273.16	540	486	530-516	54	6-7

The land utilization for mining, reclamation and rehabilitation as on September 2020 are summarized in Table 8.5.

Table 8.5: Details on the land usage as on Sep, 2020 for Reclamation & Rehabilitation in Parsa East & Kanta Basan (PEKB) in Hasdeo-Arand Coalfield in Chhattisgarh

Total land usage as on Sept., 2020 (8 years after commencement of mining) Reclamation and Rehabilitation (R&R)			
Land usage details	**Area (ha)**	**Reclamation area details**	**%**
Broken	731.50	Utilization *w.r.t.* total mining area (866.166 ha)	84.45
Backfilled	429.43	Achieved *w.r.t.* total broken area	58.71
Physically reclaimed	219.16	Achieved *w.r.t.* total backfilled area	51.04
Biologically reclaimed	135.62	Achieved *w.r.t.* total physically reclaimed area	61.88

The total area earmarked for mining is 866.166 ha, of which 731.50 ha (84.45%) has been broken for mining. Out of the total broken area of 731.50 ha, an area of 429.44 ha (58.71%) has been backfilled by in-pit dumping.

- An area of 219.16 ha (**51.04% of the total backfilled areas)** has been physically reclaimed properly by dumping of waste within the excavated mine pit through retreating method followed by benching/terracing.
- An area of 135.62 ha (**61.88% of the total physically reclaimed areas)** has been biologically reclaimed by spreading top soil with the required thickness (1.0 - 1.5 m) over the physically reclaimed dump areas followed by planting native tree species on top and grass species (mainly Hamata) on the slopes.
- Over all, the R&R has been made in an area of 648.59 ha (88.67%) of the total broken area of 731.50 ha through backfilling (429.43 ha) and physical reclamation (219.16 ha) till February, 2020.

Biological rehabilitation *i.e.*, afforestation measures implemented by the PEKB in the *in-pit* dumps are observed to be adequate with suitable mixed native tree species. The extent of the biological reclamation/afforestation measures undertaken in the backfilled dumps are provided in Table 8.6.

Table 8.6: Details on Biological Reclamation- Afforestation in the Internal Backfilled OB dumps in Parsa East & Kanta Basan (PEKB) in Hasdeo-Arand Coalfield in Chhattisgarh

Biological Reclamation- Afforestation in the Internal Backfilled OB dumps			
Location	**Total Area (ha)**	**Total area under plantation (ha)**	**Total No. of plants**
East backfilled OB Dump	156.27	66.47	1,66,119
West Backfilled OB Dump	273.16	69.15	1,72,934
Total	**429.43**	**135.62**	**3,39,053**

1.2 External OB Waste Dump

There are two external Over Burden (OB) dumps located on the non-coal bearing area at NE and NW side of the PEKB coal block covering in a total area of **138.69 ha**.

8.4.2.1 East External OB Dump

The east external OB dump is located on N-E side of the PEKB mine lease covering an area of 112.98 ha. The dump is kept partially inactive as further dumping of waste is being made at the NE corner of the lease area.

Location	Area (ha)	Active/ Inactive	Top RL (m)	Surface RL (m)	Height (m)	No. of terraces	Approx. slope angle
East External OB dump	112.98	Partially Inactive	596	538	58	3-6	25-35°

A **toe/ retaining wall** made of **Rubble masonry with Plain Cement Concrete** has been provided at a length of **1.94 km** (Height 2.4 – 3.3 m; bottom width 1.2 m & top width 0.85 m)for the protection that also includes the active part of the dump.

- A Garland Drain for the two external dumps with a bottom width of 3-10 m and height 2-10 m for a total length of **5.97 km** together has been provided starting from the toe of East External Dump. It is largely an earthen drain all along its length except at few locations towards the east settling pond where it has been provided with RCC walls.
- Out of the total dump area **(112.98 ha)** biological reclamation / afforestation has been made in an area of **73.18 ha (64.77%)** by planting over 1,70,900 mixed native tree species.

Relatively, a large part of the slope of the dump towards northern face adjoining the approach road has been vegetated/ afforested with the mixed native tree species. However, the slopes at many places were observed to eroded/collapsed due to formation of deep rainwater cuts, rills and gullies. Afforestation with mixed native tree species provided on the top surface of the inactive part of east external OB dump is observed to be effective and have contributed to stabilization of the dump and colonization of good vegetation (Plate 8.4-8.6).

- Overall, the Reclamation and Rehabilitation (R&R) measures adopted on the East External OB dump are observed to be adequate to prevent the erosion. However, significant amounts of surface water flow towards the downstream direction of the dump area towards NW was observed during rainy season. Therefore, it is suggested that adequate protective measures like, properly designed toe/retaining wall and different types of gully control measures (Gabion check dam, loose boulder check dam, brush wood/log wood check dam, *etc.*) should be provided at the toe and slopes to prevent the increasing pressure of erosion.

8.4.2.2 West External OB Dump

The dump is located towards N-W side of the mine lease and covers an area of 25.71 ha. **A toe/ retaining wall at a length of 1.68 km** (Height 1.8-2.4 m; bottom width 1.2 m & top width 0.85 m) made of rubble masonry with Plain Cement Concrete have been provided at the toe of the dump.

Location	Area (ha)	Active/ Inactive	Top RL (m)	Surface RL (m)	Height (m)	No. of terraces	Approx. slope angle
West External OB dump	25.71	Inactive	548	516	32	2-3	25-35°

A single long 5.97 km length garland drain having bottom width of 3-10 m and height 2-10 m has been provided starting from the toe of East Extern Dump to the West external dump. It is suggested to prepare separate plan for garland drains for the east and west external dumps, distinctly marking over the surface plan for easy identification during field visit.

- The Garland Drain (PCC with rubble masonry) provided with adequate height and width for the west dump is starting from almost middle of its northern boundary near the Check Post to N-W end is to accommodate the quantum of flow. At the N-NW corner of the mine lease, the garland drain is joined by the catch water drain that is made along the northern boundary of the mine lease.
- Drain networks are being implemented to facilitate the flow of water from near check post towards east to the KJS workshop area and that ultimately join the northern side catch water drain.
- The engineering /physical measures made over the west dump are observed to be adequate to protect the dump from erosion. Few rain cuts and gullies formed during heavy raining are observed that needs to be treated appropriately with gully plugging followed by vegetation to stabilize the OB dump.
- Out of the total (25.71 ha) west external dump area an area of 25 ha (97.24%) has been biologically reclaimed by planting over 74,550 mixed native tree species on on the OB dump and is observed to be almost completely stabilized.

Overall, the Reclamation and Rehabilitation measures adopted on the West External Dump is satisfactory in terms of physical and biological measures adopted for preventions of erosion and stabilization of slopes, surface water management measures such as toe wall and garland drain as well as site specific vegetation that include mixed native tree species and maintenance.

Presently after completion of 8 years of mining operations, two external waste dumps over an extent of 138.69 ha have been formed. Out of the total area of 138.69 ha under external dumping, a total number of 2,45,450 mixed native plant species have been planted over an area of 98.18 ha (70.79%).

Biological Reclamation of the external OB dumps				
Land use type	**Area (ha)**	**Total No. of plants**	**Total area under plantation (ha)**	**% *w.r.t.* total dump area**
East External Dump	112.98	1,70,900	73.18	64.77
West External Dump	25.71	74,550	25.00	97.23
Total	**138.69**	**2,45,450**	**98.18**	**70.79**

Part of the eastern external OB dump is still active during the 9th year of mining operations though disposal of waste material in both the external dumps has been proposed in the approved mining plan till 6th year of mining operations. Hence, it is suggested that dumping on east external dump has to be completed on priority basis and after stabilizing by scientifically providing proper terrace/slope angle and water drains together with engineering measures, the area should be biologically reclaimed at the earliest to reduce impact on land degradation.

8.4.3 Surface Water Management Measures

8.4.3.1 Mine Sump Water Utilization

The water accumulated in the quarry/mine pit is being harvested after settlement of the suspended particles and the clear sump water is regularly used for dust suppression, plantations activities, HEMM washing, in CHP, *etc.* In addition, the excess water is drained into the catch water drain (on the dip side of the quarry) during rainy season (Plate 8.7).

8.4.3.2 Drains

A total length of 5.97 km Garland Drain has been provided for both east and west external OB dumps. A catch water drain with a length of 8.52 km (having a bottom width of 10 m & height varies 6-25 m) has been provided on the southern side of the First Phase of mining area along E-W direction primarily to prevent water entering into the mine pit and secondly to facilitate the flow of water from rest of the block on the southern side to the nearest natural water course (Salhi Nala), which is on the NW of the PEKB mining area (Plate 8.8).

Along northern boundary within the lease area, relatively a bigger drain is provided starting from Corner Pillar No. 10 & 11 to receive water from upstream north of the mining lease including near East External Dump. The water in the drain passes through a 3-stage settling pond on the NW corner of mine lease and finally draining into the natural watercourse (Plate 8.9). The diverted watercourses along south and north of the mine lease area join together to form a single entity on the NW corner and further flows as Salhi Nala towards north and finally draining into Atem Nadi. The catch drains location data provided by the project proponent were physically verified in the field (Table 8.7).

Table 8.7: Details on the catch drain location in Parsa East & Kanta Basan (PEKB) in Hasdeo-Arand Coalfield in Chhattisgarh

Catch drains	Length of Catch drains	Location of Catch drains	Specifications if any
Along the Haul roads	3.0 km	Along coal haul road from Access Trench towards West.	Earthen Drain (W-2 X H-2 m)
	3.0 km	Along coal haul road from Access Trench towards East.	Earthen Drain (W-2 X H-2 m)
	0.50 km	Both side along Access Trench	Earthen Drain (W-2 X H-2 m)
	0.50 km		
Along the approach roads	2.80 km	Between Approach road and External Dump-1 East side	Partially RCC Drain (W-2 X H-1.5 m)
	0.30 km	Along main approach road to Admin. Building.	RCC Drain (W-1 X H-1.5 m)
	0.60 km	Along opposite side of main approach road to Admin. Building.	RCC Drain (W-1 X H-1.1 m)
	0.27 km	Approach Road to washery	RCC Drain (W-0.5 X H-0.5 m)
	1.26 km	Along road around Stacker reclaimer	RCC Drain (W-0.5 X H-0.5 m)
	0.79 km	Along opposite side of stacker re-claimer road and reject bunker	RCC Drain (W-0.5 X H-0.5 m)
	0.69 km	Along Approach road of washery beside weighbridge	RCC Drain (W-1 X H-1 m)

Three earthen catch drains (2 x 2 m width & height) are provided at three locations along the haul roads covering a total length of 7.0 km.

- RCC drains with width and height varying from 0.5-1.0 m and 0.5-1.5 m respectively are provided at 7 locations along the approach roads covering a total length of 6.71 km.

8.4.3.3 Silt Settling Ponds

A total of 12 settlings earthen ponds of varying dimensions based on the requirement at various locations have been made to facilitate silt settling and clean water flow from the mine lease area to the nearby natural water course *i.e.*, Salhi Nala (Table 8.8).

Starting from upstream, a total of 05 settling ponds (3+1+1) of varying dimensions are provided near the infrastructure area i.e., coal washery and related facilities intended to collect and process the contaminated water at source followed by:

- Two settlings ponds on both sides of the approach road that receive water from the toe and downstream of East External Dump; followed by a 3-stage settling pond of varying dimensions at the terminus of the catch water drain along the northern boundary within the lease for settling the silt and sediments in the water; and finally a 2-stage settling pond (N-NW) at the end of all the drains of the mine

lease from where the clean water is allowed to flow into the nearby natural water course (Plate 8.10).

Table 8.8: Details on the Silt settling ponds in Parsa East & Kanta Basan (PEKB) in Hasdeo-Arand Coalfield in Chhattisgarh

Location of SSPs		Nos.	Dimensions (LxBxH) in m
Near Coal Washery	South end of washery	3	85 x 70 x 4.0
			85 x 75 x 5.0
			110 x 75 x 5.0
	Behind 33 KV sub-station	1	60 x 40 x 2.5
	Near main washery	1	80 x 70 x 4.0
Near weigh bridge on both sides of road	North of approach road	1	109 x 35 x 3.5
	South of approach road	1	60 x 25 x 3.0
Baigapara – NW	At the end of the drain on left side of the main approach road	3	98 x 30 x 4.5
			105 x 35 x 4.0
			115 x 45 x 6.5
	At NW toe of the external dump near corner pillar No. 1	2	30 x 20 x 4
	Total No.	**12**	

- In addition, a 2-stage settling pond has been made at the working bench (RL 540 m, District-2) for temporary storing/settling the seepage/sump water from the mine pit. The water from this temporary pond is allowed into the catch water drain at southern boundary of the quarry.
- Severe damages to the structures are reported to occur during every heavy raining season as the mine block area is quite prone to erosion. All necessary repair works of the structures implemented are monitored periodically.
- It is suggested that the structures provided should be regularly cleaned, maintained and strengthened as per the intensity of rainfall and erosion.

8.4.3.4 Check Dams

Adequate size and width of check dams have been constructed at important locations across the catch drain towards western side to arrest the flow of silt and sediments to the downstream and to ensure enhanced ground water recharge in the mine lease area and the buffer zone (Plate 8.11). The details check dams constructed are given below:

Check dam	Location	Specification
3 Nos.	At Baigapara Near Settling Pond	4.0 x 1.5 x 1.5 m
3 Nos.	At Down Stream Along Dip Side Garland Drain	10.0 x 1.2 x 1.7 m

8.4.3.5 Top soil management and utilization

The estimated quantity of total top soil from the PEKB open cast coal block is 76,58,955 cum. Since inception of the mining 19,47,331 cum of topsoil has been

extracted of which 19,37,251 cum of topsoil has been utilized so far for covering on top of the physically reclaimed waste dumps.

- During the field survey by the team (October 2020) 1,00,800 cum of topsoil were observed to be stored for future use. The top soil dump is located along the approach road from Basen east to the East external dump. It is placed approximately 3-5 m height from surface and found not supported with any physical measures for preventing erosion. The mine lease area is more vulnerable to erosion and therefore it is suggested to utilize the same at the earliest. However, it is pointed out that the top soil has been used adequately for the planting purpose and is evident from the physically and biologically reclaimed west in-pit dumping area where the 1.0 m thickness of topsoil spread (Plate 8.12).

8.4.3.6 Safety zone & Greenbelt Plantation

Safety zone along the northern mine boundary is protected with proper fencing and adequate plantation with mixed native tree species as greenbelt vegetation.

- A total of 7.66 ha area have been afforested under safety zone with 15,017mixed native tree species. Except for few locations, the safety zone plantation is not adequate and therefore gap filling wherever mortality observed is to be carried out with good quality saplings of native tree species by PEKB.

8.4.3.7 Afforestation

- In addition, the afforestation on OB dumps and safety zone, the proponent has made afforestation with native trees species. A total area of 30.54 ha has been afforested with 49,240 plants (Table 8.9).

Table 8.9: Details on the Afforestation Site/location in Parsa East & Kanta Basan (PEKB) in Hasdeo-Arand Coalfield in Chhattisgarh

Afforestation Site/location	Area (ha)	Total No. of plants
Waste land	10.04	24,298
Avenue (transport/service roads)	0.80	488
Around coal washery/stack yards	19.70	24,454
Total	**30.54**	**49,240**

During the field visit, it was observed that the plants raised near the infrastructure areas are quite bare minimum. Therefore, it is suggested, that thick vegetation cover (as per the EC and FC) shall be raised and maintained for preventing the dust emission entering into the other areas.

8.4.3.8 Water harvesting structures

A total of 8 recharge pits have been constructed with a dimension of 86x78x6 m having recharge potential of 1,20,211 Cum/year at Basan Pond and 2 bore well with recharge pits having the potential of 65,280 Cum/year at Basan Nala Bund. Both the

uctures installed by the project proponent are falling within the buffer zone area of the mine lease.

8.4.4 Species Used for Afforestation /Plantations

The project proponent has used mixed native plant species predominantly for raising plantations/afforestation in various locations in the lease area. The species planted in safety zone, avenue area, waste land, overburden dump, etc., are detailed in the following sections and listed in the Table 8.10.

8.4.4.1 Safety zone (Greenbelt) plantations

In order to minimize the impact of mining on environmental components outside the mine lease area, greenbelt should be established on safety zone within the lease area as well as around the township, silos and stock yards as per the conditions outlined the statutory clearance such as EC and FC. The greenbelt along safety zone is meant for environmental protection as it acts as a barrier that traps airborne suspended dust particles leading to suppression of air pollutants as well as that prevents noise pollution. Hence, greenbelt should invariably be planted with tall saplings (>1 m height) of fast growing broad leaved (preferably) native species to hasten the process of greening the area. It also promotes enrichment of flora and fauna in the area adjoining the mining lease. The lease area of PEKB OCP is bounded on west and east by the proposed coal blocks of Parsa and Kente Extension respectively and towards north partly by revenue and forest land and south covered by forest land. The Project Proponent has made greenbelt towards north of the lease boundary only. The southern side of the lease is devoid of any greenbelt due to progressing of mine in phase-II. Hence, the project proponent has to undertake gap plantation on three sides of the lease, i.e., north, east and west (2.5m x 2.5m spacing) along the safety zone/greenbelt areas as per EC/FC condition with tall, fast growing, fruit bearing native tree species. A total of 15 species of mixed native trees have been used for raising plantations.

8.4.4.2 Avenue plantation (transport/service roads)

All along the approach/service roads of the OCP, avenue plantation has been made mostly with mixed native trees of about 21 species. However, few gaps along the approach road plantation are noticed. Hence, the Project Proponent (PP) has to raise the thick vegetation cover all along the approach roads to prevent dust and noise pollution.

8.4.4.3 Wasteland plantation/afforestation

Plantation has been made in the wasteland over a total area of 10.04 ha with 19 mixed native tree species.

8.4.4.4 Waste (OB) dumps plantations (during the period from 2013 to 2020)

During the 7 years period from 2013 to 2020, extensive plantation has been raised on the external and internal backfilled OB dump areas predominantly with mixed native plants of as many as 37 species (Table 8.10).

Table 8.10: List of species planted in different locations including the statutory areas under the Coal Block

Sl. No.	Tree Species	Plantation Locations			
		Avenue (Road)	Waste Dumps	Waste land	Safety Zone (Greenbelt)
1	*Acacia auriculiformis*	√	√		
2	*Acacia catechu*		√		
3	*Aegle marmelos*		√	√	
4	*Albizia lebbeck*	√	√	√	√
5	*Artocarpus heterophyllus*	√	√	√	√
6	*Azadirachta indica*	√	√	√	√
7	*Bauhinia pupurea*	√	√		√
8	*Bombax ceiba*		√		
9	*Cassia fistula*	√	√	√	
10	*Cymbopogon flexuosus*		√		
11	*Dalbergia latifolia*	√	√	√	√
12	*Dalbergia sissoo*	√	√		√
13	*Delonix regia*	√	√		
14	*Dendrocalamus strictus*		√		
15	*Ficus benghalensis*	√	√	√	√
16	*Ficus racemosa*		√		
17	*Ficus religiosa*	√	√	√	√
18	*Gmelina arborea*	√	√	√	√
19	*Haldina cordifolia*	√	√	√	√
20	*Lagerstroemia parviflora*	√	√		√
21	*Mangifera indica*	√	√	√	
22	*Melia azedarach*		√		
23	*Mitragyna parvifolia*		√	√	
24	*Neolamarckia cadamba*	√	√	√	√
25	*Peltophorum pterocarpum*	√	√	√	
26	*Phyllanthus emblica*		√		
27	*Pongamia pinnata*	√	√	√	√
28	*Pterocarpus marsupium*		√	√	
29	*Shorea robusta*	√	√		
30	*Stylosanthes hamata*		√		
31	*Syzygium cumini*	√	√	√	√
32	*Tamarindus indica*		√	√	
33	*Tectona grandis*		√		
34	*Terminalia arjuna*	√	√	√	√
35	*Terminalia bellirica*		√		
36	*Terminalia chebula*		√		
37	*Terminalia elliptica*		√		
Total No.		**21**	**37**	**19**	**15**

8.4.4.5 Natural regeneration over the area under External and Internal OB Dumps for the period 2013-2020

The natural regeneration (native species) of vegetation over the area under plantation during the period from 2013 to 2018 was observed to relatively good. However, that of the area developed during the period from 2019 to 2020 was moderate. The profuse regeneration of the native species in the plantation areas indicates that the ecosystem is on its way to near normal, despite the disturbances. The habit-wise list of plant species observed in the natural regeneration of the OCP plantation area given in Table 8.11.

Table 8.11: List of naturally regenerated species recorded in the plantation areas under the Coal Block

Sl. No.	Species	Habit
1	*Acacia auriculiformis*	Tree seedling
2	*Acacia nilotica*	Tree seedling
3	*Achyranthes aspera*	Herb
4	*Aegle marmelos*	Tree seedling
5	*Aerva lanata*	Herb
6	*Aeschynomene indica*	Herb
7	*Ageratum conyzoides*	Herb
8	*Alternanthera ficoidea*	Herb
9	*Alysicarpus monilifer*	Herb
10	*Alysicarpus vaginalis*	Herb
11	*Apluda mutica*	Herb
12	*Aristida adscensionis*	Herb
13	*Aristida setacea*	Herb
14	*Aristida hystrix*	Herb
15	*Azadirachta indica*	Tree seedling
16	*Biophytum sensitivum*	Herb
17	*Blumea mollis*	Herb
18	*Blumea oxyodonta*	Herb
19	*Bothriochloa pertusa*	Herb
20	*Bridelia retusa*	Tree seedling
21	*Butea monosperma*	Tree seedling
22	*Butea superba*	Woody climber
23	*Byttneria herbacea*	Herb
24	*Caesulia axillaris*	Herb
25	*Cajanus scarabaeoides*	Climbing shrub
26	*Calotropis gigantea*	Shrubs
27	*Careya arborea*	Tree seedling
28	*Celosia argentea*	Herb
29	*Chrysopogon fulvus*	Herb
30	*Crotalaria prostrate*	Herb
31	*Crotalaria evolvuloides*	Herb
32	*Crotalaria retusa*	Herb
33	*Croton bonplandianus*	Herb
34	*Curculigo orchioides*	Herb
35	*Cynodon dactylon*	Herb
36	*Cyperus cephalotes*	Herb
37	*Cyperus corymbosus*	Herb
38	*Dactyloctenium aegyptium*	Herb
39	*Debiao vatifolia*	Herb
40	*Digitaria ciliaris*	Herb
41	*Digitaria longiflora*	Herb
42	*Dioscorea bulbifera*	Climbing shrub
43	*Diospyros melanoxylon*	Tree seedling
44	*Eclipta prostrate*	Herb
45	*Elephantopus scaber*	Herb
46	*Eleusine indica*	Herb
47	*Emilia sonchifolia*	Herb
48	*Eragrostiella bifaria*	Herb
49	*Eragrostis ciliaris*	Herb
50	*Eragrostis tenella*	Herb
51	*Eragrostis viscose*	Herb
52	*Euphorbia hirta*	Herb
53	*Euphorbia prostrate*	Herb
54	*Evolvulus alsinoides*	Herb
55	*Ficus benghalensis*	Tree seedling
56	*Ficus racemosa*	Tree seedling
57	*Ficus religiosa*	Tree seedling
58	*Flemingia semialata*	Shrubs
59	*Gmelina arborea*	Tree seedling
60	*Hedyotis auricularia*	Herb
61	*Hemidesmus indicus*	Climbing shrub
62	*Heteropogon contortus*	Herb
63	*Holarrhena pubescens*	Tree seedling
64	*Hyptis suaveolens*	Herb
65	*Ipomoea carnea*	Shrubs
66	*Ipomoea pes-tigridis*	Climbing shrub
67	*Lagas ceamollis*	Herb
68	*Lagerstroemia parviflora*	Tree seedling
69	*Leea asiatica*	Shrubs
70	*Leucaena leucocephala*	Tree seedling
71	*Microstachys chamaelea*	Herb
72	*Mimosa pudica*	Herb
73	*Mitracarpus hirtus*	Herb
74	*Mucuna pruriens*	Climbing shrub
75	*Oldenlandia corymbosa*	Herb
76	*Oldenlandia herbacea*	Herb
77	*Oplismenus burmannii*	Herb
78	*Parthenium hysterophorus*	Herb
79	*Paspalum scrobiculatum*	Herb
80	*Pennisetum pedicillatum*	Herb
81	*Phoenix loureirii*	Shrubs
82	*Phyllanthus emblica*	Tree seedling
83	*Phyllanthus maderaspatensis*	Herb
84	*Phyllanthus urinaria*	Herb
85	*Pongamia pinnata*	Tree seedling
86	*Saccharum spontaneum*	Herb
87	*Senna tora*	Herb
88	*Shorea robusta*	Tree seedling
89	*Sida acuta*	Herb
90	*Sida cordata*	Herb
91	*Sida rhombifolia*	Herb
92	*Spermacoce articularis*	Herb
93	*Spermacoce hispida*	Herb
94	*Spilanthes calva*	Herb
95	*Stylosanthes hamata*	Herb
96	*Syzygium cumini*	Tree seedling
97	*Tamarindus indica*	Tree seedling
98	*Themeda quadrivalvis*	Herb
99	*Thespesia lampas*	Shrubs
100	*Trema orientalis*	Tree seedling
101	*Tridax procumbens*	Herb
102	*Triumfetta rotundifolia*	Herb
103	*Urena lobata*	Herb
104	*Urena sinuate*	Herb
105	*Vernonia cinerea*	Herb
106	Waltheria indica	Herb
107	Xanthium strumarium	Herb
108	Zorrnia gibbosa	Herb

Table 8.12: Observations on the Compliance to Environmental Clearance Conditions *vide* Letter No.J-11015/03/2008-IA-II(M) dated 10-08-2018 pertaining to Progressive Mine Closure and Reclamation and Rehabilitation Plan

EC Conditions stipulated by MoEF& CC, Govt. of India	Observations by ICFRE
4. (iii) Mitigative measures shall be undertaken.....wind barrier wall and vertical greenery system, greenbelt,.....etc.	It is evident that the vegetation as wind barrier wall and vertical greenery system , green belt *etc.*, along the main infrastructure areas such as CHP, Coal washery, railway siding, transport roads, etc., is bare minimum and lot of improvements in raising such vegetation are much needed.
4. (vi) Thick green belt of 75 m width at the final boundary in the downwind direction of the project site shall be developed to mitigate/check the dust pollution.	Greenbelt vegetation: A total of 15,017 mixed native tree species has been raised in the safety zone area of 7.66 ha along the entire northern mine boundary. Except for few locations, the growth of safety zone plantation is not adequate; lot of gaps in vegetation thickness were observed at many locations.
4.1 (c) (ii) The surface drainage plan including surface water conservation plan for the area of influence affected by the said mining operations. considering the presence of river/rivulet/pond/lake, etc., shall be prepared and implemented by the project proponent. The surface drainage plan and /or any diversion of natural watercourse shall be as per the approved mining plan/EIA/EMP report and with due approval of the concerned State/DoI Authority. The construction of embankment to prevent any danger against inrush of surface water into the mine should be as per the approved mining plan and as per the permission of DGMS.	No separate surface water management plan is prepared by the project proponent. The mining lease area does not have Perennial Rivers. The area is part of the Atem Nadi sub-basin. It is intersected by a prominent branch of the second order stream – the Salhi Nala that is formed by joining together as many as 3 seasonal streamlets within the lease and flow towards north-western corner of the lease boundary and ultimately drains into the Atem Nadi. The flow of this stream is now diverted as catch water drain along the southern boundary of the mine lease. Hydrogeology study report enclosed with mining plan indicates that an average rain fall of the area is 1400 mm, whereas rainfall during monsoon (June to October) is 1384 mm. Based on this, it is estimated that in the PEKB mining block of 27.11 km^2 area generate about 8.68 Mcum water and flow as runoff. It is evident from the quantum of erosion along the slope of waste dumps and the drains at its toe that the area is more prone to erosion. Therefore, surface water management measures within the lease boundary involving various bio-engineering measures that control the flow of water is very much needed.
4.1 (c) (iv) The entire excavated area, backfilling, external OB dumping (including top soil) and afforestation plan shall be in conformity with the 'during mining/post mining' land-use pattern, which is an integral part of the approved Mining Plan and EIA/EMP submitted to this	Waste generated during the course of mining is proposed to be disposed initially in external dumps and subsequently in the internal dumps as back filling of mined out pit. Presently, after completion of 8 years of mining operations, waste dump have been

ministry	disposal over an extent of 138.69 ha areas of two external dumps and 429.43 ha area of two internal dumps. Disposal of waste material in the eastern and western external dump is proposed in the approved mining plan till 6th year of mining operations, however part of the eastern external dump is still active during the 9th year of mining operations. Keeping large area under active dumping/ under land degradation is not good practice of mining. It is suggested that dumping on eastern external dump has to be completed on priority basis and after stabilizing scientifically providing proper bio-engineering measures, the area should be reclaimed at the earliest to reduce impact on land degradation. On examination of internal dumping, stabilization as well as reclamation activities, it is found that out of 731.50 ha of broken up area, an area of 429.43 ha (58.71%) has been backfilled and the remaining 302.07 ha area (41.30%) under active mine pit. Out of the total area backfilled, stabilization and physical reclamation has been completed over area is 219.16 ha, which is 51.04% of the backfilled area. Further, the area fully reclaimed by afforestation is 135.62 ha, which is 61.88% of the physically reclaimed area. Over all, the R&R has been made in an area of 648.59 ha (88.67%) of the total broken area of 731.50 ha through backfilling (429.43 ha) and physical reclamation (219.16 ha) till February, 2020.
4.1 (c) (v) The top soil shall temporarily be stored at earmarked sites(s) only and shall not be kept unutilized for long. The top soil shall be used for land reclamation and plantation purposes. Active OB dumps shall be stabilized with native grass species to prevent erosion and surface runoff. The other overburden dumps shall be vegetated with native flora species. The excavated area shall be backfilled and afforested in line with the approved Mine Closure Plan. Monitoring and management of rehabilitated areas shall continue until the vegetation becomes self-sustaining.....	The estimated quantity of total top soil of the coal block is 7.66 MCum. A quantity of 19,47,331 cum of topsoil has been extracted since inception and out of which, 19,37,251 cum of topsoil has been utilized so far for spreading on top of the reclaimed waste dumps. At the time of field visit (October 2020) about 1,00,800 cum of topsoil is stored for future use. The top soil dump is located by the side of approach road from Basen east of the east external dump. It is placed approximately 3-5 m height from surface and is not provided with any physical measures for preventing it from erosion. As the area is more vulnerable to erosion, stacking topsoil for a longer time is not advisable and therefore, it must be utilized at the earliest. The top soil has been used adequately for the planting purpose and is clearly evident from the physically and biologically reclaimed west in-pit dumping area that a topsoil

	spread of a thickness varying from 1.0 - 1.5 over the top of it.
4.1 (c) (vi) An integrated Surface Water Management Plan for the washery area upto its buffer zone considering the presence of any river/rivulet/pond/lake, etc., with impact of coal washing activities on it, shall be prepared, submitted to MoEF&CC and implemented.	The propjet proponent has not made available this report to the team during the inspection /survey.
4.1 (c) (vii) Three tier greenbelt comprising of a mix of native species of minimum 30 m width shall be developed all along the washery area to check fugitive dust emissions and to render aesthetic to neighbouring stakeholders. A 3-tier greenbelt comprising of a mix native species or tree species with thick leaves shall be developed along vacant areas, storage yards, loading/transfer points and also along internal roads/main approach roads.	As such an area of 19.70 ha around coal washery has been planted with 24,424 plants. The greenbelt around the washery is observed to be bare minimum and not all the directions of the area are covered with vegetation as required as well as suggested. Waste land and avenue plantation has been carried out over an area of 10.84 ha with 24,786 plants. It is suggested that avenue plantation can be strengthened further more making it more effective in preventing the dust and noise spreading outside the mine lease.
4.1 (c) (x) Rainwater harvesting in the washery premises shall be implemented for conservation and augmentation of ground water resources in consultation with Central Ground Water Board.	As per the project proponent, rainwater harvesting is reportedly being done in the office buildings as well as colony. It is said to have been constructed 8 recharge pits with a dimension of 86x78x6 m having recharge potential of 1,20,211 M^3/year at Basan Pond as well as 2 bore well with recharge pits having the potential of 65,280 Cum/year at Basan Nala Bund. It is seen that both the structures installed by the project proponent are falling within the buffer zone area of the mine lease.
4.1 (d) (ii) Greenbelt consisting of 3-tier plantation of width not less than 7.5 m shall be developed all along the mine lease area in phased manner. The green belt comprising of a mix of native species shall be developed all along the major approach/coal transportation roads.	Details given earlier under 4. (vi).
4.1 (d) (vii) Ground water, excluding mine water, shall not be used for mining operations. Rainwater harvesting shall be implemented for conservation and augmentation of ground water resources.	Details given earlier under 4.1 (c) (x)
4.1 (d) (x) Adequate ground water recharge measures shall be taken up for augmentation of ground water.....	Details given earlier under 4.1 (c) (x)
4.1 (d) (v) Action plan for implementing EMP and environmental condition shall be prepared and shall be duly approved by competent authority.....	No such action plan based on EMP was made available to the team during the field visit.

4.5 Observations on the Compliance of EC Conditions pertaining to Reclamation & Rehabilitation Plan and Progressive Mine Closure Plan

A detailed observations on the compliance to Environmental Clearance Conditions *vide* Letter No.J-11015/03/2008-IA-II(M) dated 10-08-2018 pertaining to Progressive Mine Closure Plan and Reclamation and Rehabilitation Plan are provide in Table 8.12.

8.5 ENVIRONMENTAL MONITORING

Monitoring of pollution levels through related environmental parameters is an essential requirement of EC granted by MoEF&CC. Ambient air quality, water and effluent quality and noise levels monitoring are carried out by NABL and MoEF&CC accredited laboratory, *i.e.,* M/s. Vardan Enviro lab. Monitoring report is regularly submitted to MoEF&CC Regional Office, SPCB and CPCB. The data on the environmental monitoring were mainly drawn from the half yearly environmental monitoring report (October, 2018 to March, 2019; April 2020 to September 2020) of PEKB Area submitted to MoEF&CC, RO (West Central Region) *vide* Ref. No. RVUN/ACE(Fuel)/SE (Fuel-II)-1087 dated 19.06.2019 for 10 sample sites ; *vide* Ref. No. RVUN/CE(Fuel)/SE (Fuel)/D.2395 dated 20.11.2020 for 8 sample sites respectively by the Superintendent Engineer (Fuel), RVUN, Jaipur which was available in the public domain and the same was reviewed for assessing air, water, effluents and noise quality of the area.

8.5.1 Monitoring of Air Quality

- Four numbers of Continuous Ambient Air Quality Monitoring Stations (CAAQMS) are installed within and around ML area.

Table 8.13: Details of the air quality monitoring location wise average ambient air quality at PEKB coal block in Surguja District of Chhattisgarh

Name of the monitoring location	$PM_{2.5}$ ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_x ($\mu g/m^3$)	CO (mg/m^3)
Village- Parsa (Near Coal Washery) AAQ-1	**45.93**	**82.74**	8.60	26.63	0.71
Village-Salhi- AAQ-2	**45.61**	**83.13**	8.66	25.88	0.71
Village-Mines Admin. Office- AAQ-3	**45.27**	**82.26**	9.07	27.51	0.71
Village-Near Washery Plant- AAQ-4	**43.82**	**82.26**	8.70	27.97	0.70
Village-Near Security Gate- AAQ-5	**45.50**	**81.80**	8.64	25.82	0.69
Village-Near Coal Stock Yard- AAQ-6	**43.82**	**81.36**	8.79	27.24	0.69
Village-Near Coal Mine Area- AAQ-7	**45.43**	**82.11**	8.97	26.28	0.69
Village Basan AAQ-8	**45.51**	**83.76**	8.80	26.22	0.67

Name of the monitoring location	$PM_{2.5}$ ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_x ($\mu g/m^3$)	CO (mg/m^3)
Village Parogia- AAQ-9	**43.85**	**80.99**	8.51	25.71	0.68
Village Ingamar AAQ-10	**44.06**	**81.25**	8.71	25.86	0.68
October, 2018 to March, 2019					

- Post-project environmental monitoring was carried for PM_{10}, $PM_{2.5}$, Sulphur Dioxide (SO_2) and Carbon Monoxide (CO) at 10 locations in the core (mine) and buffer areas (villages) and data were generated through NAAQS, 2009 (Table 8.11). The air samples were analyzed as per standard methods specified by Central Pollution Control Board (CPCB)/ IS: 5182.

Table 8.14: Details of the air quality monitoring location wise average ambient air quality at PEKB coal block in Surguja District of Chhattisgarh

Name of the monitoring location	$PM_{2.5}$ ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_x ($\mu g/m^3$)	CO (mg/m^3)
Village- Parsa	**46.52**	**68.67**	8.60	23.06	0.58
Village-Salhi	**43.21**	**64.05**	8.31	21.51	0.55
Village- Ghatabara	**43.67**	**62.63**	7.98	22.66	0.50
Village- Parogia	**43.25**	**60.30**	8.18	21.42	0.50
Village- Baigapara	**43.44**	**62.80**	7.82	22.01	0.54
Near coal Washery area	**52.91**	**74.54**	11.65	25.84	0.61
Near Coal Mine Area	**55.80**	**77.31**	11.76	28.44	0.66
Village- Basan	**46.29**	**64.21**	8.22	20.96	0.56
April 2020 to September 2020					

The average values recorded at 10 and 8 locations during the six-month period during October, 2018 to March, 2019 and April 2020 to September 2020 respectively for Particulate Matter indicate that the Particulate Matter ($PM_{2.5}$ & PM_{10}) has exceeded the permissible limit values of 40 and 60 $\mu g/m^3$ as indicated in the Table 8.13 & 8.14. The review of analytical results of SO_2, NO_2 and CO was found to be well within the limits as specified by CPCB.

- Work zone air quality was carried for SPM, PM_{10}, SO_2 and NO_x at 3 locations and data were generated through STANDARDS FOR COAL MINES (Stipulated by Ministry of Environment and Forests (MoEF), *vide* Notification No. GSR 742(E), dt: 25.09.2000). The names of the air quality monitoring location with their results are given in the Table 8.15. Results indicate that all the parameters are within the permissible limits.

Table 8.15: Details of the monitoring location wise average air quality PEKB coal block in Surguja District of Chhattisgarh

Name of the monitoring location	SPM ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_x ($\mu g/m^3$)
Washery area	165.64/ 143.60	90.73/67.76	8.76/7.13	28.36/17.26
CHP area	145.92/151.51	77.28/71.85	9.04/8.28	23.34/21.34
Near mine pit	168.54/157.89	95.20/76.38	11.26/8.43	38.42/21.58
October, 2018 to March, 2019/ April 2020 to September 2020				

8.2 Monitoring of Water and effluent quality

The impact of the mining activities on the water environment was assessed by studying the quality of groundwater and surface water bodies in the study area. 31 parameters were taken for physico-chemical and bacteriological analysis of ground water for post-monsoon (October) and winter (February) during the reported period. The ground water quality results are compared with IS: 10500, 2012 standards of groundwater. 17 parameters were taken for physico-chemical analysis of surface water from Atem River for post-monsoon (October) and winter (February) during the reported period. The surface water quality are compared with IS 2296, 1982 and CPCB Water Quality Criteria, Class-A (Drinking Water Source without conventional treatment but after Disinfection), Class-B (Outdoor bathing-organized), Class- C (Drinking Water Source with conventional treatment and after Disinfection, Class - D (Propagation of wildlife and fisheries) and Class-E (Irrigation, Industrial Cooling, Controlled Waste Disposal). Results show that all the parameters for the ground and surface water are within the permissible limits.

Table 8.16: Details of the water quality monitoring sites and the average effluent water quality monitoring results at PEKB coal block in Surguja District of Chhattisgarh

Effluent	pH	COD	BOD (3 days at 27 deg.)	TSS	Oil & grease	Copper as Cu	Nickel as Ni	Lead as PB	Mercury as Hg	Hexavalent Chromium as
Workshop ETP water	7.46	78.35	20.89	34.00	0.69	0.60	BDL	**0.71**	**0.23**	BDL
Mix drain water at settling point	7.74	81.18	26.55	41.33	0.66	0.68	BDL	**0.50**	**0.24**	BDL
STP treated water	7.78	75.32	23.99	34.50	0.20	0.32	BDL	**0.20**	BDL	BDL
October, 2018 to March, 2019										

Table 8.17: Details of the water quality monitoring sites and the average effluent water quality monitoring results at PEKB coal block in Surguja District of Chhattisgarh

Effluent	pH	COD	BOD (3 days at 27 deg.)	TSS	Oil & grease	Copper as Cu	Nickel as Ni	Lead as PB	Mercury as Hg	Hexavalent Chromium as
Workshop ETP water	7.49	61.87	16.68	29.83	0.96	0.39	BDL	**0.52**	**0.22**	BDL
Mix drain water at settling point	7.52	73.54	20.43	36.33	0.98	0.44	BDL	**0.40**	**0.27**	BDL
STP treated water	7.28	75.77	19.71	34.49	0.33	0.11	BDL	**0.13**	BDL	BDL
April 2020 to September 2020										

Effluent samples from STP treated water, workshop ETP water and mix drain water at settling point were collected and analyzed for pH, TSS, COD, BOD, Oil & Grease, Copper, Nickel, Lead, Mercury and Hexavalent Chromium. Monitoring of effluents is being done as per the Environmental Standards for coalmines, GSR-742 (E) dated 25.09.2000 and the results are presented in Table 8.16 & 8.17.

The average value of lead was reported as 0.71 mg/l and 0.52 mg/l at workshop ETP water; 0.50 mg/l /0.40 mg/l at mix drain water and 0.20 mg/l and 0.13 mg/l at STP treated water which has exceeded its permissible limit of 0.1 mg/l during the monitoring period of October, 2018 to March, 2019/ April 2020 to September 2020 respectively.

The average value of mercury was reported as 0.23 mg/l and 0.22 mg/l at workshop ETP water and 0.24 mg/l and 0.27 mg/l at mix drain water which has exceeded its permissible limit of 0.01 mg/l during the monitoring period of October, 2018 to March, 2019/ April 2020 to September 2020 respectively. The results of other parameters revealed that the parameters are within the standard limit prescribed.

8.5.3 Noise Measurement

Noise level measurements were measured at 10 villages around the study area (Table 8.18 & 8.19) both during the day and night time as per the standards and compared with the Ambient Noise Standards vide S.O.2555(E) dated 10/08/2017.

Table 8.18: Details of the noise monitoring locations and the monitoring result at PEKB coal block in Surguja District of Chhattisgarh

Location	Oct., 18				Nov., 18				Dec., 18			
	Day time		Night time		Day time		Night time		Day time		Night time	
(Village)	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Parsa	45.5	56.8	32.9	42.7	46.2	58.3	34.6	44.5	44.6	59.5	37.2	45.7
Baigapara	47.2	51.3	33.1	42.5	**41.6**	53.7	35.8	45.4	45.4	57.3	36.7	46.1
Patelpara	45.2	58.3	39.4	49.7	45.7	58.9	39.5	49.8	43.5	55.6	40.2	51.4
Parogiya	45.8	52.6	37.7	47.2	45.1	53.4	38.2	46.6	44.6	54.8	39.7	47.4
Basan	48.6	57.6	33.7	48.7	49.8	59.2	32.8	45.9	52.4	**61.7**	34.1	48.7
Shivnagar	43.2	56.6	34.6	49.8	45.6	56.9	34.1	49.4	48.2	58.4	35.6	52.8
Gidmuri	42.8	59.2	34.3	44.1	42.3	59.6	34.5	44.7	45.3	60.1	35.4	45.8
Ingamar	44.3	57.1	31.6	43.7	44.6	57.2	33.3	42.5	46.8	59.2	31.0	40.4
Mahadevpara	42.6	59.3	36.3	48.6	42.9	55.6	36.6	48.1	41.7	54.8	37.1	46.2
Tara	47.7	58.6	36.6	47.8	47.3	58.1	36.8	47.2	45.2	57.4	38.6	49.5
											October, 2018 to March, 2019	

Table 8.19: Details of the noise monitoring locations and the monitoring result at PEKB coal block in Surguja District of Chhattisgarh

Location	July 20				August 20				September 20			
	Day time		Night time		Day time		Night time		Day time		Night time	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Vill. Parsa	46.15	61.00	36.60	44.75	46.10	61.10	35.09	50.30	40.63	61.60	32.93	44.18
Vill. Baigapara	44.45	53.05	35.20	42.20	39.15	51.51	32.39	40.94	40.59	49.63	32.55	40.89
Vill. near Coal Mine area	52.95	71.00	50.10	66.95	61.08	71.50	57.21	66.64	56.56	68.61	50.16	64.33
Vill Parogiya	39.65	52.55	31.60	40.90	37.15	49.09	31.40	39.84	45.04	51.76	33.68	41.11
Vill Basan	44.80	53.50	35.30	41.75	37.06	51.10	32.00	39.38	40.29	50.46	32.55	40.24
Vill Salhi	41.90	51.50	31.35	40.30	39.44	49.65	31.88	40.11	40.04	50.40	31.64	39.85
Vill Ghatabara	43.35	51.70	32.85	43.45	**36.59**	47.93	**30.08**	37.33	39.71	50.03	31.38	40.50
Vill. near Coal Washery	56.30	**73.35**	53.65	66.45	57.61	71.13	51.19	63.13	61.16	71.35	58.11	**67.30**
April 2020 to September 2020												

8.5.4 Day time Noise Levels

The daytime noise levels were observed to be in the range between 41.6 to 61.7 dB (A)/ 36.59 to 73.35 dB (A) during October, 2018 to March, 2019/ April 2020 to September 2020 respectively. The maximum noise level of 61.7dB (A)/73.35 dB was observed at Basan village and coal washery; and the minimum noise level of 41.6 dB (A) /36.59 dB was observed at Baigapara Village /Ghatabara village during October, 2018 to March, 2019/ April 2020 to September 2020 respectively. It was observed that the daytime noise levels are exceeding the prescribed limit of 55 dB (A) for rural / residential area.

8.5.5 Night time Noise Levels

The night time noise levels are observed to be in the range between 31 to 52.8 dB (A)/ 30.08 to 67.30 dB (A) during October, 2018 to March, 2019/ April 2020 to September 2020 respectively. The maximum noise level of 52.8 dB (A)/67.30dB was observed at Shivnagar village and Ghatabara village; the minimum noise level of 31dB (A) was observed at Ingamar Village during October, 2018 to March, 2019/ April 2020 to September 2020 respectively. It was observed that the night time noise levels are exceeding the prescribed limit of 45 dB (A) for rural / residential area.

8.5.6 Results of Environmental Monitoring

Air quality: The average values particulate matter recorded at 10 locations during the six-month period for Particulate Matter indicate that the **Particulate Matter ($PM_{2.5}$ & PM_{10})** has exceeded the permissible limit values of 40 and 60 $\mu g/m^3$ (Table 8.13-8.14).

Water quality: Effluent samples from STP treated water, workshop ETP water and mix drain water at settling point analysis results indicate value of lead is 0.71 mg/l at workshop ETP water, 0.50 mg/l at mix drain water and 0.20 mg/l at STP treated

water, which has exceeded its permissible limit of 0.1 mg/l. The average value of mercury was reported as 0.23 mg/l at workshop ETP water and 0.24 mg/l at mix drain water, which has exceeded its permissible limit of 0.01 mg/l. The results of other parameters revealed that the parameters are within the standard limit prescribed.

Noise level: It was observed that the daytime noise levels are exceeding the prescribed limit of 55 dB (A) for rural / residential area. It was also observed that the night time noise levels are exceeding the prescribed limit of 45 dB (A) for rural / residential area.

8.6 OBSERVATION AND RECOMMENDATIONS

8.6.1 PARSA EAST AND KANTA BASAN (PEKB)

- Exploration reveals, occurrence of thin coal seam varying thickness from 0.2 m to 0.98 m below the coal seam IV, with parting of about 50 m thick. Mining of such thin coal seam of less than 0.5 m with more than 50 m thick parting may not be economical; therefore, concurrent backfilling of mined out pit will not adversely affect the interest of mineral conservation.
- Computerized mine planning is deployed at PEKB OC Coal Mine for surveying, production scheduling, *etc.* and may be further strengthened. As proposed in the mining plan, mine pit has been opened all along the strike length of coal seam for 6.12 km long with 650-700 m wide and for 40-45 m depth. However, opening of such a long mine face for extensive mining has serious impact on land degradation. It may be minimized by undertaking intensive mining *i.e.* mining in smaller strike length up to the bottom of the coal body with simultaneous backfilling. Practicing such type of mining shall not expose huge area of land degradation in any given point of time during entire life of the mine.
- Undertaking mining operation through 3 operators to work entire strike length of coal seams is increasing movement of more vehicles with in the mine pit and mine roads width are not sufficient to accommodate such traffic. There is no full proof traffic system for dumpers for haulage of OB and coal. One-way traffic is not provided for all the haul roads. Some road is being used even by light and heavy vehicles including 'U-turns', which is quite unsafe.
- Environmental clearance was accorded with a condition that "coal transportation in pit by belt conveyor from in pit to pithead coal handling plan, surface to siding by belt conveyor to Pre-weigh Bin and loading at siding by SILO with inbuilt Rapid Loading System". However, in pit belt conveyor is not commissioned, which is under advanced stage of its construction and SILO is damaged; now SILO is under construction. Closed conveyer system and SILO need to be completed at the earliest and commissioned, so that vehicle movements in the mine pit kept in minimum level and reduce generation of dust and noise.

- As per approved mining plan and mine closure plan cumulative stripping ratio envisaged up to 8th year of mining is 4.13 cum/ton. However, it is found that up to September 2020 (9th year of mining operation) total overburden generated is 146.32 million cum and coal extracted is 63 million tonnes, which amounts to stripping ratio of 2.32 cum /ton, which is much lesser than envisaged stripping ratio, which indicates mine development is not commensurate with quantum of extraction of coal as envisaged in the mining plan. Therefore, overburden benches have to be advanced sufficiently to ensure safe, scientific and sustainable mining. Backfilling of mine pit has not been progressed as proposed and shown in 5th year Mine Stage Plan.
- Mitigation measures adopted for dust suppression at mine pit, OB excavation area, haul roads and at waste dumps (internal dumping) are quite inadequate. Surface miner deployed for coal extraction has wet cutting system for dust suppression at coal benches/faces. Dust suppression system provided at CHP, coal washeries and coal conveying system. Pressurized water spraying system at railway siding for stacking and dispatch of coal washery rejects is also found. However, surface miner is utilized only for coal extraction and loading facilities of surface miner is not utilized. Utilization of surface miner for loading may reduce dust generation as well as minimize mining machineries at mine pit.
- Overburden removed is dumped initially in two external dumps located in non-coal bearing area at north-western and north-eastern parts of lease and subsequently backfilled at de-coaled/ mined out area (Plate 8.1). There are 02 external OB dumps *viz.*, East & West External OB Dumps spread over an area of 112.98 ha and 25.71 ha respectively. The Eastern part of external OB dump has reached up to 58 m height with 3 to 6 terraces/ decks and its slope angle is ranging from 25^0 to 35^0. It was observed that terraces width is much lesser, reclamation and rehabilitation by plantation over eastern external dump is not effective. Slopes of the dumps are collapsed at many places and afforested area at several locations has been washed off resulting siltation over adjacent roads and water drains. Formation of gullies and deep water cuts over the dump slopes are prevalent, such erosion is threat to stability of grown up trees/plants on slopes. Comparatively physical stabilization and biological reclamation of western external dump is stable with minor failures of dump slopes.
- On examination of internal dumping, stabilization and reclamation activities, it is found that out of 731.50 ha of broken up area, only 429.43 ha of land (58.71%) has been backfilled and remaining 302.07 ha area (41.29%) under active mine pit. Entire backfilled area has not been stabilized and physically reclaimed. Physically reclaimed area is 219.16 ha that is 51.04% of backfilled area. Further area fully reclaimed by afforestation is only 135.62 ha, which is 61.88% of physically reclaimed area.
- In the Progressive Mine Closure Plan, land use of pre-mining, during mining and post mining are envisaged and furnished. As per the proposal at the end 5th year and 10th year of mining operation, area to be excavated is 825.64 ha and

1226.34 ha respectively and area to be backfilled during the same period is 586.87 ha and 957.77 ha respectively. The envisaged proposal indicates that 71% to 78% of mined out land has to be backfilled between 5th and 10th year of mining operations. But it is found that during 9th year of mining operation (October 2020), 55.33% of mined out area only backfilled, which is much behind the scheduled proposal.

- To minimize quantum of land degradation at any given point of time, it is suggested to undertake intensive mining *i.e.* mining in smaller strike length up to the bottom of the coal seam with simultaneous backfilling instead of extensive mining of opening mine pit for longer strike length.
- Proposal has been inbuilt in the mine closure plan for providing retaining walls at the toe of dumps and the unstable overburden benches to prevent wash off from dumps and sliding of material from benches and construction of water channels /drains. Even though, retaining walls are provided for the external dumps, which could not prevent sliding and siltation of water drains and on nearby road due to their location was far away from the toe of the dump. Water drains provided are not scientifically made in respect of its dimension with reference to catchment area and intensity of rainfall and runoff water. Five settling ponds provided to treat water discharge from coal washery for recirculation water, of which one settling pond is not functional. Seven Silt Settling ponds provided on the northern part of mining lease to treat water drains from entire northern boundary of lease area through these settling ponds. Considering vast area and quantum of rainfall, it is felt that dimension of settling ponds are not scientifically designed to settle wash offs during rainy season. Similarly, within broken up area two temporary settling ponds of 50x30x3.5 m has been provided to treat storm water. Quantum of water discharge from mine area and size of the settling ponds are mis-matching.
- To mitigate the impact, as suggested in the ground water study report enclosed in MP & MCP, garland channel/ drains required size have to be developed, which is capable to flow 76 m^3/sec of water during peak runoff period without any logging and blockage. Accordingly the study report suggested that channel should be trapezoidal shape having width of 6m and depth of 2m. Garland channels and rainwater drains provided are not meeting this specification and ultimately resulted to breaching of dumps toes, sliding and siltation.
- It is proposed in the approved mining plan to segregate excavated topsoil separately and temporarily stored in designated area during mine development. In the initial period of mining operation topsoil was directly utilized for plantation of saplings along the roads and barren land for afforestation. Subsequently topsoil was utilized to spread over external dumps before plantation. So far 19,47,331 cum of topsoil removed from the lease area and 19,37,251 cum of topsoil has been utilized. At the time of field visit (October 2020) about 1,00,800 cum of topsoil stored for future use. Topsoil is properly utilized.

- In the PMCP a proposal has been made to utilize the rejects generated from the washery for generation of FBC based Thermal Power Plant in accordance to EC condition obtained during 2011, however in the EC dated 10.08.2018 indicate that (i) Transportation of raw coal, washed coal and the rejects shall be through rail and (ii) Disposal of washery rejects shall be in accordance with the extant policy and guideline, and environment friendly. Coal having capacity of 10 MTP, which upgrades the coal to 30% to 31% ash content and this quality of coal contributes 70% of production and weight percentage of the reject generation is 10 to 11 %. Coal extracted from Seam V and VI are G 7 quality with ash content vary from 48 to 52% is fed to Dense Media Cyclone of 5 MTP capacity and upgraded to 31 to 32% ash content, which contributes 30% of production and reject generation is 36 to 37%. Till end of September 2020 total coal reject generated is 10.85 million tonnes. It is reported that rejects generated from beneficiation of Raw Coal of Parsa East and Kanta Basan (PEKB) coal mine are disposed off to end user plants with prior approval of Coal Controller's Organization.
- The third-party audit (undertaken by IIT, Dhanbad (ISM) report concluded that M/s. RVUNL has carried out all the activities envisaged under approved mining closure plan till 31st March 2018 and summary of expenditure incurred for FY 2017-18 is amounting to Rs. 24,13,16,126/-. Even though proposed activities of mine closure envisaged in the mine closure plan are undertaken, it effectiveness is not full proof. As mine closure activities are generalized and it is not site-specific considering characteristics of each parameters such is nature and quality of dump material, competence of rocks, nutrition content in top soil, rain fall of the area, geomorphology of the area, etc., which are need to be considered to make site specific mine closure proposal.
- Environmental monitoring of air, water and noise level are reviewed and observations are as follows: The average values particulate matter recorded at 10 locations during the six month period (October 2018 to March 2019) indicate that the Particulate Matter ($PM_{2.5}$ & PM_{10}) has exceeded the permissible limit values of 40 and 60 $\mu g/m^3$.
- Effluent samples from STP treated water, workshop ETP water and mix drain water at settling point analysis results indicate the value of lead is 0.71 mg/l at workshop ETP water, 0.50 mg/l at mix drain water and 0.20 mg/l at STP treated water, which has exceeded its permissible limit of 0.1 mg/l. The average value of mercury was reported as 0.23 mg/l at workshop ETP water and 0.24 mg/l at mix drain water, which has exceeded its permissible limit of 0.01 mg/l. The results of other parameters revealed that the parameters are within the standard limit prescribed.
- It was also observed that the daytime noise levels are exceeding the prescribed limit of 55 dB (A) for rural / residential area and night time noise levels are also exceeding the prescribed limit of 45 dB (A) for rural / residential area.

8.7 OBSERVATIONS ON THE EFFICACY OF MINE CLOSURE PLAN OF CHOTIA (sub blocks 2A & 2B) MINE BLOCK

- Chotia mine has two sub blocks *viz.* **Chotia-2A and Chotia-2B**. The blocks are not contiguous and 10 km apart. Mining operations planned in both the blocks by open cast as well as underground mining methods. Open cast mining operations in Chotia-2A have been completed and mining operations suspended from September 2016. Exhausted mine pit partly converted into water pond and remaining portion is being backfilled with fly ash (Plate 8.13). However, presently in mine plan 4th revision, it is planned to operate some portion of Chotia – 2A under opencast mining from 2023-24 onwards.
- **Chotia-2A** has been explored by drilling 69 bore holes for total meterage of 6318 m. Three coal seams *viz.* 2, 3 & 4 are established, of which coal seams 2&4 are prominent and seam 3 occur in patches, which was mined and exhausted by open cast method. The area is structurally disturbed, 11 faults interpreted in Chotia-2A, which widely affected floor level of coal seams. Total geological reserves estimated is 29.186 MT, of which minable reserves are arrived based on 4th revision of mining plan is 12.65 million tonnes. It is planned to mine 7.77 million tonnes by OC and 4.88 million tonnes by UG mining.
- **Chotia-2B** mine has been explored by drilling 42 bore holes for cumulative meterage of 2650m. Five faults identified in this block. Total reserves estimated are 10832 MT and minable reserves are 10.40 MT. Extractable reserves available are 7.91 MT, out of which 4.31 MT reserves of coal seam 3,2 and 1 will be mined by 2022 23 by open cast mining method with envisaged production of 1 million tonnes per annum and balance reserves of (2.7 MT) from coal seam 1 will be mined by underground mining method.
- Due to limited quarry area, the haul roads do not have sufficient width for two way traffic and movement of light and service vehicles. Haul road within the pit for OB as well as coal haulage are quite steep (gradient more than 1 in 15 and at some places as 1 in 12) due to very limited area of operation in the quarry. Ramp/approach road to benches in OB is also found to be quite steep (1 in 10 to 1 in 12). It is to be maintained with relatively flat gradient. Road surface of approach road to mine benches and haul road is found to be quite rough/bumpy and undulating and need proper grading.
- Mine benches are not clearly maintained as lot of loose material is found to be lying on OB bench faces. All such loose material should be lifted/ removed from mine benches to provide sufficient width for deployment of HEMM. Dust suppression within the mine for OB excavation, haul road for OB and coal and at waste dump (backfilling) are not effective.
- Computerized mine planning is adopted at Chotia OC Mine using 'Auto CAD' and 'Minex Software' for mine survey and calculating volume of OB removed and actual coal bench top and floor of OB level. It is used by Geology Department for coal seam modelling and revalidation of bore hole data earlier

provided in geological report. It may be further strengthened whenever underground mining operations are planned.

- **Chotia-2A** OC Mine has exhausted and it has a very large sump with clean water. Although, the mine area (sub-block area) has been fenced, quarry area has not been fenced. To avoid unauthorized entry into the quarry and possible accidents, it needs to be protected by fencing. As per recent proposal (mining plan 4th revision) mine is likely to be operated by OC from 2023-24.
- **Chotia-2B** Mine is likely to get exhausted for open cast mine operation by 2022-23. Virtually there will be two underground mining operations (may be connected by a drive/cross cut) in Chotia-2A sub-block and one underground mining operation in Chotia-2B sub-block, which have to planned very meticulously.
- External dumps are close to Bango Reservoir backwaters, no protective measures adopted to arrest wash off and silting. Most of the OB dumps are partially active and not much attention has been made to reclaim. Since open cast operation of the Chotia 2B is likely to be completed by 2022-23, it essential to implement all mine closure activities in respect of waste dumps, degraded lands; and land reclamation and rehabilitation with suitable environmental protective measures.

8.7.1 Recommendations

- Mine development, waste disposal, stabilization and reclamation of waste dumps and environmental protective measures to prevent wash offs and sliding of dumps, afforestation dumps etc. should be scientifically planned and implemented before commencement of underground mining operation in Chotia 2B.
- Detailed planning of mine development and allied activities including disposal of mine waste need to be scientifically addressed before commencement of opencast mining in Chotia 2A.

8.8 OBSERVATIONS ON EFFICACY OF MINE CLOSURE PLAN OF OTHER PROPOSED /IDENTIFIED COAL BLOCKS

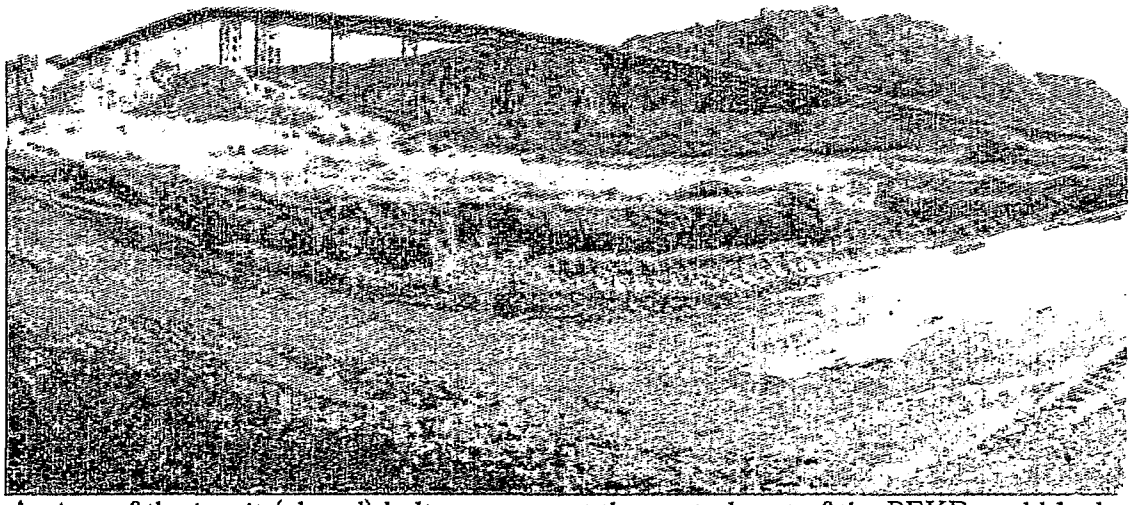
There are about 23 coal blocks identified by CMPDI. Four blocks were re-allotted. Remaining 19 blocks are divided into three groups such as Group A, B and C,

GROUP A: Five (05) coal blocks such as Tara, Madanpur (North), Madanpur (South), Paturia and Gidmuri have only geological, mining and mine closure proposals.

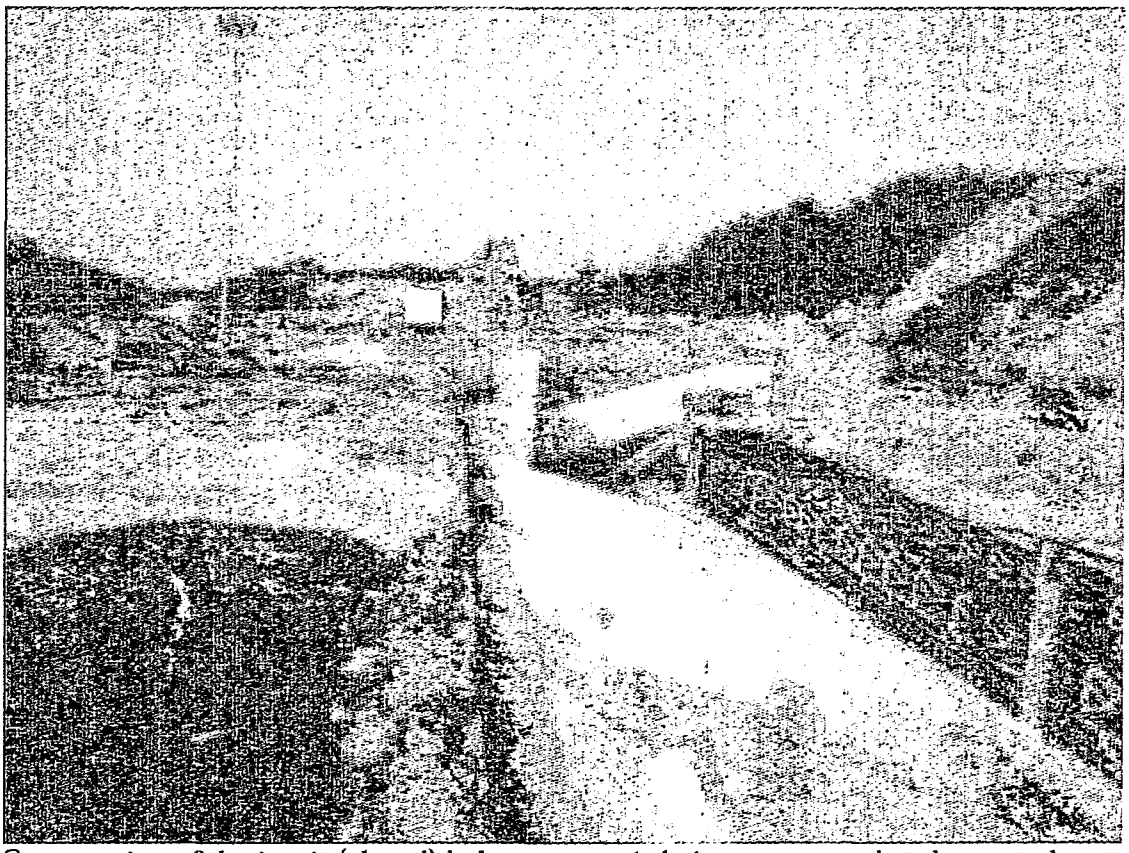
Group B: Limited information is available for another 05 coal blocks such as Morga-II, Morga-III, Morga-IV, Morga South and Saidu

GROUP C: Remaining 09 coal blocks (Puta-Parogia, Parogia, Pindraki, Sarma, Laxmangarh, Bhakurma-Matringa, Kedma, Morga-I and Nakiya) no information is available.

The detailed information on the Feasibility Report, Mining Plan, Mining Scheme, Mine Closure Plan, EIA/EMP reports for the above mentioned 19 mines were not available. **In the absence of technical inputs in field of exploration, mining and mine closure, no comments on these blocks could be offered.**

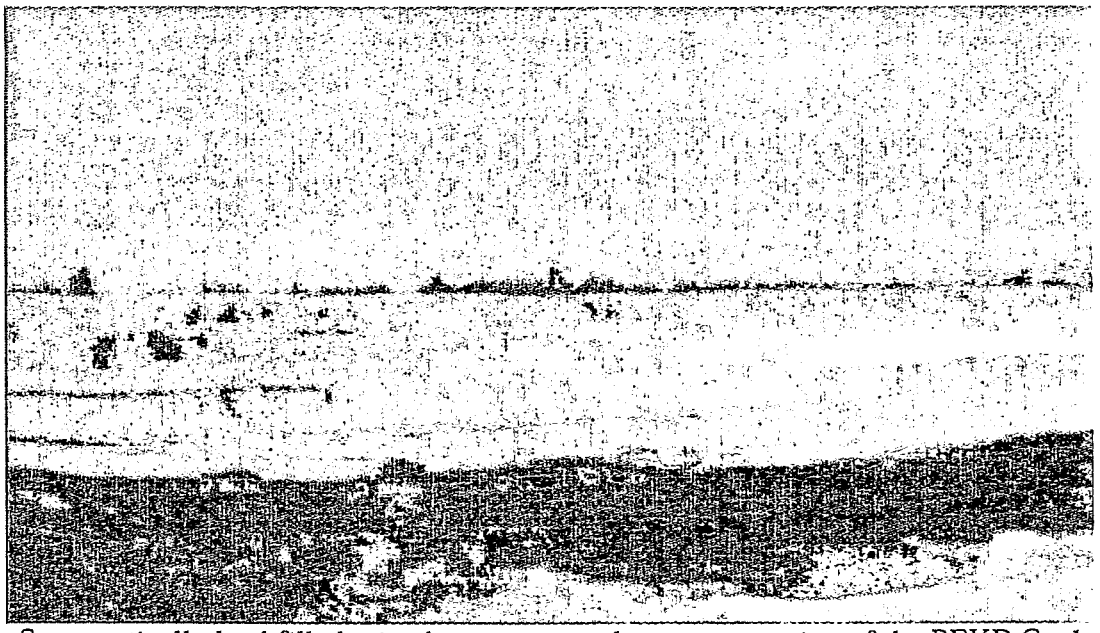


A view of the in-pit (closed) belt conveyor at the central part of the PEKB coal block



Construction of the in-pit (closed) belt conveyor is being progressed at the central part of the PEKB coal block

Plate 8.1: In-pit (closed) Belt Conveyor System in being implemented in the PEKB Coal Block (images as on February, 2021)

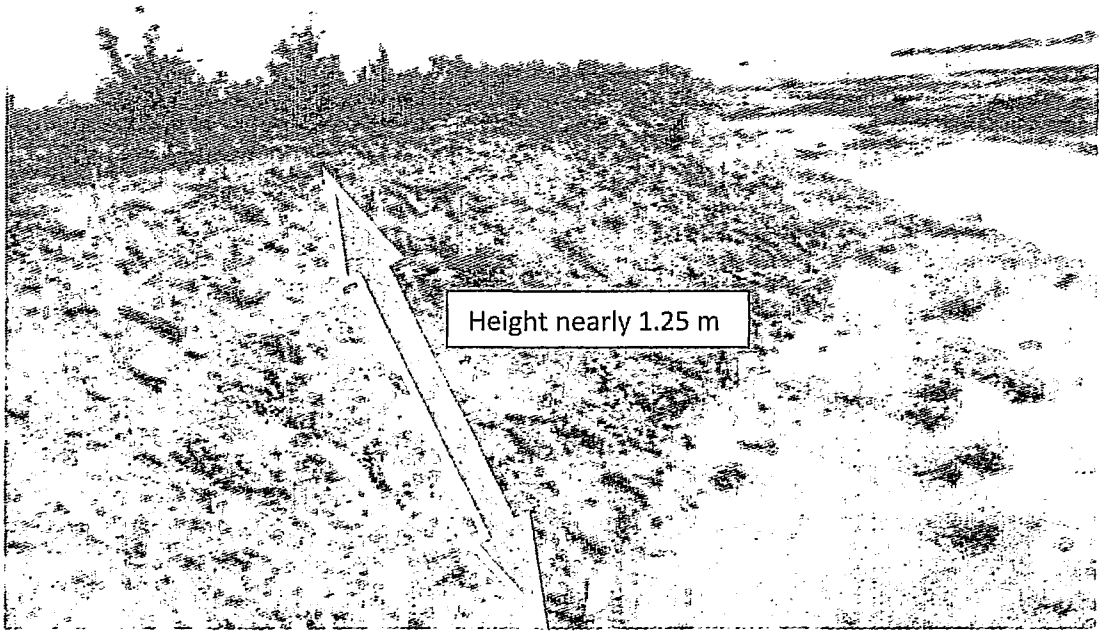


Systematically backfilled mined out areas on the eastern section of the PEKB Coal Block – a view of active part of the east internal backfilling area



Systematically backfilled mined out areas on the western section of the PEKB Coal Block – a view of active part of the west internal backfilling area

Plate 8.2: East and West Internal Backfilling (Inpit dumping) areas of the PEKB Coal Block (images as on February, 2021)



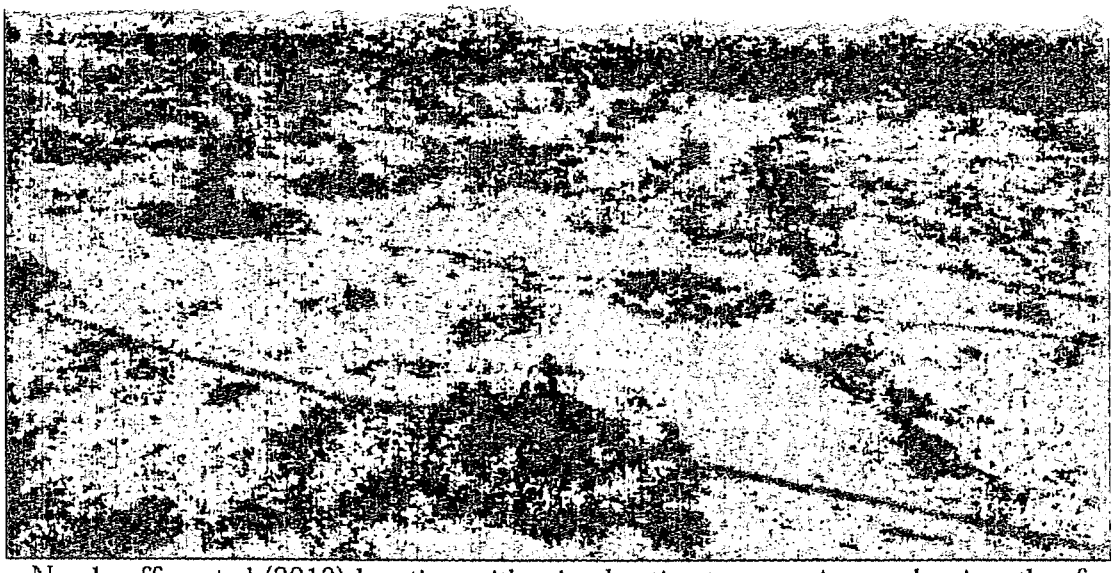
Topsoil spread, followed by plantation, on top of the west internal backfilled-reclaimed area of the PEKB Coal Block (image as on October 2020)



Newly afforested location with mixed native tree species predominantly of *Terminalia arjuna* on the west internal backfilled-reclaimed area of the PEKB Coal Block (image as on October 2020)



Newly afforested location with mixed native tree species predominantly of *Dalbergia sissoo* on the west internal backfilled-reclaimed area of the PEKB Coal Block (image as on May, 2019)



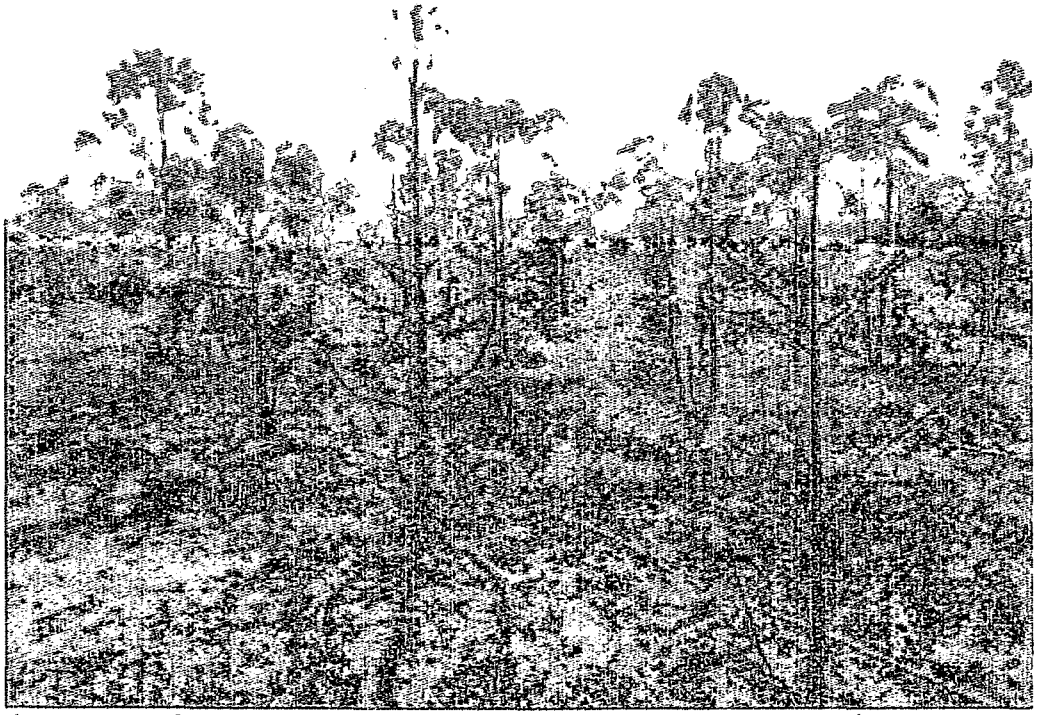
Newly afforested (2019) location with mixed native tree species predominantly of *Shorea robusta* on the west internal backfilled-reclaimed area of the PEKB Coal Block



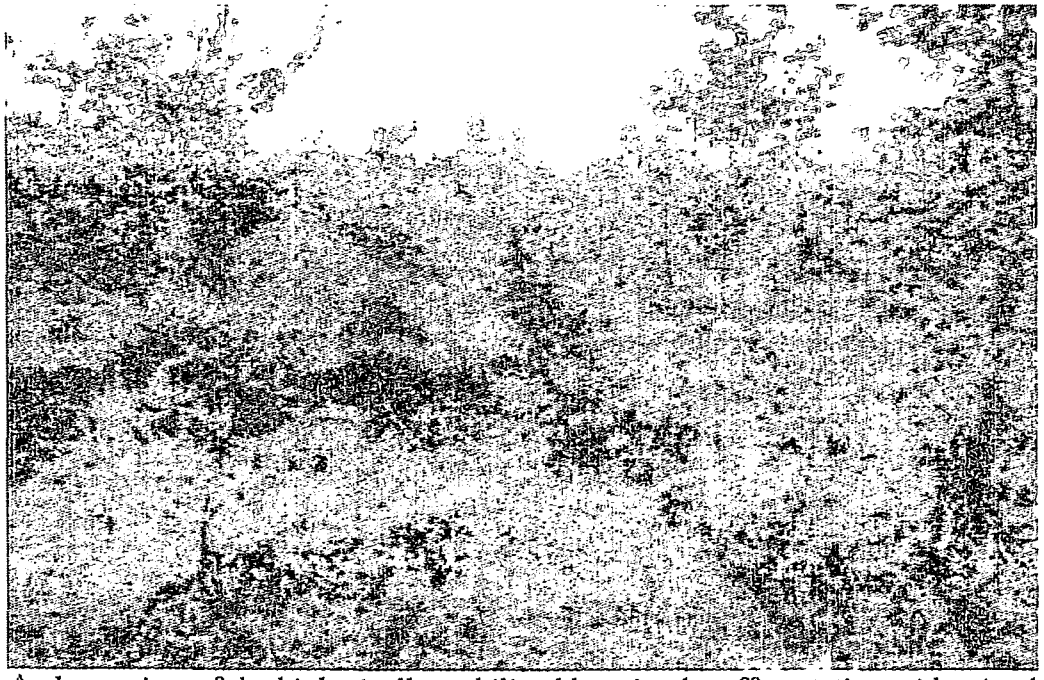
Newly afforested location with mixed native tree species predominantly of *Gmelina arborea* on the west internal backfilled-reclaimed area of the PEKB Coal Block



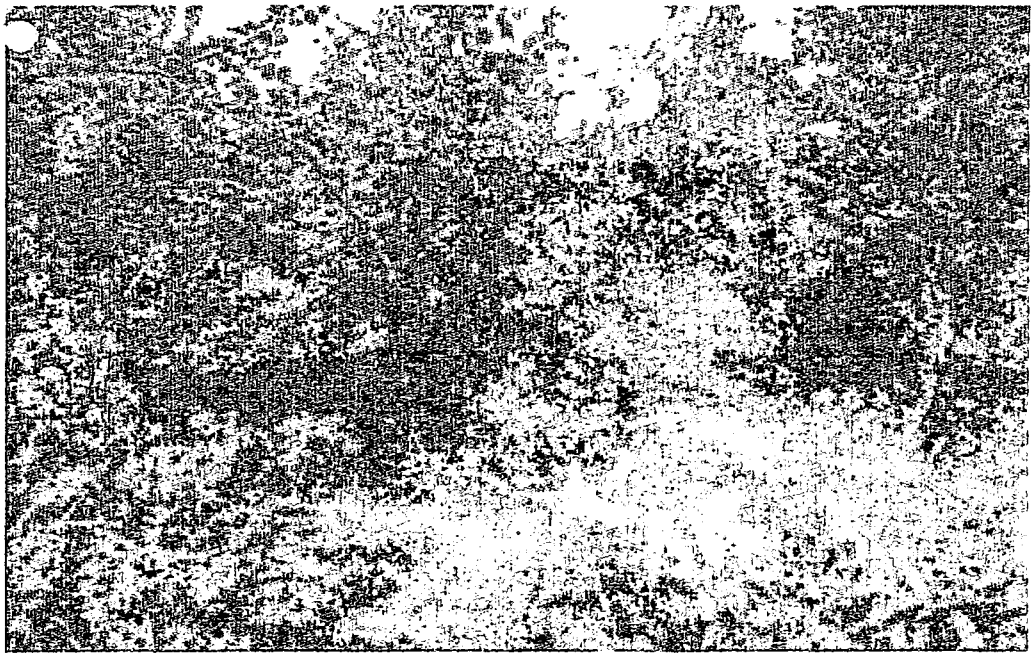
Newly afforested (2017) location with mixed native tree species predominantly of *Neolamarckiana cadamba* on the west internal backfilled-reclaimed area of the PEKB Coal Block



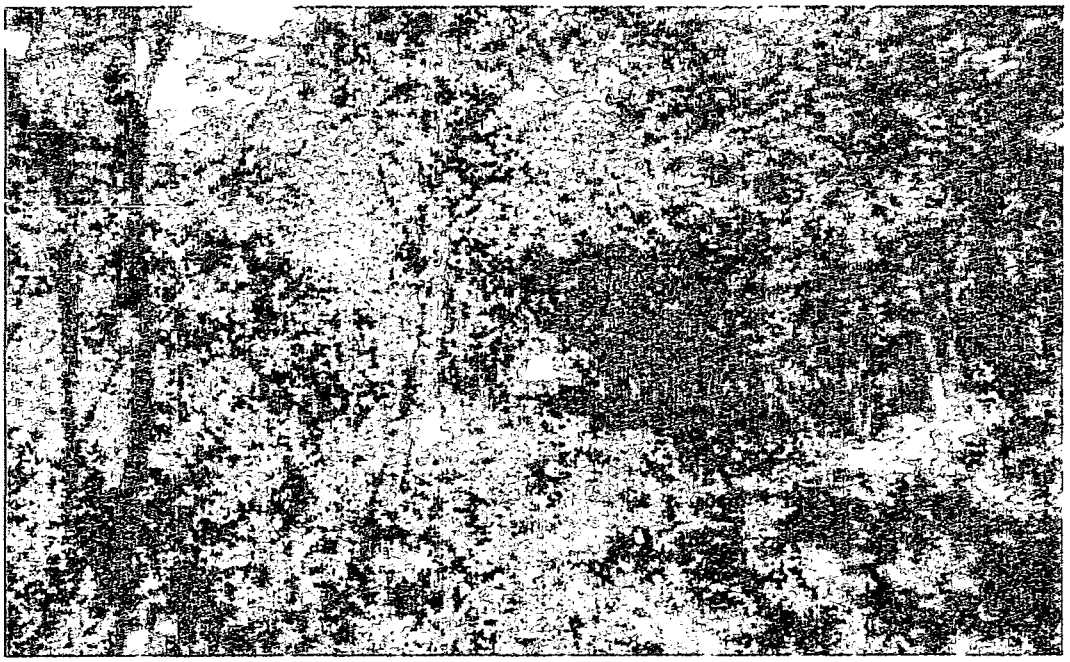
A closer view of the biologically stabilized location by afforestation (block plantation of *Mitragyna parvifolia*) on the reclaimed West internal backfilled area of the PEKB Coal Block (image as on October 2020)



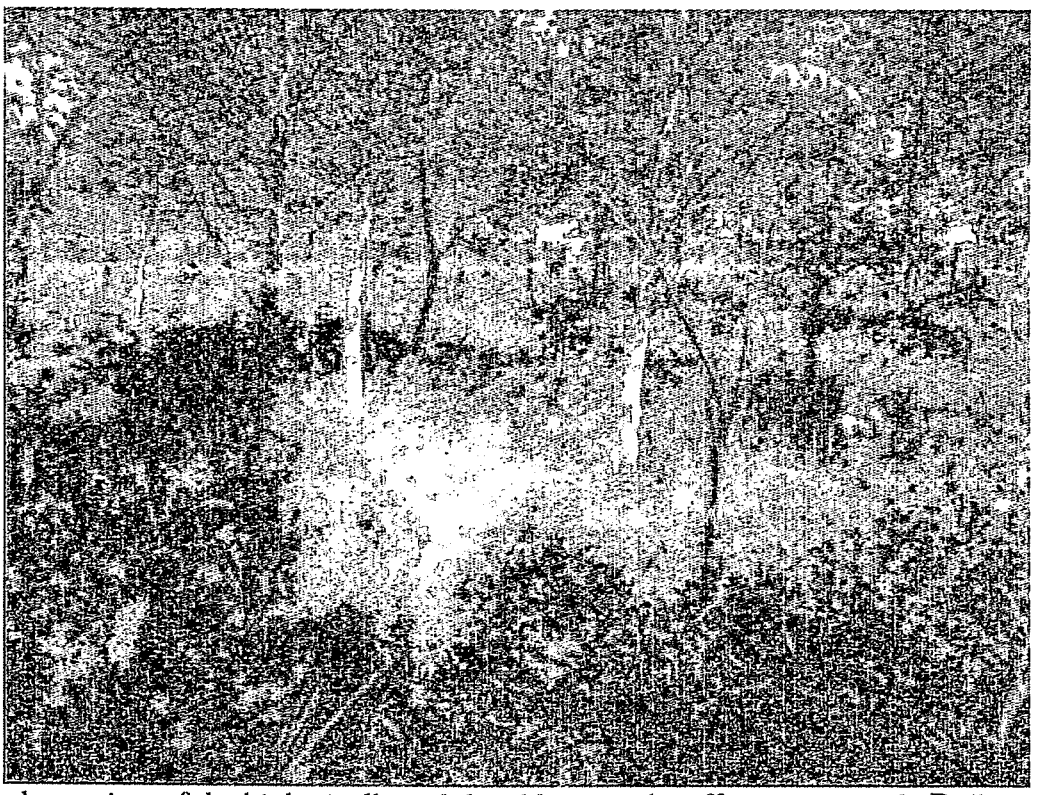
A closer view of the biologically stabilized location by afforestation with mixed native species predominantly of *Dalbergia sissoo* (2018-19) on the West internal backfilled-reclaimed area of the PEKB Coal Block with profuse natural regeneration of under storey growth (image as on October 2020)



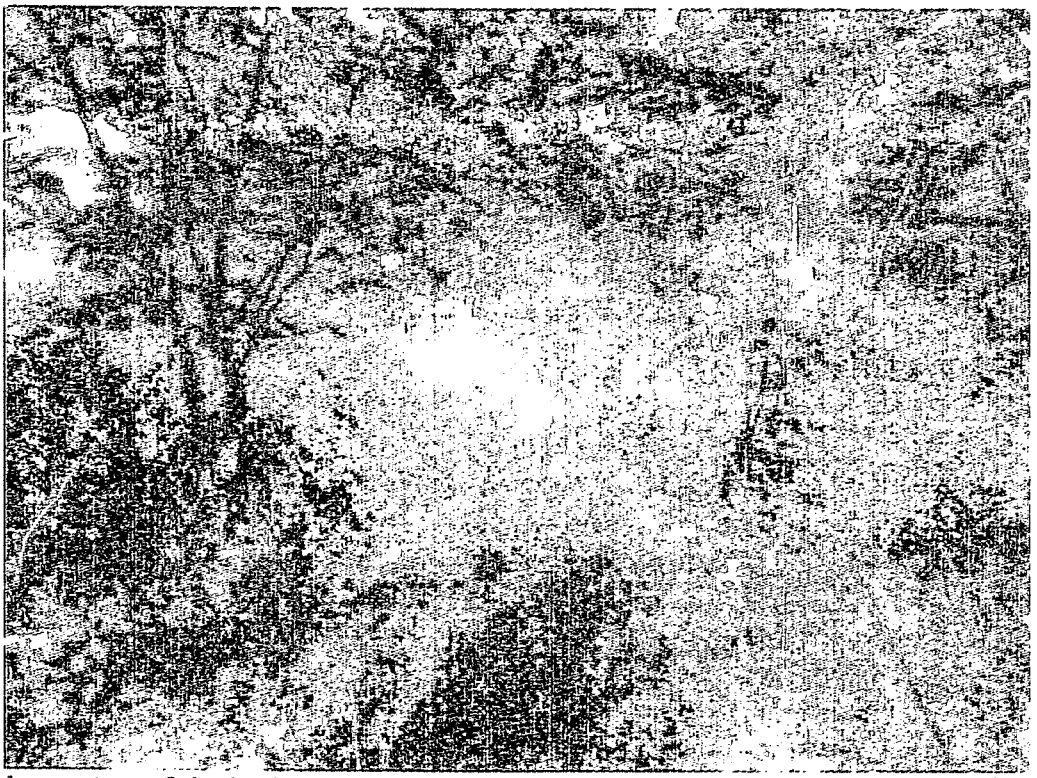
A closer view of the biologically stabilized location by afforestation with mixed native species predominantly of *Dalbergia sissoo* (2018) on the West internal backfilled-reclaimed area of the PEKB Coal Block with profuse natural regeneration of under storey growth (image as on October 2020)



A closer view of the biologically stabilized location by afforestation with *Gmelina arborea* (2015-16) on the West internal backfilled-reclaimed area of the PEKB Coal Block with profuse natural regeneration of under storey growth (image as on October 2020)



A closer view of the biologically stabilized location by afforestation with *Dalbergia sissoo* (2015-16) on the West external OB dump of the PEKB Coal Block with profuse natural regeneration of under storey growth (image as on October 2020)



A closer view of the biologically stabilized location by with *Pongamia pinnata* (2014-15) on the West external OB dump of the PEKB Coal Block with profuse natural regeneration of under storey growth (image as on October 2020)



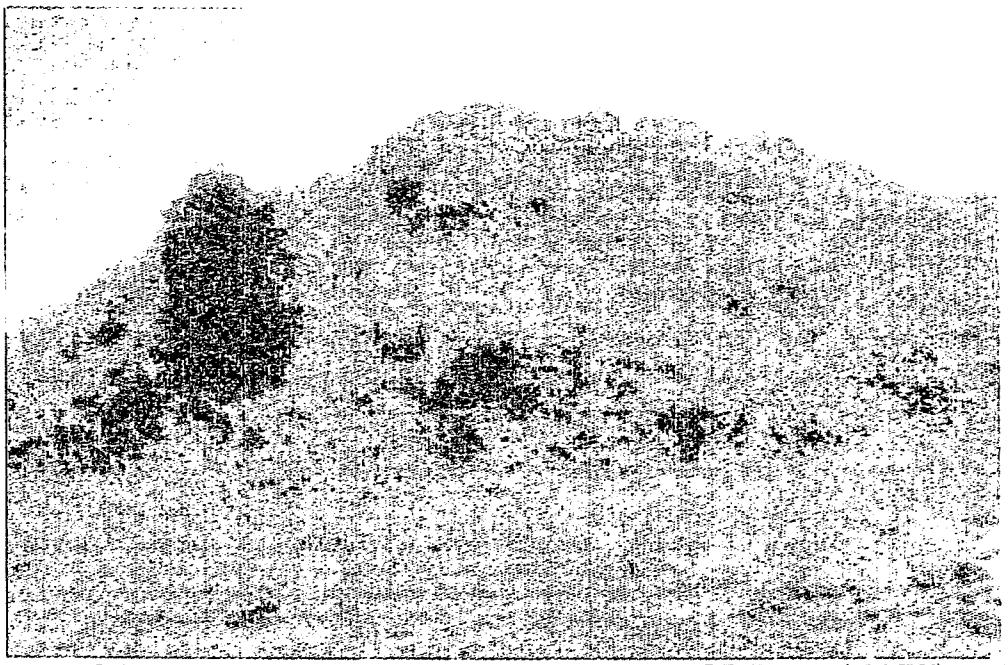
A closer view of the biologically stabilized location by afforestation with *Dalbergia sissoo* (2013-14) on the West external OB dump of the PEKB Coal Block with profuse natural regeneration of under storey growth (image as on October 2020)



A closer view of the biologically stabilized location by afforestation with *Tectona grandis* (2013-14) on the West external OB Dump of the PEKB Coal Block with profuse natural regeneration of under storey growth (image as on October 2020)

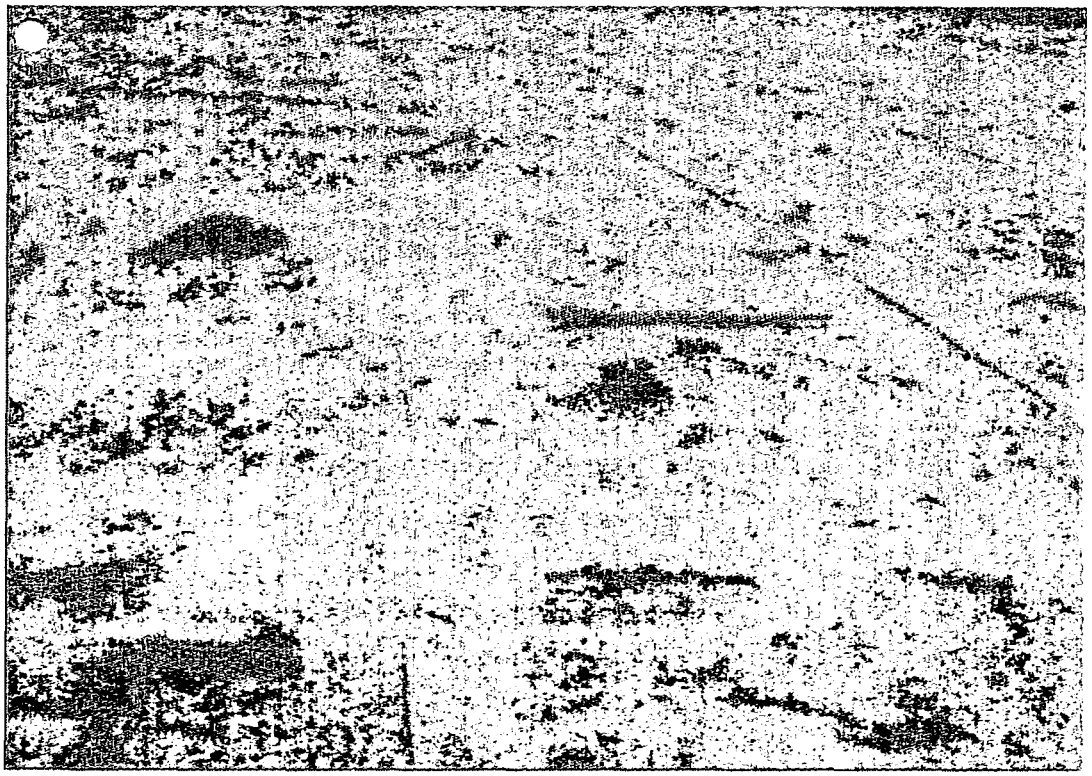


A closer view of the biologically stabilized slope by afforestation on the West external OB Dump of the PEKB Coal Block with adequate barbed wire protection for preventing grazing and stabilization vegetation on the toe (image as on October 2020)



A view of the stabilized slope area on the West external OB Dump (N-NW) of the PEKB Coal Block with profuse natural regeneration (image as on October 2020)

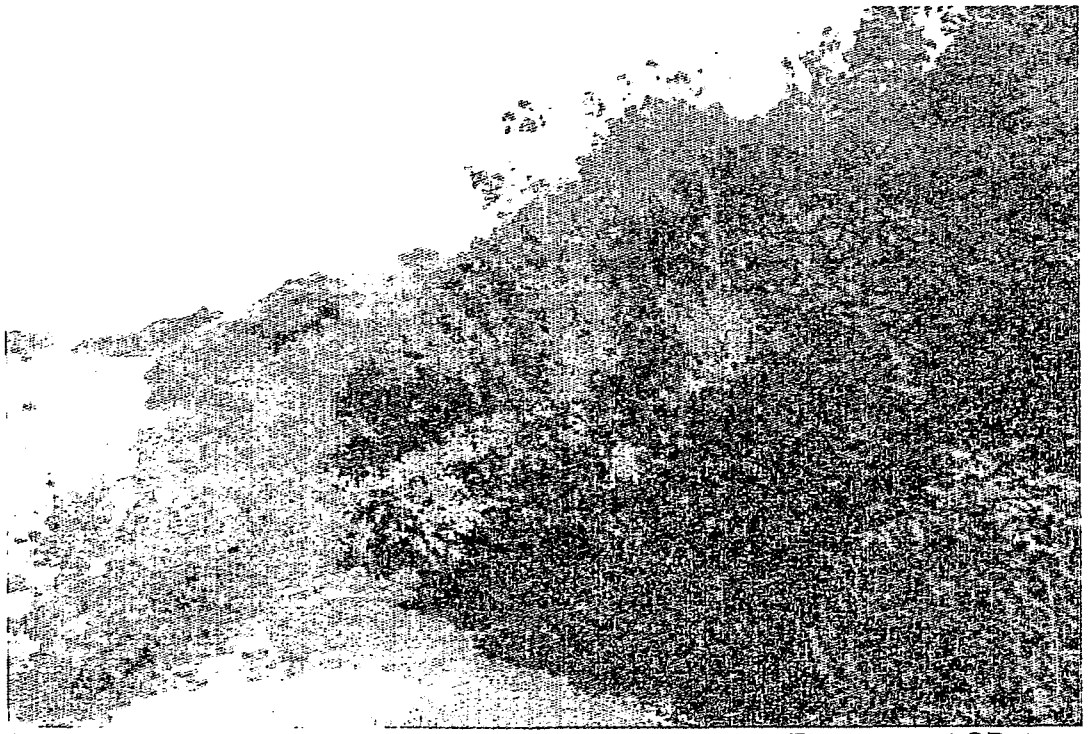
Plate 8.3: Reclamation & Rehabilitation measures for stabilization on the West Internal Backfilling (Inpit dumping) areas and West External OB dump of the PEKB Coal Block



Topsoil spread on the backfilled-reclaimed area, followed by plantation, on top of the east internal backfilled area of the PEKB Coal Block



A closer view of the biologically stabilized location by afforestation with *Neolamarckiana cadamba* (2015-16) on the East internal backfilled-reclaimed area of the PEKB Coal Block with profuse natural regeneration of under storey growth

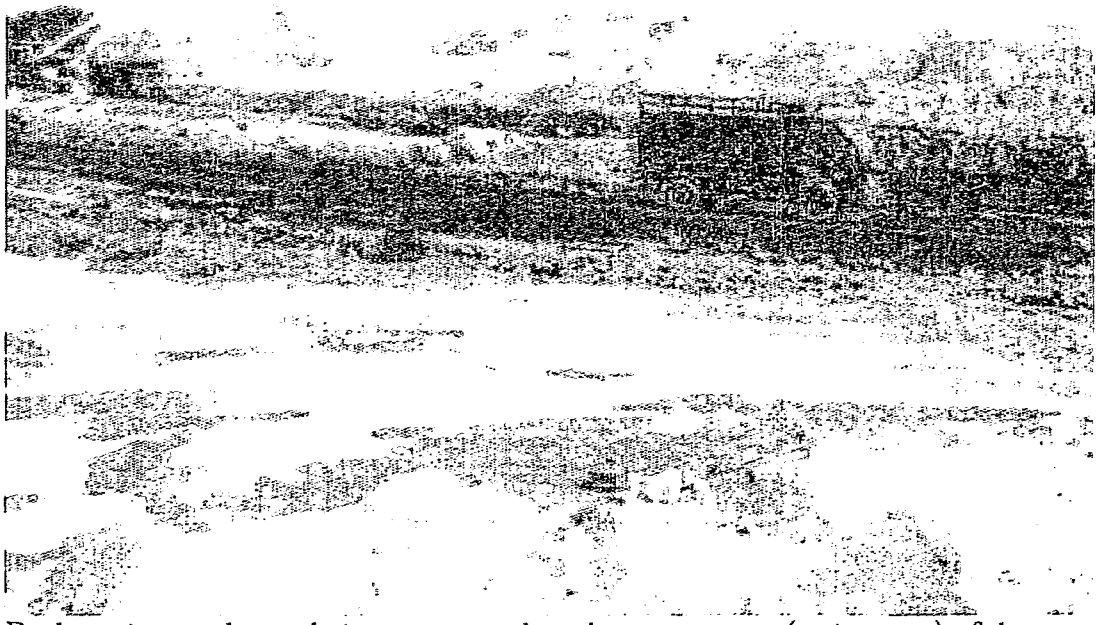


A closer view of the biologically stabilized slope area on the East external OB dump of the PEKB Coal Block

Plate 8.4: Reclamation measures for stabilization on the East Internal Backfilling (Inpit dumping) areas and West External OB dump of the PEKB Coal Block



A view of the actively progressing (eastern part) area of the east external OB dump of the PEKB Coal Block



Reclamation works are being progressed on the eastern part (active area) of the east external dump of the PEKB Coal Block

Plate 8.5: Physical reclamation works currently being carried out on the active part of the East External OB dump of the PEKB Coal Block



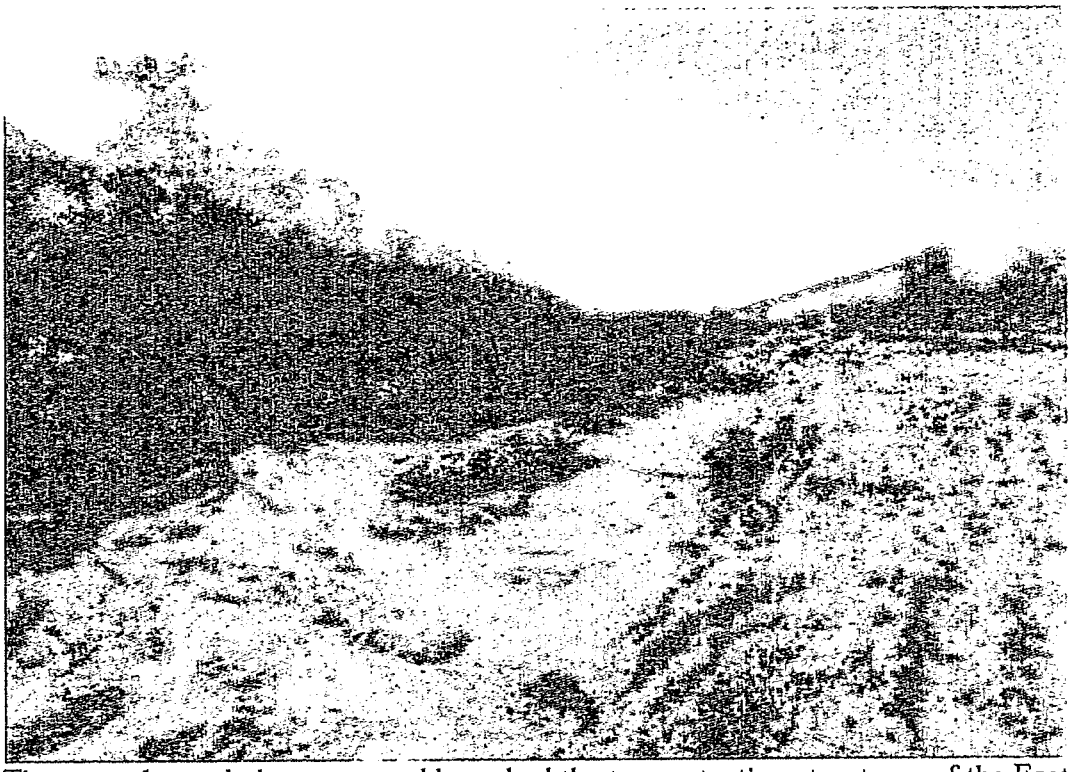
The relatively stable slope and toe area of the East External OB Dump of the PEKB Coal Block. The vegetation on the slope has been severely eroded owing loose material not adequately protected.



Severely eroded slope of the east external dump of the PEKB Coal Block and is being revamped with suitable gully control grade stabilization structures like check dams, gully plugs, etc.



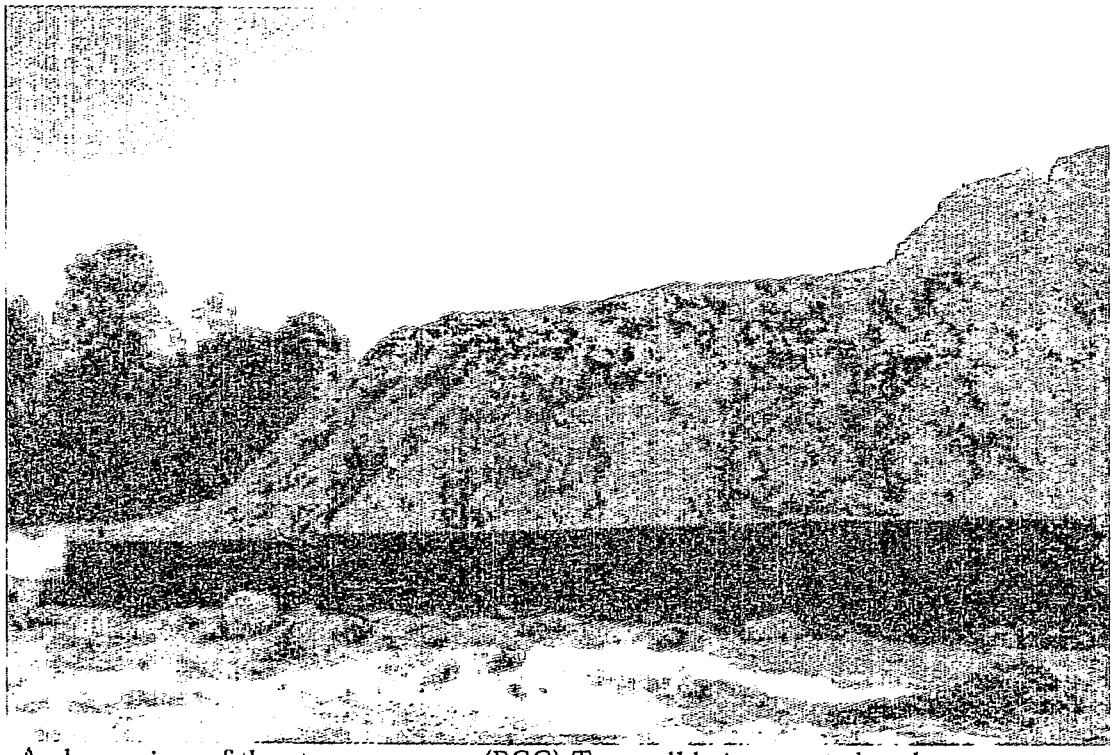
The severely eroded toe area and breached the toe protection structures of the East External OB Dump – a view towards eastern side of the dump, along the toe.



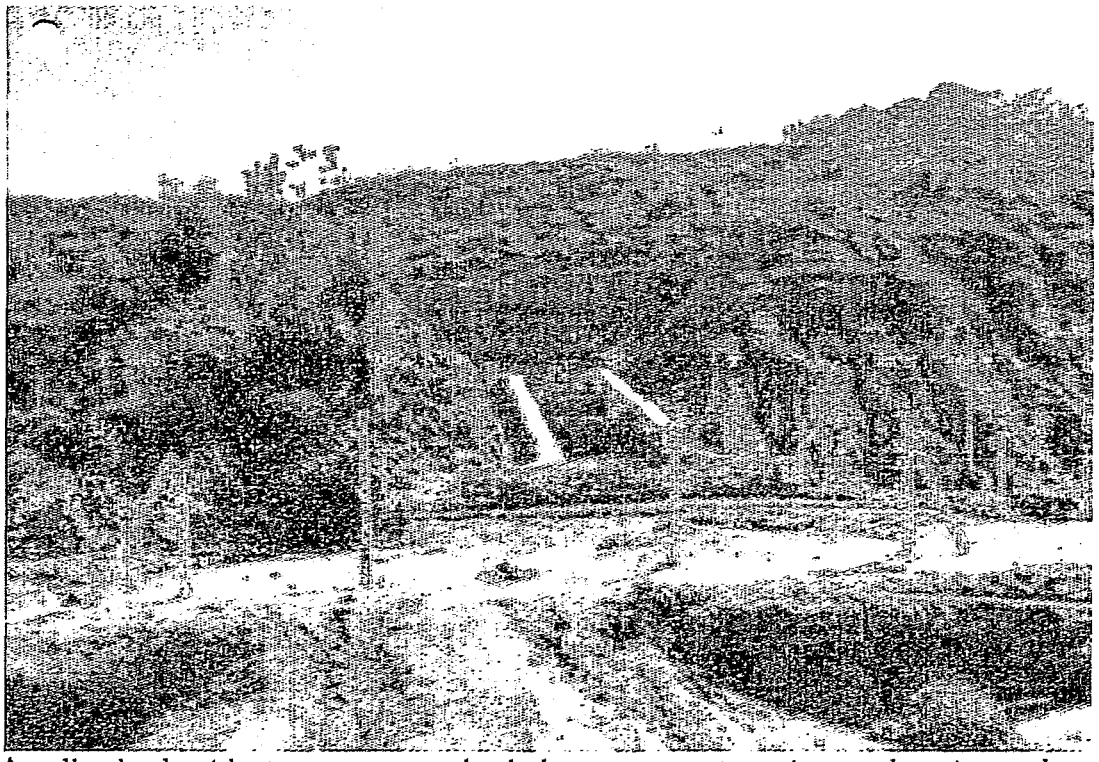
The severely eroded toe area and breached the toe protection structures of the East External OB Dump – a view towards western side of the dump, along the toe.



Stone masonry (PCC) Toe wall is being erected at the eastern part of the East External OB dump of PEKB Coal Block



A closer view of the stone masonry (PCC) Toe wall being erected at the eastern part of the East External OB dump of PEKB Coal Block



A gully check with stone masonry check dam to prevent erosion on the rain cut deep gully on East External OB dump of PEKB Coal Block

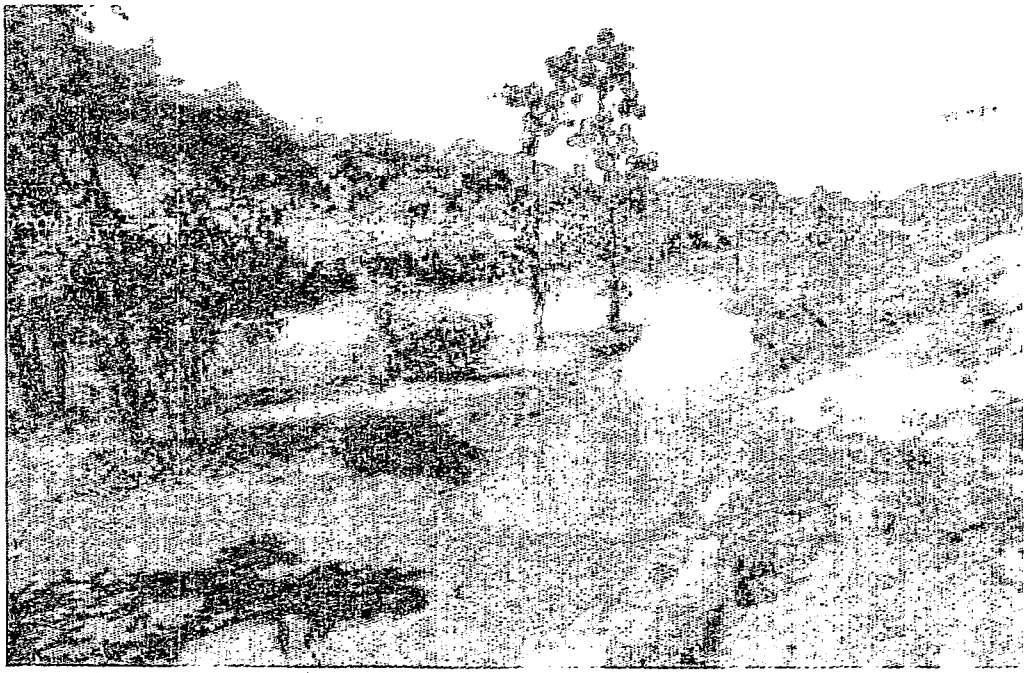


Series of Brush Wood Check Dams (BWCD) to prevent erosion on the gully along the slope on the East External OB dump of PEKB Coal Block

Plate 8.6: Current state of the East External OB Dump of the PEKB Coal Block and physical reclamation measures actively being carried out on its vulnerable parts

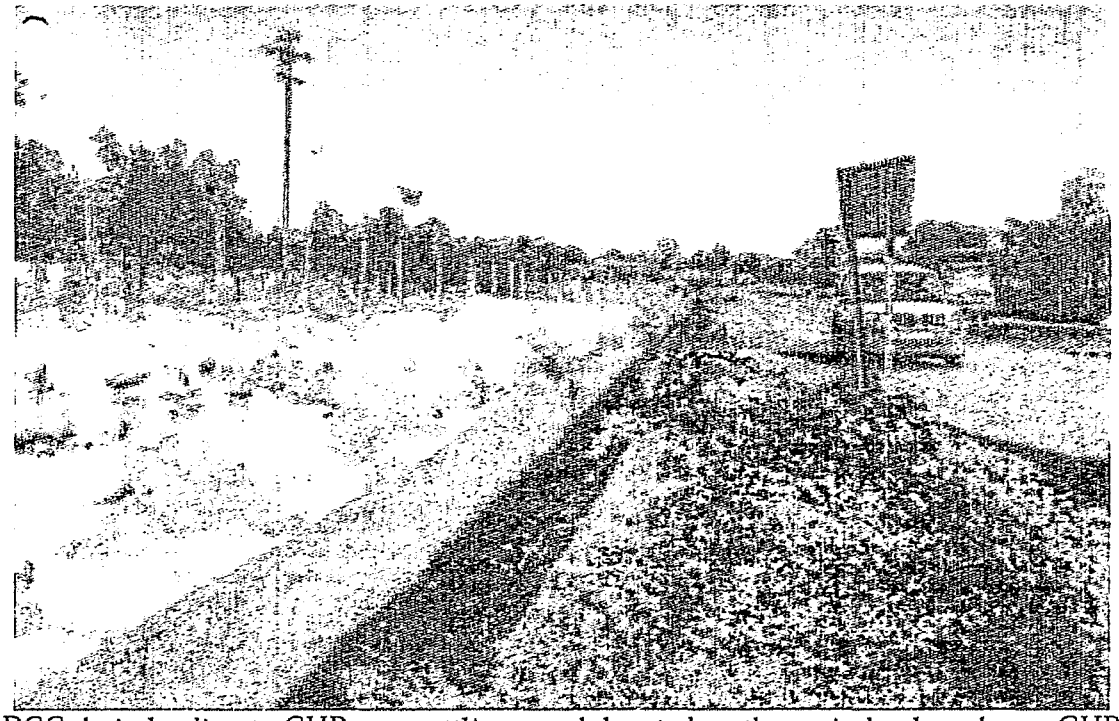


A view of the vulnerable (water logged) areas on the middle part of the west external dump of the PEKB Coal Block, having poor surface water management measures (Image as on February, 2020)

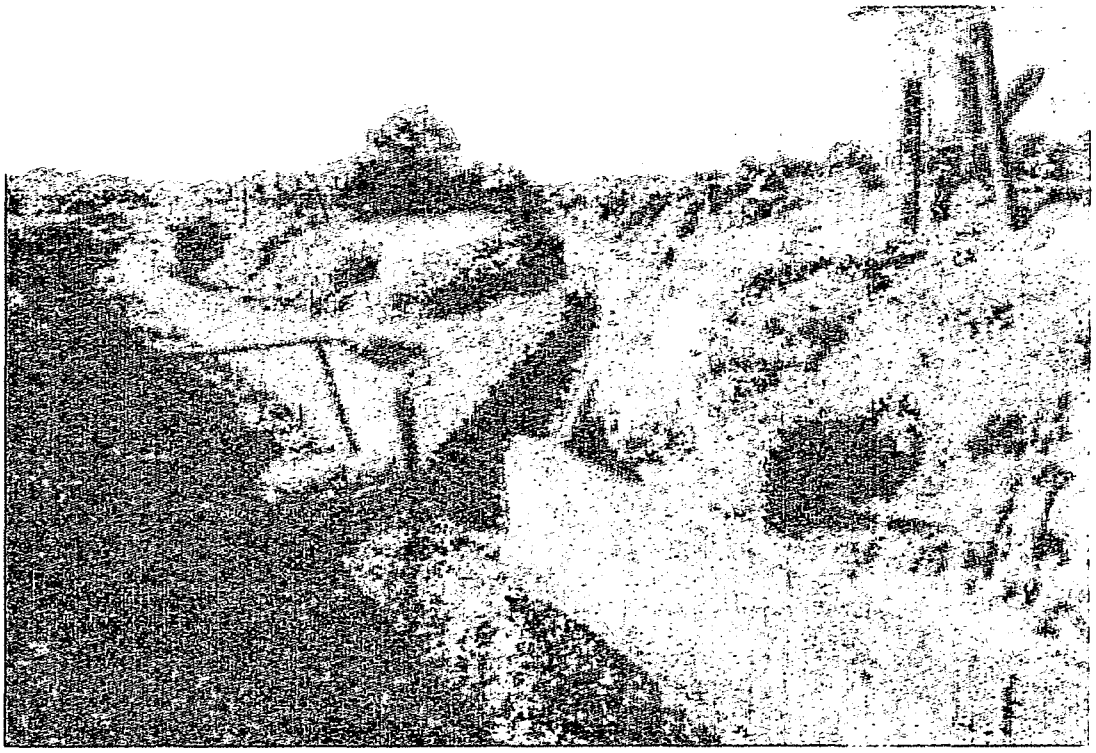


A view of the vulnerable (water logged) areas on the middle part of the west external dump of the PEKB Coal Block, having poor surface water management measures (Image as on October, 2020)

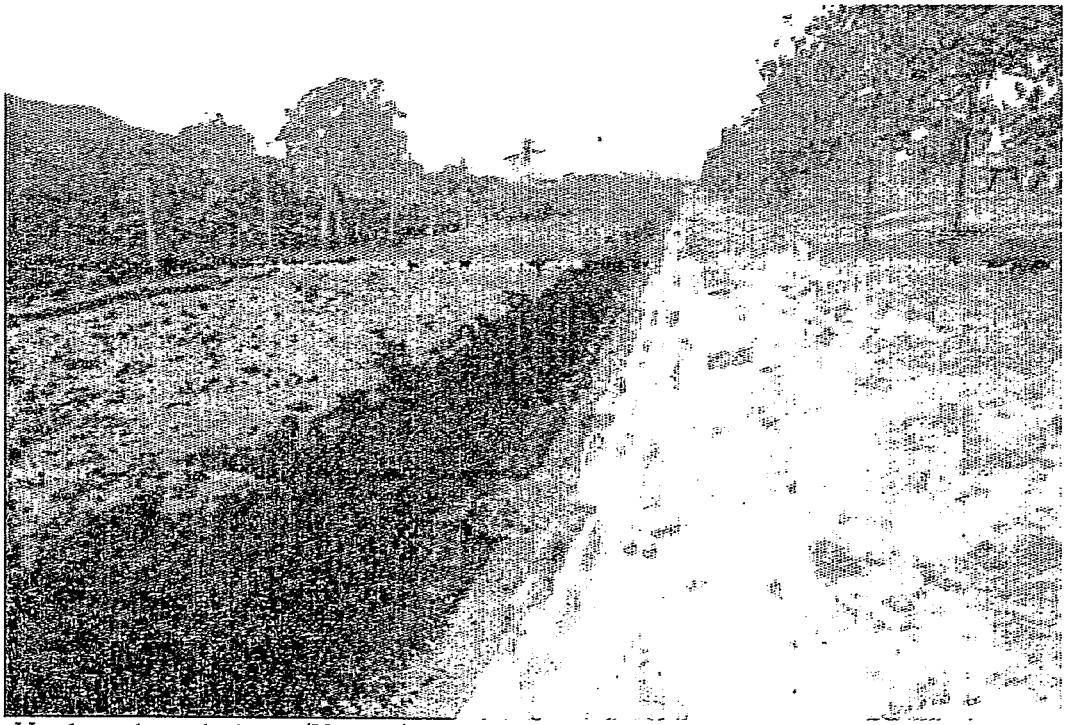
Plate 8.7: Vulnerbale area due to lack of adequate surface water management measures on the middle part of the west external OB dump



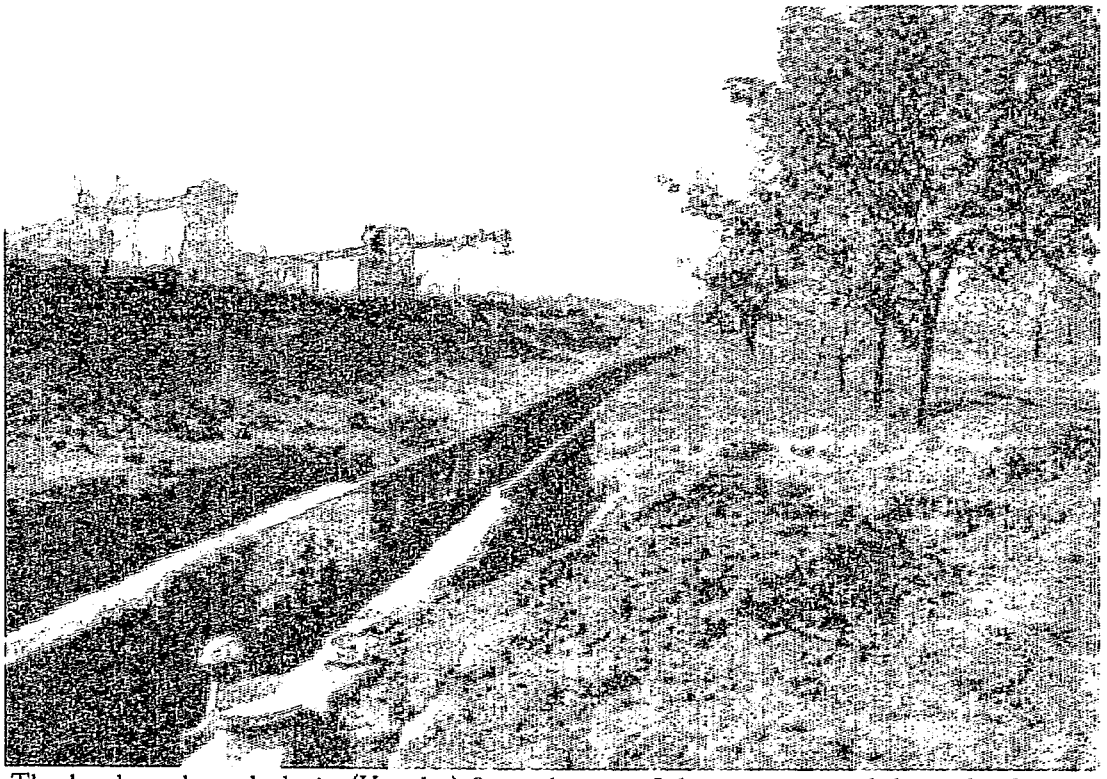
RCC drain leading to CHP area settling pond, located on the main haul road near CHP area of the PEKB Coal Blcok



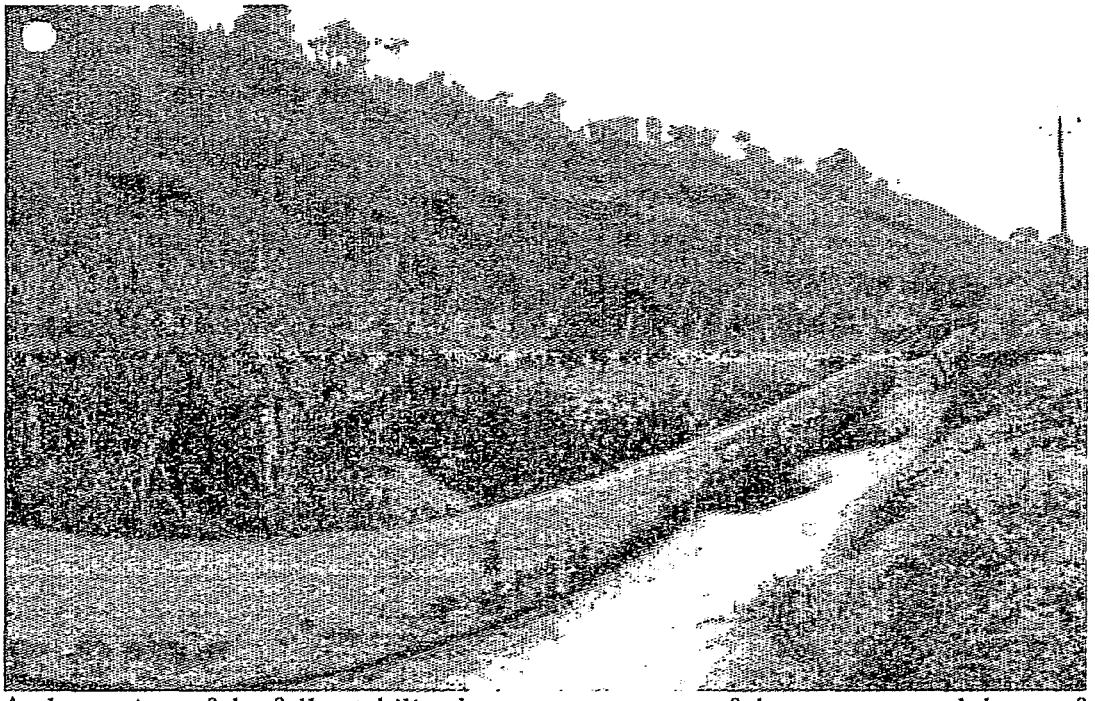
RCC drain being diversted to a settling pond, located on the side of the main haul road near CHP area of the PEKB Coal Blcok



Haul road catch drain (Kutcha) alongside coal stock yard from the toe of the east external dump leading to a settling pond near CHP area



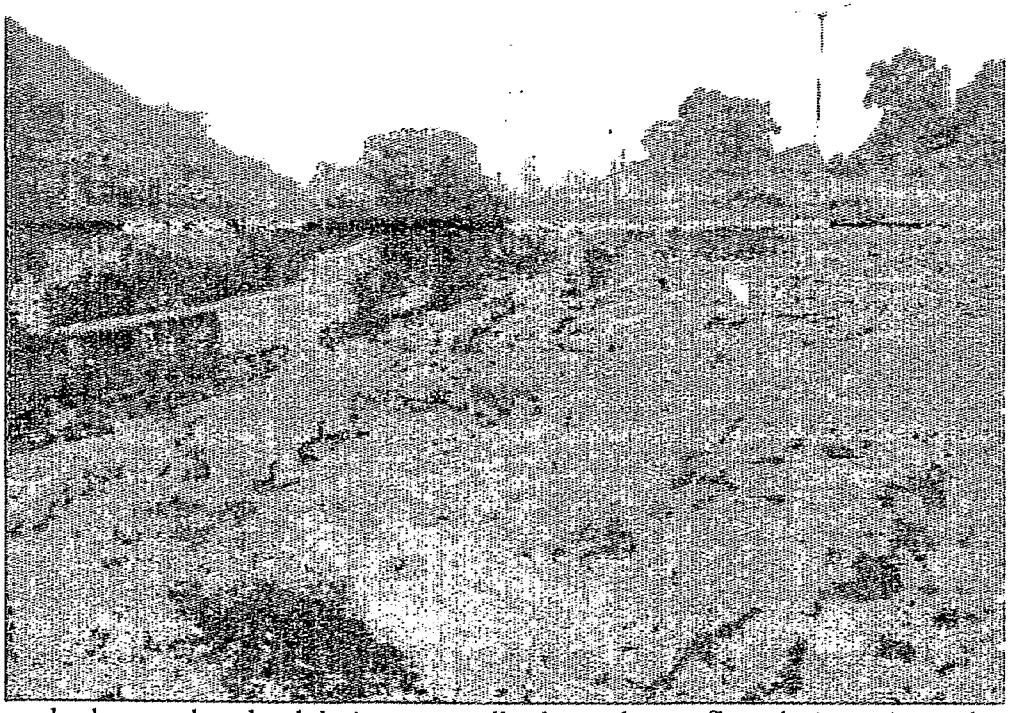
The haul road catch drain (Kutcha) from the toe of the east external dump leading to settling pond near CHP area alongside the coal stack yard is being revamped with RCC/PCC stone masonry walls for facilitating better surface water flow



A closer view of the fully stabilized western most part of the west external dump of the PEKB Coal Block with adequate surface water management measures

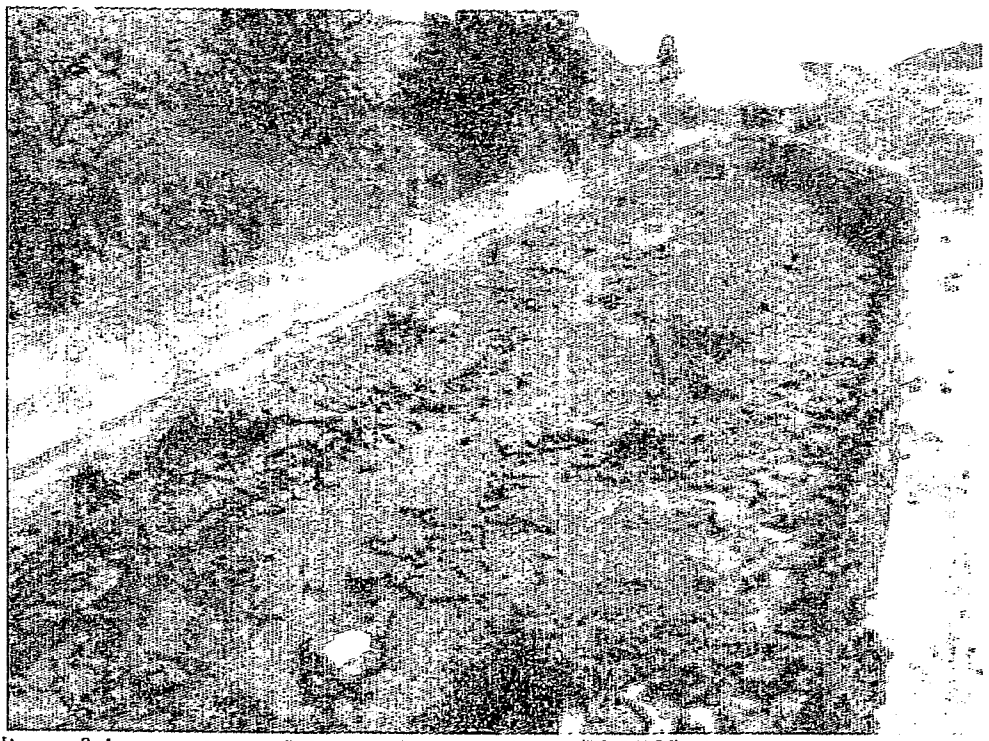


Revamped surface water management measures at the toe of the west external OB dump of the PEKB Coal Block



Severely damaged garland drain, reportedly due to heavy flow during rain, at the toe of the west external OB dump (N-NW) of the PEKB Coal Block

Plate 8.8: Various measures implemented for surface water management of the area under haul road, east and west external dumps, etc., of the PEKB Coal Block



View of the terminus of the catch water drain (N-NW) that is flowing along the northern border of the PEKB Coal Block

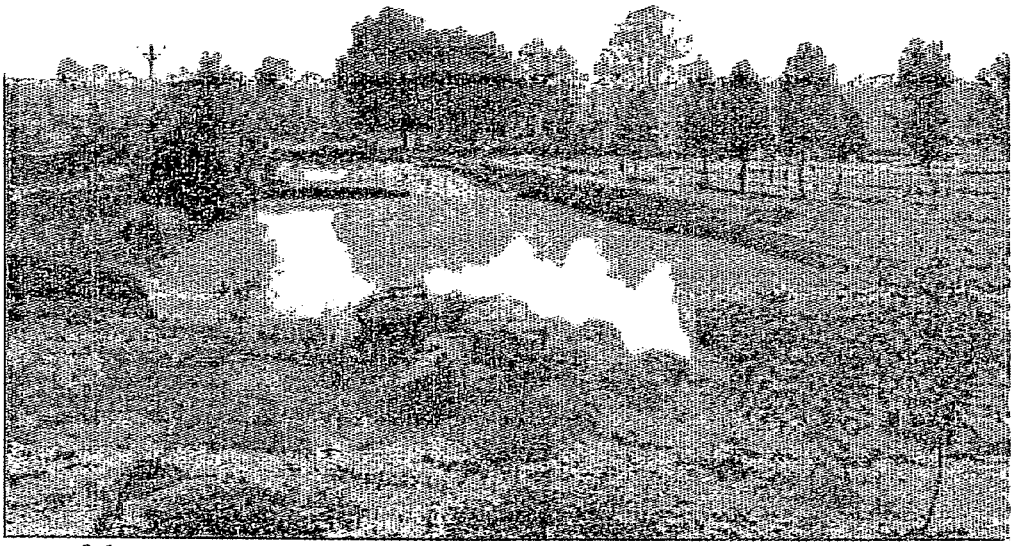


The catch water drain flowing along the northern border of the coal block terminates into a three stage settling pond (at N-NW) near the entry point of the PEKB Coal Block



A view of the three stage settling pond (at N-NW) that is the terminus point of the catch water drain along the northern boundary of the coal block

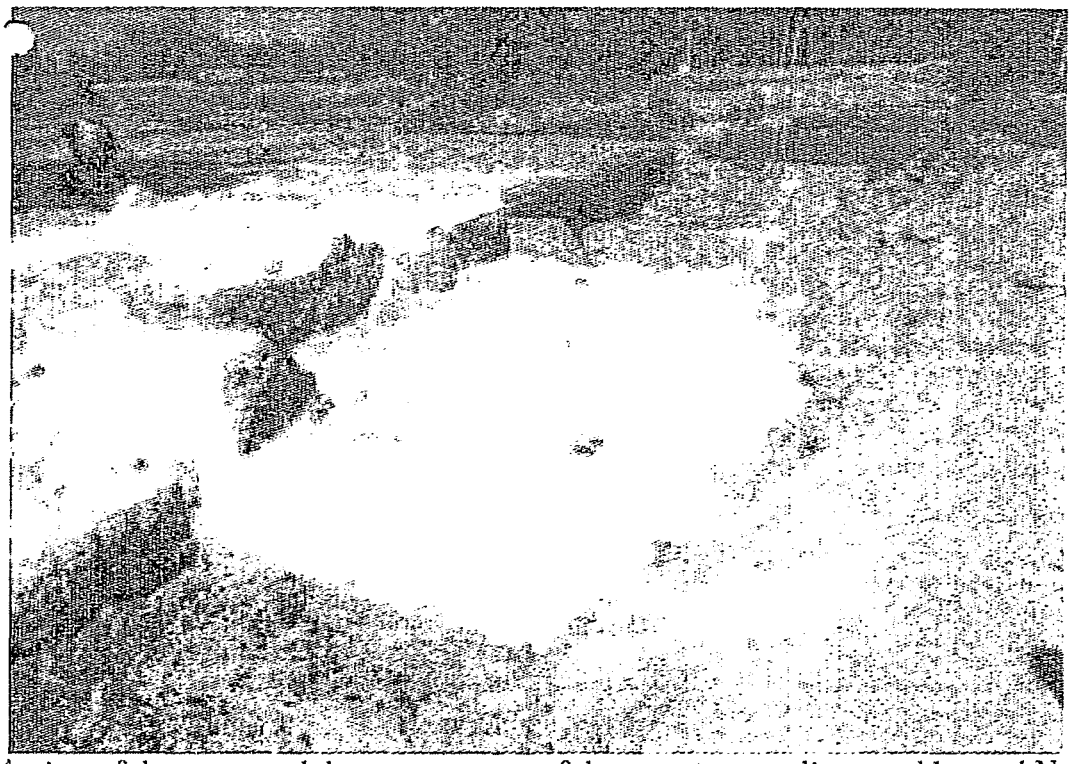
Plate 8.9: A view of the northern boundary catch water drain and its terminus *i.e.*, a three stage settling pond near entry point at N-NW of the PEKB Coal Block



A view of the two stage settling pond located N-NW at the end of all drains from the north including that of West External Dump and Catch Water Drain along north of the PEKB Coal Block

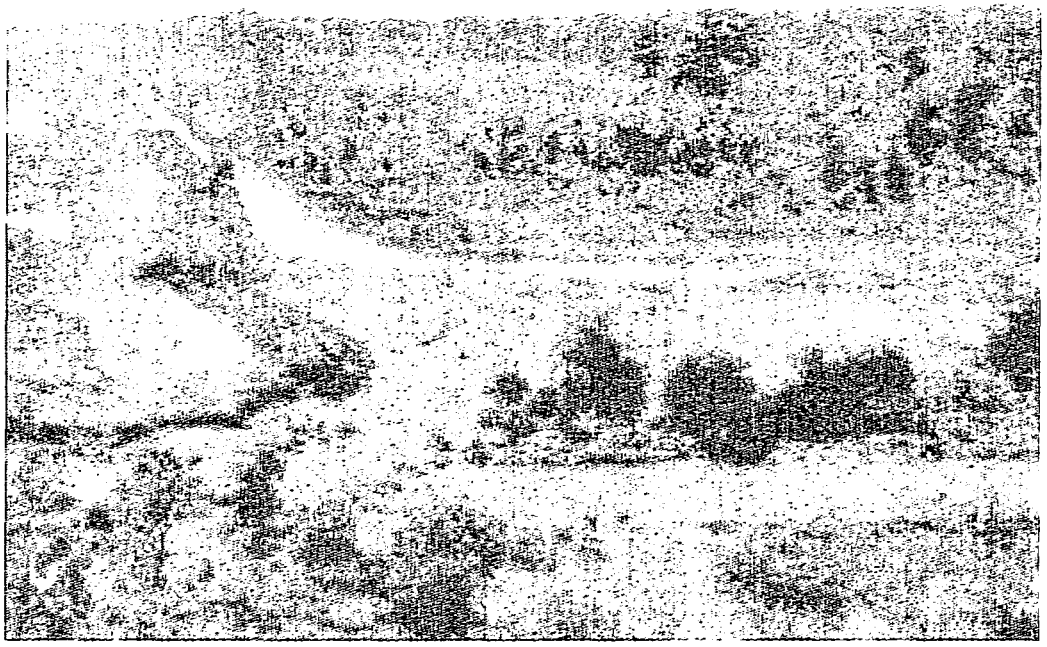


Severely damaged downstream of the two stage settling pond located N-NW, at the end of all drains from the north of the PEKB Coal Block

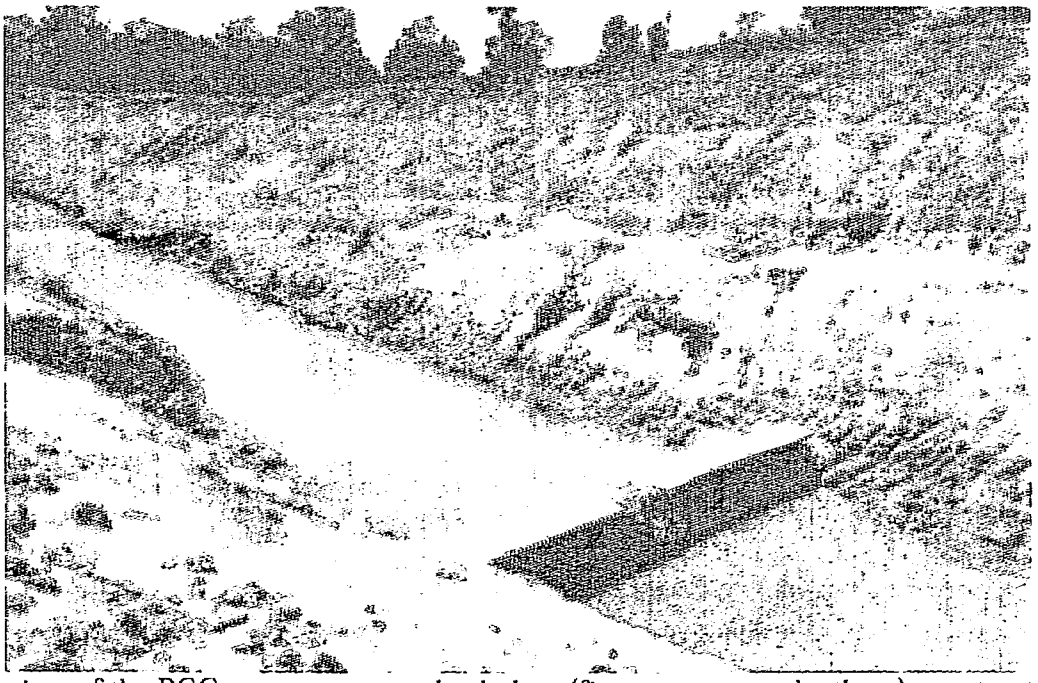


A view of the revamped downstream part of the two stage settling pond located N-NW, at the end of all drains from the north of the PEKB Coal Block

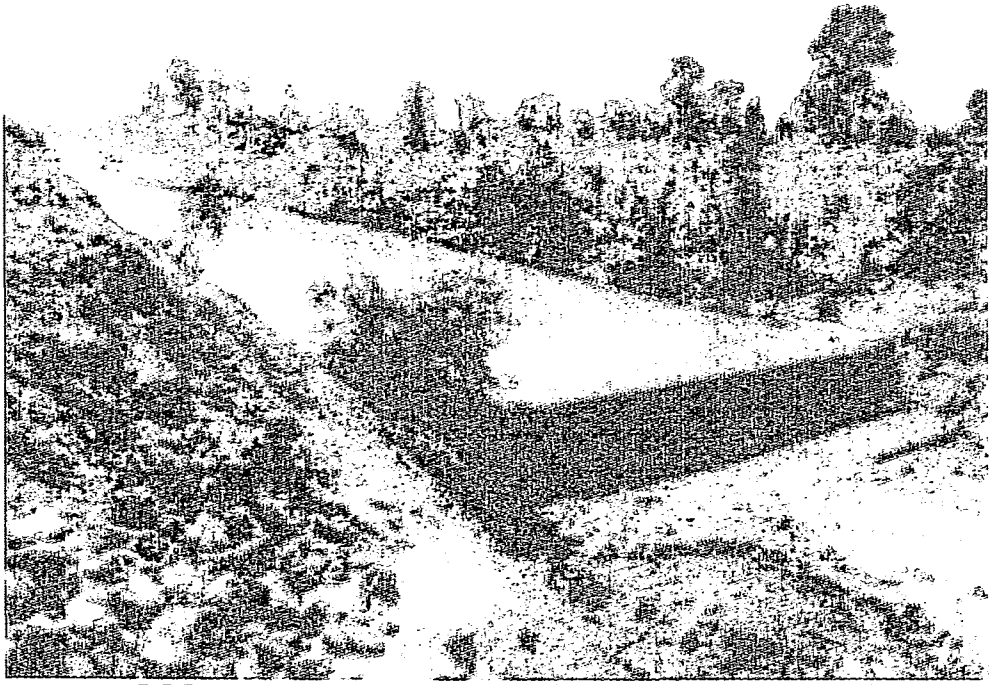
Plate 8.10: A view of the two stage settling pond located N-NW, at the end of all drains from the north of the PEKB Coal Block and its revamped downstream part



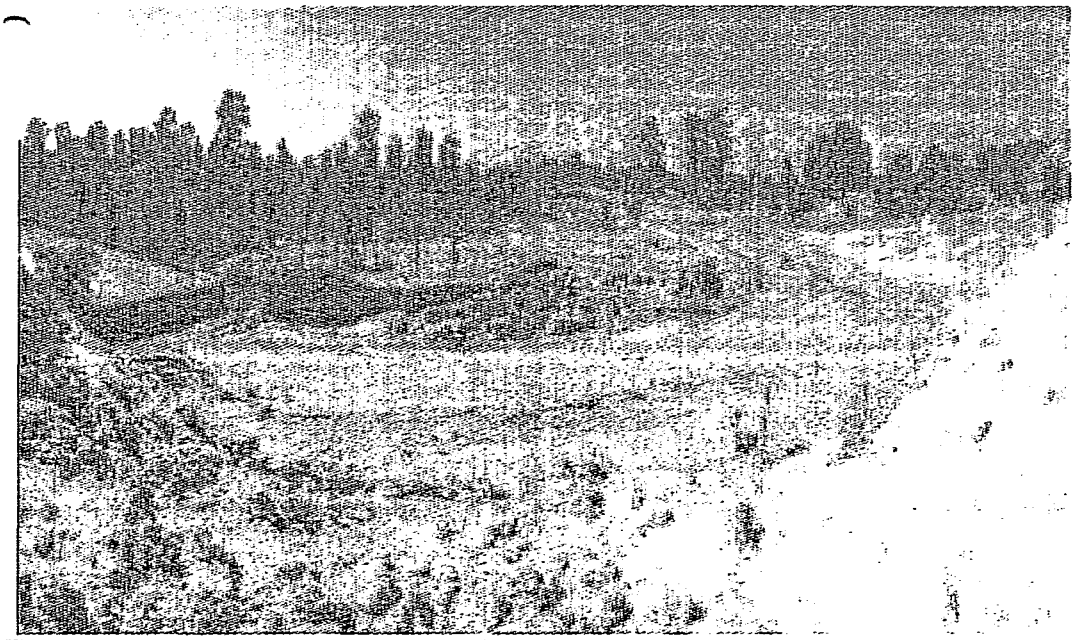
A view of the catch water drain located along the southern limit, passes through the western boundary of the PEKB Coal Block leading to Salhi Nala at N-NW (before implementing any kind of flow control measures) – Image as on October 2020



A view of the PCC stone masonry check dam (first one among the three) constructed across the catch water drain located on the western boundary of the PEKB Coal Block leading to Salhi Nala (Image as on February, 2021)



A view of the PCC stone masonry check dam (last one among the three) constructed across the catch water drain located on the western boundary of the PEKB Coal Block leading to Salhi Nala

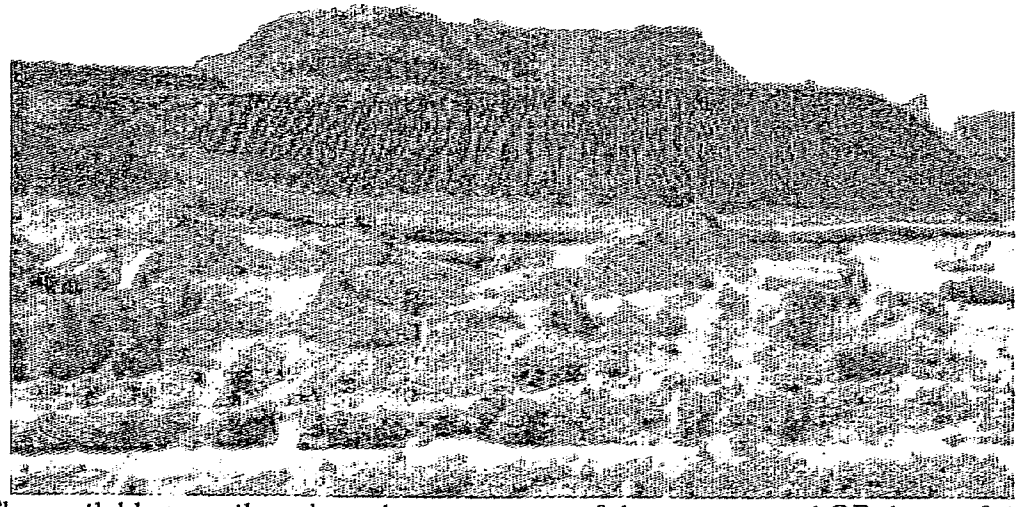


The catch water drain at the western boundary passes through series of check dams before draining into the Salhi Nala

Plate 8.11: The catch water from the southern limit of the coal block leading to Salhi Nala at N-NW passes the western boundary through a series of check dams built for control of erosion



The safety zone green belt of the PEKB Coal Block protected by barbed wire fencing



The available topsoil stack on the eastern part of the east external OB dump of the PEKB Coal Block with no apparent protective measures (image as on October, 2020)



The topsoil stack on the eastern part of the east external OB dump of the PEKB Coal Block is being eroded due to wash from rain (image as on February, 2021)

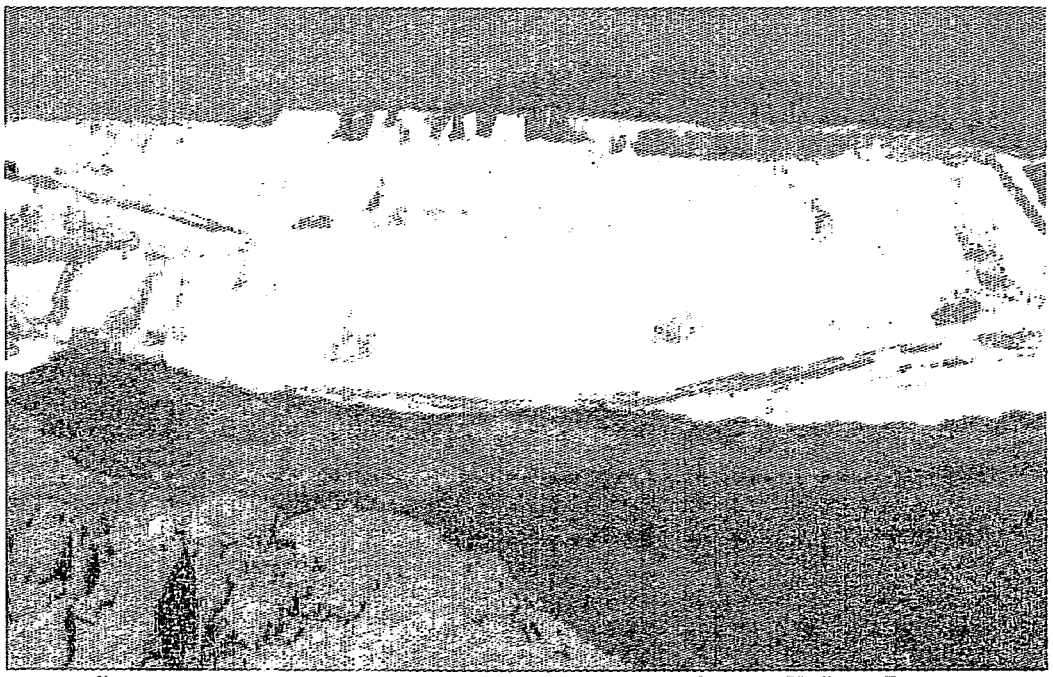
Plate 8.12: A view of the presently available top soil stack of the PEKB Coal Block and its severely eroded present condition due to wash off from rain



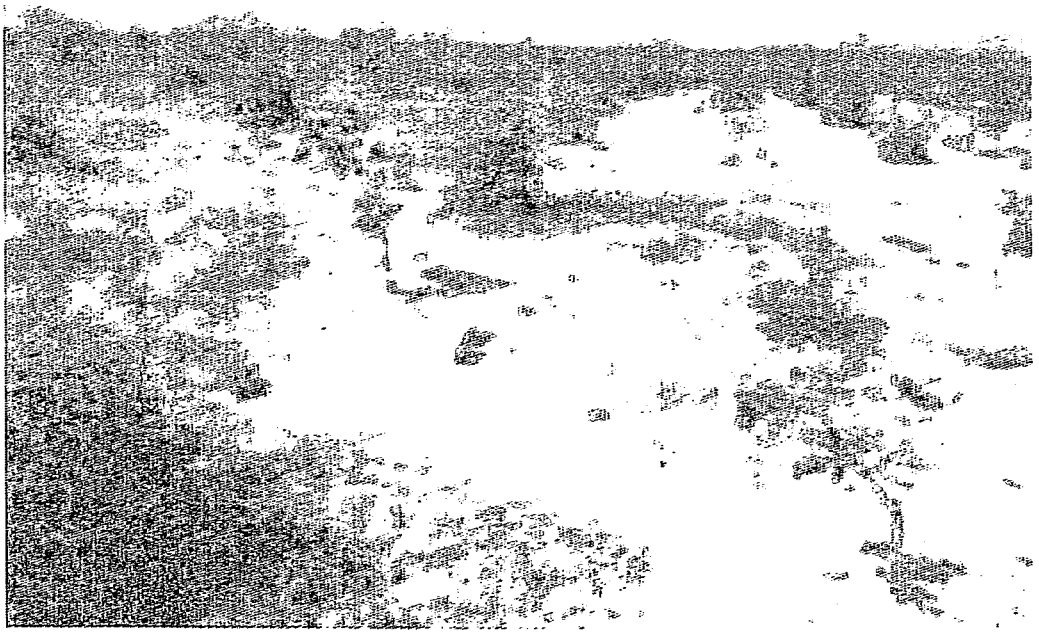
Reclamation of the mine pit of Chotia-I Coal Block is being progressed by using flyash



Growth of planted vegetation (Block plantation) on the backfilled areas of the Chotia-I Coal Block



Systematically backfilled mined out pit of the Chotia-II Coal Block



Plantation vegetation on the reclaimed waste dump areas of the Chotia II Coal Block

Plate 8.13: Reclamation and rehabilitation measures including afforestation and surface water management measures implemented in the Chotia-2A & 2B Coal Blocks

CHAPTER-9

EFFICACY OF TRANSLOCATED TREES

This chapter provides comprehensive observations on the efficacy of the tree translocation in Parsa East and Kanta Basan (PEKB) with reference to the compliance to the National Green Tribunal (NGT) judgment on 24th March 2014 (Annexure 1.3) on the efficacy of the translocation of the tree *vis-a-vis* the gestation period for regeneration of the flora in PEKB and as per the Stage-I Forest Clearance (FC)Condition stipulated by the MoEF & CC in favour of M/s. Rajasthan Rajya Vidyut Utpadan Nigam Limited (RVUNL) *vide* letter No.8-46/2017-FC dated 04.12.2017. Accordingly, detailed assessment was made and the same is presented below:

9.1 INTRODUCTION

Translocation practice is widespread globally in biodiversity conservation (IUCN, 1987; Maunder, 1992; Muller and Eriksson, 2013) and are being increasingly practiced for conserving biodiversity in the form of augmentation, introduction and re-introduction particularly for programmes such as species conservation, biodiversity conservation, ecological restoration, and resilience (Griffith *et al.*, 1989; Dodd and Seigel, 1991; Maschinski and Duquesnel, 2006; Wuethrich, 2007; Palmer and Filoso, 2009; Germano and Bishop, 2009; Weeks *et al.*, 2011; Godefroid *et al.*, 2011; IUCN/SSC, 2013; Volis, 2016; Commander *et al.*, 2018; SER and IUCN-CEM, 2018). Tree Transplantation/translocation is referred to the procedure of unearthing the trees and replanting it from one location to another with the objective of re-growing the tree at a new location for continued environmental services and to create or contribute to a viable, self-sustaining population. Determining sustainability of the transplanted/translocated trees can be possible only after many years of monitoring up to several decades or even centuries depending upon generation time of the species (Albrecht *et al.*, 2019; Menges, 2008; Pavlik, 1996).

Translocation of trees in India is relatively a new concept; though have been tried in the past only in few places with limited success (https://forests.Gujarat.gov.in; Times of India report, 2018; Kshirsagar *et al.*, 2018; Hindustan Times, 2019). Translocation of full-grown tree is a complex process, requires scientific, technical human resources and equipment to make it successful as the process needs to start much before the movement of trees and needs extensive care ensure post survival. Therefore, it is imperative to learn from the successful and unsuccessful cases from India and elsewhere, because it is challenging and essential to build and create knowledge on different factors that impact the success rates of translocation. In addition, the survival remains a challenge depending upon the species sensitivity, size, age of the tree, soil, climatic condition, suitable season, method used, cost effectiveness, pre and post care etc., (National Green Highways Mission, 2016; Telangana Today, 2017; The Quint, 2017; Times of India, 2018; The Hindu, 2019).

9.1.1 Policy Scenario in India

Unlike compensatory plantation, tree translocation is not discussed in the policy framework of India, but certain states and cities have already started experimenting with translocation of trees. The Indian industry and infrastructure developers have been asked by the law to undertake plantation of saplings for each tree that is required to be removed for the project. The State Forest Departments and the Horticulture Departments have been empowered to check for the necessity of felling a tree and the number of trees to be planted as compensation. In certain cases, there is a provision for monetary compensation as well for the loss of each tree. The status regarding tree translocation changed when the Ministry of Road Transport and Highways (MoRTH), Government of India came up with the 'Green Highways (Plantation, Transplantation, Beautification and Maintenance) Policy 2015' which places transplantation at the center of the compensatory plantation.

The policy considers transplantation as a 'desirable' method to relocate the full-grown trees from the road construction sites (Himanshu and Chandan, 2016). The policy considers the time required for transplantation activities and briefly mentions the practices to be incorporated in the process. The policy also highlights the survival rate of such plantation as a criterion of final payment to ensure the survival of trees post plantation. National Green Highway Mission (NGHM) is also exploring the need to develop separate set of guidelines for transplantation (along Highways) for effective execution of the policy. Delhi has become the first State in India to pass 'Tree Transplantation Policy' 2020. The Ministry of Environment, Forest and Climate Change (MoEF&CC, 2018), GoI, has communicated to all the states that 'successful translocation of trees should not be treated as felling of trees' provided the tree is translocated on a land as suggested by the Forest Department. In case of any unsuccessful translocation, compensation in terms of planting of trees in lieu of each such tree felled will be provided at the cost of the user agency, as per the provisions of the concerned Act.

Translocation of a tree is generally based on a balancing consideration of its conditions (e.g. form, health and structure), size, species, conservation status & amenity value, suitability for transplanting, environmental & cultural factors, functional & engineering considerations and cost effectiveness that varies from species of importance to determine the factors for transplanting. Therefore, "Guidelines on Tree Transplanting' (The Guidelines) or Standard of Practice (SoP) is essential as it serves as a general reference with a view to providing systematic steps in assessing the feasibility and suitability of transplanting in the project feasibility/planning stage and the major considerations in design, documentation, implementation and post construction stages for proper tree transplanting works, monitoring and the after care. The SoP in case of translocation of trees as a general reference is essential for the successful implementation.

9.1.2 Plant Translocation

In general, trees translocation is considered time-consuming activities, as they require several in-depth preparatory studies, a constant commitment to multiply the out plants, realize and monitor the activities, and a long-term monitoring plan to verify their effectiveness; in addition, translocation programs are considered economically expensive activities, because the pre- and post-translocation management actions required are generally high-priced. Actually, the factors that made translocation challenging, as well as stimulating, included limited human resources and availability of optimal hosting sites, bureaucratic difficulties encountered by working on both private and public properties, and the high uncertainty of success due to stochastic events.

Any translocation requires an in-depth understanding of the biology and ecology of the target species and the main threats affecting the population (Maunder *et al.*, 2004; Maschinski and Duquesnel, 2006; Noel *et al.*, 2011; Cogoni *et al.*, 2013; IUCN/SSC, 2013; Commander *et al.*, 2018); expert-based decisions on site selection, origin and type of the out plants planting methods, and the appropriate monitoring plan (Maunder *et al.*, 2004; IUCN/SSC, 2013; Commander *et al.*, 2018). Reviews on plant translocations have been conducted with a global focus (Dalrymple *et al.*, 2012; Menges, 2008), and for regions, countries, vegetation communities and plant groups (Albrecht *et al.*, 2019; Brichieri-Colombi and Moehrenschlager, 2016; Liu *et al.*, 2015; McDougall and Morgan, 2005; Milton *et al.*, 1999; Morgan, 1999; Reiter *et al.*, 2016). Transplanting is an age old practice but cannot be applied for all species of all ages at all places on a large scale (Gilman Edward, 1997). The emerging consensus highlights translocation as relatively high-risk, high-cost and challenging (Drayton and Primack, 2012; Holl and Hayes, 2006). Survival, flowering and fruiting rates are generally low and sometimes show a downward trend with time, where monitoring data is available (Godefroid *et al.*, 2011). This is often due to poor understanding of the biology, ecology and habitat requirements of rare and threatened plants (Fiedler and Laven, 1996; Reiter *et al.*, 2016; 2017), short timeframes and funding constraints of projects meaning a lack of long-term management and monitoring (Falk *et al.*, 1996), and the small size of many introduced populations (Krauss *et al.*, 2002). Sometimes the reasons for translocation failures are unknown (Drayton and Primack, 2012). Nevertheless, translocation has proven to be a highly successful tool for threatened species conservation in some instances (Colas *et al.*, 2008; Maschinski and Duquesnel, 2007; Milton *et al.*, 1999; Munt *et al.*, 2016).

Ministry of Environment, Forest and Climate Change (MoEF&CC), GoI, while extending Forest clearance *vide* letter No.F.No.8-31/2010-FC dated 15thMarch 2012 emphasized for Translocation of trees (point number-17) with in the PEKB coal block lease area from natural forest in consultation with State Forest Department. Meanwhile, National Green Tribunal (NGT) *vide* order dated 23rd June 2014 directed MoEF&CC, GoI and the State Government under section 2 of the Forest

(Conservation) Act 1980 for diversion with emphasis on seeking answer to question including efficacy of the transplanted trees in PEKB mine lease. Further, on the basis of the FAC recommendation the MoEF&CC, GoI *vide* letter No.8-46/2017-FC dated 04.12.2017 issued Stage-I Forest Clearance in favour of M/s. Rajasthan Rajya Vidyut Utpadan Nigam Limited (RVUNL), and directed State government to assess the efficacy of the translocation of the trees *vis-à-vis* the gestation period for regeneration of the flora. Subsequently, ICFRE undertook the study and the observation and recommendations are presented below:

9.2 OBJECTIVE

- To assess efficacy of the tree translocation in Parsa East and Kanta Basan (PEKB) *vis à vis* the gestation period for regeneration of the flora.

9.3 TREE TRANSLOCATION PROCESS FOLLOWED AND DOCUMENTED BY PEKB

Tree Translocation considered at PEKB coal mine block is only the suggested size and girth of the tree from the forest block. Trees with less than 60 cm girth from various forest blocks as directed by the State Forest Department (SFD)were observed to be translocated in the predetermined sites within the PEKB mine lease area. The entire process of the tree translocation adopted by PEKB coal mine authorities is given below.

9.3.1 Team Involved in Translocation

The PEKB coal mine has dedicated team for translocation of Sal, Mahua and other trees with designated work chart and responsibilities to consult, plan, execute and monitor. The team comprising of following senior level officers of the PEKB coal mine with specific responsibility.

(1) Mr. Rajkumar Pandey, Manager, Horticulture

(2) Mr. DipakUttamrao Deokar, Deputy Manager, Horticulture

(3) Mr. Avneesh Kumar Chauhan, Deputy General Manager, Environment

(4) Mr. Rakesh Kushwaha, Operation Transplanter

(5) Mr. Kamlesh Upadhaya, Operator, Environment

9.3.2 Machinery and Manpower used for Translocation

PEKB coal mine authorities have employed *Trans Planter Model 100d*(Volvo) along with carrier for digging, uprooting, transporting and replanting of selected trees (Plate 9.1- 9.2). Following are the facilities maintained for pre and post care:

- One water tanker with driver and labour.
- One labour for lopping branches at uprooting sites.
- One labour for treatment to the pit at transplantation/ planting site.
- Spray pump, bucket, hand glows, shovel, and branch cutting/lopping instruments.
- Fertilizers, insecticides, fungicides, etc.

Process Adopted in Translocation

- Digging Pit as per the size of the selected Tree.
- Uprooting Tree keeping Root Stock and Earth Ball Intact.
- Transporting the Uprooted Tree with the help of Tree Transplanter truck.
- Identification of Translocation site /area within the mine lease area.
- After translocation of the tree, filling the Pit with dugout soil and Farmyard Manure

- Trees with basal girth ranging from 20 cm to 60 cm and the age could not be determined were translocated in consultation with the State Forest Department, Chhattisgarh during the year 2012 to 2020 from the Forest Blocks (2012 to 2016: P-2007, P-2004, P-2008); (2016 to 2017: P-2007 & P-2004); (2017 to 2018; P-2005); (2018 to 2019: P-2005 & P-2004): (2019 to 2020: P-2004 & P-2003) using *Trans-Planter Model-100d*mode.

- The trees were transported on the same day in the identified location and the distance travelled from the forest blocks to PEKB coal mine planting sites varied from 1.5 km to 5km.

- The identified tree is lifted and the entire bowl of root with tree is tilted to rest on the truck chassis.

- The branches of the tree were either tide or trimmed properly to avoid any hindrance during transportation.

- Heavy traffic areas were informed well in advance and required special assistance were acquired for road clearing during transportation of the tree from forest areas to the translocation site through truck.

Process followed at Translocation Site

- The team ensured that no other development activities fall under and around the working zone of the translocation site. Spectators and other workers were advised to keep safe distance.

- While tree translocation operation, followed all the precautions such as wearing helmet, not applying extra pressure beyond limit to the blades while penetrating, ensure stabilizing pad are placed at required position during operation and after operation.

- At the destination, the pit digging process made and the tree brought was translocated. Before planting, the pit was treated with the following:

  - Anti-termite and anti-fungal treatment (5 ml Imidacloprid + 30 ml of Anti-fungal liquid).

  - Added 10-15 kg of organic manure (Vermi-compost/Compost) + 100 g NPK fertilizer.

  - After transplanting the tree, an earthen ring bund of 2 m radius was made manually and watering is done thoroughly.

9.3.3 Season and time of translocation

Tree translocation activities have been undertaken during monsoon and winter seasons by the PEKB coal mine authorities and avoided very hot months *i.e.*, April, May and June. Depending on the distance between the two places *i.e.*, tree to be uprooted from the forest compartment and transplanted at the site within coal block mine lease area, site condition in a day, the PEKB authorities have translocated7-8 trees daily. Trees from the natural forest blocks/compartments were translocated to the predetermined areas within mine lease areas by the PEKB coal mine authority. The trees species translocated are listed as follows:

Tree Species Translocated			
Species Name	**Common Name**	**Species Name**	**Common Name**
Shorea robusta	Sal	*Ficus benghalensis*	Bargad
Madhuca longifolia	Mahua	*Haldina cordifolia*	Haldu
Aegle marmelos	Bel	*Lagerstroemia parviflora*	Lendia
Artocarpus heterophyllus	Katahal	*Mangifera indica*	Aam
Bombax ceiba	Semal	*Pongamia pinnata*	Karanj
Buchanania lanzan	Chironji, Chaar	*Schleichera oleosa*	Kusum
Cassia fistula	Amaltas	*Semecarpus anacardium*	Bhilva
Dillenia pentagyna	Karmal	*Syzygium cumini*	Jamun
Diospyros melanoxylon	Tendu	*Terminalia arjuna*	Arjun

9.3.4 Design of Translocation

The out-planting design for transplantation consists of small block consisting of four or five rows in the safety zone area and on the dump; two rows of stripplantation or individual at various sites such as road, view point, near CHP, nursery and near village in the PEKB coal mine.

9.3.5 Post Translocation Care

Following are the post planting care measures adopted in the newly translocated site to facilitate establishment of the trees:

- Watering/irrigation to the trees were made thoroughly and frequently depending on the season. Methods standardized for watering and found suitable such as 2-3 watering per week for first month and then after 1 watering per week for 1 month.
- The PEKB team observed shed-off leaves in the first month and new leaves sprout thereafter.
- Necessary treatment was given against Termite attacks where ever noticed on translocated trees in different sites.

Monitoring of the translocated trees has been maintained by the Mine Lessee (PEKB) only for the survival.

9.3.6 Constraints overcome by PEKB

Soil

The kinds of soil within mine lease having depth up to 2 m were found suitable for tree translocation. Soft Murrom areas were found difficult in the translocation operation as the penetrating blades in such area was very hard and such areas needed rigorous watering. Also, the translocated trees need special care and vigilance while working in such areas.

9.4 SURVIVAL OF THE TRANSLOCATED TREES MONITORED AND DOCUMENTED BY PEKB

A total of 8177 trees within the girth ranging from 20 cm to 60 cm (and the age is not known or documented) have been translocated in 16 sites in the PEKB coal mine during the period from 2012 to 2020 (As per project proponent document) (Annexure 9.1).The location-wise details of the trees translocated, planted and their survival status in the PEKB coal mine lease areas as per the data provided by the Project Proponent are given in Table 9.1 (Plate 9.3).

The trees translocated in large number are *Shorea robusta* except for few *Madhuca longifolia* at various sites. The coppices found in some trees that are either dead or diseased have contributed to higher survival percentage in some sites documented by the PEKB authority. Considering the importance of the trees specific to the study area, the efficacy of these two transplanted trees were considered. The rest of the trees were of common trees planted for aesthetic and other economic value.

Table 9.1:Location-wise survival details of the translocated trees within mine lease area of PEKB coal mine block as per the records maintained by the PEKB coal mine management

Location	Year of planting	Species	Survival status of the trees		
			Planted	Survived	% Survival
(1) Baigapara Dispatch Road	2015-16	*B. lanzan*	41	4	9.76
	2015-16	*M. indica*	2	2	100.00
	2015-16	*M. longifolia*	326	34	10.43
	2015 16	*S. robusta*	173	172	99.42
	2015-16	*D. melanoxylon*	20	12	60.00
	2015-16	*H. cordifolia*	1	1	100.00
	2015 16	*S. anacardium*	5	5	100.00
(2) Baigapara Dump	2015-16	*S. robusta*	76	76	100.00
	2016-17	*M. longifolia*	120	35	29.17
	2016-17	*S. robusta*	270	270	100.00
(3) Baigapara Pond	2017 18	*S. robusta*	114	99	86.84
(4) Check Post	2017 18	*S. robusta*	69	59	85.51
(5) Check Post Safety Zone	2012 13	*C. fistula*	4	4	100.00
	2012 13	*B. lanzan*	18	4	22.22
	2012 13	*A. heterophyllus*	1		
	2012 13	*M. indica*	3	3	100.00
	2012 13	*M. longifolia*	45	24	53.33
	2012 13	*S. robusta*	1341	1097	81.80
	2013-14	*S. robusta*	993	744	74.92
	2014 15	*S. robusta*	118	109	92.37
	2014 15	*M. longifolia*	215	157	73.02
	2015 16	*M. longifolia*	5	1	20.00
	2015 16	*S. robusta*	149	149	100.00
	2015 16	*S. cumini*	1	1	100.00
(6) CHP Dump	2018 19	*M. longifolia*	10	2	20.00
	2018 19	*S. robusta*	8	8	100.00
	2019 20	*M. longifolia*	26	10	38.46
	2019 20	*S. robusta*	59	23	38.98
(7) CHP Main Washery	2018 19	*F. benghalensis*	1	1	100.00
	2018 19	*C. fistula*	12	7	58.33
	2018 19	*T. arjuna*	1	1	100.00
	2018 19	*A. marmelos*	1	1	100.00
	2018 19	*B. lanzan*	5	5	100.00

Location	Year of planting	Species	Survival status of the trees		
			Planted	Survived	% Survival
	2018-19	*P. pinnata*	1	--	--
	2018-19	*D. pentagyna*	1	--	--
	2018-19	*S. anacardium*	1	1	100.00
	2018-19	*M. longifolia*	7	1	14.29
	2018-19	*S. robusta*	173	152	87.86
	2018-19	*B. ceiba*	1	1	100.00
	2018-19	*L. parviflora*	16	9	56.25
	2018-19	*D. melanoxylon*	7	5	71.43
(8) Dispatch Road	2018-19	*S. robusta*	33	31	93.94
	2016-17	*M. longifolia*	60	20	33.33
	2016-17	*S. robusta*	163	163	100.00
(9) Dispatch Road Area Dump	2017-18	*S. robusta*	187	163	87.17
(10) Front of MahuwaDevDump	2015-16	*S. robusta*	18	18	100.00
	2016-17	*B. lanzan*	35	8	22.86
	2016-17	*M. indica*	17	6	35.29
	2016-17	*M. longifolia*	215	54	25.12
	2016-17	*S. robusta*	268	268	100.00
	2016-17	*D. melanoxylon*	40	12	30.00
	2017-18	*M. indica*	40	23	57.50
	2017-18	*S. robusta*	204	173	84.80
(11) KJS Filling Point	2017-18	*S. robusta*	500	367	73.40
(12) New Nursery Dump	2017-18	*S. robusta*	200	172	86.00
(13) New Nursery Road	2019-20	*S. robusta*	40	40	100.00
(14) New View Point	2016-17	*C. fistula*	1	--	
	2016-17	*S. cumini*	6	6	100.00
	2016-17	*S. anacardium*	1	1	100.00
	2016-17	*M. longifolia*	60	24	40.00
	2016-17	*S. robusta*	410	410	100.00
	2017 18	*S. robusta*	202	174	86.14
	2018-19	*S. oleosa*	1	1	100.00
	2018-19	*M. indica*	5	2	40.00
	2018-19	*M. longifolia*	58	11	18.97
	2018-19	*S. robusta*	592	507	85.64
	2019-20	*M. longifolia*	18	16	88.89
	2019-20	*S. robusta*	109	79	72.48
(15) Parsa Village Basdi Para	2015-16	*M. indica*	1	1	100.00
	2015-16	*M. longifolia*	1		
	2015-16	*S. robusta*	227	227	100.00
(16) View Point	2015-16	*S. robusta*	25	25	100.00
Total			**8177**	**6291**	**76.94**
Sources: as per the PEKB Coal Mine Records					

9.5 EFFICACY ASSESSMENT OF TRANSLOCATED TREES BY ICFRE

9.5.1 Factors Affecting Transplanted Trees

Translocated trees are reported to have numerous stresses (Davis *et al.*, 1972; Kozolowski and Davis, 1975; McKay, 1996; Watson and Himelick, 1997; Gilbertson and Bradshaw, 1985, Watson, 1985; Nowak *et al.*, 2004; Beeson and Gilman, 1992; Andrew and Ryan, 2009; Heidi *et al.*, 2019). Trees suffer "translocation shock" due to improper translocation or maintenance, and recovery is hindered. Under stressful conditions, aggravated with insect pests and diseases, plants are unable to recover, continue to decline, and eventually die. If care is taken to minimize stress through proper translocation techniques and maintenance, plants are likely to recover rapidly and become well-established in their new sites.

Generally, woody plants may take as long as 3 to 5 years to establish in their new locations and to recover from translocation shocks/stresses. Visible leaf and shoot emergence are not indicators of plant establishment but considered established when the primary roots expand into native surrounding soil, branch out, and produce sufficient feeder roots on their tips. And therefore, the tree handling, transport, re-plantation and after care have an impact on the establishment, survival and regeneration of the trees translocation. The translocated trees fails to regenerate new, healthy root or fail to establish (Struve, 2009) in the new sites due to one or more factors such as:

- Symptoms due to translocation
- Causes due to translocation shock
- Undesirable growing site
- Poor translocation techniques
- Poor follow-up practices

In addition, the environmental conditions of the new sites also have a strong influence on the functional characteristics of plants and consequently on their performance (van den Driessche, 1991; Villar-Salvador *et al.*, 2004). Defining success remains problematic, especially for long-lived species, and each translocation will have its own success criteria based on relevant objectives (Monks *et al.*, 2012; Reiter *et al.*, 2016). Given that, the present evaluation to assess the efficacy of the translocated trees was conducted considering the above factors.

9.6 APPROACH AND METHODOLOGY

9.6.1 Approach

The translocation made by PEKB coal mine authority in 16 different sites has not been maintained or documented any cause and symptoms during digging, transport, planting and after care for the translocation trees after planting for the following symptoms:

- Symptoms due to translocation.

- Causes due to transplant shock.
- Causes due to undesirable growing site/climate, after care; except for the soft Murrom.
- No documentation on health and performance of the transplanted trees is available or made in the PEKB mine.

In order to assess the efficacy, the ICFRE selected the two-tree species that were translocated from natural forest block in large number that are indigenous species used to restore the degraded land. The above-mentioned symptoms are very important parameters to assess the efficacy of the translocated trees and also asses the duration taken for gestation. However, the present study on the efficacy assessment confined to tree species, diameter at breast height (DBH); height of the tree and overall health condition of the tree due to lack of systematic data on the cause and symptom monitoring by PEKB. The ICFRE team had an interactive meeting with the mine officials of PEKB coal mine block and collected details of translocations, species translocated and year of plantation, number of trees planted, survival and their maintenance.

9.6.2 Methodology

9.6.2.1 Collection of Data on Tree Height (m) and Girth (DBH) (cm)

The team visited the 16 different tree translocation sites in PEKB coal mine block during February and October, 2020. A reconnaissance survey was made and collected relevant documents and records for desk review during February, 2020. Individual translocation sites were visited and GPS locations of the sites were noted for mapping. The Height (m) and Girth (DBH) (cm) of translocation trees (Sal and Mahua) in all the 16 different locations were measured using Haga Altimeter and Vernier-Calliper/ Graduated Measuring Tape respectively.

9.6.2.2 Estimation of Survival Percentage

Survival of existing number of translocated trees of Sal and Mahua survived from 16 different translocation sites in PEKB coal mine block were recorded. Percentage survival of Sal and Mahua trees was calculated by adopting the following formula:

$$\% \text{ Survival} = \frac{\text{No. of trees survived}}{\text{Total number of trees planted}} \text{ X } 100$$

9.6.2.3 Health Status of the Translocated Tree

The translocated trees in all the sites were assessed/evaluated for their health status. The overall condition ratings assigned to trees were Good, Fair, Poor, Dead/ Absent (Table 9.2). Condition ratings were used to calculate the survival rates and identify trees.

Table 9.2: Explanation of overall condition ratings used in the translocated trees re-inventories protocol

S.No.	Rating	Explanation
1	Good	Full canopy, minimal to no mechanical damage to trunk, no branch dieback, or no stunted growth.
2	Fair	Thinned canopy, new growth in medium to low, tree may be stunted, significant mechanical damage to trunk (new or old); insect/disease is visibly affecting the tree, premature fall and coloring on foliage.
3	Poor	Tree is declining, visible dead branches in canopy, significant dieback of other branches in inner and outer canopy, severe mechanical damage to trunk usually including decay from damage, new foliage is small, stunted or minimum amount of new growth, needs priority pruning of dead wood
4	Dead/ Absent	Standing dead tree, no signs of life with new foliage, bark beginning to peel. No tree present, not even a stump remains visible in the location where the tree should have been; this category to the replaced tree (are the incorrect species, much smaller than they should be given the planting date, etc.) and there is no evidence of the original tree.
		http://www.fao.org/3/a-y5041e.pdf

9.6.2.4 Efficacy of transplanted trees regeneration

The ICFRE defined success criteria of the translocated tree species *viz.*, Sal and Mahua as:

- Short-term (% of plants that survived first year and % of healthy trees and site secure).
- Medium-term (sufficient plants established to be considered a viable number for a population, evidence of flowering and/or fruit set, disease free population and site secure) and - The timeframes required for plants to set seed and recruit are dependent upon species life history and prevailing site conditions.
- Long-term (self-sustaining population established, with recruitment into the translocated population and dynamics comparable to natural populations).

9.7 SITE WISE SURVIVAL RATE OF THE TRANSLOCATED TREES

The ICFRE team visited PEKB coal mine lease area during October, 2020 and inspected the 16 tree transplanted sites covering safety zone, dump areas and other reclamation sites. Details of location-wise number of trees translocated and survival of the translocated Sal and Mahua trees in the PEKB coal mine lease area are given in Table 9.3; girth and height measurements of Sal (Tables 9.4-9.5 & Figures 9.1-9.2 respectively) and Mahua in the 16 different translocated sites are given in Tables 9.6 – 9.7 & Figures 9.3-9.4 respectively (Plate 9.4).

Table 9.3: Survival of the translocated Sal and Mahua trees at various sites in the PEKB Coal Mine Lease Area

Sl. No.	Location	Area (m^2) under tree translocation	Tree species planted	Total No. of trees Planted as per records of the mine management	Total No. of trees observed surviving as on October 2020	Survival %
1	Check Post Safety Zone	18512	*S. robusta*	2601	783	30.10
			M. longifolia	265	119	44.91
2	Front of Mahua Dev Dump	19462	*S. robusta*	490	197	40.20
			M. longifolia	215	85	39.53
3	New View Point	9977	*S. robusta*	1313	327	24.90
			M. longifolia	136	12	8.82
4	New Nursery Road	*	*S. robusta*	40	17	42.50
5	New Nursery Dump	1800	*S. robusta*	200	86	43.00
			M. longifolia	Nil	6	Nil
6	CHP Dump Area	850	*S. robusta*	67	8	11.94
			M. longifolia	36	4	11.11
7	CHP Main Washery	540	*S. robusta*	173	33	19.08
			M. longifolia	7	7	100.00
8	Dispatch Road	*	*S. robusta*	196	108	55.10
			M. longifolia	60	1	1.67
9	Dispatch Road Area Dump	1683	*S. robusta*	187	31	16.58
			M. longifolia	Nil	16	Nil
10	KJS Filling Point	4618	*S. robusta*	500	237	47.40
11	Parsa Village - Busdi Para	6132	*S. robusta*	227	118	51.98
			M. longifolia	1	0	0.00
12	View Point	--	*S. robusta*	25	6	24.00
13	Check Post	6495	*S. robusta*	69	29	42.03
14	Baigapara Pond	3258	*S. robusta*	114	48	42.11
15	Baigapara Dump	2099	*S. robusta*	346	49	14.16
			M. longifolia	120	2	1.67
16	Baigapara Road	3258	*S. robusta*	173	6	3.47
			M. longifolia	326	0	0.00
Total		**78684**	***S. robusta***	**6721**	**2083**	**30.99**
			M. longifolia	**1166**	**252**	**21.61**

***&--Area not available** **ICFRE – enumeration/observation during October, 2020**

Table 9.4: Girth class of translocated Sal trees at various locations within the PEKB coal mine lease area

Sl. No.	Location	Girth (cm) of Translocated Sal Trees			
		Min.	Max.	Mean	Std. Dev.
1	Check post Safety Zone	24	63	43.74	7.01
2	Front of Mahua Dev Dump	23	42	32.39	4.87
3	New View Point	17	42	26.71	6.71
4	New Nursery Road	**11**	34	19.65	6.51
5	New Nursery Dump	19	46	30.27	4.79
6	CHP Dump Area	13	25	18.75	4.27
7	CHP Main Washery	13	47	22.41	6.98
8	Dispatch Road	16	42	27.86	5.50
9	Dispatch Road Area Dump	13	39	25.25	5.79
10	KJS Filling Point	12	54	29.22	8.29
11	Parsa Village Busdi Para	41	**67**	51.30	7.19
12	View Point	26	33	28.33	2.50
13	Check Post	12	32	23.86	5.16
14	Baigapara Pond	15	49	28.85	7.43
15	Baigapara Dump	16	47	23.92	6.01
16	Baigapara Road	18	25	21.33	2.80
Total				**30.22**	**9.72**
ICFRE- recorded during October, 2020					

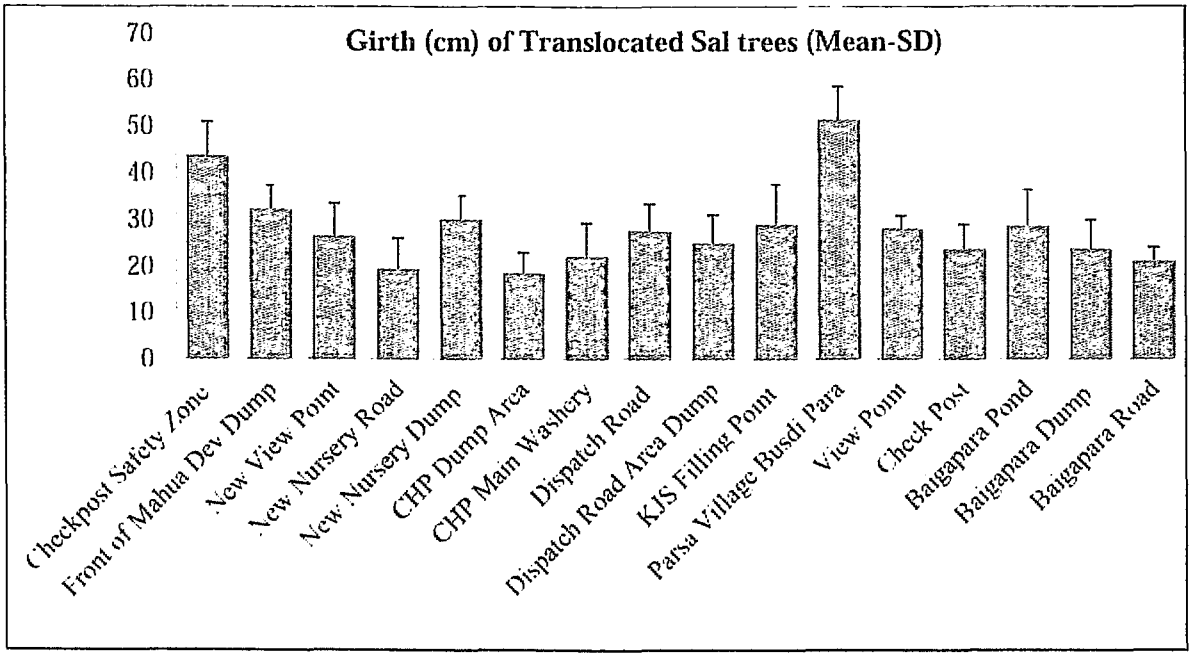


Figure 9.1: Girth class of translocated Sal trees at various locations within the PEKB coal mine lease area

9.7.1 Survival of Sal and Mahua Trees

Among 16 translocation sites surveyed, the survival percentage of Sal trees varied from 3.47% to 55.1% and Mahua trees from 1.67% to 44.91%. The mean survival percentage of Sal tree is 39.99% and Mahua is 21.61% (Table 9.3).

9.7.2 Girth and Height measurement of Sal trees in 16 different translocated sites

Among 16 translocation sites surveyed, the girth (cm) of Sal trees was varied from 11.0 cm to 67.0 cm and the mean girth is 30.22 cm (Table 9.4 and Figure 9.1), while height (m) of Sal trees was varied from 1.68 m to 9.75 m and mean height is 4.53 m (Table 9.5 and Figure 9.2).

Table 9.5: Height class of translocated Sal trees at various locations within the PEKB coal mine lease area

Sl. No.	Location	Height (m) of Transplanted Sal Trees			
		Min.	Max.	Mean	Std. Dev.
1	Check post Safety Zone	2.74	9.54	7.17	1.27
2	Front of Mahua Dev Dump	1.83	7.13	4.42	1.27
3	New View Point	**1.68**	6.40	3.94	1.25
4	New Nursery Road	1.68	4.88	3.18	0.99
5	New Nursery Dump	3.84	8.17	5.58	0.93
6	CHP Dump Area	2.59	3.84	3.17	0.49
7	CHP Main Washery	1.83	5.18	3.01	0.87
8	Dispatch Road	2.13	5.97	4.17	0.92
9	Dispatch Road Area Dump	1.98	4.82	3.43	0.76
10	KJS Filling Point	2.13	5.43	3.62	0.92
11	Parsa Village - Busdi Para	5.79	**9.75**	7.43	1.02
12	View Point	2.29	4.33	3.65	0.79
13	Check Post	2.44	6.22	3.85	1.11
14	Baigapara Pond	1.83	6.28	3.67	1.02
15	Baigapara Dump	2.07	5.30	3.05	0.79
16	Baigapara Road	1.95	3.05	2.46	0.40
Total				**4.53**	**1.74**

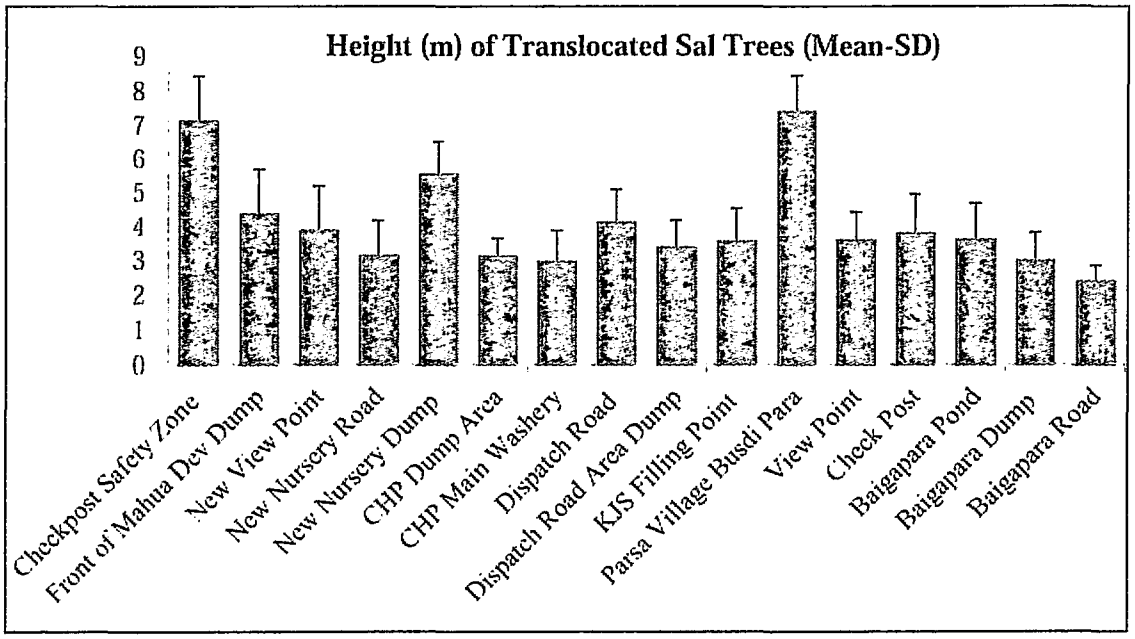


Figure 9.2:Height class of translocated Sal trees at various locations within the PEKB coal mine lease area

9.7.3 Girth and Height measurement of Mahua trees in 16 different transplanted sites

Among 16 transplantation sites surveyed, survival of Mahua trees was recorded in 9 sites and the girth (cm) varied from 16.0 cm to 57.0 cm; and the mean girth is 34.59 cm (Table 9.6 and Figure 9.3)and the height (m) varied from 2.13 m to 8.66 m and the mean height is 4.58 m (Table 9.7 and Figure 9.4).

Table 9.6: Girth class of translocated Mahua trees at various locations within the PEKB coal mine lease area

Sl. No.	Location	Girth (cm) of Transplanted Mahua Trees			
		Min.	Max.	Mean	Std. Dev.
1	Check Post Safety Zone	24	57	36.64	8.63
2	Front of Mahua Dev Dump	36	48	44.60	5.27
3	New View Point	24	31	27.50	4.95
4	New Nursery Dump	28	48	39.00	7.54
5	CHP Dump Area	26	37	30.25	4.99
6	CHP Main Washery	19	**57**	32.00	11.76
7	Dispatch Road	**16**	16	16.00	
8	Dispatch Road Area Dump	28	39	34.25	3.00
9	Baigapara Dump	19	21	20.00	1.41
	Total			**34.59**	**8.63**

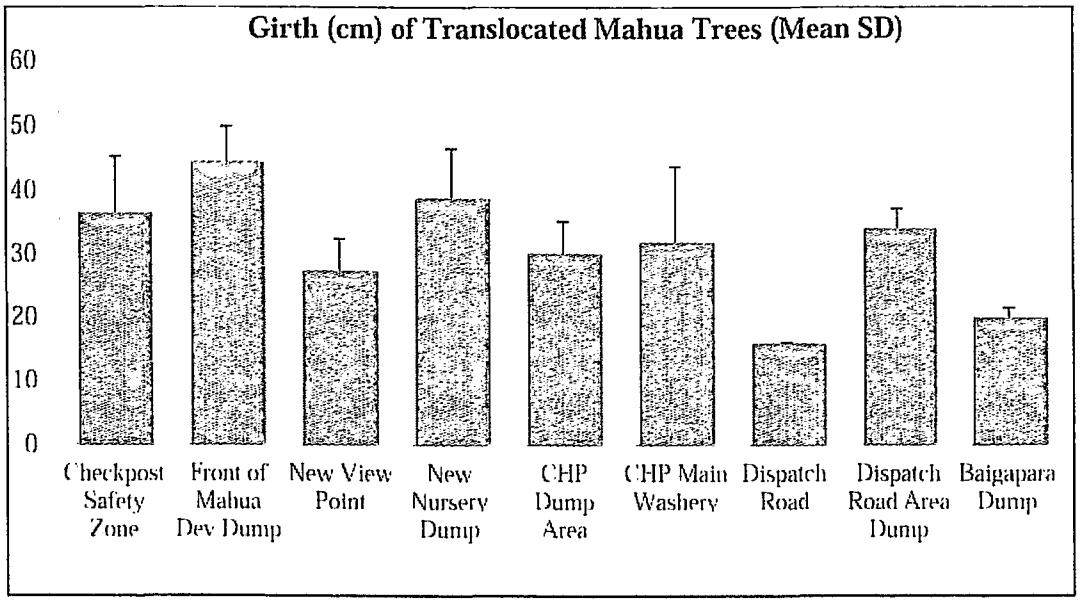


Figure 9.3: Girth class of translocated Mahua trees at various locations within the PEKB coal mine lease area

Table 9.7: Height class of translocated Mahua trees at various locations within the PEKB coal mine lease area

Sl. No.	Location	Height (m) of Transplanted Mahua Trees			
		Min.	Max.	Mean	Std. Dev.
1	Check Post Safety Zone	3.78	6.55	4.86	0.82
2	Front of Mahua Dev Dump	4.94	**8.66**	6.37	1.57
3	New View Point	4.24	5.21	4.73	0.69
4	New Nursery Dump	3.66	8.23	6.04	1.85
5	CHP Dump Area	3.60	4.33	3.99	0.34
6	CHP Main Washery	**2.13**	6.04	3.89	1.26
7	Dispatch Road	**2.13**	2.13	2.13	-
8	Dispatch Road Area Dump	3.23	5.24	4.06	.53
9	Baigapara Dump	2.50	3.17	2.84	0.47
	Total			**4.58**	**1.35**

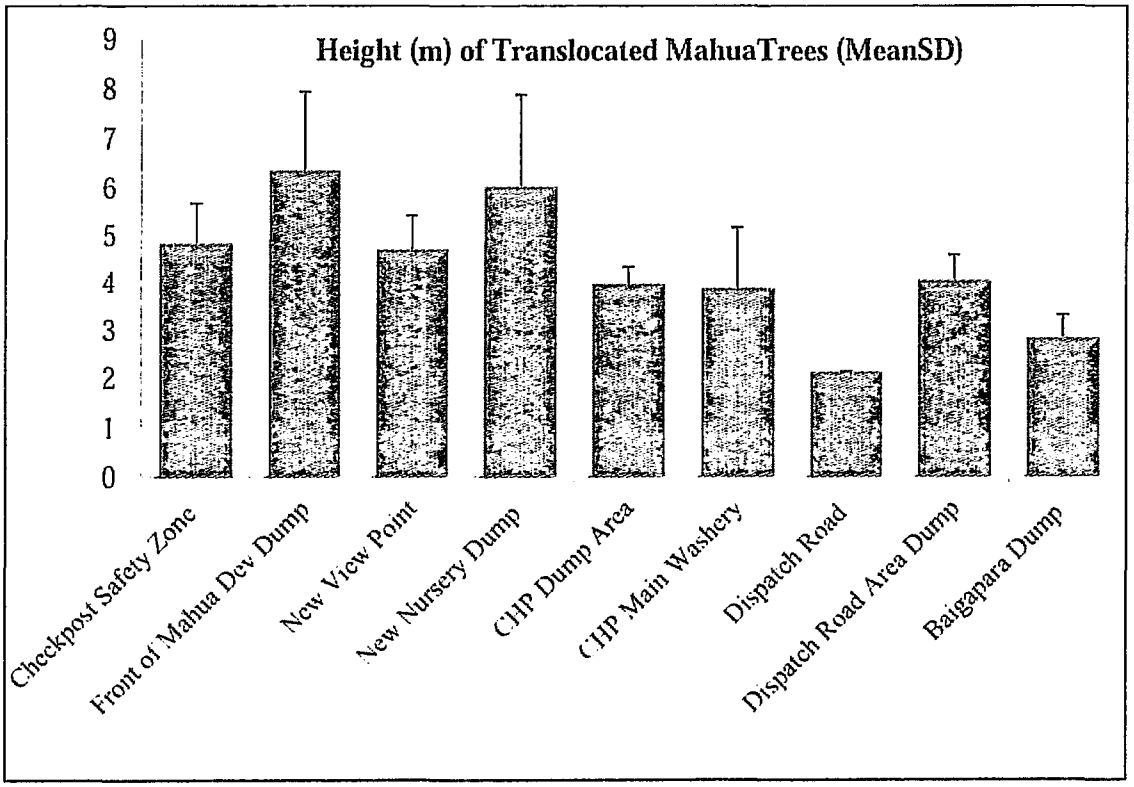


Figure 9.4: Height class of translocated Mahua trees at various locations within the PEKB coal mine lease area

9.8 COMPOSITION OF GROUND FLORA IN TRANSLOCATION SITES

A total of 15 Grass species have been recorded from different transplantation sites during the period of inspection in PEKB coal mine lease area (Table 9.8a).

Among Grass species, *Dicanthium* sp. (11) had more frequency of occurrence followed by *Sporobolus* sp. (10) and *Setaria glauca* (9). Among different transplantation sites, Check Post site had more number of grass species (8), followed

by Baigapara Dump site and Baigapara Road site (7 Nos. each), while site Parsa Village-Busdi Para site had only one species.

A total of 28 Herb species has been recorded from different transplantation sites during the period of inspection in PEKB coal mine lease area (Table 9.8b).

Table 9.8a: Grass species recorded from different Transplantation sites within the PEKB coal mine lease area

Sl. No.	Plant Species - Grass	Tree Translocation sites*														Frequency of occurrence
		1	2	3	6	7	8	9	10	11	12	13	14	15	16	
1	*Apluda mutica*														√	1
2	*Aristida hystrix*										√					1
3	*Aristida setacea.*												√			1
4	*Cenchrus ciliaris*		√	√		√						√	√			5
5	*Cymbopogon* sp.											√				1
6	*Cynodon dactylon*	√			√				√			√	√	√	√	7
7	*Cyperus compressus*					√	√	√			√					4
8	*Dicanthium* sp.	√	√	√	√	√			√		√	√	√	√	√	11
9	*Heteropogon contortus*		√	√										√	√	4
10	*Imeprata cylindrica*		√	√										√	√	4
11	*Paspalidium flavidum*	√				√	√			√		√				5
12	*Pennisetum pedicellatum*		√											√	√	3
13	*Saccharum spontenium*											√				1
14	*Setaria glauca*	√	√		√	√	√		√		√	√		√		9
15	*Sporobolous* sp.	√			√	√	√	√			√	√	√	√	√	10
Total		5	6	4	4	6	4	2	3	1	5	8	5	7	7	
' No vegetation recorded from Transplantation Site Nos. 4 & 5																

Table 9.8b: Herb species recorded from different Translocation sites within the PEKB coal mine lease area

Sl. No.	Plant Species - Herbs	Tree Translocations sites*														Frequency of occurrence
		1	2	3	6	7	8	9	10	11	12	13	14	15	16	
1	*Achyranthes aspera*		√	√	√	√				√		√				6
2	*Ageratum conyzoides*	√	√	√	√	√			√	√	√	√	√	√	√	12
3	*Alternanthera ficoidea*	√	√	√	√	√	√	√		√		√	√			10
4	*Andrographis paniculata*									√						1
5	*Senna tora*	√				√	√						√	√	√	6
6	*Corchorus* sp.	√														1
7	*Crotalaria juncea*		√	√	√	√	√	√			√	√	√	√		10
8	*Curculigo orchioides*		√	√				√			√					4
9	*Desmodium gangeticum*		√	√												2
10	*Desmodium triflorum*	√	√	√	√	√	√	√	√	√	√		√	√	√	13
11	*Elephantopus scaber*										√					1
12	*Euphorbia hirta*		√	√	√	√	√		√	√		√				8
13	*Evolvulus alsinoides*	√			√											2
14	*Hemidesmusindicus*													√		1
15	*Hyptis suaveolens*		√	√								√		√	√	5

Sl. No.	Plant Species - Herbs	Tree Translocations sites*														Frequency of occurrence
		1	2	3	6	7	8	9	10	11	12	13	14	15	16	
16	*Justicia glauca*	√							√			√				3
17	*Launaea nudicaulis*	√		√												2
18	*Phyllanthus amarus*	√	√		√	√	√			√	√	√	√			9
19	*Rungia pectinata*	√	√		√	√										4
20	*Sida acuta*	√		√		√	√									4
21	*Sida cordata*	√	√	√	√	√			√	√	√		√		√	10
22	*Sida rhombifolia*											√			√	2
23	*Stylosanthes hamata*		√	√	√			√			√		√	√	√	8
24	*Spilanthes calva*	√				√		√			√		√	√		6
25	*Tridax procumbens*		√	√	√	√	√	√	√		√	√	√	√	√	11
26	*Triumfetta rhomboidea*	√				√	√			√	√		√	√	√	8
27	*Vernonia cinerea*	√	√	√	√	√	√		√		√	√				9
28	*Xanthium strumarium*	√	√	√	√	√	√			√	√		√	√		10
Total		**16**	**16**	**16**	**14**	**16**	**11**	**7**	**7**	**10**	**13**	**11**	**11**	**11**	**9**	
** No vegetation recorded from Transplantation Site Nos. 4 & 5*																

Among Herb species, *Desmodium triflorum* (13) had more frequency of occurrence followed by *Ageratum conyzoides* (12), *Tridax procumbens* (11) and *Alternanthera ficoidea, Crotalaria juncea, Sida cordata* and *Xanthium strumarium* (10 each). Among different transplantation sites, Check Post Safety Zone site, Front of Mahua Dev Dump site, New View Point site and CHP Main Washery site had more number of herb species (16 each), followed by CHP Dump Area site (14) and View Point site (13), while Dispatch Road Area Dump site and KJS Filling Point had only 7 herb species. A total of 7 Shrub species has been recorded from different translocation sites during the period of inspection in PEKB coal mine lease area (Table 9.8c). Among Shrub species, *Calortropis gigantea, Sida cordifolia* and *Urena lobata* (9 each) had more frequency of occurrence followed by *Phoenix loureirii* (6). Among different translocation sites, Front of Mahua Dev Dump site, New View Point site, CHP Dump Area site and Dispatch Road site had more number of Shrub species (4 each), while KJS Filling Point had only one Shrub species.

Table 9.8c: Shrub species recorded from different Translocation sites within the PEKB coal mine lease area

Sl. No.	Plant Species - Shrubs	Tree Translocations sites *														Frequency of occurrence
		1	2	3	6	7	8	9	10	11	12	13	14	15	16	
1	*Calortropis gigantea*		√	√	√		√		√		√	√	√	√		9
2	*Ichnocarpus frutescens*				√											1
3	*Phoenix loureirii*		√	√		√		√				√			√	6
4	*Pueraria tuberosa*				√											1
5	*Sida cordifolia*	√	√	√		√	√	√		√	√		√			9
6	*Urena lobata*	√			√	√	√			√		√	√	√	√	9
7	*Ventilago maderaspatensis*		√	√			√							√		4
Total		**2**	**4**	**4**	**4**	**3**	**4**	**2**	**1**	**2**	**2**	**3**	**3**	**3**	**2**	
** No vegetation recorded from Transplantation Site Nos. 4 & 5*																

A total of 31 saplings of Tree species have been recorded from different transplantation sites during the period of inspection in PEKB coal mine lease area (Table 9.8d). Among Tree species, *Diospyros melanoxylon* (10) had more frequency of occurrence followed by *Shorea robusta* (8) and *Butea monosperma* & *Holarrhena pubescens* (7 each). Among different transplantation sites, New View Point site had more number of tree saplings (20), followed by Front of Mahua Dev Dump site (19) and Baigapara Dump site (10), while sites such asDispatch Road had no tree species, KJS Filling Point site had only 1 Tree species and CHP Main Washery site & View Point site had only 2 Tree saplings each were recorded.

Table 9.8d: Tree saplings recorded from different Transplantation sites within the PEKB coal mine lease area

Sl. No.	Plant Species - Tree	Tree Translocations sites														Frequency of occurrence
		1	2	3	6	7	8	9	10	11	12	13	14	15	16	
1	*Acacia catechu*													√		1
2	*Ailanthus excelsa*							√								1
3	*Anogeissus latifolia*		√	√								√		√	√	5
4	*Azadirachta indica*		√	√										√		3
5	*Bombax ceiba*		√	√											√	3
6	*Bridelia retusa*			√										√	√	3
7	*Buchanania lanzan*		√									√				2
8	*Butea monosperma*	√	√	√					√			√		√	√	7
9	*Casseria tomentosa*	√														1
10	*Cassia fistula*		√	√												2
11	*Cassine glauca*		√	√										√		3
12	*Catunaregam spinosa*	√		√				√								3
13	*Diospyros melanoxylon*	√	√	√	√			√		√	√		√	√	√	10
14	*Ficus benghalensis*		√	√												2
15	*Ficus racemosa*											√	√			2
16	*Ficus religiosa*												√			1
17	*Gmelina arborea*		√	√												2
18	*Holarrhena pubescens*		√	√	√	√		√				√			√	7
19	*Lagerstroemia parviflora*		√	√						√						3
20	*Leucaena leucocephala*	√											√			2
21	*Madhuca longifolia*				√											1
22	*Oroxylum indicum*											√				1
23	*Pongamia pinnata*	√								√						2
24	*Pterocarpus marsupium*					√										1
25	*Semicarpus anacardium*		√	√	√											3
26	*Shorea robusta*	√	√	√	√			√		√		√		√		8
27	*Syzygium cumini*		√	√							√					3
28	*Terminalia arjuna*		√	√												2
29	*Terminalia bellirica*		√	√												2
30	*Terminalia elliptica*		√	√								√		√		4
31	*Ziziphus mauritina*	√	√	√									√	√	√	6
Total		**8**	**19**	**20**	**5**	**2**	**0**	**5**	**1**	**4**	**2**	**8**	**5**	**10**	**7**	

** No vegetation recorded from Transplantation Site Nos. 4 & 5*

9.9 SUMMARY OF THE GROUND FLORAL VEGETATION COMPOSITION

A total of 81 plant species belong to grasses (15), herbs (28), shrubs (7) and trees (31) recorded from different transplantation sites in PEKB coal mine lease area (Figure 9.5).

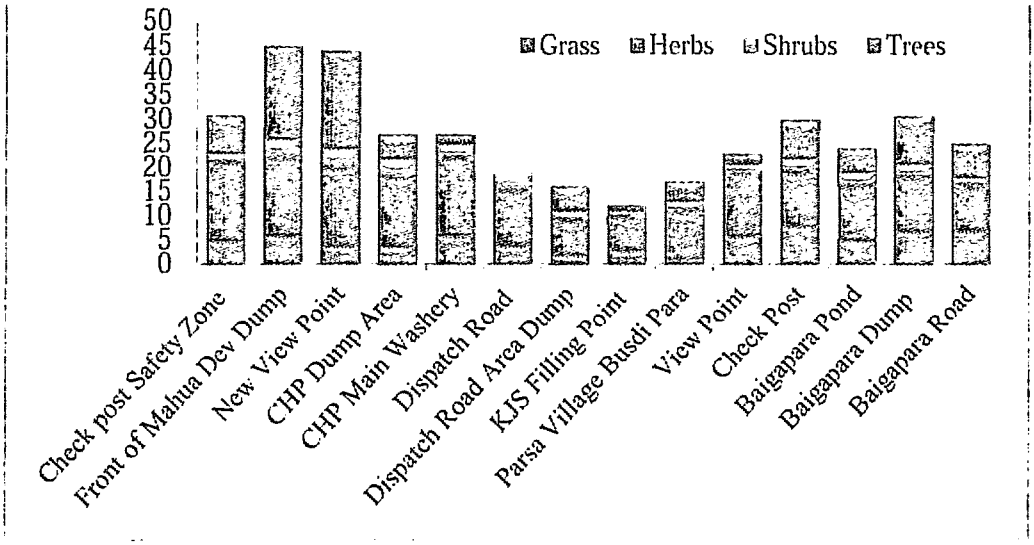


Figure 9.5: Summary of species of ground floral vegetation composition recorded in different transplantation sites within the PEKB coal mine lease area

The Front of Mahua Dev Dump followed by New View Point had more number of natural regeneration of vegetation (45 and 44respectively), while least number of natural vegetation was observed in KJS filling point (12) during the period of investigation. Overall, the entire tree transplanted sites showed regeneration or colonization of herb, shrub and tree species. Of which Front of Mahua dev dump site and New View Point were observed with relatively good regeneration of herb, shrub and tree species in spite of having low survival due to biotic pressure such as weed growth, cattle movement, people's movement /village disturbances, water logging, broken fencing, and sewage water flowing in to the plantation areas.

9.10 HEALTH STATUS OF THE TRANSPLANTED TREES

The probability of achieving desired results is favoured by early identification of the risk factors that might be encountered across all aspects of the translocation (IUCN – SSC, 2013). Risk is assessed as the likelihood of any risk factor occurring, combined with the severity of its impact. The risk due to transplant in the form of symptoms were not monitored or recorded. Therefore, the overall health condition of trees was assessed through physical visual observation for good, fair, poor, and dead or absent (Table 9.2). Data on percentage of health trees with the total number of translocated trees (different rating) in 16 different sites of PEKB coal mine lease area is given in Table 9.9 and Figure 9.6 (Plate 9.5-9.6). It was found that maximum per cent of Good trees recorded in Check Post site (28.99%) and this is followed by New Nursery Dump site (22.5%) and Dispatch Road site (21.48%) and minimum per cent of good trees recorded in Baigapara Road site (0.4%) and New View Point site (4.9%).

Table 9.9: Percentage of total number of translocated trees based on the health status rating at different transplanted sites within the PEKB coal mine lease area

Sl. No.	Locations	% total of trees under different rating			
		Good	Fair	Poor	Dead/Absent
1	Check Post Safety Zone	13.71	0.84	0.42	85.03
2	Front of Mahua Dev Dump	10.07	1.84	5.39	82.70
3	New View Point	4.90	5.31	2.21	87.58
4	New Nursery Road	12.50	27.50	2.50	57.50
5	New Nursery Dump	22.50	16.00	0.00	61.50
6	CHP Dump Area	8.74	2.91	0.00	88.35
7	CHP Main Washery	20.56	7.78	4.44	67.22
8	Dispatch Road	21.48	18.75	2.34	57.42
9	Dispatch Road Area Dump	9.63	14.97	1.07	74.33
10	KJS Filling Point	14.40	24.00	9.00	52.60
11	Parsa Village - Busti Para	9.65	0.44	0.00	89.91
12	View Point	20.00	4.00	0.00	76.00
13	Check Post	28.99	7.25	5.80	57.97
14	Baigapara Pond	17.54	18.42	6.14	57.89
15	Baigapara Dump	7.30	3.43	0.21	89.06
16	Baigapara Road	0.40	0.60	0.20	98.80
Total		**11.14**	**5.29**	**1.99**	**81.58**

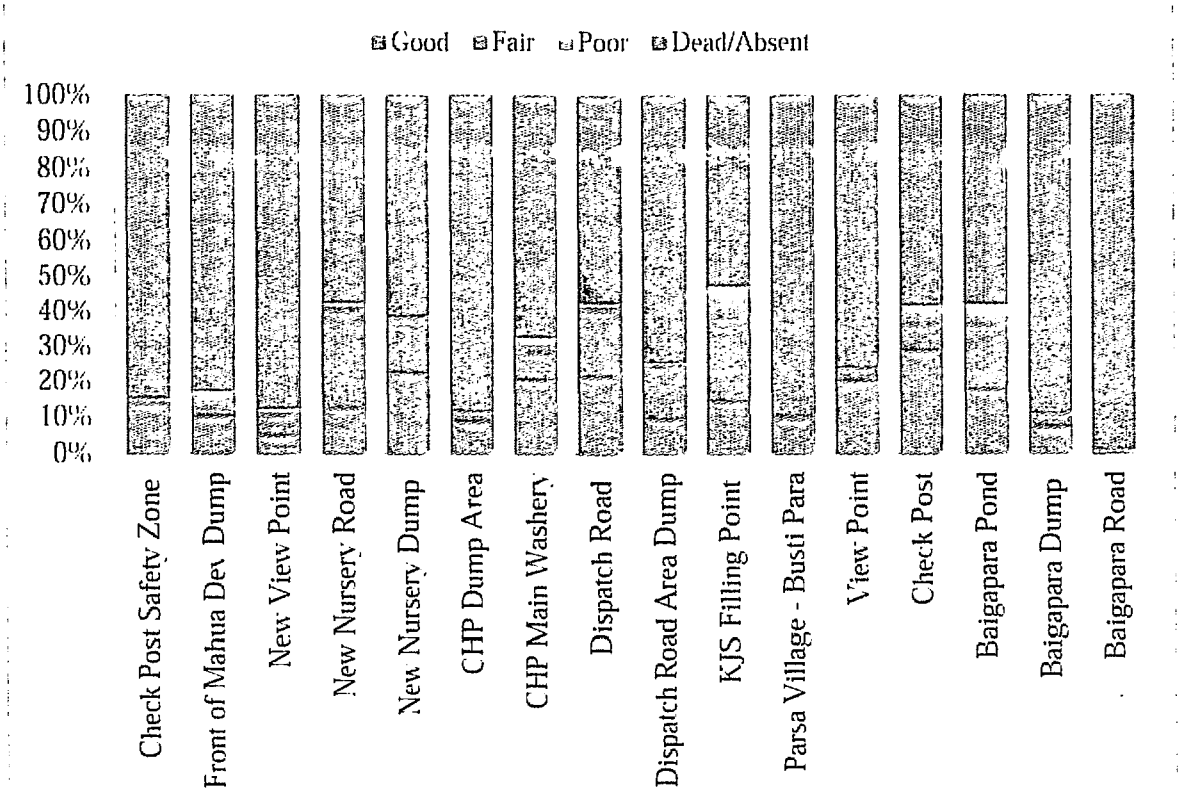


Figure 9.6: Data on percentage of total number of transplanted trees (based on rating) in 16 different sites of PEKB Coal Mine Lease Area

The maximum per cent of Fair trees was recorded in New Nursery Road site (27.5%) followed by KJS Filling Point site (24.0%) and Dispatch Road site (18.75%) & Baigapara Pond site (18.42%). The minimum percent of Fair trees was recorded in Parsa Village-Busti Para site (0.44%), Baigapara Road site (0.60%) and Check Post Safety Zone site (0.84%) and Front of Mahua Dev Dump site (1.84%).

The maximum percent of Poor trees was recorded in KFS Filling Point (9.0 %) followed by Baigapara Pond site (6.14%), Check Post site (5.80%), Front of Mahua Dev Dump site (5.39%). The minimum percent of Poor trees was recorded in Baigapara Road site (0.20%) and Baigapara Dump site (0.21%).

The maximum percent of Dead/Absent trees was recorded in Baigapara Road site (98.8%) followed by Parsa Village-Busti Para site (89.91%) and Baigapara Dump site (89.06%). The minimum percent of Dead/Absent trees was recorded in KJS Filling Point site (52.6%) followed by New Nursery Road site (57.5%) and Dispatch Road site (57.42%) and

9.11 EFFICACY OF REGENERATION OF THE TREES *vis-a-vis* THE GESTATION PERIOD FOR REGENERATION OF THE FLORA

Sal tree (*Shorea robusta*), is native to the Indian subcontinent, an evergreen tree growing up to 50 m in height with a cylindrical bole that can be un-branched for up to 25 m and up to 200 cm in diameter. Younger tree has an elongated crown but as the tree grows older, the crown becomes more rounded. It is moderate to slow growing, evergreen in wetter areas and dry-season deciduous in drier areas. The bark is rough and reddish brown. Young trees grow quickly, developing a long taproot at a very young age and attaining top height of up to 6 metres after 6 years (Rautiainen and Suoheimo, 1997).Fruit and seed bearing begin around the age of 15 years, the tree then bears fruit regularly every 2 years or so, and a good seed-bearing year can be expected every 3 - 5 years.

In PEKB, the trees translocated were reported to be within the girth class of 20-60cm because >60 cm shall be clear felled before mining operations are initiated. Therefore, tree below 60 cm girth class as suggested by the SFD has been translocated. Documentation on the girth class for the trees translocated has not been made available to assess either for girth or age efficacy of the tree transplanted in the PEKB mine block. The translocation of trees has been carried out from 2012 to 2020. Considering the non- availability specific criteria or data to assess the efficacy of regeneration of these trees transplanted, ICFRE adopted the criteria of short, medium- and long-term growth parameters as outlined below:

9.11.1 Efficacy of Regeneration

Generally, Sal takes 15 years to set flower and seed in its natural condition. The time required for the transplanted trees to set seed and recruit is dependent upon age of the tree and prevailing site conditions.

- None of the trees was observed to show evidence of flowering and / or fruit setting. As majority of the trees tanslocated were found unhealthy, dead or absent except In Front of Mahua Dev Dumpsite where recruitment of new copies was observed from base of the dead stump and regeneration of new seedlings. The colonization could be due the reason that the soil from the parent site might have had seed bank of those local species.
- There is possibility regeneration of the local species, provided the top soil from mining areas is scientifically preserved and utilized for restoration purpose which has good seed bank of local/native grasses, herbs, shrubs and tree species and soil microorganisms such as VAM fungi, PGPR, etc.
- Long term systematic and scientific approach or standard of practice since beginning of the translocation are required to arrive at the desired findings as the species selected are long gestation tress.

9.12 OBSERVATIONS AND RECOMMENDATIONS

9.12.1 Observations

1. The PEKB coal mine authorities have complied with the FC condition and translocated Sal trees and few other multipurpose tree species from forest blocks within mine lease in various sites in consultation with the State Forest Department (SFD). A total of 8177 trees and 18 different species have been made during2012-2020.

2. The PEKB mine have employed modern technology and a dedicated team to transplant grown up trees with pre-planning and post care of those trees translocated. The overall cost of transplantation has been worked out to be Rs 4,468 per tree excluding cost of technology and maintenance.

3. The cost of nursery for raising the seed-based tree species is Rs. 30/- per seedling of forestry species which includes purchase of seed, potting mixture, infra-structure facilities, raising of seedling, watering and maintenance till transplanting to the field.

4. Due to non-availability of the Standard Operating Procedures (SoP) the mine lessee has followed the State Forest Department (SFD) directions and translocated trees having girth class of 20-60 cm indigenous (Sal and Mahua trees) and other tree species having aesthetic& economic values, site identification for translocation, pre-planning, post care for translocated trees and gap filling to replace dead trees.

5. The translocated trees have been planted at random, no document to monitor the girth class or site or systematic translocation symptoms due to transport/new place and damage during transport monitoring, growth pattern at new place, new foliage growth, death, insect/termite/ disease attack, to assess the efficacy of translocated trees in different sites.

6. Translocation sites were within the PEKB mine lease area. Used *Trans-Planter Model-100d* machine for uprooting, transport and planting along with adequate manpower and few precautions such as pruning of branch to avoid any damage while transporting, planting of the uprooted trees on the same day, re-planting of the tree in the treated pit with fertilizer, pesticides and fungicides, water at regular intervals, monitor for survival and gap filling for the dead one at few places either with Sal or *Pongamia* (safety zone) or Neem (front of Mahua Dev dump site).

7. Therefore, the team confined the efficacy assessment to survival and health status of the translocated trees in 16 different translocated sites in PEKB coal mine lease area.

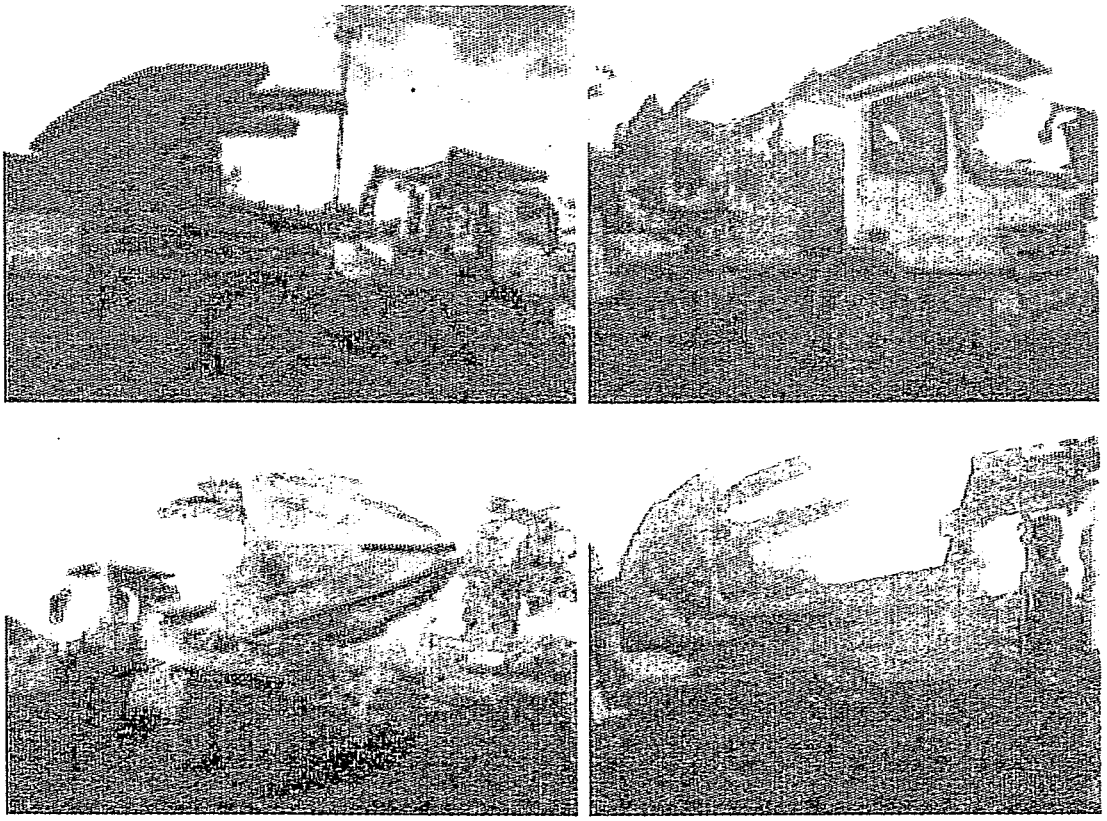


Plate 9.1: A view of the Tree Trans-Planter (Model: *ACTROS 4841*) of PEKB coal block

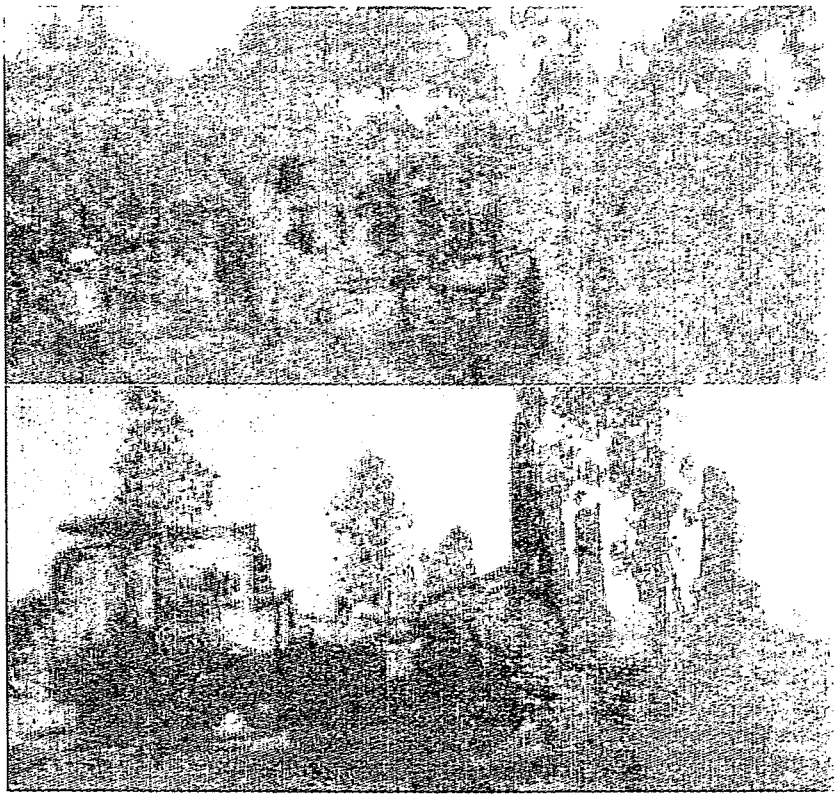
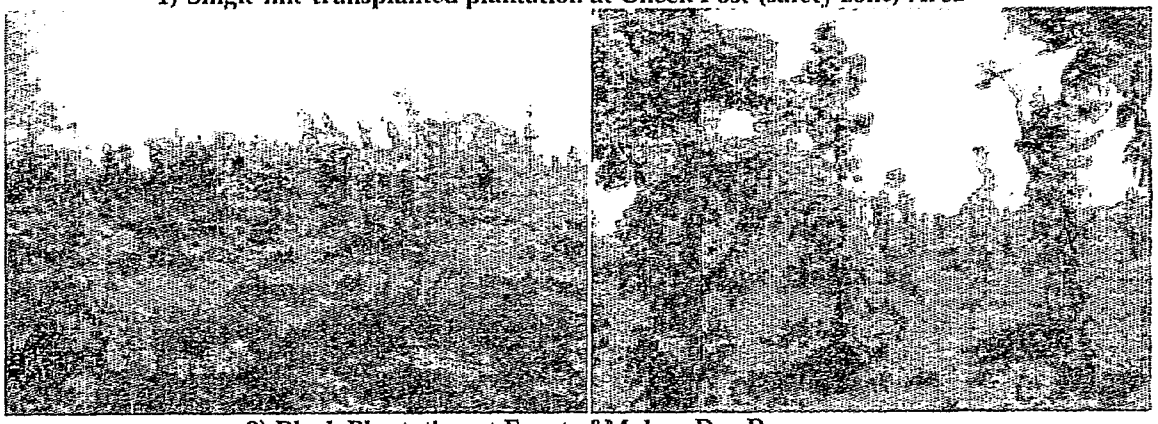


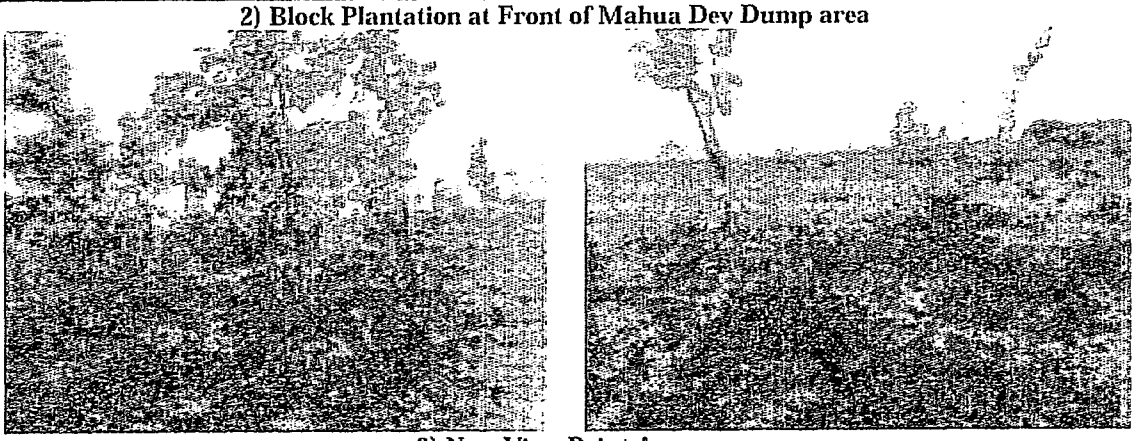
Plate 9.2: The Tree Trans-Planter is being employed for uprooting a tree and transplanting at the desired site in the PEKB coal block



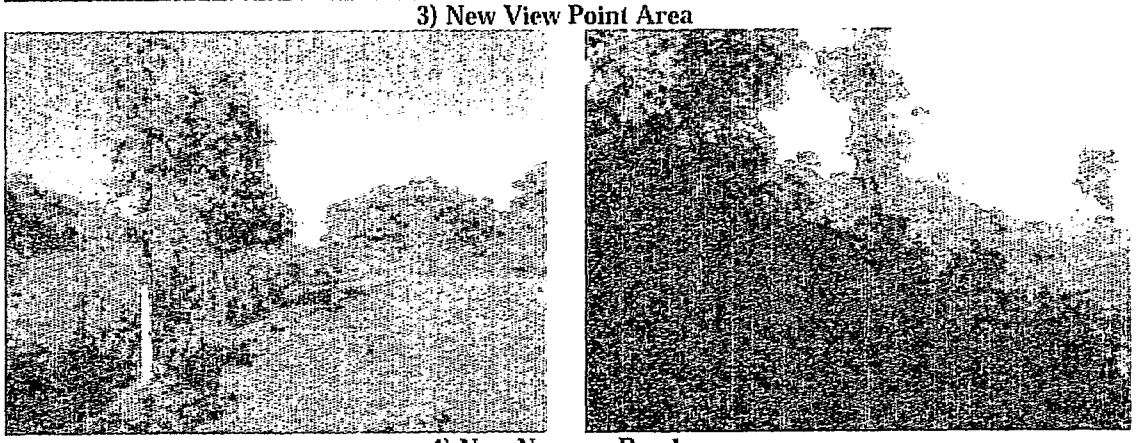
1) Single line transplanted plantation at Check Post (safety zone) Area



2) Block Plantation at Front of Mahua Dev Dump area



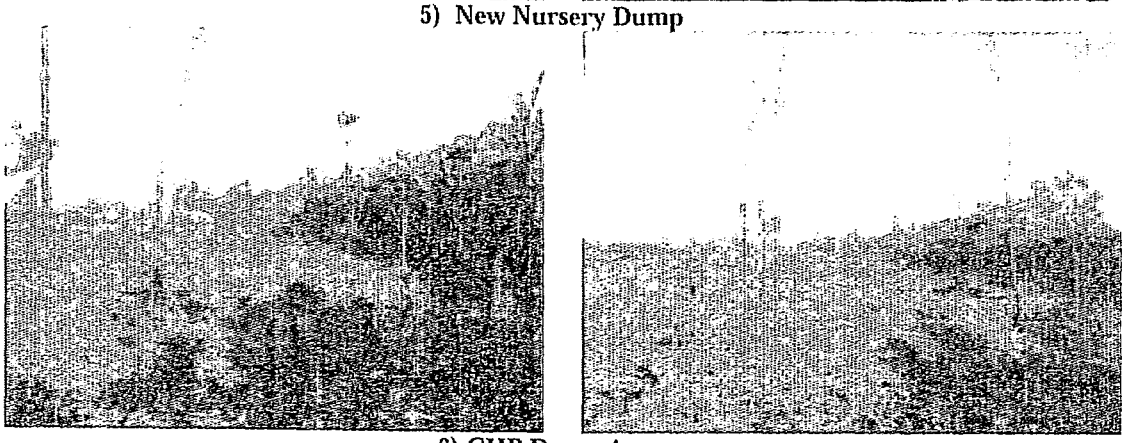
3) New View Point Area



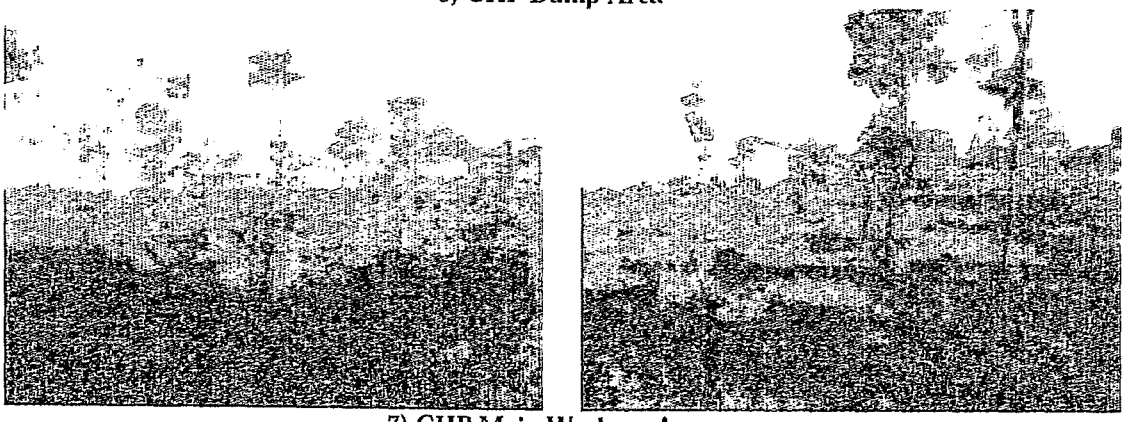
4) New Nursery Road



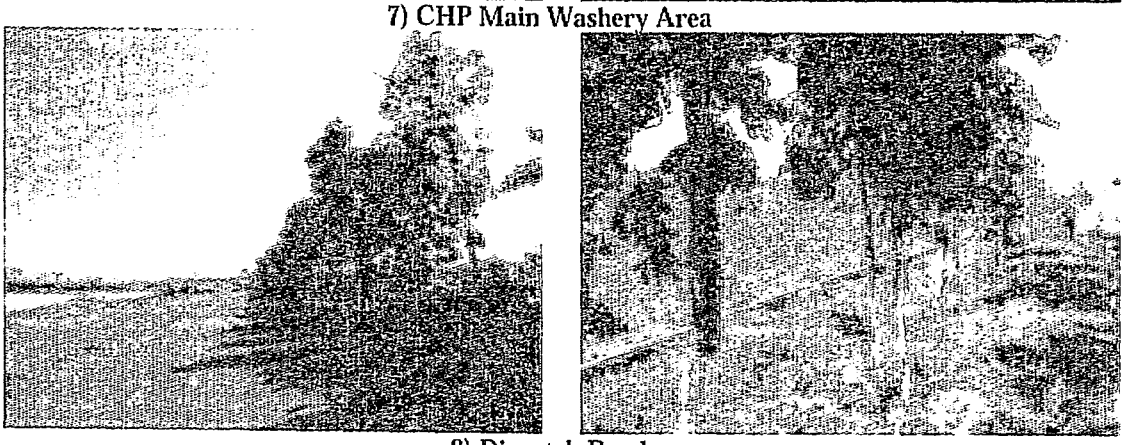
5) New Nursery Dump



6) CHP Dump Area



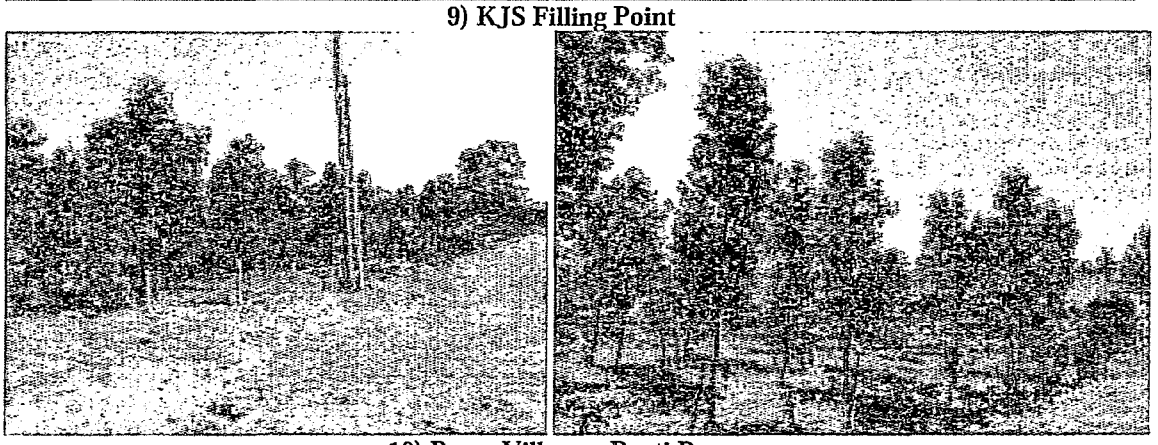
7) CHP Main Washery Area



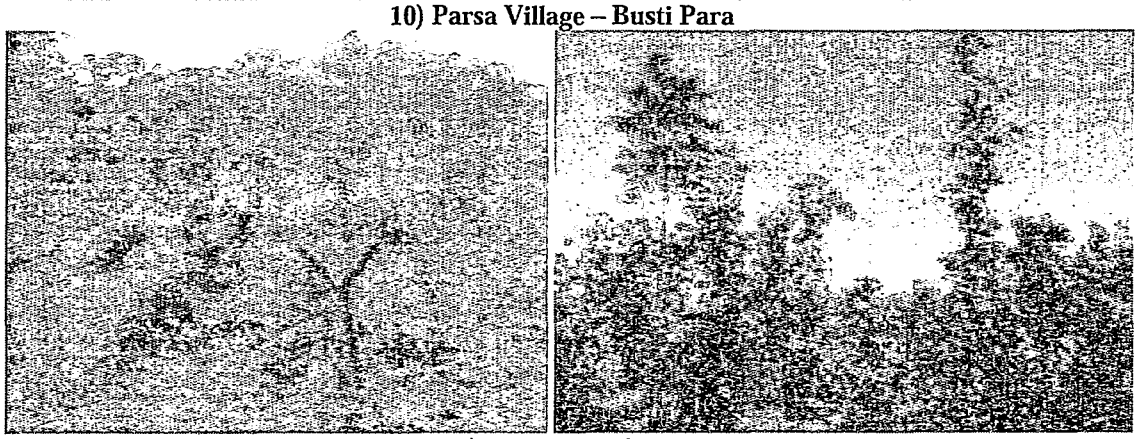
8) Dispatch Road



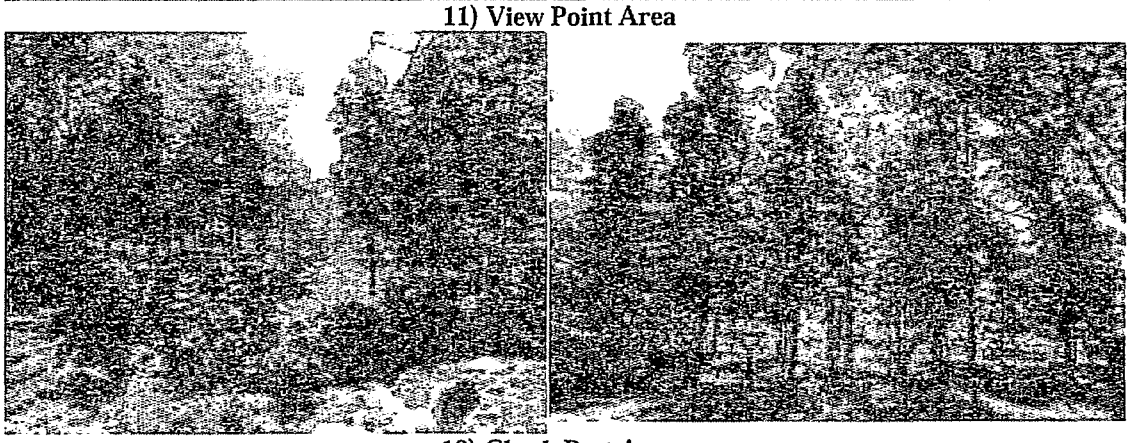
9) KJS Filling Point



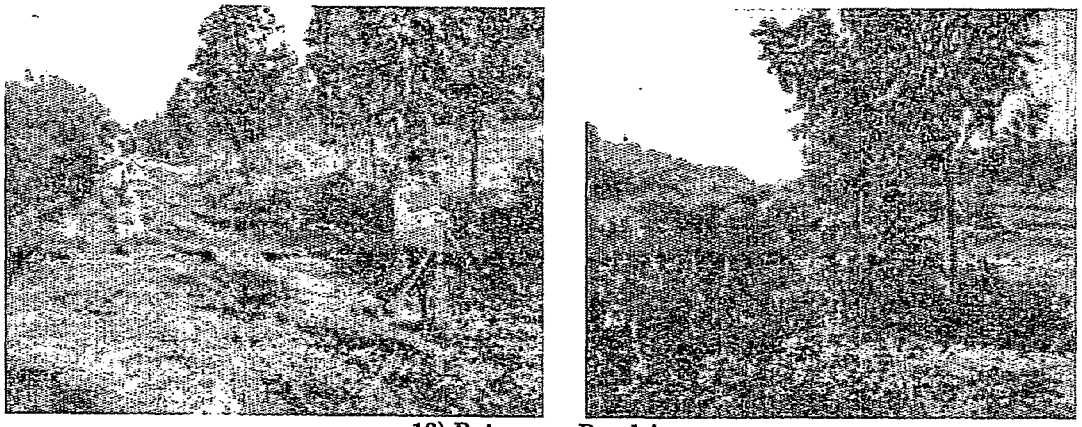
10) Parsa Village – Busti Para



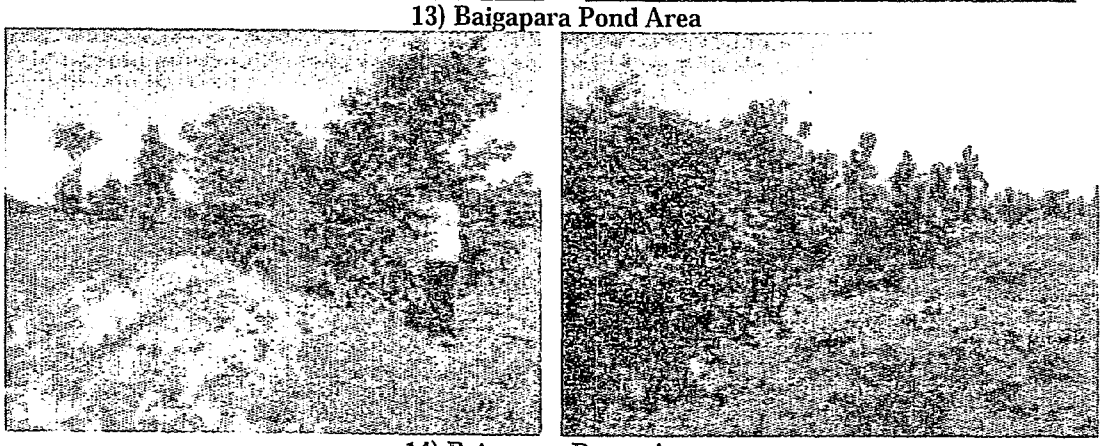
11) View Point Area



12) Check Post Area



13) Baigapara Pond Area



14) Baigapara Dump Area

Plate 9.3: View of the Transplanted Plantation sites in the PEKB Coal Block



Growth data collection from Parsa Village-Busdi Para (Safety Zone) tree transplanted Plantation site in PEKB coal Block



Growth data collection of Tree Transplanted site in KJS filling area in PEKB coal Block

Plates 9.4: Growth data collection and visual assessment of mortality by counting the dead trees in the tree transplanted sites in the PEKB Coal Block



A view of Trees transplanted site with profuse natural growth of weedy plants



A tree transplanted site with profuse weed growth and significant mortality of the trees

Plate 9.5: View of Heavy Weed Growth, Termite mounds and Mortality of Trees in Plantation at Dump Areas in PEKB Coal Block



Plate 9.6: View of top dying and coppicing as well as regeneration of associated species from the Sal tree transplanted location in PEKB Coal Block

IN THE HON'BLE NATIONAL GREEN TRIBUNAL

PRINCIPAL BENCH

AT NEW DELHI

ORIGINAL APPLICATION NO. 59 OF 2024

IN THE MATTER OF: -

HASDEO ARRAND BACHAO SANGHRSH SAMITI ... INTERVENOR

Versus

In the Suo motu matter of-

NEWS ITEM TITLED "DEFORESTATION FOR MINING RESUMES IN HASDEO LOCALS ACTIVISTS ALLEGE DETETION''APPEARING IN THE HINDU DATED 22.12.2023

Next Date 03.07.2024

VOLUME -1 (Part-04)

SI. NO	PATICULARS	PAGE NO
1.	**ANNEXURE A– 2** Copy Of the Bio- Diversity Assessments Study Executive Report prepared by ICFRE in Consultation With Wildlife Institute of India along with main Report.	601- 847

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CHAPTER-10

FINDINGS AND RECOMMENDATIONS

10.1 BACKGROUND OF THE STUDY

The study as per the ToR, comprises of biodiversity assessment of terrestrial flora, fauna, avi-fauna, aquatic diversity; socio-economic *vis-à-vis* biodiversity values, prepare outline for Biodiversity Conservation Management Plan (BCMP) for Parsa East & Kanta Basan (PEKB). In addition, the study also includes, assessment of efficacy of conservation measures implemented as per the mine closure plan, if any; opinion on the sequential mining *vis-à-vis* progress in mine closure and efficacy of the translocated trees in PEKB coal block (Phase-I) as directed by the Principal Bench, National Green Tribunal (NGT) in its judgment *vide* dated 24th March 2014 (Chapter 1, Annexure 1.3).

The study is of multi-disciplinary in nature and therefore, a team of experts in the fields of taxonomy, forestry, ecology, soil science, biodiversity, wildlife, mining, reclamation and rehabilitation, social and environment were involved in primary/secondary data collection upto finalization of the report of their respective domains. All the aspects of the study were conducted by the ICFRE, Dehradun, except the faunal/wildlife part, which was conducted by the Wildlife Institute of India (WII), Dehradun. A comprehensive three season baseline study to assess the environment and biodiversity including social survey in HAC region consist of 23 coal blocks that comprises of four coal blocks of Tara, Parsa, PEKB and Kente Extension was carried out by ICFRE commenced from May 2019. Due to COVID-19 pandemic and nationwide lock down, the survey was suspended from March 2020 and resumed from October, 2020 after the unlock. Therefore, baseline data and residual information as per requirement were collected from October 2020 till February 2021. The shape files of all the 23 coal blocks provided by M/s Rajasthan Rajya Vidyut Utpadan Nigam Limited (RVUNL) were considered for the study to maintain uniformity in the data generated.

Profile of the study area (entire HAC) and that of the 23 coal blocks are presented in Chapter 2 and Chapter 3 respectively. Comprehensive baseline data on biodiversity and environment *i.e.*, flora, fauna and aquatic biodiversity and socioeconomic *vis-à-vis* biodiversity values as well as the likely impacts perceived of the activities of on-going/proposed coal blocks are detailed in Chapter-4 to Chapter-7. Evaluation of conservation measures (*w.r.t* to the environmental compliance conditions); efficacy of mine closure plan (coal block for which details are available) and the efficacy of the translocated trees in PEKB coal block (Phase-I) are presented in Chapter-8 and 9 respectively. This Chapter highlights the important findings of the study at various levels to predict the perceived cumulative impacts of the on-going/identified *w.r.t.* mining in the coal blocks and relevant recommendations for the mitigations.

10.2 STUDY AREA HASDEO-ARAND COALFIELD

The entire study area of Hasdeo-Arand Coalfield (HAC 1879.6 sq.km) comprising of 23 coal blocks including Tara (15), Parsa (13), Parsa East & Kanta Basan (PEKB 14) and Kente Extension (12) lies in between 22°56'37.397" to 22°24'18.359" N latitudes and 82°22'41.579" to 83°08'53.875" E longitudes that fall partly in Udaipur tehsil of Surguja district; Premnagar tehsil of Surajpur district; and Poudi Uproda and Korba tehsils of Korba district in Chhattisgarh State. The entire HAC landscape comprises of 649 forest compartments spread over 12 forest ranges in 4 forest divisions *viz.*, Surguja, Katghora, Korba and Surajpur, while the area under 23 coal blocks falls within 230 forest compartments under 5 forest ranges and 4 forest divisions.

10.2.1 Land Use Land Cover Changes

The Land Use Land Cover changes (LULC) were estimated using NRSC-ISRO digital data for the year 2011-12 and 2015-16. The entire HAC (1879.6 sq.km) falls under the LULC class (2015-16) of forests (1526.49 sq.km; 81.20%); agriculture (179.53 sq.km; 9.55%), wastelands (129.45 sq.km; 6.89%); water bodies (29.97 sq.km; 1.59%) and the built-up area (14.33 sq.km; 0.76%).

10.2.2 River and Drainage

The HAC is primarily drained by Hasdeo River, a major tributary of the Mahanadi River, running on the north-south of the HAC; and Rihand River, a tributary of Sone River of Lower River Ganga running on south- north of the HAC. Thus, the area forms one of important watersheds of the Mahanadi River sub-basin. Hasdeo Bango Dam a multipurpose project built across the Hasdeo River is the prominent water harvesting structure falls within the buffer area of HAC region. Several water courses of up to 6^{th} order (*viz.*, Chornai, Atem, *etc.*) leading to the reservoir are originating from the surrounding hillocks where mining is active/proposed to be carried out.

10.2.3 Topography, Climate and Forest

Physio-graphically/Geographically, Chhattisgarh state is divided into three distinct land areas/ zones *viz.*, 1. Chhattisgarh Plains, 2. Bastar Plateau and 3. Northern Hill Zone. The HAC falls under northern hill region that occupies parts of Surguja, Surajpur and northern part of Korba districts.

Topographically, the HAC is highly rugged in the southern part that dissected by deep gorges ranging from 450 m to 550 m above msl. There are two major forest type groups *i.e.*, **Tropical Moist Deciduous Forests and Tropical Dry Deciduous Forests** as per the Champion & Seth classification (1968). The elevation zone of 410-418 m above msl in HAC occupies a maximum of 597.60 km^2 (31.01%) where coal blocks are reported to occur. The study area experiences tropical to semi-tropical climate with three well-defined seasons *i.e.*, summer (March to mid-June), monsoon

(from mid-June to mid-September) and winter (mid-September to February). Considering the Geographic settings and agro-climatic regions;

- The entire northern part of Korba, Surguja and Surajpur falls in Northern hill zone and therefore, the entire HAC shall be grouped under ***single environmental unit.***

10.2.4 Extent of Forest Cover

The extent of forest cover class in entire HAC (1879.6 sq.km) were estimated (FSI 2017 digital format) using GIS and Remote Sensing. The moderate dense forest (1158.04 sq.km) cover class dominates the area, followed by non-forest (351.05 sq.km), open forest (197.57 sq.km), very dense forest (126.72 sq.km), scrub (33.52 sq.km) and water body (12.69 sq.km).

10.2.5 Coal Resources

The coal deposits/resources in India primarily are concentrated in the Gondwana sediments occurring mainly in the eastern and central parts of Peninsular India. The HAC region in Chhattisgarh state has the third highest coal resources (5529 million tons) that accounts for 9% of coal reserves of the state next to Mand-Raigarh and Korba coal fields In HAC, only four coal blocks *viz.*, PEKB, Parsa, Kente Extension and Choita (2A & 2B) are either active in operation (PEKB and Chotia 2A & 2B) or in the process of obtaining statutory clearances (Parsa & Kente Extension). These four-coal blocks put together covers an area of 68.75 sq.km *i.e.,* about 4% of HAC coal bearing area having 1198 million tons of coal resources. The mineable coal reserve from the allotted four coal blocks is 1012.42 MT, of which both PEKB and Chotia contributes to 488.31 MT (48% of the total allotted) of mineable reserve.

10.2.6 Profile of the Coal Blocks

Twenty-three coal blocks in the entire HAC (SFD, Chhattisgarh and CMPDI 2021) were considered for the present study during the period 2019-2021.

Detailed information on exploration, mining and mine closure activities envisaged are available for only 04 blocks *i.e.*, Parsa East & Kanta Basan (PEKB), Parsa, Kente Extension and Chotia (sub blocks 2A & 2B). Five (05) re-allotted coal blocks *i.e.*, Tara, Madanpur (North), Madanpur (South), Paturia and Gidmuri have only geological, mining and mine closure proposals. Limited information was available for 05 identified coal blocks such as Morga-II, Morga-III, Morga-IV, Morga South and Saidu; and no information was available for the remaining nine identified and not allotted coal blocks (Puta Parogia, Parogia, Pindraki, Sarma, Laxmangarh, Bhakurma-Matringa, Kedma, Morga-I and Nakiya).

Table 10.1: Profile of the coal blocks in Hasdeo-Arand Coalfield that fall within Surguja, Surajpur and Korba districts of Chhattisgarh

Sl.No.	Name of Coal Block	Block No	District	Allotment status	Extent in sq.km
Mine lease under various stages of development					
1	Parsa East & Kanta Basan (OC)	14	Surguja	Allotted to M/s Rajasthan Rajya Vidyut Utpadan Nigam Limited	26.828
2	Parsa (OC)	13	Surajpur/Surguja		12.524
3	Kente Extension (OC)	12	Surguja		17.600
4	Chotia 2A & 2B (OC/UG)	02	Korba	Allotted to M/s BALCO (Vedanta Group).	11.798
5	Tara (OC)	15	Surajpur	Not Allotted	24.00
6	Madanpur South (OC)	11	Korba	Not Allotted	7.14
7	Gidmuri (OC/UG)	08	Korba	Not Allotted	7.33
8	Paturia (OC/UG)	09	Korba	Not Allotted	16.14
9	Madanpur North (OC/UG)	10	Korba/ Surajpur	Not Allotted	21.387
10	Morga – II (NA)	04	Korba	Not Allotted	26.64
11	Morga – III (NA)	05	Korba	Not Allotted	6.00
12	Morga – IV (NA)	06	Korba	Not Allotted	6.87
13	Morga South (NA)	07	Korba	Not Allotted	21.92
14	Saidu (NA)	18	Korba /Surguja	Not Allotted	6.72
15	Puta Parogia (NA)	16	Korba /Surguja/Surajpur	Not Allotted	48.04*
16	Parogia#	17	Surguja	Not Allotted	7.15*
17	Pindraki	19	Surguja	Not Allotted	23.94*
18	Mogra-I	03	Korba	Not Allotted	21.19*
19	Sarma#	20	Surguja	Not Allotted	18.15*
20	Laxmangarh#	21	Surguja	Not Allotted	23.63*
21	Bhakurma-Matringa	22	Surguja	Not Allotted	25.99*
22	Kedma#	23	Surguja	Not Allotted	18.93*
23	Nakiya I, II, &III (NA)	01	Korba	Not Allotted	34.29*
				Total extent of area of 23 coal blocks	**434.207**

NA – Not available/not known;
* No document available on extent of mine lease area therefore estimated using shapefiles provided by M/s. RVUNL and GIS/RS; may vary with the actual.
#Kedma, Laxmangarh, Sarma and Parogia are regionally promotionally explored as per CMPDI,2021.

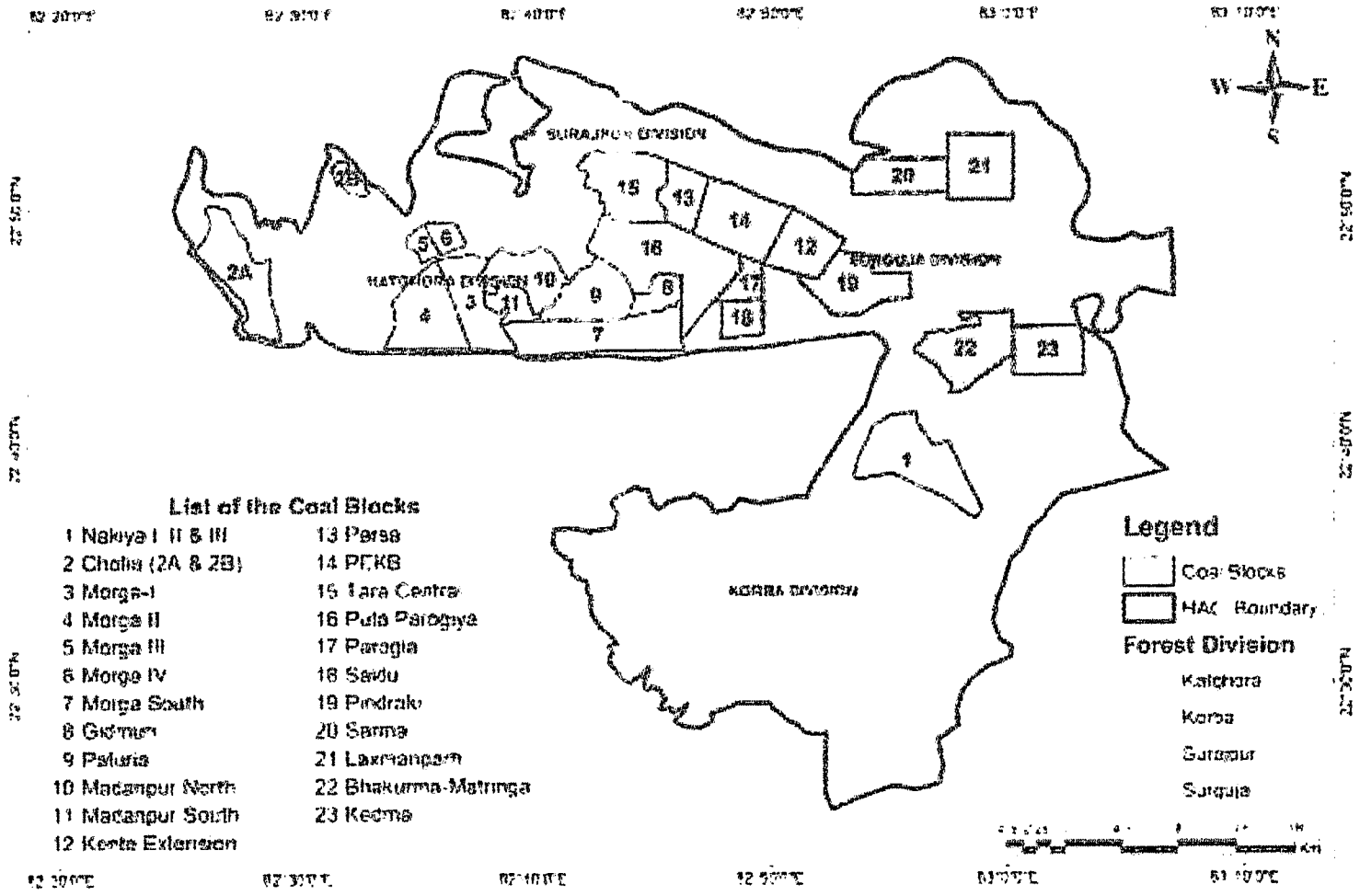


Figure 10.1: Map showing the coal blocks in entire Hasdeo-Arand Coalfield that falls in Surguja, Surajpur, Katghora and Korba Forest Divisions of Chhattisgarh

Further, as per the information received from CMPDI *vide* letter No. DG/CMPDI/Forests/714(A)/2021 dated 05.03.2021, it was intimated the coal blocks namely Parogia, Sarma, Laxmangarh and Kedma are only regionally promotionally explored and are yet to be identified once the boundary area finalized after detailed exploration.

- In summary, there are 23 coal blocks in the entire HAC, of which two are in operation; two are under process of obtaining statutory clearances and the remaining 19 are identified and not allotted (Table 10.1 & Figure 10.1).

10.3 FINDINGS OF THE BIODIVERSITY STUDY IN THE ENTIRE HASDEO-ARAND COALFIELD

The following section highlights the findings on flora, terrestrial fauna (wildlife) and avifauna, aquatic diversity and socio-economic *vis-à-vis* biodiversity values for the entire Hasdeo-Arand Coalfield (HAC) comprising of 23 coal blocks and the impact as outlined in the ToR.

10.3.1 Floral Diversity

The HAC falls primarily under Deccan bio-geographical area, which is characterized by both tropical dry deciduous and tropical moist deciduous forests (Champion & Seth, 1968) with large area under tropical moist deciduous forest group, where the tree canopy is not dense and comprises of few species.

10.3.1.1 Characterization of forest cover and forest types

Characterisation of the entire forest cover class (Figure 10.2) and forest types in HAC and 23 coal blocks were made using FSI (2017) and FSI (2011) digital data respectively.

Table 10.2: The extent of forest cover in the entire Hasdeo-Arand Coalfield that falls in Korba, Surguja and Surajpur districts of Chhattisgarh

Forest Cover Class	Entire HAC Area (Sq.km)	23 coal blocks Area in Sq.km (% of the HAC area)
Water body	12.69	0.66 (5.20%)
Scrub	33.52	11.21 (33.44%)
Very Dense Forest	126.72	69.18 (54.59%)
Open Forest	197.57	52.65 (26.65%)
Non-Forest	351.05	104.16 (29.67%)
Moderate Dense Forest	1158.04	233.40(20.15%)
Total	**1879.58**	**472.13 (25.12%)**
Source: Estimated using 2015 digital format (FSI, 2017)		

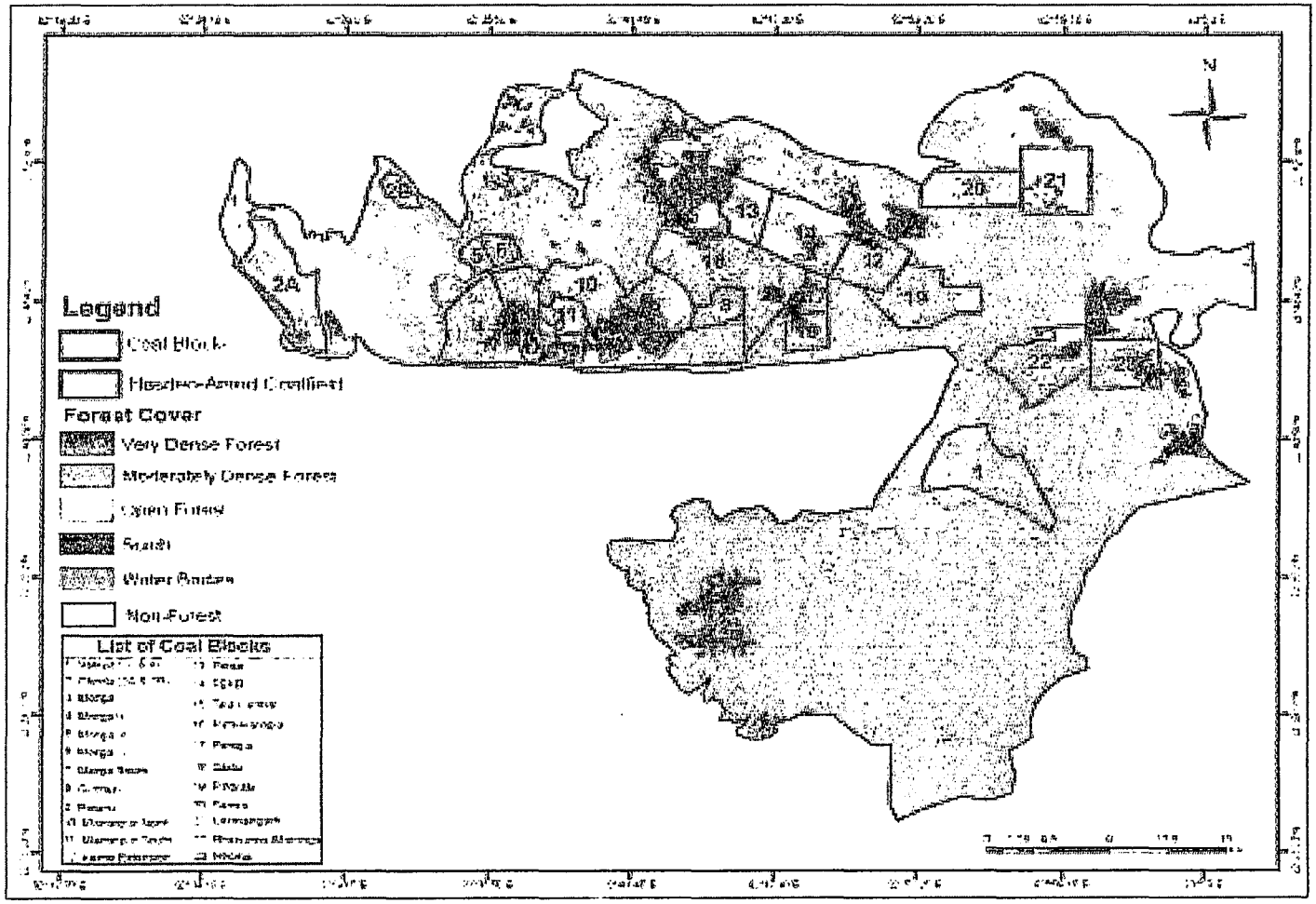


Figure 10.2: Distribution of various forest cover classes within 23 coal blocks in Hasdeo-Arand Coalfield that falls in Surguja, Surajpur and Korba districts of Chhattisgarh

The study area is comprising of six forest cover classes and characterised by of tropical moist deciduous forest group comprises of five forest types (Table 10.2 - 10.3)

Table 10.3: Forest types and their extent of area within Hasdeo-Arand Coalfield that falls within Korba, Surguja and Surajpur districts of Chhattisgarh

Forest Type	Area (sq.km) HAC	23 coal blocks sq.km and % of HAC area
3C/C2e (ii) Moist Peninsular Low-Level Sal Forest	835.61	198.01 (23.70%)
3B/C2 Southern Moist Mixed Deciduous Forest	314.53	105.71 (33.61%)
5B/C1c Dry Peninsular Sal Forest	70.22	16.94 (24.12%)
5/E9 Dry Bamboo Brakes	133.98	7.13 (5.132%)
5B/C2 Northern Dry Mixed Deciduous Forest	46.61	08.82 (18.92%)
Total	**1400.95**	**336.61 (24.03%)**
Non-Forest	464.23	133.79 (25.22%)
Total	**1865.19**	**470.40 (23.70%)**
Plantation/ TOF	0.03	-
Water	14.35	1.69 (11.78%)
Total	**1879.57**	**472.09 (25.12%)**
Source: Estimated using 2011 digital format		

The forest cover observed significant area under moderately dense forests followed by very dense forests. The Moderately Dense forest observed lowest 2.06 sq.km in Morga-III (2.06 sq.km) and highest in Nakiya (21.48 sq.km); and Very Dense forest in 15 coal blocks ranging from 0.04 sq.km in Laxmangarh to 16.88 sq.km in Tara. The relative occupancy area of forest cover and forest type in all the 23 coal blocks comprises of 472.13 sq.km and 336.61 sq.km respectively.

Out of the five-forest types recorded from the study area, two-forest types 3B/C2e(ii) Moist Peninsular low-level Sal forest occupy maximum (192.11 sq.km) in all 23 coal blocks that accounts for 23 % of the entire HAC (835.40 sq.km); followed by 3B/C2 Southern Moist Mixed Deciduous forest (104.38 sq.km) which accounts for 33% of the total forest type in HAC (314.46 sq.km).

The study area top canopy of the Moist Peninsular low-level Sal forest constituted by *Shorea robusta* followed by *Diospyros melanoxylon* and *Madhuca longifolia* among trees; *Phoenix loureiroi*, followed by *Ichnocarpus frutescens* and *Hemidesmus indicus* among shrubs; and *Desmodium triflorum* followed by *Rungia pectinata* and *Justicia quinqueangularis* among herbs.

10.3.1.2 Vegetation Structure and Composition

A total of 640 species belonging to 400 genera, 109 families were recorded from the entire HAC (Table 10.4). The vegetation was dominated by Poaceae family with 72 species followed by Fabaceae (64 species), Rubiaceae (31 species) and Asteraceae (27 species). Thirty-eight families were represented by single species each. Out of the total plant species, 146 species were trees, 363 herbs including grasses and ferns, 66 shrubs, 48 climbing shrubs and 17 woody climbers. Sal was the dominant tree species in the core and buffer areas of entire HAC (Table 10.4).

Table 10.4: Composition of vegetation within Hasdeo-Arand Coalfield comprising of 23 coal blocks that fall within Korba, Surguja and Surajpur districts of Chhattisgarh

Floral Diversity		Resources	
No. of species	640	Medicinal plants	128
No. Genera	400	Timber yielding plants	40
No. families	109	Edible plants	60
No. of Invasive species	9	Fodder plants	65
No. of threatened (RET) species	33	Fuel plants	75
		Commercial	59

The five families namely Poaceae, Fabaceae, Rubiaceae, Asteraceae and Euphorbiaceae are the dominant families.

10.3.1.3 Stand Density

The stand density in the core zone of the four-coal blocks (Figure 10.3 - 10.6) recorded varied greatly due to site quality, climatic conditions and various anthropogenic pressures.

- The stand density of trees in the core zone of four contiguous coal blocks (Tara (15), Parsa (13), PEKB (14) & Kente-Extension (12) was low (424 stems/ha) as compared to the respective buffer zone (535.71 stems /ha). This could be due to selective removal of lower girth-class individuals of all tree species within the core zone; while that of the remaining 19 coal blocks in HAC varied between 599.46 stem/ha and 910.55 stem/ha respectively in the core are buffer zones. The difference between core and buffer zone could be attributed to distribution pattern or occurrence of very dense forest in few coal blocks and moderately dense forest in many coal blocks and fringe forest villages.
- The density of shrubs in general found to be low in buffer of all the 19 coal blocks (1966 stems /ha) and around the four-coal blocks (1217 stem/ha). This is perhaps due to removal of vegetation for NTFP collection such as Mahua flowers, Tendu leaves, fuel wood, etc., in around the forest fringe villages (142 revenue villages in the fringe forests). In addition, frequent spontaneous forest fire used to occur in the area, and also the post monsoon vegetation

survey was made immediately after the forest fire in some of the sampled areas. Comparative account of mean basal area for tree species is presented below:

Locations	Stand density (stems/ ha)	Stand basal Area (m^2/ha)	Mean Basal area/ plant(m^2)
Core of 4 coal blocks	424.0	21.87	0.052
Buffer of 4 coal blocks	535.7	13.98	0.026
Core of other coal blocks	599.5	19.92	0.033
Buffer of other coal blocks	910.6	28.87	0.032

S*horea robusta* was recorded dominant species with highest IVI values in all the four category of sampling locations followed by *Diospyros melanoxylon, Madhuca longifolia* var. *latifolia, Buchanania lanzan, Lagerstroemia parviflora, Terminalia elliptica* and *Anogeissus latifolia.*

- Among shrubs, in general *Phoenix loureirii* was the dominant species common to all blocks and buffer areas followed by *Ichnocarpus frutescens* and *Hemidesmus indicus.*
- Among herbs, *Elephantopus scaber* was the dominant species common to all coal blocks and their buffer areas followed by *Rungia pectinata. Evolvulus nummularius, Sida cordata, Rungia pectinata, Desmodium triflorum* and *Phyllanthus urenaria.* In case of HAC and all identified coal blocks locations S*horea robusta* was found to be dominant tree with highest IVI values (ranging from 87.80 to 120.06). *Diospyros melanoxylon* showed second highest values except in buffer areas of **the four contiguous coal blocks.**
- The diversity of trees and shrubs (represented by *H'*) ranged from 1.87 to 2.68 and from 1.67 to 2.87 respectively indicating that the area is medium diverse. Herbs recorded high diversity i.e., ranged from 3.83 to 4.10. In terms for forest cover **the four contiguous coal blocks** though had moderately dense forest and very dense forest cover (FSI, 2017); In summary, the four contiguous coal blocks including PEKB recorded less plant diversity in both their core and buffer areas (Figure 10.7-10.8). It could be due to the impacts of open cast mining and allied activities being carried out in PEKB (15).

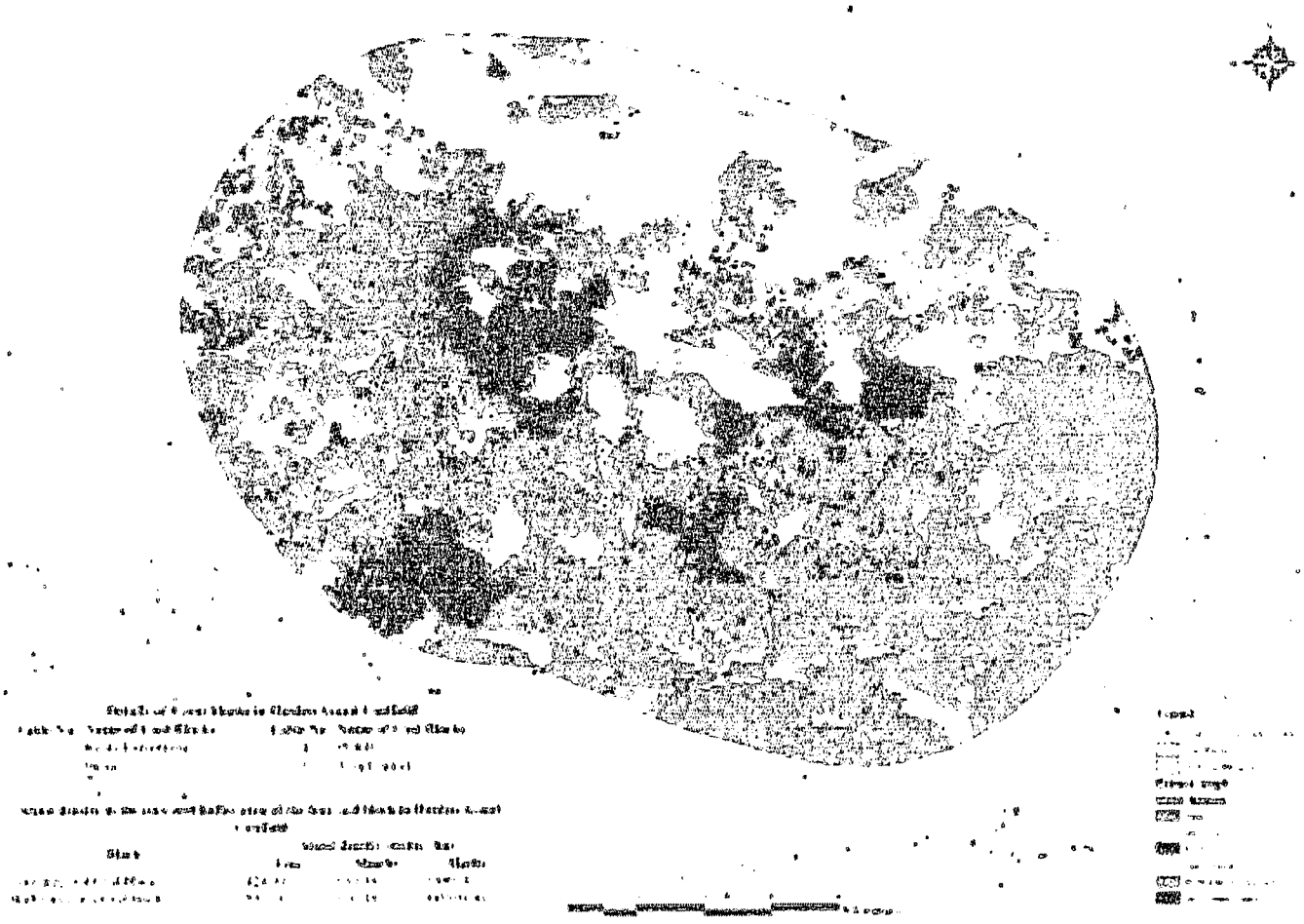


Figure 10.3: Comparative account of the stand density of trees, shrubs and herbs in core and buffer areas of four coal blocks in Hasdeo-Arand Coalfield area that falls within Korba, Surguja and Surajpur districts of Chhattisgarh

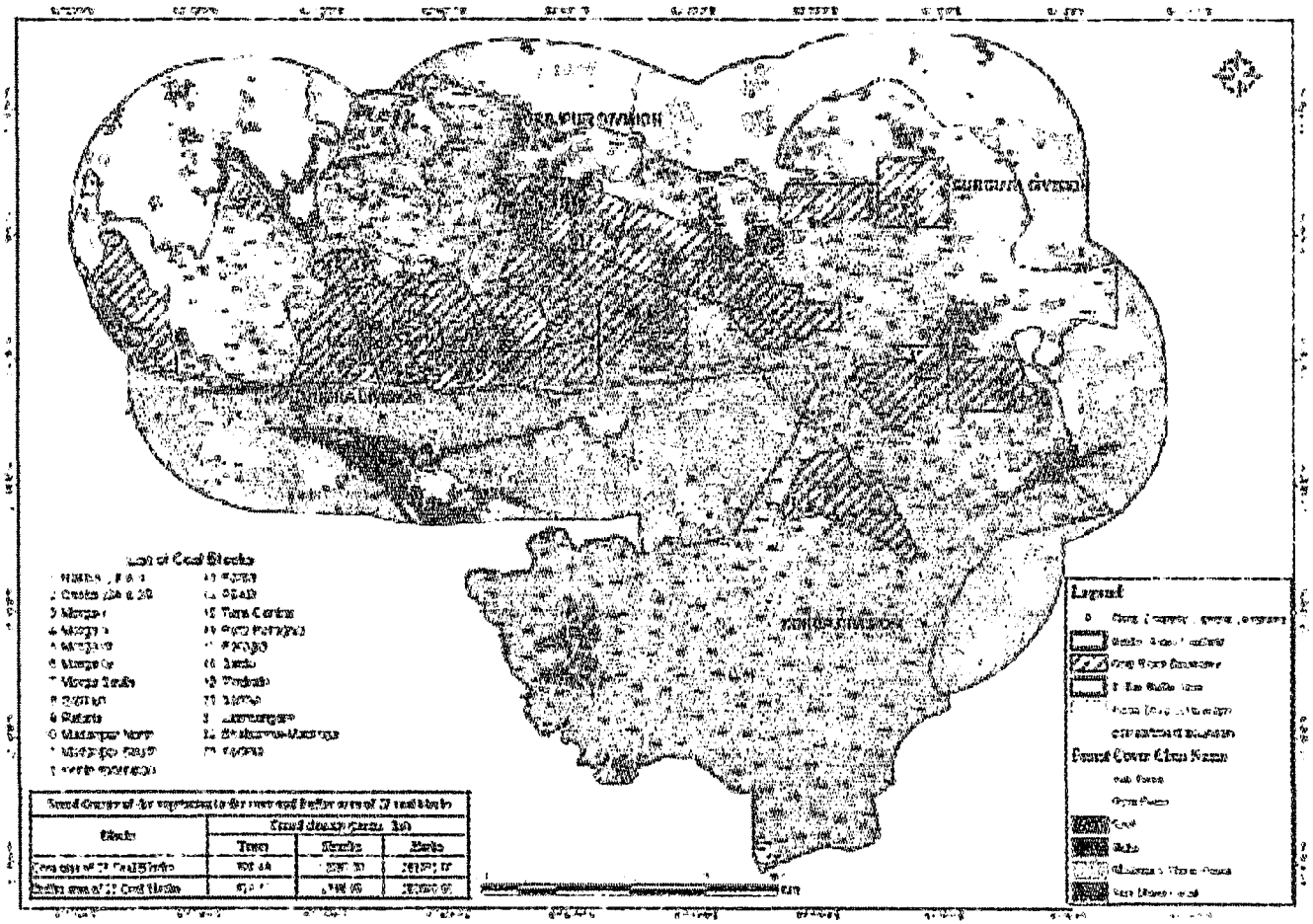


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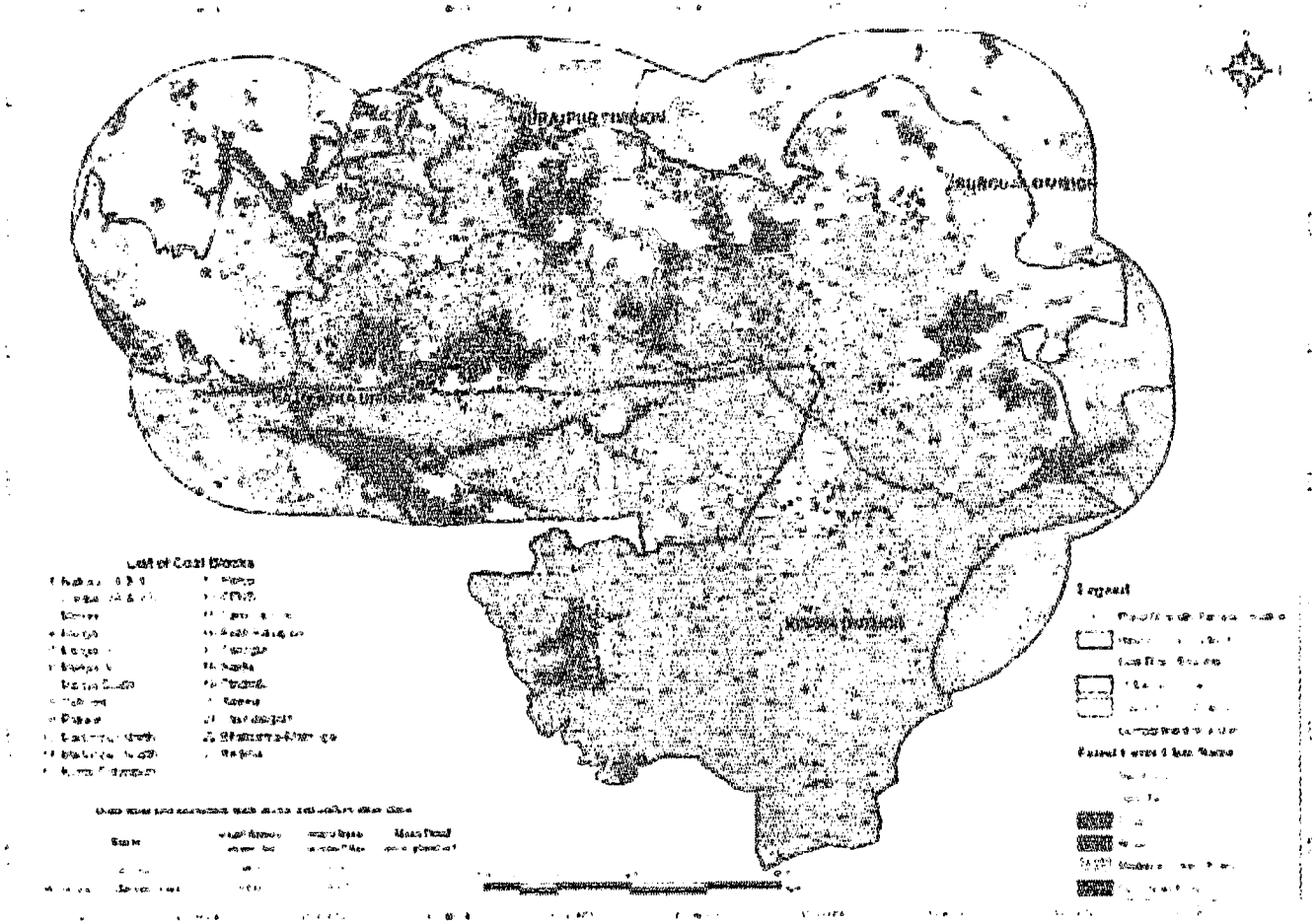


Figure 10.5: Stand basal area assessment made in core and buffer areas of 23 coal blocks in Hasdeo-Arand Coalfield area that falls within Korba, Surguja and Surajpur districts of Chhattisgarh

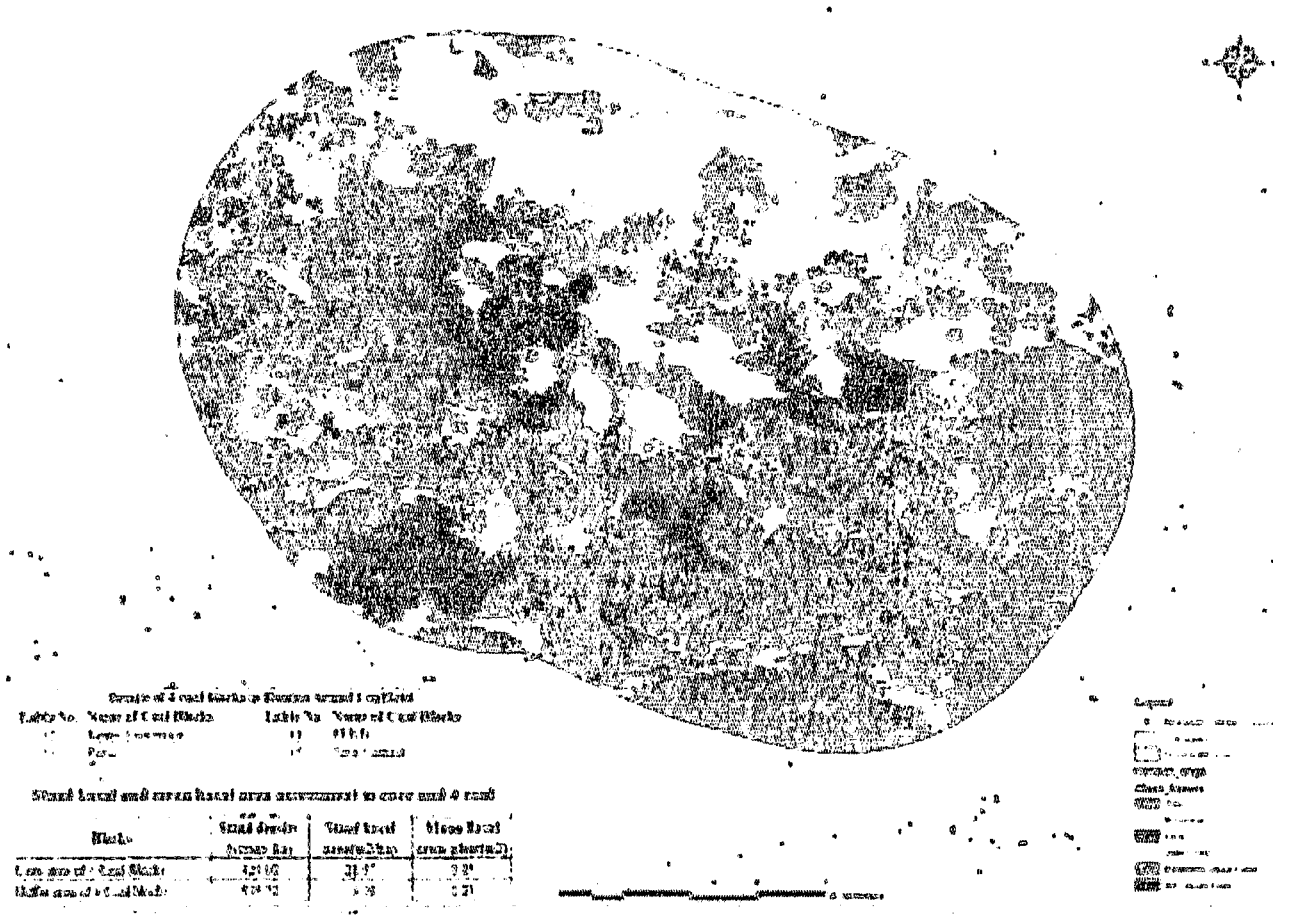


Figure 10.6: Stand density and mean basal area assessment in core and buffer areas of four coal blocks in Hasdeo-Arand Coalfield area that falls within Korba, Surguja and Surajpur districts of Chhattisgarh

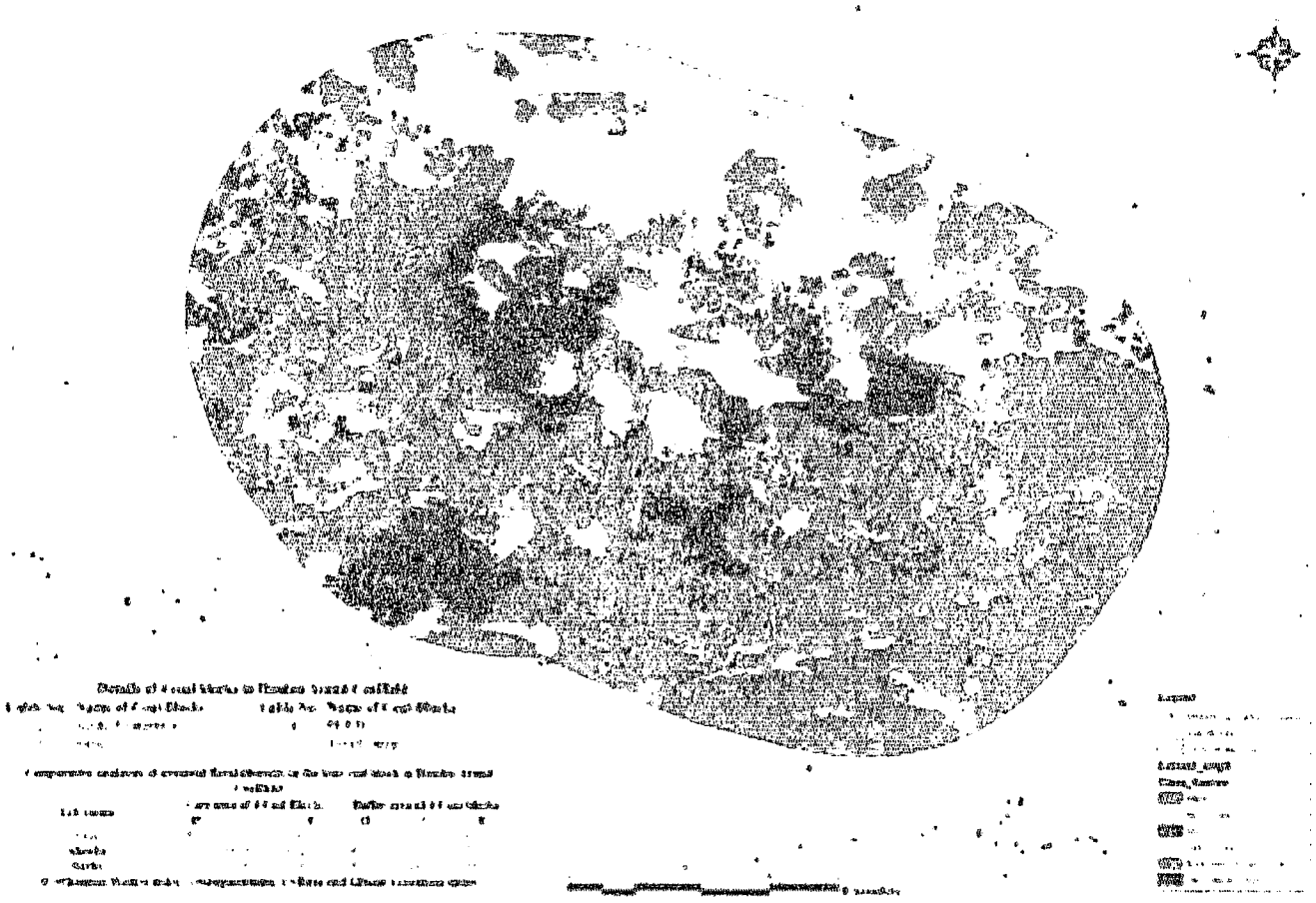


Figure 10.7: Showing the diversity index in and around four coal blocks in Hasdeo-Arand Coalfield area that falls within Korba, Surguja and Surajpur districts of Chhattisgarh

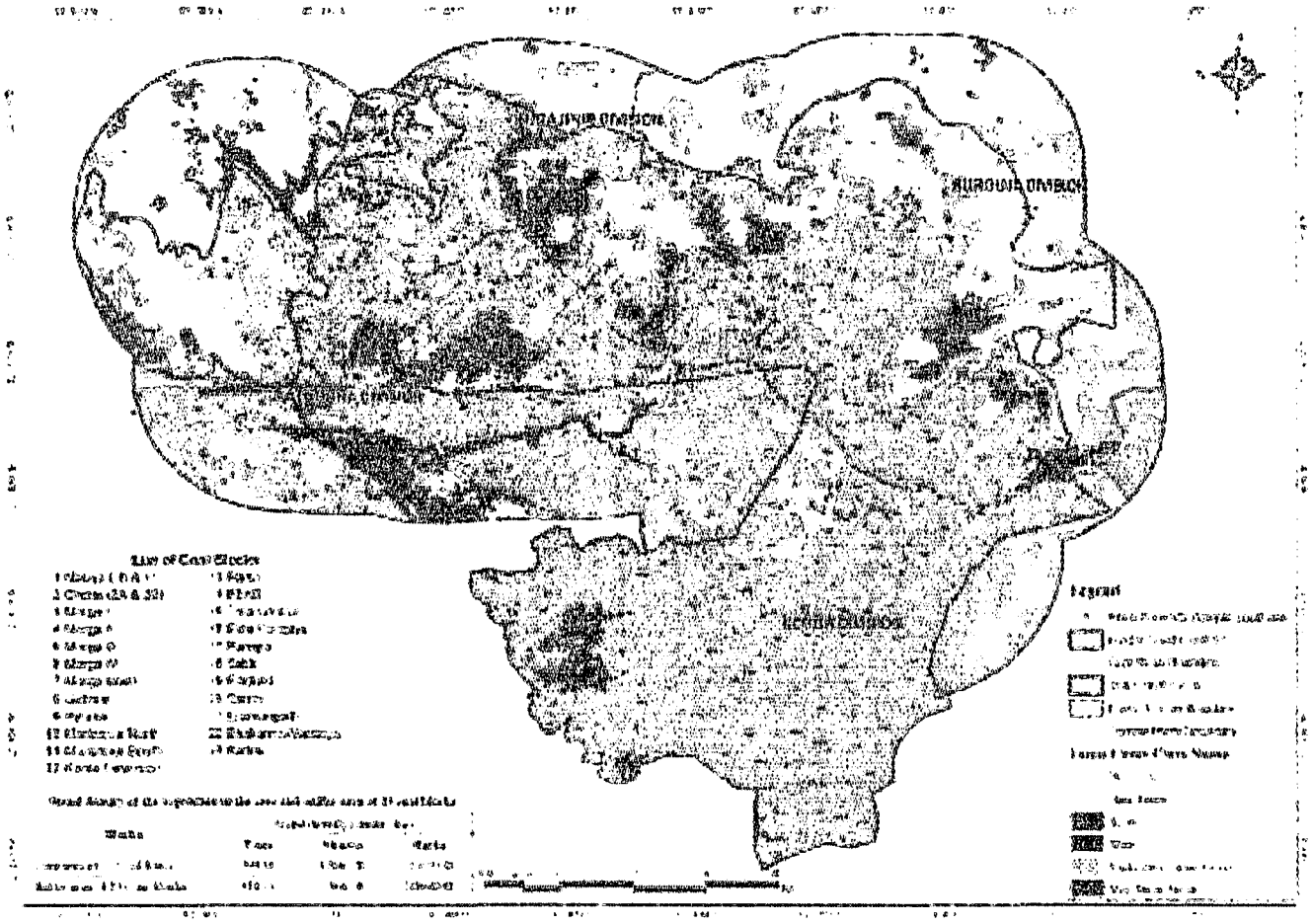


Figure 10.8: Showing the diversity index in and around all the coal blocks and in Hasdeo-Arand Coalfield area that falls within Korba, Surguja and Surajpur districts of Chhattisgarh

The comparative account on the diversity index in and around the coal blocks and Hasdeo-Arand Coalfield area is presented below:

Life forms	Coal Blocks	H'	λ	E
Trees	Core of 4 Coal blocks	2.28	0.17	0.66
	Buffer of 4 Coal blocks	1.87	0.21	0.65
	Core of all coal blocks	2.40	0.17	0.63
	Buffer of all coal blocks	2.68	0.12	0.66
Shrubs	Core of 4 Coal blocks	1.67	0.33	0.62
	Buffer of 4 Coal blocks	1.8	0.25	0.72
	Core of all coal blocks	2.87	0.08	0.63
	Buffer of all coal blocks	2.56	0.12	0.68
Herbs	Core of 4 Coal blocks	2.10	0.19	0.66
	Buffer of 4 Coal blocks	3.83	0.04	0.79
	Core of all coal blocks	3.99	0.03	0.78
	Buffer of all the coal blocks	4.10	0.03	0.79
H'=Shannon Weiner index; λ=Simpson index; E=Buza and Gibson's evenness index				

10.3.1.4 Rare, Endangered, Threatened and Invasive species

The HAC is very important in terms of its phytogeography and occurrence of **33** Rare, Endangered and Threatened (RET) plant species recorded both from core and buffer areas of coal blocks (Annexure 4.10, Plate 4.5). No detailed inventory is available or undertaken in the past. Based on the survey the significant occurrence of RET both in core and buffer zone indicates the nice and amplitude of RET species in HAC.

A total of nine invasive and weedy plant species were recorded from the entire HAC region/study area, having high potential to produce numerous propagules (Ref. Table 4.11 of Chapter 4).

The findings of the biodiversity assessment revels that the entire HAC is extremely important ecosystem by virtue of species diversity. The HAC landscape is the largest un-fragmented forests in Central India consisting of pristine Sal (*Shorea robusta*) and teak forests outside the official protected area system and is an important corridor for movement of flagship species like elephants and tigers in Chhattisgarh.

- Assuming that, if mining in all 23 coal blocks are allowed, 25% (472.21 sq.km) forest cover class comprising of forest (368.34 sq.km); non-forest (103.86 sq.km) in the entire HAC (1879.6 sq.km) will be subjected to land use land cover change resulting in loss very dense (69.66 sq.km); moderately dense (233.37 sq.km); scrub (11.19 sq.km) forest and waterbodies (0.66 sq. km) (Figure 10.2).
- Cumulative impact of all coal blocks will result in fragmentation of land use land class, forest, river courses. Which, will result in loss of vegetation, loss of

top soil, nutrient, forest produce and hydrology. The fragmentation of forest will contribute to edge effect and changes in micro climate which will further facilitate growth of invasive species and change the structure and function of the existing forest.

10.3.2 Terrestrial and Avi-Faunal Diversity in the Entire HAC and Coal Blocks

The faunal biodiversity assessment survey carried out by WII suggest that the Hasdeo-Arand Coalfield serve as habitat for many threatened fauna. The threatened fauna list indicates a total of 9 and 14 spp., exists in the core and buffer zones of PEKB (Table 10.5). The HACF and the landscape surrounding supports a minimum of 25 species of mammals. The mammals of the Order Chiroptera and Rodentia (except for *Ratufa indica* that is included in the list) were not surveyed as that would require a long-term duration and thus, the number of species reported in the assessment is best considered minimal. Among the mammal species recorded the Hasdeo–Arand area, nine species are listed in the Schedule - I, which are accorded the highest level of legal protection under the Wildlife (Protection) Act, 1972. Mammalian species diversity includes threatened large carnivores like common leopard, Indian grey wolf, striped hyena, sloth bear, and others that appears to be widely distributed as evidenced by camera trap captures and sign surveys.

The Hasdeo-Arand area is spread across three districts, viz. Surguja, Surajpur and Korba. The Korba district has two Forest Divisions (FD) viz. Korba FD and Katghora FD. The Korba FD had reported occurrence of tigers. The habitat connectivity between HACF along with the landscape surrounding it, and Achanakmar TR, Boramdeo WS and Kanha TR is strong, and may support sporadic tiger dispersal.

During the biodiversity assessment, a total of 92 species of birds were recorded with in HAC and the landscape surrounding it and the list is best considered minimal. As per the ebird (https://ebird.org/) a total of 406 species of birds have been reported in the three districts of Surguja, Surajpur and Korba-the districts in which the HAC and the landscape surrounding. It is quite likely that many of the species of birds reported in HAC either use or pass through it. However, it may be noted that HAC and the landscape surrounding it just supports ~ 12.4% of the combined area (~ 15,110 sq.km) of the three districts.

Table 10.5: List of different threatened biotas exist in PEKB (Core and buffer) and overall Hasdeo-Arand Coalfield area

Threatened Biota	Core Zone (PEKB)	Buffer Zone (PEKB)	WII	Overall (Hasdeo-Arand Coalfield)
Plants	13			13
Reptiles		2		2
Terrestrial Birds	6	8	6	10
Mammals	12	18	25	8
Total Species	9	14	14	22
Relative % of only fauna	40.09%	63.63%		

The wildlife protection act (WPA, 1972) and IUCN Red-list status is mentioned in Table 10.6. **Thus, it highlights the conservation importance of the area as a whole.**

Table 10.6: WPA (1972) and IUCN red list status of different threatened biotas exist in Hasdeo-Arand Coalfield and surrounding forests

Wildlife (Protection) Act, 1972	IUCN Red-list
Schedule-I = 9 species	Endangered=2
Schedule-II = 10 species	Vulnerable=5
Schedule-III = 4 species	Near Threatened=3
Schedule-IV = 2 species	Threatened=15

- A total of 25 mammalian vertebrates were recorded in and around the Parsa, Parsa East & Kanta Basan (PEKB), Kente Extension and Tara coal blocks. Among the mammal species recorded the Hasdeo-Arand area, **nine species are listed in the Schedule- I.**
- SDM model were developed to assess the distribution probabilities of mammalian species occurrence using camera trap and sign survey for each functional guild of large carnivore, meso-carnivore, ungulates and overall species richness suggested **relatively high habitat-use** in the Tara, Parsa, PEKB and Kente Extension coal blocks, in the surrounding for meso-carnivores; and in the vicinity of the villages (Figure 10.9).
- A total of 92 species birds belonging to 44 families were recorded. Among the recorded avian species, six species are under Schedule I of Wildlife (Protection) Act, 1972, **12 species are endemic to Indian Subcontinent**, and 19 are winter visitors. it represents the importance of the landscape in providing the suitable habitat to these critical species. All the coal blocks, particularly the **Morga-II, Saidu and Pindraki and the surrounding habitats support high species richness** as well as diversity of birds. Among the winter migrants' species, most of them are insectivores in the study area and probably migrate from the Himalayas to avoid harsh, cold months.
- The whole of HAC and its surrounding landscape comprise of 647 forest compartments spread over 12 forest ranges in 4 forest divisions. Of the 647 forest compartments, elephant occurrence is recorded in 148 compartments during the period 2018-2020. Elephant occurrence during the period 2018-2020 was reported in the all the 12 forest ranges located within HAC and the landscape surrounding it. Elephant occurrence is not limited to any particular part of the landscape; however it spread across in HAC and the landscape surrounding it. The number of compartments with reported elephant occurrence is best considered minimum, as obtaining compartment-level information in large forested tracts is seldom easy as elephants could occur undetected in dense conditions and elephants do occur outside of HAC and landscape surrounding it as well entailing back and forth movement.
- Wildlife Institute of India (WII) in collaboration with Chhattisgarh Forest Department is assessing the elephant movement home range pattern since

2017 and have established that elephants have large home ranges. In addition to the collared elephants, a breeding herd of elephants that operates in the northern portion of the Hasdeo-Arand area (Figure 10.10) and the home range of a cow elephant Gautami in the entire HAC landscape (Figure 10.11).

- Wildlife Institute of India (WII) in collaboration with Chhattisgarh Forest Department have established that, the elephants have large home ranges. A conservative estimate revealed that about 40 to 50 elephants use HAC and the surrounding landscape at different times of the year as the habitat use by elephants is not limited to any specific area, but is spread across the entire landscape. In addition, home range polygons of some of the elephants that were monitored using satellite collars also fall within the landscape.
- Chhattisgarh human-elephant conflict (HEC) situation is relatively low in number (<300, which is <1% of India's wild elephant population), but significant levels of HEC with over 60 human lives are lost every year due to conflict (>15% of the reported human deaths due to HEC) from HAC. In addition to loss of human lives, crop loss and damage to property due to HEC are severe.
- A total of 2357 elephant-related crop and property damage incidents were reported during the period 2015-2018 in HACF and surrounding landscape. High fraction (19.3%) of crop loss cases were reported during December followed by October (18.45%) coinciding with paddy harvest. House/building damage instances were recorded mostly during July and January.
- There is continuous dispersal of elephant herds from the neighbouring states of Jharkhand and Odisha. The study carried out by WII in collaboration with Chhattisgarh Forest Department from the year 2017 onwards clearly highlight that elephants have large home ranges. The forests that elephants currently occur are highly fragmented and degraded due to incompatible land-use resulting in reduced home range of good quality therefore the home range in HAC is large and scattered.
- It is observed that home range size is a function of habitat quality – in areas that support good intact habitats, the elephant home ranges are relatively small (eg. Rajaji, Mudumalai *etc.*). However, in fragmented areas, elephant home ranges are typically large. The elephant herds are generally interlinked and home ranges spread over two or more states.

Major disturbances to habitats such as mining not only cause habitat loss and fragmentation (as understood generally) but can affect individual herd's home ranges. Such disturbances can lead to abandonment of habitats as threats to home ranges have a threshold limits. The effect of mining on elephant habitat may not reflect in the same habitat, but could be a silent trigger for HEC in some other area within the landscape. In general, one of the reasons for HEC being disproportionately high in EC

region is the elephant dispersal from forest habitats through fragmented human use areas.

- Sporadic reports of tiger presence in Korba forest division suggest that habitat connectivity between Kanha–Boramdeo–Achanakmar (KBA) and Hasdeo-Arand area could be still functional for tigers. To establish connectivity with the habitat *Circuitscape* models was used and the habitat connectivity between KBA and HAC landscape recorded a higher conductance values indicating a strong connectivity (Figure 10.12). The forest department at Korba Forest Division has recorded tiger presence in a few locations within Hasdeo-Arand area .
- HAC is part of a large forested landscape in the Central Highlands, which itself is an amalgamation of diverse landforms. Therefore, it supports rich avi-fauna with over 92 species, this is probably that the landscape supports a diversity of habitats that include dense forests, relatively open forests, scrubland and riparian tracts. Among the recorded species, six species are under Schedule I of Wildlife (Protection) Act, 1972, 12 species are endemic to Indian Subcontinent, and 19 are winter visitors, it represents the importance of the landscape in providing the suitable habitat to these critical species. All the coal blocks, particularly the Morga II, Saidu and Pindraki and the surrounding habitats support high species richness as well as diversity of birds. Presence of high number of birds of prey may indicate good habitat quality and abundance of prey species. Family Muscicapidae, Cuculiade are species-rich HAC and as most them are insect eaters. Among the winter migrants' species, most of them are insectivores and probably migrate from the Himalayas to spend the harsh, cold months in Peninsular India. Mining will certainly contribute to loss of habitat for birds.
- The livelihood of local communities in Hasdeo-Arand area is closely dependent on forest resources and they come across a variety of wildlife in and around their settlements. The human–wildlife conflict – in the form of crop, property and livestock losses were expressed as a concern by the local communities.
- In addition, the major linear infrastructure in KBA and Hasdeo-Arand area tiger dispersal corridor include Ambikapur to Bilaspur National Highway and the Bilaspur–Anuppur Railway line. Maintaining the current level of connectivity would be essential to facilitate putative tiger dispersal from KBA to Hasdeo-Arand Area. HAC and the landscape surrounding it is ecologically similar to other tiger habitats in central India. That seems to preclude tiger recovery in the landscape is low density of ungulate prey. Tiger recovery and persistence in Hasdeo-Arand area seems conditional on four main factors namely 1. recovery of ungulate prey, 2. maintaining the existing habitat connectivity with KBA, 3. enriching habitat conditions through protection and habitat management, and 4. real-time mitigation of human-wildlife conflict (like compensation for livestock loss). If these conditions are met, Hasdeo-

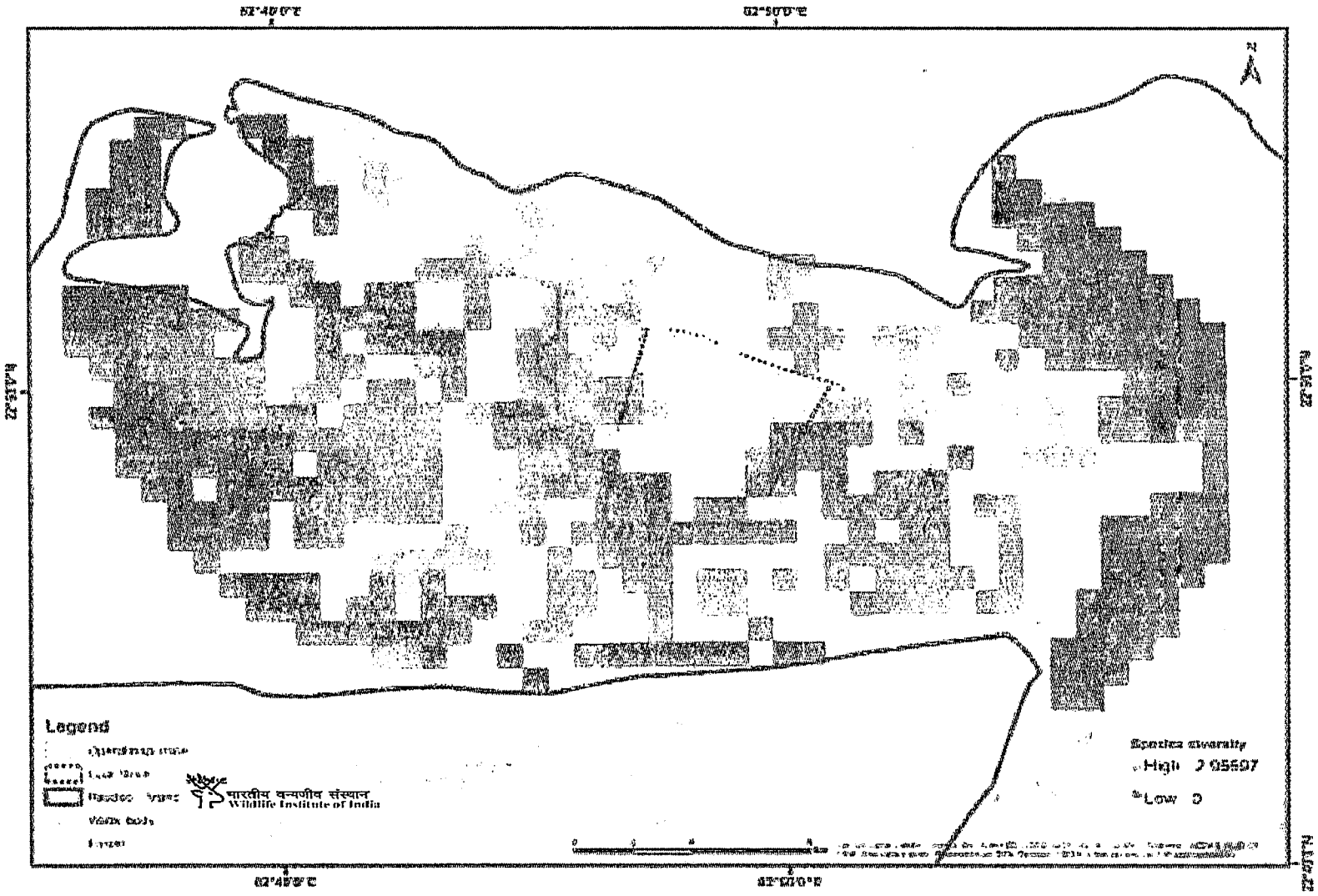


Figure 10.9: Species diversity of selected mammalian species in and around 10 km buffer of Parsa, Kente Extension, Tara and PEKB in Hasdeo-Arand Coalfield that falls within Korba, Surguja and Surajpur districts, Chhattisgarh

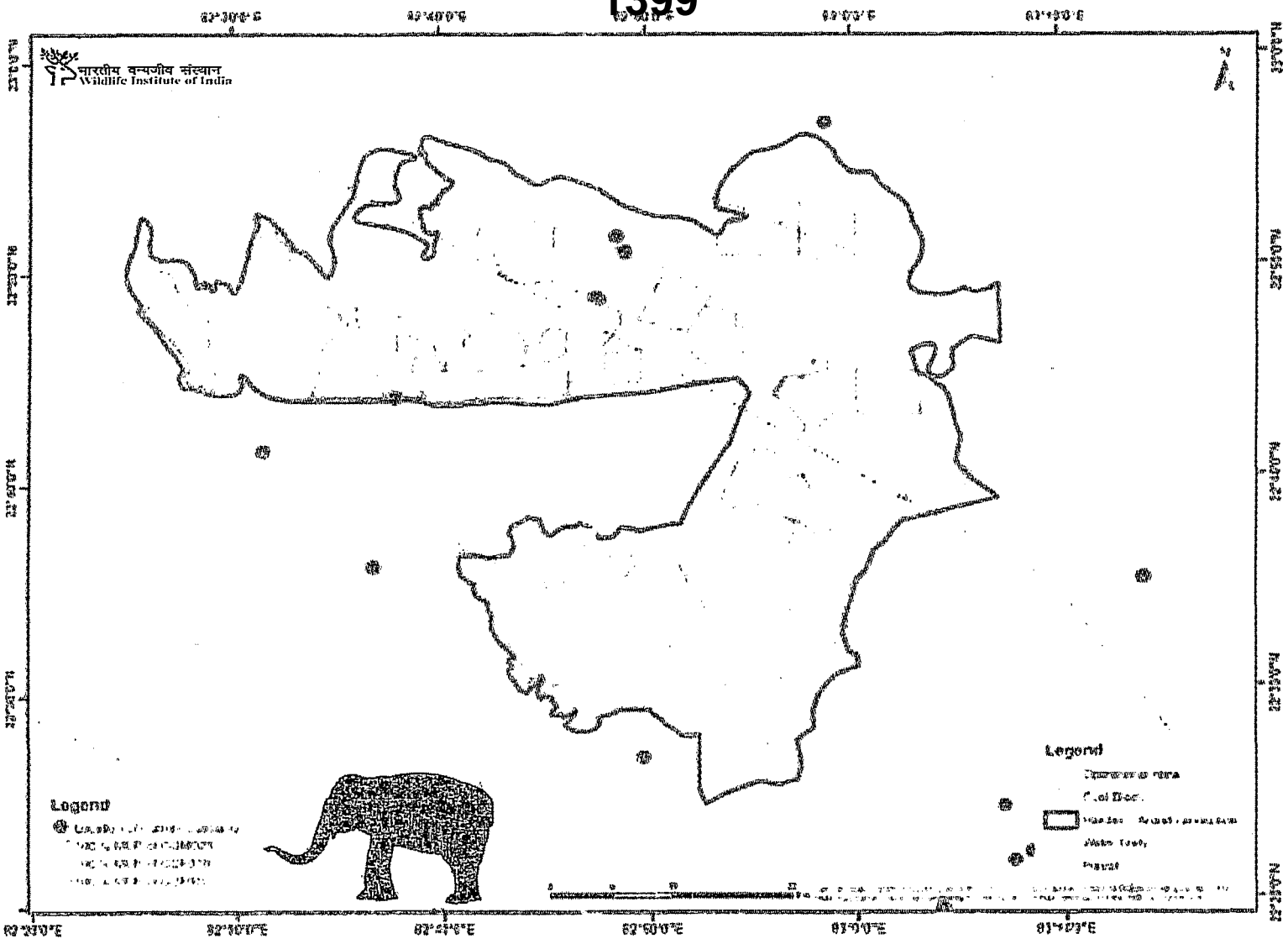


Figure 10.10: Showing the ranging patterns of elephants in and around the Hasdeo-Arand Coalfield, that falls within Korba, Surguja and Surajpur districts, Chhattisgarh

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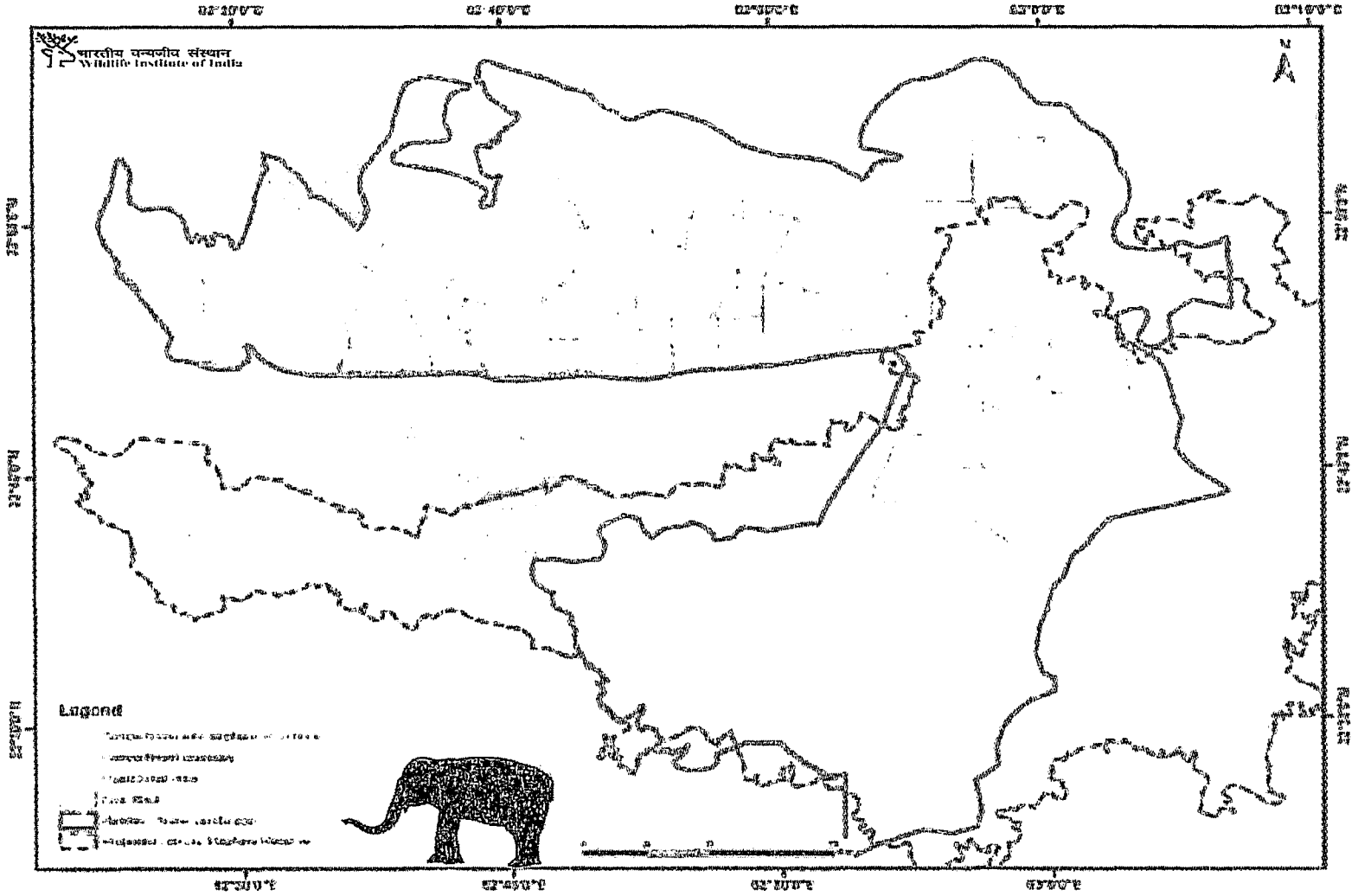


Figure 10.11: Elephant occurrence in and around the Hasdeo-Arand Coalfield, prepared based on compartment-level information obtained from Chhattisgarh FD for the period 2018-2020

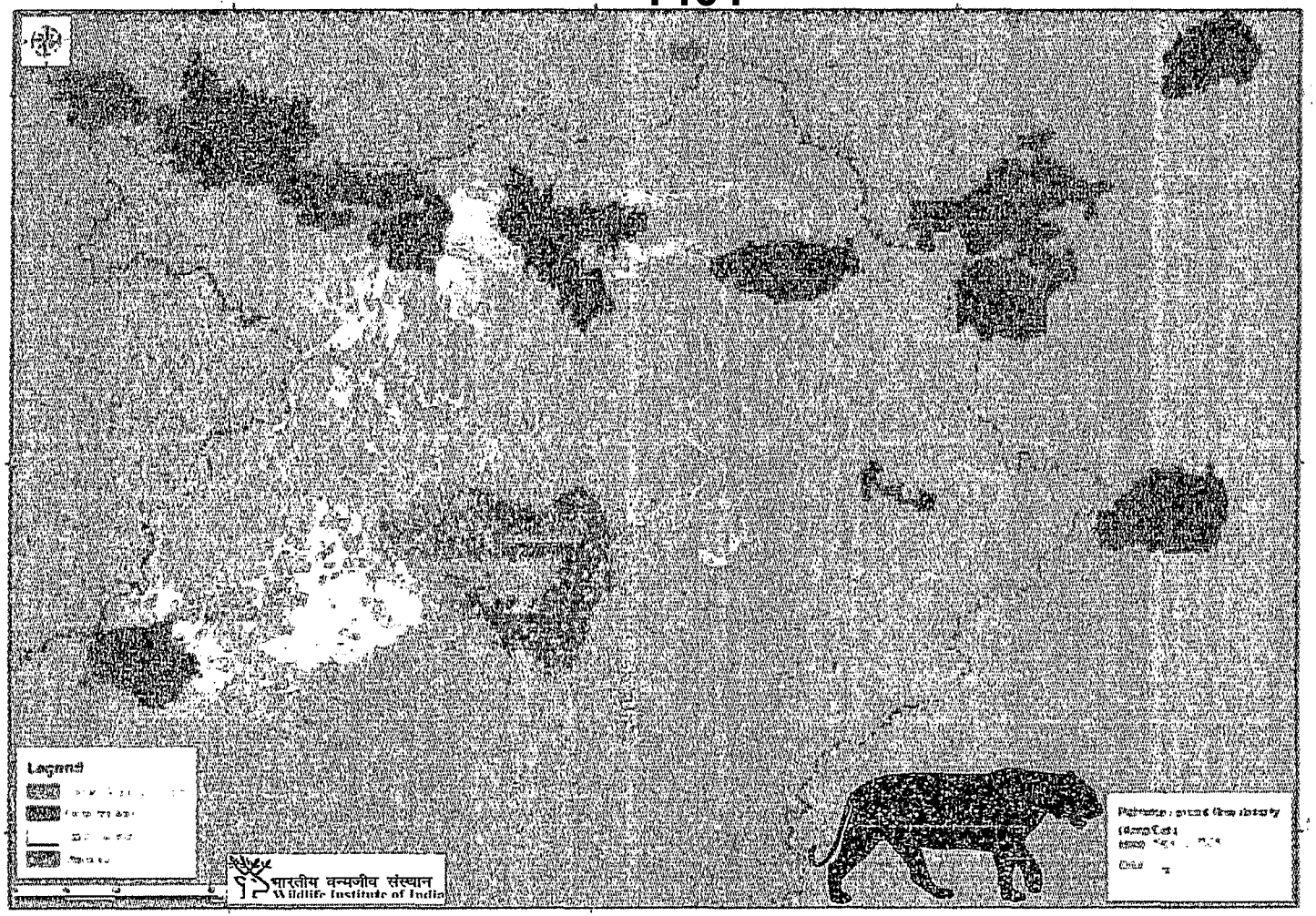


Figure 10.12: Pairwise current flow density, shown in shades of pale yellow to red gradient, indicates areas where current flow is high between adjacent pair of PAs from Hasdeo-Arand Coalfield

- Arand area can support a minimum crude density of 1 tiger/ 100 sq.km (this density is arrived at based on the median tiger densities in ecologically comparable tiger habitats in Central India). Thus, in highly suitable areas encompassing over 1000 sq.km in Hasdeo-Arand area, it could be possible to support 10 to 15 tigers. It may also be noted that the Hasdeo-Arand area is contiguous to other forests in Surguja, Raigarh and Surajpur districts. Thus, the estimates of potential tiger abundance in Hasdeo-Arand area are best considered conservative.

10.3.3 Drainage and Aquatic Biodiversity

The study area of HAC and its 10 km buffer falls under eleven watersheds *viz.*, Gej, Jhink, Bamni, Anjan, Ton, Teti, Chornai, Hasdeo, Mand, Chuiya and Rehar. While, all the watersheds are part of the Hasdeo drainages that contribute to the Mahanadi River, Rihar watershed forms part of the lower Ganga River basin (Figure 10.13). Of all the watersheds falling within the Mahanadi River sub-basin, mainly four *viz.*, Bamni-Anjan, Ton-Teti, Gej-Jhink and Chornai are contributing to the flow in the Hasedo River and the Hasdeo-Bango Reservoir. The Chornai watershed spreads across almost half the area of entire coalfield and the Chornai Nadi is an important and the largest drainage system that occupies nearly one fourth of the HAC.

The Atem Nadi falls within the Gej-Jhink watershed and joined by two streams *viz.*, ***Salhi Nala*** and ***Garjan Nala.*** The area under both the streams together forms the core and buffer zone of the active/proposed coal blocks *viz.*, **Tara-Central (15), Parsa (13), PEKB (14) and Kente Extension (12), of which the PEKB (No. 14) is the operating coal mine.** Over all, these coal blocks area forms part of the Atem River system, which runs towards north from the HAC and joins the Hasdeo River at north (Figure 10.14).

- **Salhi Nala** – The area drained by Salhi Nala forms part of the core and buffer of the **Parsa (13), PEKB (14) & Tara (15)** coal blocks, of which **PEKB is the only operating/active mine.** Salhi Nala and its primary feeder streams drains the **core/buffer areas of the PEKB coal block** (14). The Salhi Nala joins the Atem Nadi at Shivnagar.

Before the PEKB (14) coal block came into operation, the Salhi Nala drained the area upto Kete, Basen, Ghatbarra, *etc.* Presently, the open cast coal mining and related land use land cover changes in the core/buffer areas of the PEKB is observed to have signficant ***influence on the Atem Nadi mainly through the Salhi Nala*** **.**

- Besides PEKB (14), the core/buffer area of Sarma (20) and Laxmangarh (21) coal blocks are also drained by the Salhi Nala at its origin. Over all, the Salhi Nala is most likely to be infleunecd by the **Kente Extension (12), Parsa (13), Tara (15),**

Sarma (20) and Laxmangarh (21) coal blocks, in addtion to the active coal block i.e., PEKB .

Chornai Nadi: It is an important sixth order drainage systems that spreads across almost half the area of the entire HAC. It is fed by two fifth order streams of (i) the **Chornai Nala** (ii) the **Rapta Nala (Lemru).**

- **Chornai Nala:** This stream drains the area falling under the influence zone of as many as 12 coal blocks Nos. 7-9, 12-19 and 21 *viz.*, **Morga South (7), Gidmuri (8), Paturia (9) Kente Extension (12), Parsa (13), PEKB (14), Tara Central (15), Puta Parogia (16), Parogia (17), Saidu (18), Pindraki (19),** and **Laxmangarh (21),** of which the coal blocks 12-15 are either operating/advaned stage of its commencement of mining (Figure 10.15).

Rapta Nadi (Lemru): The network of streams of Rapta Nadi together with Chornai Nala form one of the major drainage systems that originate and occupies nearly one fourth of the HAC.The main portion of the stream is formed by two fourth order streams - the **Gandher Nala** and **Rapta Nala**. Another fourth order stream joins the main water course of the Rapta Nadi on the left bank downstream near Kuturuwan. The Rapta Nadi, at its origin, drains the area under the coal blocks of **Nakiya-1** (I, II & III).

- **Both Gandher Nala and Rapta Nala with its** stream networks namely Lamti Nala and Bimalta Nala drains the core/buffer areas of the Coal Block **Nakiya-1 (I, II & III).** They are under these stream networks are charactrized by rugged mountainous terrain having deep cut valleys and relatively dense mountainous/riparian forest
- **Rehar River** originates near the villages Bhakurma and Kedma, **where the proposed two coal blocks Bhakurma (22) and Kedma (23) is located.** Two out of the three important tertiary feeder streams (Barka Nala & Balu Nala) of the river drain the core zone of the coal blocks 22 & 23. In addition to these two coal blocks, nearly half of the area of the coal block No. 21 (Laxmangarh) is drained by one of the secondary streams that join the River near Udaipur (Figure 10.15).
- The streams under **Ton-Teti watershed/** other smaller streams *viz.*, **Bisrar Nala/ Dhajag Nala/ Bamni-Manasi Nala/ Maniari Nala** drain the areas that form the core/buffer areas of as many as nine proposed coal blocks *viz.*, **Morga-I (3) Morga-II (4), Morga-III (5), Morga-IV (6), Morga South (7), Paturia (9), Madanpur north (10), Madanpur south (11) and Puta Parogia (16).** These streams directly drain into the Hasdeo River at the upstream of the Hasdo-Bango reservoir. The lower reaches of these streams particularly the surrounding area of Dhajag/Manasi Nala are occupied relatively **undisturbed dense forest cover** (Figure 10.16 - 10.18).

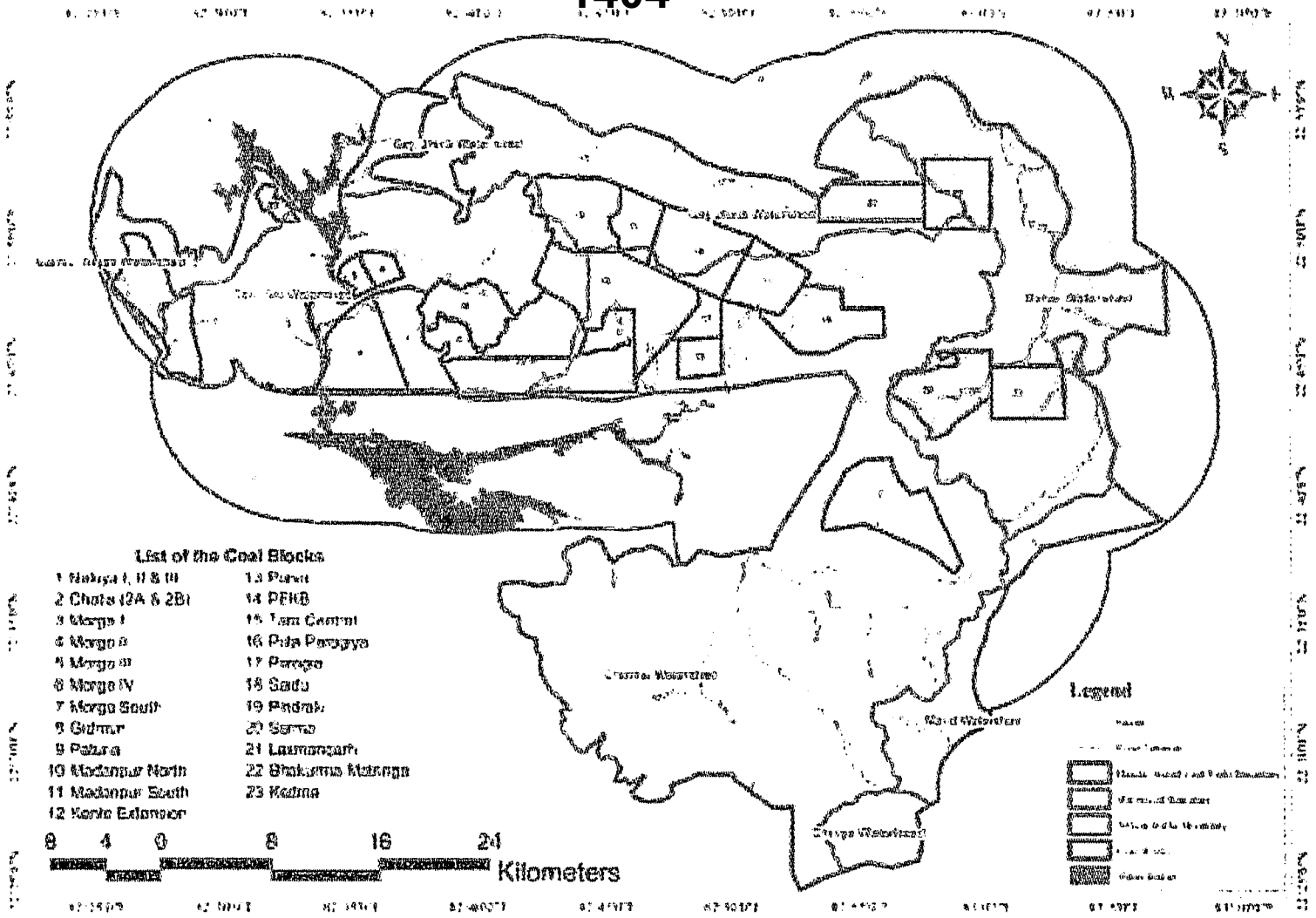


Figure 10.13: Different watersheds with drainage networks falling within the entire Hasdeo-Arand Coalfield & 10 km buffer in the Surguja, Surajpur and Korba districts, Chhattisgarh

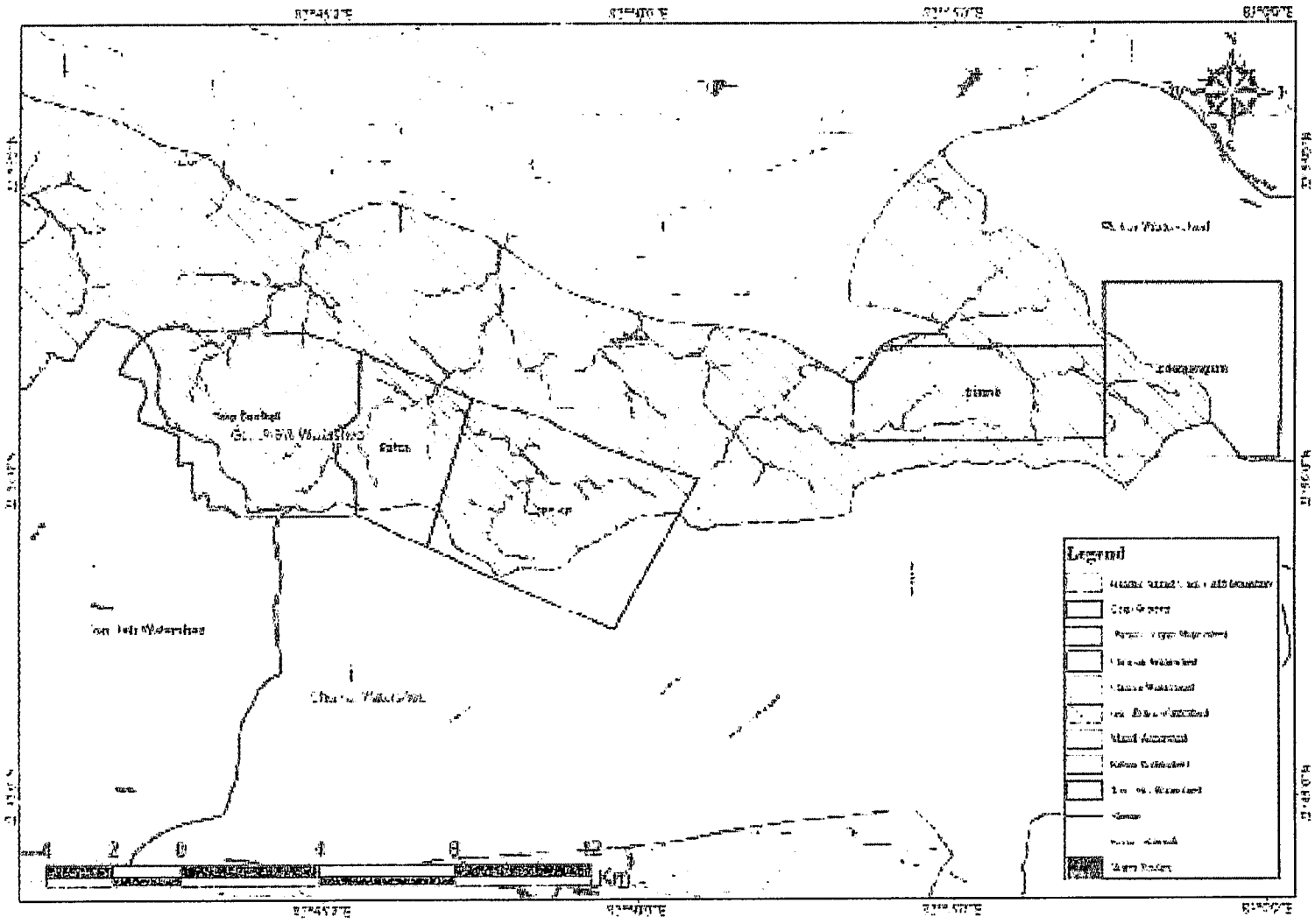


Figure 10.14: Map showing Gej-Jhink watershed with drainage networks falling within coal block 12-15 & 20-21 in Hasdeo-Arand Coalfield, Chhattisgarh

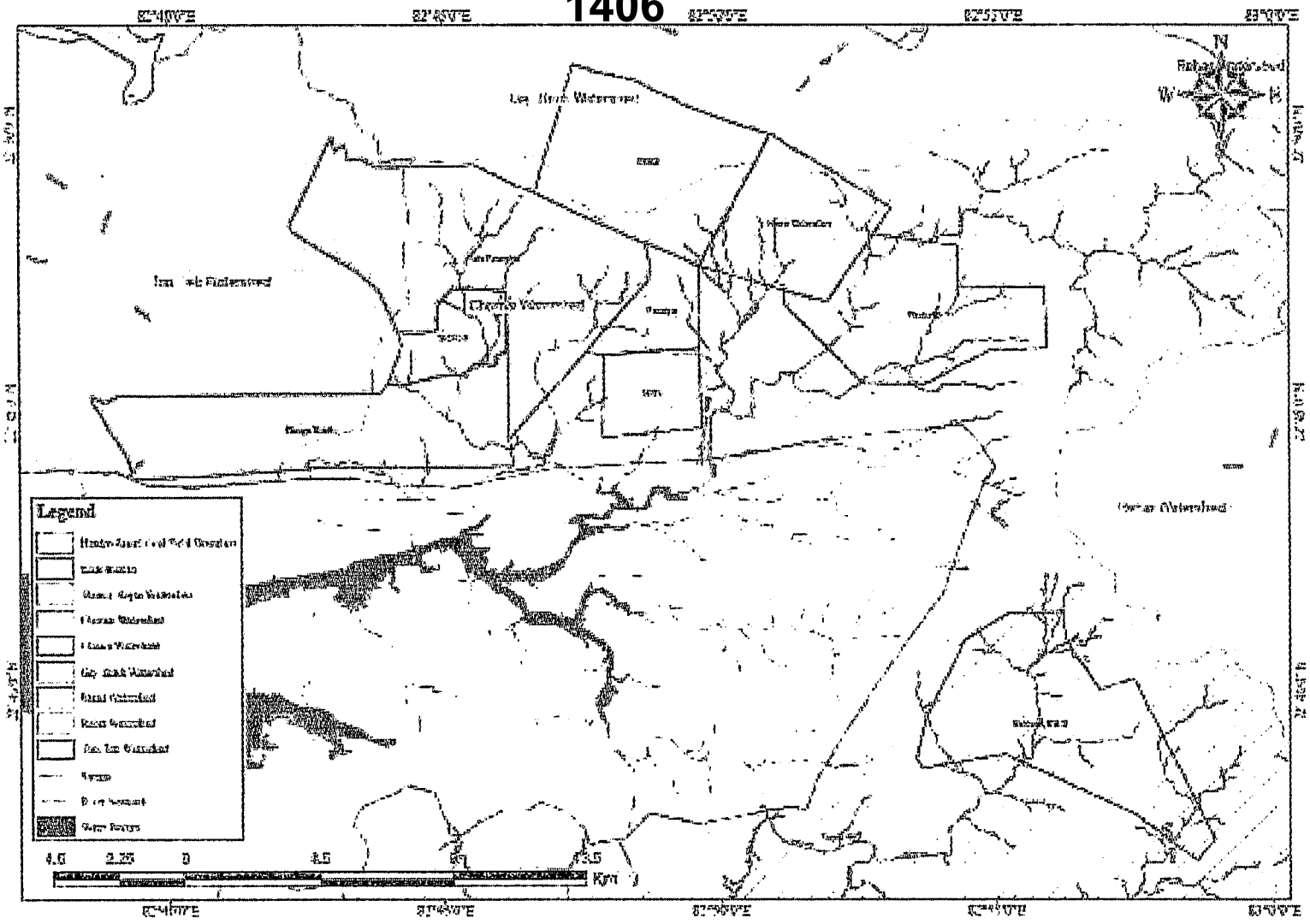


Figure 10.15: Map showing the Chonai watershed area and drainage network of the Gandher Nala and Rapta Nadi of Chornai watershed falling within the Nakiya coal block (I, II & III) in Hasdeo-Arand Coalfield, Chhattisgarh

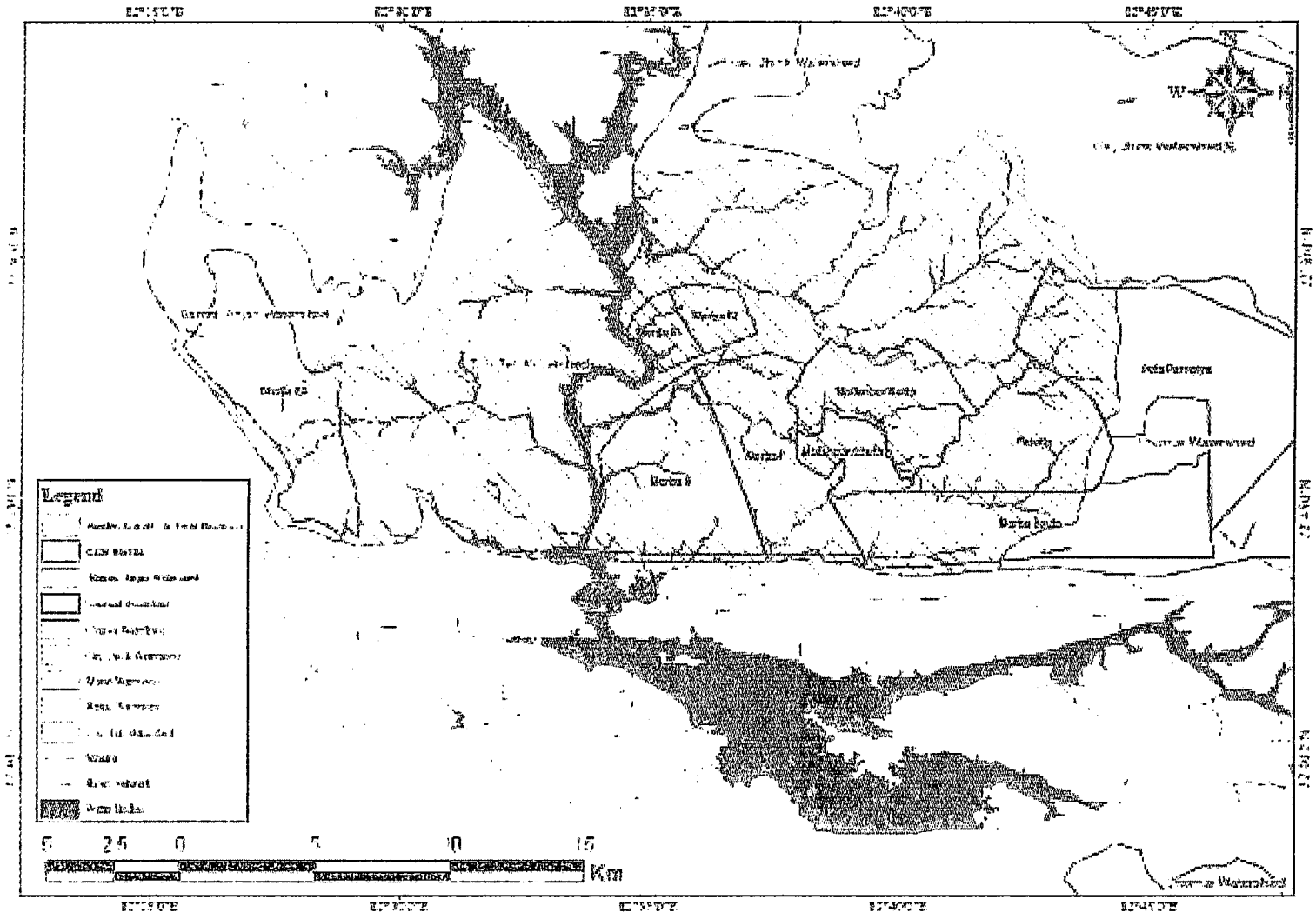


Figure 10.16: Map showing the Ton Teti watershed area and drainage networks that fall within in Hasdeo-Arand Coalfield, Chhattisgarh

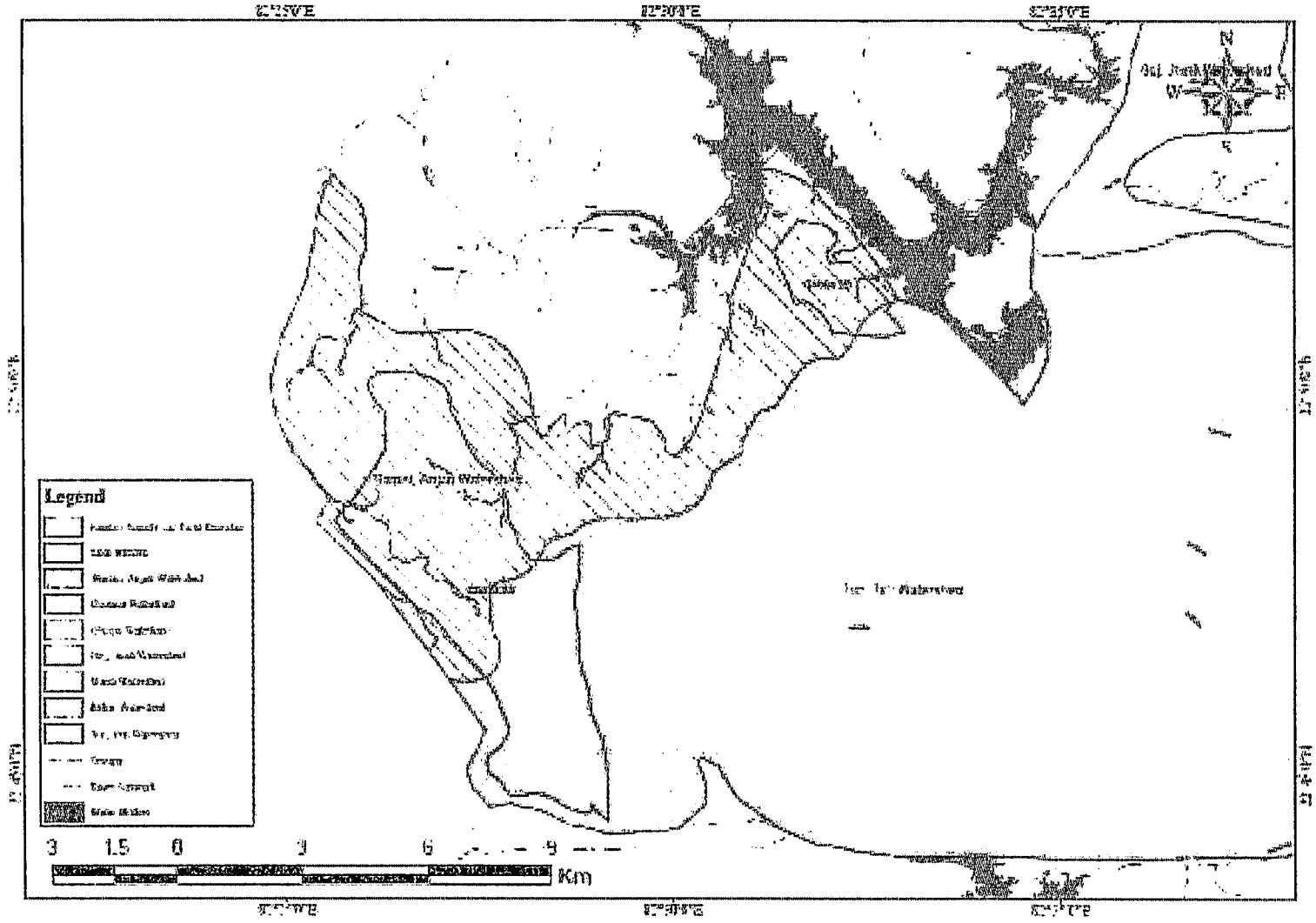


Figure 10.17: Map showing the Bamni Anjan watershed area in Hasdeo-Arand Coalfield, Chhattisgarh

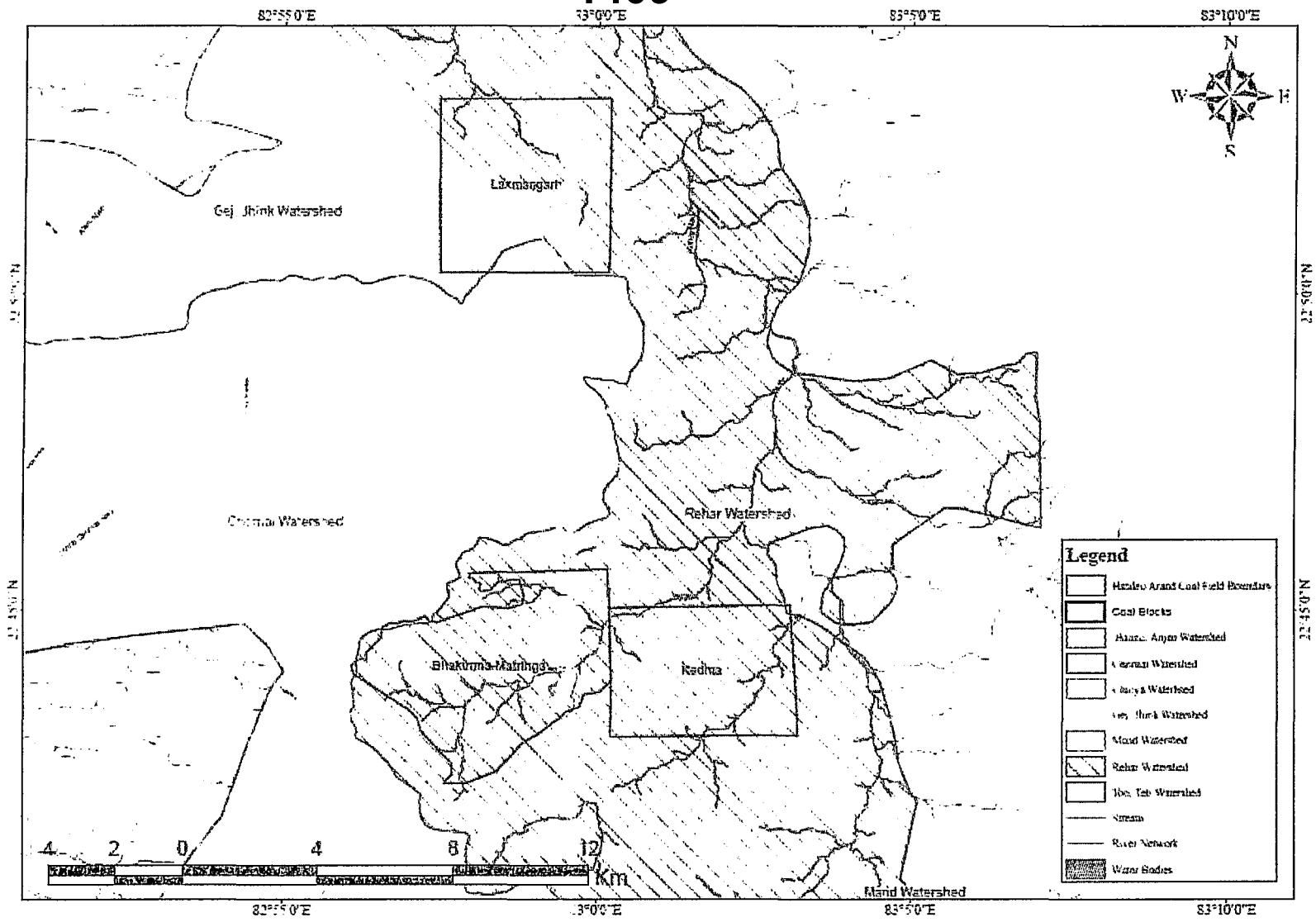


Figure 10.18: Different Rehar watershed with drainage networks falling within the Hasdeo-Arand Coalfield & 10 km buffer in the Surguja, Surajpur and Korba districts, Chhattisgarh

13.3.1 Water quality and aquatic diversity

- In general, the physico-chemical water quality parameters of the streams in the area varied within their expected natural ranges characteristic to the general features of the study area. Among the parameters studied, comparatively higher values were recorded for pH, Conductivity and TDS during winter compared to that of the post-monsoon. The surface water temperature varied according to both diurnal and seasonal changes in solar radiation.
- The assessment of community (Biotic) metrics of the aquatic macroinvertebrates, one of the most prominent indicator organisms of water quality of freshwater streams, in different stream networks revealed a total of 9924 individuals of macro-invertebrates belonging to 04 phyla (Platyhelminthes, Annelida, Arthropoda and Mollusca), 06 classes (Rhabditophora, Clitellata, Insecta, Malacostraca, Gastropoda and Bivalvia), 19 orders and 61 families.
- The insect taxa constitute the most dominant taxonomic group in macro-invertebrate assemblages of the entire sampling location with a relative abundance of 86.82% and a total richness of 45 families. The Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) with Odonata (*EPT/O*) taxa accounted for nearly half (52.61%) of the abundance of all taxa. The relative abundance of *EPT/O* were high in both Chornai Nadi -Left bank (71.96%) and right bank streams (71.67%) compared to that of all other stream networks sampled, including the Atem Nadi and Salhi-Garjan Nala, where mining is active (in PEKB).
- The probable biological water quality of the sampling locations, based on different biotic indices employing aquatic macroinvertebrates *viz.*, ***Taxa Tolerance Score (TTS), Average Score Per Taxon (ASPT)*** **and** ***Macroinvertebrate Water Quality Index (MWQI)*** revealed that
    - Both Chornai Nadi-Right and Left bank streams had high value of *TTS* (>100) with water quality category **'Very Good' (Unpolluted, Un-impacted)** compared to that of all the other locations sampled. Also, the TTS recorded at Atem Nadi and Salhi-Garjan Nala with water quality category **'Good' (Clean, but Slightly impacted)** were on par with that of locations other than Chornai Nadi-Right and Left bank streams.
    - The Average Score Per Taxon *(ASPT)* indicated '**Good**' water quality in five sampling locations *viz.*, Bisrar & Maniar Nala, Bamni Nala, Chornai Nadi-Right and Left bank streams and Khadpadi & Parla Nala as well as '**Moderate**' water quality in the remaining three locations *viz.*, Atem Nadi, Salhi & Garjan Nala and Rehar River.
    - The Macroinvertebrate Water Quality Index (MWQI) indicated '**Very good' water quality with 'Slight organic pollution'** for Chornai Nadi-Left bank streams, Chornai Nadi-Right bank streams and Khadpadi & Parla Nala;

'Good' water quality with 'Some organic pollution' for Bamni Nala; **'Fair' water quality with 'Significant pollution'** for Atem Nadi and Bisrar & Maniar Nala; **'Fairly Poor' water quality with 'Significant organic pollution'** for Rehar River and **'Poor' water quality with 'Very significant pollution'** for Salhi and Garjan Nala.

- A relatively high diversity (based on indices *viz.*, Shannon and Fisher's alpha) of aquatic macroinvertebrates was observed at the two locations (Chornai Nadi-Right bank streams and Salhi & Garjan Nala) and a low diversity at other two locations (Bisrar & Maniar Nala and Bamni Nala).
- It is to note that, in terms of diversity of aquatic invertebrates, Salhi & Garjan Nala followed by Atem Nadi, which are located in the core/buffer area of the active coal block (PEKB) in the coalfield, were one of the relatively good/moderate diverse locations. On the contrary, the Taxa Tolerance Score and ASPT indices ascertained that these locations ranked relatively low in terms of the abundance of pollution sensitive aquatic organisms.
- Overall, the biotic metrics, diversity indices and biotic indices of water quality calculated for the aquatic macroinvertebrates revealed that the water quality and the likely impacts of various natural and anthropogenic stresses on aquatic resources at the forested stream locations such as:
    - Chornai Nadi- Right and Left bank streams were not observed to be impacted very significantly.
    - The two prominent sampling locations *i.e.*, core/buffer to the active mining areas *viz.*, Atem Nadi and Salhi & Garjan Nala were more or less similar in all respects of aquatic macroinvertebrate biodiversity and biological water quality and both varied significantly from that of the other sampling locations.
- A total of 13 common indigenous fish species and 02 introduced exotic fish species *viz.*, *Cyprinus carpio carpio* (Common carp), *Oreochromis mossambicus* (Tilapia); few crustaceans that include prawns and crabs were recorded and reported to occur in the streams of the HAC area. Most of the catch hardly consists of few grams to 1-2 kg, which is often utilized for individual consumption, and therefore, do not attract significant commercial value.
- Of the 13 fish species recorded three fish species (*Garra mullya; Cirrhinus reba* and *Channa gachua*) are categorized under Vulnerable (VU) and six species under Lower Risk near threatened (LRnt) category of conservation status (CAMP, 1998).

10.3.3.2 Coal blocks identified under the important catchments/watersheds of HAC

- Mining in forested landscape involves significant land use land cover changes that mostly likely results in geo-morphological/hydrological changes in the river water courses.

- In the present scenario, mining is being done in a relatively small geographical area as compared to the extent of the all the coal blocks allotted/re-allotted and identified (23 coal blocks) in the entire HAC; however, the direct and indirect impacts are quite evident and significant from the observable changes in the land use, forest cover and natural drainages.
- The PEKB (14) coal block under operation and the other three proposed coal blocks (12, 13 and 15) are of a cluster of open cast projects lying along the boundary of three watersheds *viz.*, **Gej-Jhink (north), Chornai (south) and Ton-Teti (west)**. Therefore, the cumulative impacts envisaged in the areas under these coal blocks are of great concern.
- The resultant land use land cover changes on account of open cast coal blocks of these magnitude in the relatively moderately dense forest tracts intersected by numerous water courses will most likely to have significant cumulative impacts that contribute to alteration of drainages and hydrological regime, *etc.*, mainly due to reduced stream water flow, increased erosion in the high rain fall in the area, increased sediment deposition on the river bed, reservoir and other related environmental issues.
- The stream that originates from Ghatbarra and flowing along S-N across the PEKB coal block (14) was one of the primary feeder streams of Salhi Nala and that has been channelized as Catch Water Drain along the active dip side margin of the mine pit (PEKB Phase-I) from S-SE to S-SW to facilitate the flow of water along the mine boundary. **The primary/secondary feeder streams once existed in the core area of the coal block (PEKB) which drained the area up to Kete, Basen, Ghatbarra** *etc.*, have been modified/diverted due to ongoing mining/dumping and the resultant changes in the land use land cover pattern.
- The aquatic biodiversity and the biological water quality characteristics in Salhi Nala and Atem Nadi adjoining the active mining areas were not within the ambient quality as compared to that of the other stream locations. Therefore, it is evident that the cumulative impacts on the water quality is most likely to be increased further when all the coal blocks (coal block 15, 13 and 12 and other contiguous coal blocks) commence its operation, especially, during monsoon when the flow is relatively high due to high rainfall in HAC.
- ***In summary, as the coal blocks 12-15, are either already opened or advanced stages of according approval or obtaining ToR, mining in this zone may be permitted with appropriate conservation measures of surface water management, afforestation to control erosion from disturbed landscapes, sediment and siltation in stream water courses, maintain the required minimum flow in the important stream channels, gap plantation with native vegetation to strengthen the riparian buffer zone, catchment area treatment plan for the individual as well as the cluster of coal blocks, etc.***

The area under the **Chornai catchment** with all its feeder/headwater streams falls within the core/buffer of as many as 13 coal blocks *viz.*, Nakiya (1), Morga south (7), Gidmuri (8), Paturia (9), Kente Extension (12), Parsa (13), PEKB (14), Tara Central (15), Puta Parogia (16), Parogia (17), Saidu (18), Pindraki (19) and Laxmangarh (21).

- Of all the coal blocks under the Chornai stream catchment, a total of five *viz.*, Nos. 1, 8, 17, 18 & 19 are falling completely (100%) within the area.
- Coal Block No. 12 (Kente Extension) is falling almost upto 90% of area within the catchment.
- A total of 2 coal blocks *viz.*, Nos. 7 and 16 are falling as much as 50% of area within the catchment.
- The PEKB coal block (14) is falling as much as 20% of area within the catchment.
- The remaining 4 coal blocks *viz.*, Nos. 9, 13, 15 and 21 are falling partly within the catchment, which is considered relatively very negligible.

- As the area under this stream catchment is quite large and varied than the other stream locations in the HAC in terms of physiographic features including, land use, forest cover, drainage density, etc. The proposed open cast coal mining is most likely to have significant influence on the quality and quantity of the riparian forest as well as ecology of stream water courses.
- The aquatic biodiversity and biological water quality of the streams originating from the Chornai basin are much varied towards higher side of the quality than that of the other stream locations in the entire HAC. Therefore, the area needs much attention in terms of conservation of the dense network of streams as well as the forest tracts, which is much influenced by the relatively different physiographic features prevailing in the basin.
- The cumulative impacts of the proposed open cast coal mining in the identified 8 coal blocks *viz.*, Nakiya-1 (I, II & III), Morga south (7), Gidmuri (8), Puta Parogia (16), Parogia (17), Saidu (18) and Pindraki (19) falling within the Chornai watershed area and its entire stream channels are observed to be quite significant. The open cast mining for coal in this area is most likely to contribute significant fragmentation in the stream channels as well as the dense riparian vegetation of the catchment leading to alteration of the drainages/hydrological regime, reduced stream/water flow, increased erosion, increased sediment deposition on the stream channels/and in the Hasdeo-Bango dam and other related environmental issues.
- ***In summary, the proposed open cast coal mining in the 8 identified coal blocks falling within the Chornai basin should not to be recommended in view of increasing demand in conserving the relatively dense moist-dry deciduous sal dominated forest tracts intersected by dense stream channels of the higher order characteristic to the basin.***

- *Although Kente Extension (12) is part of the catchment, mining in this coal block may be permitted as it is under advanced stage of commencement of mining. However, appropriate conservation measures of surface water management, afforestation to control erosion from disturbed landscapes, sediment and siltation in stream water courses, maintain the required minimum flow in the important stream channels, gap plantation with native vegetation to strengthen the riparian buffer zone, catchment area treatment plan for the individual as well as the cluster of coal blocks, etc., should be implemented to mitigate the impacts of mining on environment.*

The **Ton-Teti watershed** as well as catchment other small streams (*viz.*, Bisrar Nala/ Dhajag Nala/ Bamni-Manasi Nala/ Maniari Nala, etc.) are drained by a total of 10 coal blocks *viz.*, Morga-I (3), Morga-II (4), Morga-III (5), Morga-IV (6) Morga South (7), Paturia (9), Madanpur North (10), Madanpur South (11), Tara-Central (15) and Puta Parogia (16) are falling within these stream networks are directly draining into the Hasdeo River at the upstream of the Reservoir.

- Of all the coal blocks, **six** are falling completely (100%) within the catchment (Morga-I, II, III, IV; Madanpur North, Madanpur South).
- Paturia (9) falling as much as 90% of area within the catchment.
- Morga south (7) falling as much as 50% of area within the catchment.
- Puta Parogia (16) falling as much as 30% of area within the catchment.
- Tara-Central (15) falling as much as 10% falling within the catchment.

- Also, many of these proposed coal blocks falling within the above-mentioned catchments are quite significant in terms of its proximity to the Hasdeo River, which is running west of these coal block cluster as well as the Hasdeo-Bango reservoir. Moreover, the vegetation density and the stream networks are much significant in the area downstream to these catchments. Hence, the proposed mining in the coal blocks is most likely to have profound influence on the aquatic system/stream networks of the catchments as well as its riparian forest ecosystem. However, the upstream forested location within the catchment is relatively plain area and is much disturbed in terms of its forest cover owing to anthropogenic influence both in the forest as well as the catchments of major drainages.

10.3.4 Socio-Economic *vis-a-vis* Biodiversity Values of HAC

The HAC is a notified *Scheduled Area* under the 5th Schedule of the Constitution of India due to preponderance of tribal population. The society is dominated with scheduled communities to the extent of 76.33% of total population, comprising of scheduled tribes (69.74 %) and scheduled castes (3.92 %).

- A total of 142 revenue villages are situated in rural areas and in the fringes of the forest (Figure 10.19) within the landscape Hasdeo-Arand Coalfield region having a total population of 124948 belonging to 28948 households (HHs).

- The average population density is 95 persons per sq. km and the average family/household size of 4.32 individuals with an average sex ratio of 981. Household population is dominated with age group of 6-15 followed by 16-25 years age group.
- Ethnic groups inhabit in the HAC represented with 24 STs, 12 SCs, 23 OBCs and 05 general communities amongst the notified ST, SC and OBC communities of Chhattisgarh state.
- No particular vulnerable tribal group (PVTG) were recorded or reported within the core zone of any of 23 coal blocks. However, Birhor PVTG were reported from Lalpur village of **Lalpur Gram Panchyat of Poundi-Uproda CD block, Korba district; and Pahari Korwa is reported to be inhabited in Kadamjheriya village, a solely Pahrai Korwa inhabited tribal village.**
- Majority of land holding pattern of households comprises of marginal and small. Overall 89.39% of total working population are engaged in agricultural related activities, 9.46 % as other workers and 1.22 % as household industrial workers.
- Weekly markets locally known as "Haats' satisfies the daily needs of the local communities and provides an opportunity to sell their minor farm produce, forest produce and handicrafts to supplement the household income. Surplus paddy production is sold at Primary Co-operative Societies by medium and large farmers.
- Paddy is the main crop and taken as single crop during kharif season besides Maize, Kodo, Kutki, *etc.* Wheat is grown as rabi crop in irrigated areas and low laying areas to a limited extent. Average productivity of Paddy is 13 quintal/ha, Maize (18 quintal/ha) and Wheat (13 quintal/ha). Vegetable and fruit production are mainly for subsistence use; however, the surplus vegetable and fruit production, are sold in weekly markets.
- There are about 25,494 priority and 9,831 Antodaya (poorest of poor) eligible ration card holders (HHs) for subsidized ration as on 2020-21 as per the provision of National Food Security Act 2013 in HAC.
- Area under village forest land use is 398.74 sq.km that fall within the 23-coal blocks (Census of India, 2011), nearly 98.57% households are dependent on forest for fuel wood, fodder, small timber, non-timber forest produce for their livelihood and sources of income.
- Annual household fuel wood removal from forest estimated to be 2.47 tonnes with a maximum of 4.12 tonnes by the villagers living in fringes of Lemru forest range of Korba Forest Division and a minimum of 1.7 tonnes by villagers in the fringes of Udaipur forest range, South Surguja Forest Division. The annual fuel wood dependence on forest was estimated at 0.07 million tonnes.

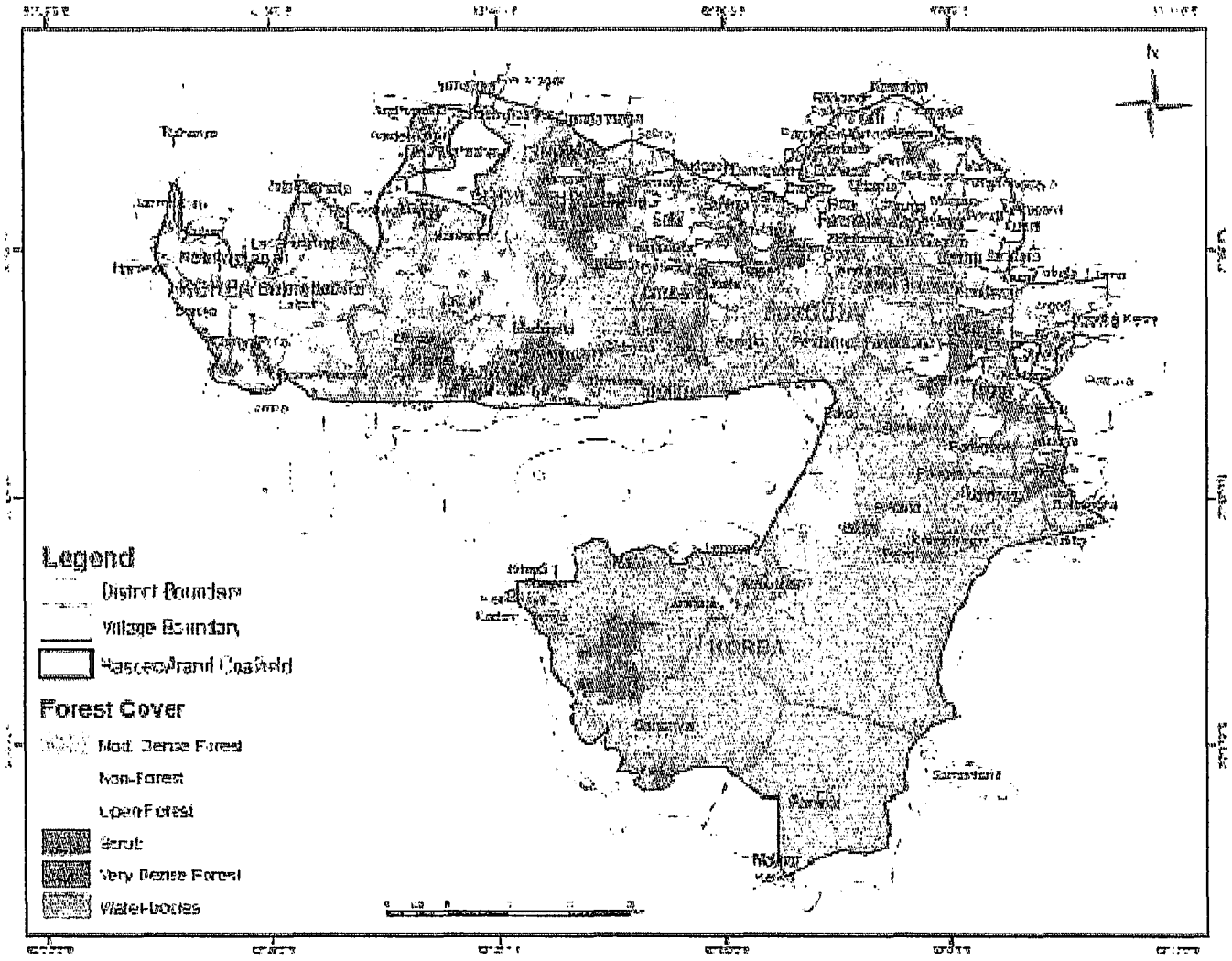


Figure 10.19: Map showing forest fringe villages in Hasdeo-Arand Coalfield area that falls in Korba, Surguja and Surajpur districts of Chhattisgarh

- Annual household dependence on forest for small timber is estimated to be 6368.56 cu m and the household heavily (97.37%) depend on forest for fodder and NTFPs.
- There are about 129 Tendu leaves collection centres belonging to 10 Primary Co-operative Societies under 04 district unions in the study area. During the 2019 season Tendu leaves removal from study area was around 20,003 standard bags of value Rs .80 million from HAC. In addition, unregulated trade of Mahua, Chirongi seeds *etc.* also contributes to substantial income to house hold.
- In the past cattle rearing in the HAC were mainly used for ploughing, cart pulling and as source of meat. However, the same has increased due to increased usage of milk and the livestock composition comprises of cattle (76221), goat (62533), buffalo (14767) and pig (2043).
- Total 128455 Adult Cattle Unit (ACU) are dependent on forests for grazing, sources of fodder in addition to agricultural crops waste and road side grazing. Majority of the (96.70 percent) households graze their livestock in the nearby pasture and forest land. Per capita annual fodder requirement is estimated to be 9.10 tonnes/ACU accounting for 1.13 million tonnes as annual dependence on fodder from forest.
- There is no place of religious, cultural, and archaeological importance within core zone of any coal block. However, there are three Archaeological sites namely Jogimara caves & Sita Bengra caves and Mahespur Shiva temple notified by Archaeological Survey of India (ASI) which are falling in influence zone (*i.e.* 10 km aerial radius) of PEKB and Laxmangarh Coal blocks respectively.

Hasdeo-Arand Coalfield (HAC) area is home to a large and vulnerable population, most of them are Scheduled tribes and others area traditional forest dwellers. Over 90% of the residents are dependent on agriculture cultivation and forest produce for their livelihoods. The watersheds are the most important sources for their livelihood activity that maintains the environmental service to the area on which they are dependent.

- Overall, the livelihood of the community inhabiting in the HAC region and their *subsistence* will adversely be impacted due to large-scale mining in the form of loss of forest land, agriculture land, water sources and related produce as majority of the populations are highly dependent on agriculture and forest produce for their livelihood and sources of income.
- The HAC there are nearly 129 Tendu leaves collection centres belonging to 10 Primary Co-operative Societies. During the 2019 season Tendu leaves removal from HAC have contributed a value of Rs 80 million indicating the rich resources and dependency on the forest produce by the local community.
- The average annual household income of sampled households was estimated to be Rs. 86,341/-; of which Rs. 17,195/- from forest; Rs. 28,381/- from

- cultivation and Rs. 40,763/- and secondary sources of income like manual casual labour in cultivation/agriculture, jobs and business.
- The estimated average monthly income was Rs. 7195/- out of which Rs. 1432/- from forest, Rs. 2365/- from cultivation and Rs. 3396/- from secondary sources such as labour in cultivation /agriculture etc.

- *Coal mining if allowed in all 23 coal blocks the cumulative Impact in terms of fragmentation of streams/hydrology and resulting reduced flow, loss of forest land and forest produce, agriculture land and allied dependency on agriculture and forest produce will have serious negative impact on the community in terms of loss of livelihood, identity and culture.*

10.4 RECOMMENDATIONS BASED ON THE FINDINGS OF THE BIODIVERSITY STUDY

10.4.1 Floral Diversity

10.4.1.1 Recommendation

The following are the recommendations that include the coal blocks that are in operation:

- Assisted regeneration, soil and water conservation measures in the entire HAC and around the Forest fringe villages, buffer area forest in the coal blocks that are in operation.
- It is essential to create a greenbelt along transport road keeping in view the exceeding the prescribed limit of 45 dB (A) night time noise levels in rural / residential area (Based on the Monitoring report - during October, 2018 to March, 2019 and April 2020 to September 2020) and to avoid deposition of dust on the agriculture crop and forest in PEKB coal block.
- Mine dust should be suppressed by enhancing the greenbelt along the transport road, coal washery and coal handling plant to avoid emission in view the exceeded the permissible limit values (six-monthly monitoring report during October, 2018 to March, 2019 and April 2020 to September 2020) of Particulate Matter ($PM_{2.5}$ & PM_{10}) in PEKB coal block. The greenbelt will act as a barrier to trap the suspended dust particles and also suppress the dust and noise emission. Emphasis may give for creating greenbelt with tall seedlings (of more than 1 m height) of indigenous species for early establishment and good survival.
- Intensive bio-engineering measures in and around the mine lease block areas as per the specific conditions laid down by the MoEF&CC should be strictly implemented in PEKB coal block.

- The 13 RET species were recorded from the core and buffer areas of Parsa (13), PEKB (14), Kente Extension (12) and Tara (15) coal blocks, which are to be conserved in the same habitat (*in situ conservation measure*) in the buffer area of the coal blocks to enhance their population whenever encounter during mining operation in the core areas of PEKB, Kente extension, Tara and Parsa coal blocks are given below:

Sl. No.	Name of the species	Threat Status
1.	*Aegle marmelos*	R
2.	*Andrographis paniculata*	VU
3.	*Aristolochia indica*	NT
4.	*Asparagus racemosus*	T
5.	*Chlorophytum tuberosum*	VU
6.	*Drosera indica*	R
7.	*Drosera burmanni*	R
8.	*Habenaria diphylla*	R
9.	*Homalium nepalense*	R
10.	*Ophioglossum reticulatum*	R
11.	*Premna herbacea*	R
12.	*Pterocarpus marsupium*	VU
13.	*Uraria picta* (Jacq.)	VU

Awareness programme should imparted to the fringe village communities to reduce anthropogenic pressures on the forest.

- The presence of 33 species is a vital information about the niche and amplitude of RET in HAC. A detail survey on the RET species shall be undertaken for identifying priorities in the HAC.

10.4.2 Terrestrial and Avi- Faunal Diversity

10.4.2.1 Recommendation

Study conducted by WII shows that Hasdeo-Arand Coalfield (HAC) supports rich faunal biodiversity especially mammal species and the area harbors forest-dependent communities. The forest cover and forest type maps prepared by ICFRE for the entire HAC area and the coal blocks; forest density at forest compartment level indicates that the area is comprised of diversified moderately high and very dense forest habitats

- Based on the baseline survey, it evident that HACF and the landscape surrounding is rich in biodiversity and supports an intact faunal diversity typical to peninsular India. Even the habitats within the coal blocks (both proposed and operational) support wildlife, particularly the threatened species of mammals. The area supports rich biodiversity with a multitude of mammalian species including elephants and also the area harbours forest-dependent communities. Therefore, sustaining the forest cover and maintaining its overall ecological integrity is essential. It is pertinent that Chhattisgarh Forest Department with due consultation and involvement of

local communities identify areas for declaration as conservation reserves. Under the ambit of a conservation reserve, habitat improvement activities such as restoration of grasslands and restoration of degraded forests; improving surface water availability for wildlife in relatively drier tracts during summer, controlling of forest fires, and improving overall protection can benefit wildlife.

- Elephant occurrence in HACF and the landscape surrounding it, is not limited to any particular portion, but spread throughout. Elephants use the area as both habitat as well as corridor for movement. With respect to human-elephant conflict, there are records of crop loss, property loss and even loss of human lives. Considering this, landscape-level HEC mitigation strategies at a larger spatial scale is essential.
- The Human-Elephant conflict mitigation strategies in the HACF and surrounding landscape should include the following:
    - Maintaining the ecological integrity of intact natural habitats without fragmentation and degradation is critical. Any additional mining leading to loss of habitat would escalate HEC unpredictably high.
    - Formation of landscape-level Rapid Response Teams by engaging village youth with adequate remuneration is essential. The RRT members should be adequately trained in elephant behaviour and conflict management methods.
    - Judicious use of mobile barriers in select areas of HACF and surrounding landscape where HEC is high need to be experimented with active community participation.
    - *Ex gratia* payment for crop, property and other losses due to elephants have adequately and timely. The overall process of filing and obtaining compensation by villagers should be made smooth and transparent
    - Habitat enrichment by improving surface water availability has to be carefully selected. Development of grasslands and fodder based on the list of plants suggested in the report, and protection of critical micro-habitats such as riparian tracts are critical.
    - Human-elephant conflict is dynamic in nature. The above-mentioned mitigation measures need to be experimented in smaller areas and based on the evaluation of efficacy can be scaled up.
- A total of 25 mammalian species are found. Evidence of some endangered species like elephant (*Elephas maximus*), grey wolf (*Canis lupus*), sloth bear (diurnal spp.), Indian Pangolin (*Manis crassicaudata)* and Honey badger (*Mellivora capensis*) (nocturnal spp.) were recorded from the core area. Hence, considering their threatened status, a long-term monitoring (at least once in two years) and status survey are recommended for effective conservation plan.
- Progressive restoration to compensate the biodiversity and forest habitat loss through implementing compensatory afforestation program, by means of improving the habitat quality of alternative afforestation sites, also developing natural grasses on same sites for reducing biotic pressures on the forest

resources outside the mine lease area as well as for increasing livelihood income. In addition, habitat restoration and improvement through enriching the area with grasses and other fodder plant species preferred by elephant and herbivore spp.

- The HAC and surrounding supports high species richness of birds including winter migrant from Himalayan region. Among 92 species reported, 28 species are found to be hole nesters. Therefore, recommended for Nesting Niche for Hole Nesting Birds with conservation and action plan in the BMCP in Volume II, WII report, page no. 199-204,
- The post mining land use area indicated 2127 ha as backfilled and 260 ha as mine-pit or void. These areas have been suggested for developing mine pit wetlands to create wetland habitat for enhancing the local aquatic biodiversity.
- Development of biological intervention measures i.e. biofilter check dams, etc., so as to reduce mining impacts on hydrological regimes.
- Greenbelt development in and around the sites such as mine and washery plant, infrastructure areas and roads for reducing impact of air pollution and dust on forest fauna and flora.
- Physical and biological enrichment of mine waste dumps through eco-restoration program.
- Suggestion to monitoring the unregulated vehicle movement and also, construction of underpasses within project area and other approach roads to reduce wildlife mortality in the area.
- Habitat enrichments with indigenous fodder species in the degraded forest and habitat connectivity whereever required to facilitate the elephant, ungulate and meso carnivore's movement.
- Artificial birds' nest for facilitating nesting niche for hole nesting birds are detailed in BCMP section 9.3 and 9.3.3 of WII report Volume -II.

A comprehensive **Biodiversity Conservation Management Plan** (BCPM) has been recommended in the EIA report of IIFM focused on the following three levels for conservation which should be implemented:

i. Species group specific conservation plan– habitat/niche development

Suggested for development of habitats niche for different species groups i.e. butterfly, reptile, hole nesting birds, small mammals (denning species) and wetlands spp., at sites such as mine lease and human habitat area, protected forests, reclaimed mine lease areas and greenbelt areas, mine lease dump and mine peat wetland, respectively.

ii.Threatened species conservation plan

Recommended for habitat development plan for some large endangered/threatened species such as sloth bear (*Melursus ursinus*), four-horned antelope or Chousingha (*Tetracerus quadricornis*).

iii. Biodiversity resource use by the local communities

Vegetation and fruits – organic farming program i.e. apiculture and aquaculture, particularly and their associated awareness education activities.

10.4.3 Drainage and Aquatic Diversity

10.4.3.1 Recommendation

Most villages in the HAC area are dependent on agriculture and forest produce for their livelihoods. The entire HAC area forms the watershed of the Hasdeo-Bango reservoir on the Hasdeo River, which is a tributary of the Mahanadi River. A relatively smaller part of the HAC area is also drained by Rehar River, part of the lower Ganges Basin.

The major streams of HAC are of perennial in nature and are very important in mainatining the ecological services of the landscapes. **Chornai Nadi:** It is an important sixth order drainage that spread across almost half the area of entire HAC. It is fed by two fifth order streams (i) the **Chornai Nala** (ii) the **Rapta Nala (Lemru)** that contributes to the maximum flow in the chornai watershed and to the **Hasdeo-Bango Dam**. The mitigation measures for the probable impacts arising out of mining on the aquatic resources and biodiversity of the area are summarized as follows:

- In case of the active coal block (PEKB), the open cast coal mining has resulted in significant impacts on the local water courses and aquatic environment. The natural stream from Ghatbarra area towards north has now been connected to the catch water drain along the southern boundary of the first Phase of the PEKB for facilitating the progress of mining. Adequate flow should be ensured and regulated during monsoon to prevent erosion.
- The surface drainage that fall within the core and buffer zone of the mine blocks will be greatly affected due to retention, flow restriction, low discharge and drainage condition. Opencast operations on river bank, stream and water course will accelerate such alteration. To restore the natural river flow, mining and dumping of spoil in channels should be avoided, and concurrent reclamation of opencast mines should be implemented. Continuous flow monitoring and quantitative assessment of the water budget would aid further investigations on the cause and effect of hydrologic disturbances and future efforts at restoring stream flow.
- To ensure the availability of alternate sources of nutritious food together with income earning employment as well as to reduce the dependence on the rivers/streams, community level pisciculture (in the mode of co-operative societies/SHGs)/NGOs) should be explored with the help from concerned local government bodies as well as technical guidance from local Agriculture Universities.

- The prospects for potential indigenous food fish like *Cirrhinus reba, Barilius bendelisis, etc.*, through aquaculture shall be explored. The seedlings propagated elsewhere shall be released in to the local waters especially large water bodies for enriching their population and for utilization as food. Intensive cultivation can be attempted in appropriate area and season when water is available in plenty in association with State Fisheries Department.
- The Coochbehar Fisheries Department has set an example for enriching the fishery potential with aquaculture and stocking of small indigenous fish species in varying magnitude for the welfare of the community and protection of the environment. The details of the same shall be obtained. (http://coochbehar.nic.in/Fishery/HTMfiles/Fishery_Photos.html#)
- Introduction of exotic species like Tipalia, African Catfishes (which is otherwise banned by law), *etc.*, should not be encouraged as they pose potential threat to the indigenous fishes.
- As envisaged in the Biological Diversity Act, 2002, setting up of a Biodiversity Management Committee in every local body is essential for management of issues related to aquatic biological diversity in association with State Universities, NGOs and other stakeholders. This would contribute enormous information to the People's Biodiversity Register (PBR), which is envisaged under the BDA, 2002 as a valid document for the exclusive right of their resources.

10.4.4 Socio-economic *vis-a-vis* biodiversity value

10.4.4.1 Recommendation

Most villages in the HAC are dependent on agriculture and forest produce for their livelihoods. The forest also the watershed of the Hasdeo river, which is a tributary of the Mahanadi River a lifeline of the adjoining states of Chhattisgarh and Odisha. Considering the importance of the indigenous community and the traditional forest dwellers dependency in the HAC on natural resource for their sustenance, lifestyle and livelihood strategic planning would be required to safe guard the community welfare and rights.

- A total of 33 villages are falling in core zone of the coal blocks having 6,434 HHs that are likely to be affected or displaced either as home oustees or land oustees or both home and land oustees if the mining is allowed. These villages fall within the mine lease of the coal blocks would require resettlement & rehabilitation specific to tribal notified area, if mining is allowed. However, considering the traditional vulnerable community in the study area requires strategic planning and consultation with the community to protect their right, as the resource provide home, economic sustenance to the ethnic community.

There are five (05) Particularly Vulnerable Tribal Groups (PVTGs) reported from Chhattisgarh state and of which 2 PVTGs are reported to occur in HAC:

- A study may be initiated to document the PVTG population to document their exact population number to ensure their livelihood within HAC. They migrate from one place to another in search of natural resources during different season.

10.5 OBSERVATION ON THE CONSERVATION MEASURE AND RECOMMENDATIONS

10.5.1 PARSA EAST & KANTA BASAN (PEKB)

10.5.1.1 Geological reserve

The coal block is a fully mechanized open cast mine with a state-of-the-art technology for coal beneficiation through coal washeries and dispatch of coal through rapid loading system with a dedicated 75 km railway line from mine head to Surajpur Railway Station on Bilaspur-Ambikapur route of South East Central Railway. Computerized mine planning is deployed at PEKB OC Coal Mine for surveying, production scheduling, *etc.*, and the same may be further strengthened. The total geological reserves estimated are 516.40 million tons. Exploration reveals, occurrence of thin coal seam varying thickness from 0.2 m to 0.98 m below the coal seam IV, with parting of about 50 m thick.

- ***Mining of such thin coal seam of less than 0.5 m with more than 50 m thick parting may not be economical; therefore, concurrent backfilling of mined out pit will not adversely affect the interest of mineral conservation.***

10.5.1.2 Mining and ore transportation

Three operators are engaged to work in the 6.12 km entire strike length of coal seams has contributed to increase in movement of vehicles within mine pit and mine roads; the width (800 m) of the quarry is not sufficient to accommodate such increase in traffic.

Parameters	Dimension
Length of quarry	6.12 km (approx)
Width of quarry	800 m (approx)
Depth of quarry	45 m (approx)
Area of quarry	731.5 ha (approx)
Coal seam exposed	Two (Seam No IV &V)

- There is no full-proof traffic system for dumpers, for haulage of OB. Coal transportation road does not have sufficient width and at many places and did not provide one-way traffic for all the haul roads.
- Haul road within the mine is quite steep (gradient more than in 15). Road surface of bench roads and haul roads in the mine and ramps/approach roads is

found to be quite rough/bumpy, undulating and need proper grading on regular basis.

- Some part of the road is being used even by light and heavy vehicles including 'U-turns', due to scattered mining operations over a strike length of 6.12 km results in very large network of haul roads which is quite unsafe. Haul road management require adequate improvement.
- *In pit* conveyer belt is under construction at the middle of the mine pit; two external dumps and two internal dumps are planned on eastern and western sides.
- Considering operational convenience, proximate to dumping site, ore loading point and to minimize lead distance, it is suggested:

  - ***to operate the mine on the western and eastern end intensively up to bottom of coal seam without opening lengthy mine face with simultaneous concurrent backfilling and advancing mining operation at the middle of the mine pit to minimize land degradation at any point of mining operation.***

  - Similar Mining operation may be adopted during the IInd phase of the mining; accordingly, mine planning needs to be envisaged and implemented as suggested above in bold.

As per the Environment Clearance (EC) condition stipulated by the MoEF & CC that the "coal transportation is to be made through *in pit* by belt conveyor from *in pit* to pithead coal handling plant; surface to siding by belt conveyor to Pre-weigh Bin and loading at siding by SILO with inbuilt Rapid Loading System".

- The *in-pit* belt conveyor is yet to be commissioned, which is under advanced stage of its construction.
- SILO-1 was collapsed during Feb 2020 and the same was under construction (as on February 2021). In addition, SILO-2 is also under construction.
  - ***Closed conveyer system and SILO-1 needs to be completed and commissioned at the earliest, so that vehicle movements in the mine pit shall be kept minimum to reduce dust emission and noise pollution.***

The approved mining and mine closure plan envisage cumulative stripping ratio up to 8th year of mining is 4.13 cum/ton. It was observed during the study in September 2020 (9th year of mining operation) that a total overburden generated is 146.32 million cum and coal extracted is 63 million tons, which accounts to the stripping ratio of 2.32cum /ton.

- The stripping ratio is much lesser than envisaged indicating that the ***mine development is not in commensurate with quantum of extraction of coal as***

- ***envisaged in the mining plan.*** Therefore, overburden benches have to be advanced sufficiently to ensure safe, scientific and sustainable mining.
- Backfilling of mine pit **has not been progressed** as proposed and shown in 5th year Mine Stage Plan.

10.5.1.3 Environmental Measures

Environmental monitoring of air, water and noise level was reviewed and observations are as follows:

- The monitoring stations are located in Coal washery and mine pits. The average values of particulate matter recorded at 10 locations during the six-month period (October 2018 to March 2019/April 2020 to September 2020) indicated that the **Particulate Matter ($PM_{2.5}$ &PM_{10})** ***has exceeded*** the permissible limit values of 40 and 60 µg/m3.
- Effluent samples from STP treated water, workshop ETP water and mix drain water at settling point analysis results showed value of lead is 0.71 mg/l at workshop ETP water, 0.50 mg/l at mix drain water and 0.20 mg/l at STP treated water, which is ***above the permissible limit of 0.1 mg/l.***

Dust suppression system are provided at CHP, coal washeries and coal conveying system. Pressurized water spraying system at railway siding for stacking and dispatch of coal washery rejects is provided. Surface miner deployed for coal extraction has wet cutting system for dust suppression at coal benches/faces.

- Mitigation measures adopted for dust suppression at mine pit, OB excavation area, haul roads and waste dumps (internal dumping) ***are quite inadequate.***

- ***Utilization of surface miner is made in coal extraction and not in loading facilities.*** Same may be utilized to reduce dust generation.

10.5.1.4 Efficacy of Mine Closure Plan

Overburden removed is dumped initially in two external dumps located in non-coal bearing area at northwestern and northeastern parts of mine lease and subsequently backfilled at de-coaled/ mined out area.

There are two external OB dumps *viz.*, East & West External OB Dumps spread over an area of 112.98 ha and 25.71 ha respectively. The Eastern part of external OB dump has reached up to 58 m height with 3 to 6 terraces/decks and its slope angle is ranging from 25^0 to 35^0. The West External dump located on the north-western side of the lease has reached 32 m height with 2 to 3 terraces/decks and slope angle vary from 25^0 to 35^0.

- ***It was observed that the terraces width is much lesser, and the reclamation & rehabilitation activities over eastern external dump is not effective.***

- *Formation of gullies and deep rainwater-cuts over the East external dump slopes are prevalent, such erosion is threat to the stability of grown up trees/plants on slopes.*
- The physical stabilization and biological reclamation of West external dumps is comparatively stable, however with minor failures of dump slopes, which is being rectified/revamped.
- Although, terracing (decking) has been done on the internal backfilled dump, width of terracing at few places is observed to be inadequate for two-way traffic of 35 tonne dumpers.

The Progressive Mine Closure Plan has furnished and envisaged for land use of pre-mining, during mining and post mining. Accordingly, at the end of 5th year and 10th year of mining operation, area to be excavated is 825.64 ha and 1226.34 ha and area to be backfilled during the same period is 586.87 ha and 957.77 ha respectively. The envisaged proposal indicates that 71% to 78% of mined out land has to be backfilled between 5th and 10th year of mining operations. The observation (survey by the ICFRE team) during 9th year of mining operation as on December 2020 indicates that only 58.71% of mined out area were backfilled, ***which is much behind the scheduled proposal.***

- ***It is suggested to undertake intensive mining i.e., mining in smaller strike length up to the bottom of the coal seam with simultaneous backfilling instead of extensive mining of opening mine pit for longer strike length and not compliance to the progressive mine closure plan for backfilling within the stipulated time, to minimize quantum of land degradation, soil erosion and sedimentation in the drainage.***

The mine closure plan has an inbuilt mechanism for providing retaining walls at the toe of dumps and the unstable overburden benches to prevent wash off from dumps; sliding of material from benches and construction of water channels /garland drains.

- The PEKB Mining lease area do not have Perennial River, however 3 first order seasonal streamlets flowing north easterly, northerly and north westerly join as second order stream and flow towards north western corner of the lease boundary and ultimately join to Salhi Nala, a tributary of Atem Nala.

- About 60% of annual rainfall is within a period of two months and an average single day rainfall of 100 year's average is 243 mm and mine operation will disrupt the hydrology and surface water runoff to the vibrant streams. The Hydrogeology study report enclosed with mining plan indicated that the average rainfall of the area is 1400 mm and the monsoon rainfall (June to October) is 1384 mm. Based on the indicated rainfall data the runoff for PEKB mining block of 27 sq.km area was estimated to be

generated nearly 8.88 million cubic meter water and flow as runoff. In addition, the mining conditions increase percolation of water and increase groundwater runoff from 10% to 21% of rainfall.

The surface run is not addressed scientifically to plan garland drains dimension and dumps configuration, etc. Increase of surface water runoff in post mining conditions may damage toes of the dumps, if proper drainage channel is not provided.

- *The ground water study report (enclosed in MP & MCP) suggested for garland channel/ drains of required size, which is capable to flow 76 m^3/sec of water during peak runoff period without any logging and blockage.*
- *Also, suggest that the channel should be trapezoidal shape having width of 6 m and depth of 2 m. The garland channels and rainwater drains provided does not meet this specification and ultimately resulted to breaching of dumps toes, sliding and siltation.*
- *The study area is quite prone to erosion resulting in severe damages to the structures occur especially during every heavy raining season. Necessary repair works of the damaged structures are being taken up periodically by the PEKB mine.*
- *The East external OB dump is slopping towards NW; where, a significant amount of surface water flow towards the downstream direction. Therefore, adequate protective measures like, properly designed toe/retaining wall and different types of gully control measures (Gabion check dam, loose boulder check dam, brush wood/log wood check dam, etc.) should be provided to prevent the increasing pressure of erosion during rainy season.*
- The Reclamation and Rehabilitation measures adopted on the West External Dump is satisfactory in terms of physical measures adopted for prevention of erosion and stabilization of slopes, surface water management measures such as toe wall and garland drain as well as stabilization vegetation including tree species and plantation maintenance thereof.

As against the estimated quantity of top soil i.e., 76,58,955 cum, a quantity of 19,47,331 cum have been excavated since inception of the mine, of which 19,37,251 cum have been utilized so far for covering on top of the physically reclaimed waste dumps and the remaining quantity of 1,00,800 cum is observed at the site during the field visit as on October 2020.

- *The top soil dump is placed by the side of approach road from Basen, east of the East external dump. It is placed approximately 3-5 m height from surface and is not provided with any prominent physical measures to prevent erosion. As the area is more vulnerable to erosion, stacking topsoil for a longer period is not advisable and therefore, it must be utilized properly at the earliest.*

The Progressive Mine Closure Plan (PMCP) has proposed to utilize the rejects generated from the washery for generation of Fluidized Bed Compression (FBC) based Thermal Power Plant in accordance to EC condition obtained during 2011, however in the EC dated 10.08.2018 indicate that (i) Transportation of raw coal, washed coal and the rejects shall be through rail and (ii) Disposal of washery rejects shall be in accordance with the extant policy and guideline, and environment friendly.

- Coal having capacity of 10 MTP, which upgrades the coal to 30% to 31% ash content and this quality of coal contributes 70% of production and weight percentage of the reject generation is 10 to 11 %. Coal extracted from Seam V and VI are G 7 quality with ash content vary from 48 to 52% is fed to Dense Media Cyclone of 5 MTP capacity and upgraded to 31 to 32% ash content, which contributes 30% of production and reject generation is 36 to 37%.
- ***Till end of September 2020 total coal reject generated is 10.85 million tons. It is reported that the rejects generated from beneficiation of raw coal of Parsa East & Kanta Basan coal mine are disposed of to end user plants with prior approval of Coal Controller's Organization.***

LED lighting system is provided at the periphery of the mine (pit), working places and haul road, ***however it is found to be quite inadequate and needs strengthening.***

Use of helmets and other Personal Protective Equipment's (PPE) is quite satisfactory, but ***persons deployed at the mine (mostly by contractors) are not using dust masks to protect themselves from inhaling micro-fine coal and siliceous dust. It must be enforced and monitored.***

10.5.1.5 Reclamation and Rehabilitation

Overall, the Rehabilitation and Reclamation, including biological reclamation, has been implemented over an area of 135.62 ha (61.88%) of the total physically reclaimed backfilled area.

- ***Biological rehabilitation measures implemented for the in-pit dumps are found to be adequate, with afforestation of suitable mixed native tree species.***

The details of total extent of biological reclamation/afforestation of the backfilled dumps are as follows:

Biological Reclamation of the Internal Backfilled OB dumps			
Location	**Total Area (ha)**	**Total area under plantation (ha)**	**Total No. of plants**
East backfilled OB Dump	156.27	66.47	1,66,119
West Backfilled OB Dump	273.16	69.15	1,72,934
Total	**429.43**	**135.62**	**3,39,053**

In terms of reclamation of external waste dump, as on 2020, after completion of 8 years of mining operations, two external waste dumps over an extent of 138.69 ha have been formed.

- Out of the total area of 138.69 ha under external dumping, a total number of 2,45,450 mixed native plant species have been planted over an area of 98.18 ha (70.79%).

Biological Reclamation of the external OB dumps				
Land use type	**Area (ha)**	**Total No. of plants**	**Total area under plantation (ha)**	**% *w.r.t.* total dump area**
East External Dump	112.98	1,70,900	73.18	64.77%
West External Dump	25.71	74,550	25.00	97.23%
Total	**138.69**	**2,45,450**	**98.18**	**70.79%**

Part of the eastern external OB dump is still active during the 9th year of mining operations though disposal of waste material in both the external dumps proposed in the approved mining plan till 6th year of mining operations.

- It is suggested that dumping on east external dump has to be completed on priority basis and after stabilizing by scientifically providing proper terrace/slope angle and water drains together with engineering measures, the area should be biologically reclaimed at the earliest to reduce impact on land degradation.

10.5.1.5.1 Engineering measures implemented for reclamation

- **Retaining/Toe wall** made of **Rubble masonry with Plain Cement Concrete** has been provided at a length of **1.94 km** and **1.68 km** respectively for the **east and west external OB dumps**.
- **Garland Drain** of a total length of **5.97 km** (bottom width of 3-10 m and height 2-10 m) has been provided for the East and West External OB Dumps. It is largely an earthen drain all along its length except at few locations towards the east settling pond where it has been provided with RCC walls.
- **Catch water drain with a length of 8.52 km** (having a bottom width of 10 m & height varies 6-25 m) has been provided on the southern side of the Phase-I of mining area along E-W direction.
- **Catch drains (earthen) and RCC drains** of a total length of 7.0 km and 6.71 km respectively have been provided along the haul/approach road of the mine.
- A total of 12 **settlings (earthen) ponds** of varying dimensions based on the requirement at various locations have been provided to facilitate silt settling and clean water flow from the mine lease area to the nearby natural water course.

- A total of 6 **Check dams** of varying dimensions have been provided at important locations across the catch drain towards western side to arrest the flow of silt and sediments downstream.
- A total of 8 **recharge pits** have been constructed at various locations falling within the buffer zone area of the mine lease.

10.5.1.6 Safety zone

Safety zone along the northern mine boundary is protected with proper fencing as well as planted with adequate Greenbelt vegetation of mixed native tree species.

- ***It is observed that over 7.66 ha area under safety zone is afforested with 15,017 mixed native tree species through planting and few translocated trees from the forest. Except few locations, the growth of safety zone plantation is not adequate for the purpose it is planted. Therefore, gap filling wherever mortality/water logging occurred needs to be carried out with good quality saplings of mixed native tree species.***

10.5.1.7 Other afforestation areas

General afforestation on areas other than OB dump and safety zone has been carried out with mixed native tree species:

- In summary, a total area of 30.54 ha has been afforested by planting with 49,240 plants. Details are as follows:

Afforestation Site/location	Area (ha)	Total No. of plants
Waste land	10.04	24,298
Avenue (transport/service roads)	0.80	488*
Around coal washery/stack yards	19.70	24,454
Total	**30.54**	**49,240**
*Include few translocated trees from forest		

- However, during field visit, it was observed that the plants raised near the infrastructure areas are quite bare minimum. Therefore, it is suggested that dense vegetation cover (as per the EC and FC) shall be raised and maintained for preventing the suspended particles spreading into the other areas.

10.6 OBSERVATION ABOUT OPENING THE PEKB COAL BLOCKS FOR MINING AS PER THE SEQUENTIAL MINING - NGT QUERY

As proposed in the mining plan, the mine pit has been opened all along the strike length of coal seam for a length of 6.12 km along mine surface with 650 -700 m wide and up to a depth of 40-45 m depth. The extensive mining operations is being carried out by three contractors confined to their designated area of mining in the entire strike length of coal seams. This has resulted in inadequate bench width in over burden (OB) benches ranging from 8 to 12 m than that of 20 m minimum bench width

planned. Height of the benches in OB is below 6 m and well maintained except at cross-section C-1 where on dip side three benches have height more than 6 m (534 m to 501.9 m).

- Opening of such a long mine face for extensive mining has seriously impacted the land degradation. Such practice will not only expose huge area but also result in land degradation. Such land degradation is not specific to any particular time but for the entire life of the mine.
- ***Therefore, it is suggested that opening of long mine face shall be minimized by undertaking intensive mining i.e. mining in smaller strike length up to the bottom of the ore body with simultaneous backfilling.***
- Mine benches are comparatively clean with not much of blasted/spilled material scattered on the mine faces. ***However, seepage water was seen accumulated on lower coal seam (IV) floor at surface miner operational area. Such seepage water may be properly channelized to mine sump for keeping coal seam floor clean.***

10.7 EFFICACY OF MINE CLOSURE PLAN

There are about 23 coal blocks identified by CMPDI in HAC; of which four blocks were re-allotted. The remaining 19 blocks are divided into three groups such as Group A, B and C, based on the availability of their documents:

GROUP-A: Five (05) coal blocks such as Tara, Madanpur (North), Madanpur (South), Paturia and Gidmuri have only geological, mining and mine closure proposals.

GROUP-B: Limited information is available for another 05 coal blocks such as Morga-II, Morga-III, Morga-IV, Morga South and Saidu

GROUP-C: Remaining 09 coal blocks (Puta Parogia, Parogia, Pindraki, Sarma, Laxmangarh, Bhakurma-Matringa, Kedma, Morga-I and Nakiya), no information is available.

The detailed information on the Feasibility Report, Mining Plan, Mining Scheme, Mine Closure Plan, EIA/EMP reports, etc., for the above mentioned 19 mines were not available.

10.7.1 Efficacy of Parsa mine closure plan

State of the art technology in respect of coal beneficiation through coal washeries and dispatch of coal through rapid loading system with pit head rail siding is envisaged. Strike length of coal seam along the floor of the pit proposed is 2.95 km (approx.), advancement of mining operations towards dip direction; strike length of the ore body divided into two and haulage roads of 1 in 16 gradient and conveyer are planned at the

middle of the pit. Ultimate depth of the pit envisaged is 275m from the surface/ground level.

- Assumed life of the mine is 45 years; therefore, dedicated long-term planning, simultaneous reclamation and rehabilitation for stabilizing internal dumps for periodically undertaking and reclaim completely should be formulated. Therefore, five yearly reclamation plans with definite target should be incorporated in the mine closure plan.
- One third of area acquired for mining is private land. Proposal may be inbuilt in the mine closure plan to bring back original topography and original land use to the extent possible through reclamation, which may mitigate impact on land use pattern.

10.7.2 Efficacy of Kente Extension mine closure plan

Kente Extension coal block has been fully explored by drilling 137 boreholes for cumulative meterage of 14388.8 m. Density of bore hole is 8 per sq.km. Total geological reserves estimated is 410.25 million tons, of which 323.70 million tons (79%) are minable. It is reported that coal seam IV A has been developed locally on the northern part has average thickness of 1 m with parting of 6 to 8 m, however the coal seam has not been considered for estimation of resources.

- *Resources of the coal seam and economic feasibility of mining needs to be assessed in the interest of mineral conservation.*

Open cast and fully mechanized mining proposal are envisaged in Kente Extension Coal Block with envisaged production of 9 million tons per annum and life of the mine envisaged is 49 years with stripping ratio of 3.65 cum.

- *Developing mine pit for entire strike length of 3.7 km over a period of 49 years may lead to huge land degradation for longer period. To minimize land degradation intensive mining may be emphasised instead of extensive mining, alternatively life of the mine may be reduced by increasing production level.*

Proposal has been inbuilt to have external dump accommodating 27.67 Mcum mine waste and also proposed the height of the dump will be 60 m at the end of the life of the mine, it appears that external dump will be active for entire life of the mine.

- *It is suggested to stabilize external dump at the earliest and reclaim, subsequently mine waste may be accommodated in the internal dumps/ back filling alternatively external dump may be planned as retreating dumping method so that simultaneous reclamation can take place.*

10.3 Efficacy of Chotia (sub block 2A and 2B) mine closure plan

Chotia mine has two sub blocks viz. Chotia 2A and Chotia 2B and the details are provided in the chapter-3. These two coal blocks are situated 10 km apart. Mining operations planned in both the blocks through open cast and underground methods. Open cast mining operations in Chotia 2A have been completed and mining operations suspended from September 2016. Exhausted mine pit partly converted into water sump and remaining portion is being backfilled with flyash. However, presently planned to operate some portion of Chotia 2A under opencast mining from 2023-24 onwards.

- *The haul roads do not have one-way traffic, due to limited quarry area and also there is no sufficient width for two-way traffic and movement of light and service vehicles;*
- *Haul road within the pit for OB and coal haulage are quite steep (gradient more than 1 in 15 and at some places as 1 in 12) due to very limited area of operation in the quarry. Ramp/approach road to benches in OB is also found to be quite steep (1 in 10 to 1 in 12). It is to be maintained with relatively flat gradient.*
- *Road surface of approach road to mine benches and haul road is found to be quite rough/bumpy and undulating and need proper grading.*
- *Mine benches are not clearly maintained a lot of loose material is found to be lying on OB bench faces. All such loose material should be lifted/ removed from mine benches to provide sufficient width for deployment of HEMM.*
- *Dust suppression within the mine for OB excavation, haul road for OB and coal and at waste dump (backfilling) is not found to be satisfactory and needs considerable strengthening.*
- Terracing (decking) has been done very systematically in the internal waste dump.
- Use of Personal Protective Equipment (PPE) is quite satisfactory except dust mask, which shall be made mandatory and monitored.
- *Lighting arrangement at the periphery of the pit as well as at operating benches appears to be inadequate as power supply to lighting towers is through DG Set and sufficient numbers of such lighting towers are not provided.*
- Computerized mine planning is adopted at Chotia OC Mine using 'Auto CAD' and 'Minex Software' for mine survey and calculating volume of OB removal, actual coal bench top and floor OB level. It is used by Geology Department for coal seam modelling and revalidation of borehole data earlier provided in geological report. *It is a very good practice and may be further strengthened whenever underground mining operations are planned.*

- Presently no mine water from the sump/void is discharged outside the ML area even during rainy season both from Chotia 2A (exhausted pit) and Chotia 2B pit with the result water quality in the vicinity is not getting adversely affected.
- *Chotia 2A OC Mine has exhausted and it has a very large sump with clean water. The mine area (sub-block area) has been fenced and not the quarry area. To avoid unauthorized entry towards sump area and possible accidents, the quarry area should be protected and fenced.*
- As per recent proposal (mining plan 4th revision) mine is likely to be operated by OC from 2023-24. Chotia 2B Mine is likely to get exhausted for open cast mine operation by 2022-23. *Virtually there will be two underground mining in operations (may be connected by a drive/cross cut) in Chotia sub-block 2A and one underground mining operation in Chotia sub-block 2B, which have to be planned very meticulously.*
- External dumps are close to Bango Reservoir backwaters, no protective measures adopted to arrest wash off and silting. Most of the OB dumps are active and not much attention has made to reclaim the dumps. Since the open cast operation of the Chotia 2B is likely to be completed by 2022-23, **it essential to implement all mine closure activities in respect of waste dump disposal, land reclamation and rehabilitation with suitable environmental protective measures.**
- Overall working condition of Chotia 2B coal block is not satisfactory and needs improvement in bench formation, haul road management and dust suppression system.
- *Chotia 2B coal block is likely to get exhausted for open cast mine operation by 2022-23 and proposed to undertake mining operations by underground mining method, which will have less impacts on land use and environment, which may be permitted to continue subject to conditions that present external dumps has to be stabilized, reclaimed and prevented from wash offs etc.*

10.7.4 Other blocks

The detailed information on the Feasibility Report, Mining Plan, Mining Scheme, Mine Closure Plan, EIA/EMP reports etc., for the rest of the 19 mines were not available. **In the absence of technical inputs in the field of exploration, mining and mine closure, no comments on these blocks could be offered**

10.8 EFFICACY OF TRANSLOCATED TREES

To comply with the FC condition, the PEKB mine authorities have translocated/transplanted mainly Sal saplings/trees falling under the girth class 20-60 cm from forest blocks and few other common species at various sites within mine lease in consultation with the State Forest Department (SFD). A total number of **8177**

trees belong to **18** different species have been transplanted during the period i.e., 2012-2020. They have employed modern technology and a dedicated team in the transplantation process with detailed pre-planning and post care for those trees translocated. The overall cost of transplantation has been worked out to **Rs 4,468/-** per tree excluding cost of technology and maintenance. The cost of nursery for raising the seed-based tree species is **Rs. 30/-** per seedling.

- Sal (*Shorea robusta*) and Mahua (*Madhuca longifolia*) trees having girth class of 20-60 cm together with other tree species having aesthetic & economic values have been transplanted. The Standard Operating Procedure (SoP) followed by the mine lessee is confined to suggestion by the SFD such as specific girth class of trees, site identification for translocation, pre-planning, post care for translocated trees and gap filling to replace dead trees.
- The translocated trees have been planted at random. Lack of documents/records on girth class, site characteristic, systematic translocation symptoms due to transport, damage during transport, growth pattern at translocated sites, new foliage growth, death, insect/termite/disease attack, etc., were the major the constraints to assess the efficacy of translocated trees in different sites, except for the survival.
- Translocation sites were within the PEKB mine lease area. Used *Trans-Planter Model-100d* machine along with adequate manpower for uprooting, transport and planting. Only few precautions were followed during transplanting and post-case such as pruning of branch to avoid any damage while transporting, planting of the uprooted trees on the same day, re-planting of the trees in the treated pit with fertilizers/pesticides/fungicides, watering at regular intervals, monitor for survival and gap filling for the dead one at few places either with Sal or *Pongamia* (Safety zone) or Neem (Front of Mahua Dev dump site). This was a major impediment for the team to assess the performance of the transplanted trees.
- Therefore, the efficacy assessment made by ICFRE team is confined to survival and health status of the translocated trees in 16 different translocated sites in PEKB coal mine lease area.

10.8.1 Suggestions and Recommendations

- The survival rate at few places are significant, however overall, it is poor due to lack of monitoring.
- Species and site specific Standard Operating Procedures (SoP) needs to be framed by the State Forest Department (SFD) for local species (Sal, Tendu, Char, Mahua, *etc.,)* for translocation of forest trees species.
- It is further suggested that a long-term site-specific scientific study for suitability assessment of indigenous species of HAC shall be undertaken by the SFD in association with the coal block in operation to assess the success rate and to develop species specific SoP.

10.8.2 Coal Resources

India is second highest and largest coal consuming country in the world and consuming about 11% of world production, however the per capita consumption is lowest among top 10 coal consuming countries. The coal production in India was reported with 24% shortage for the year 2017-18; and 26% shortage for the year 2018-19 against the internal demand. Import of coal during the same period substitute to 23% and 24% for the years 2017-18 and 2018-19 respectively indicating for accelerating the production to fill gap between demand and supply. However, it is important to note that USA produces coal about 25% lesser than India but consumes electricity about 40% higher than India. Similarly, Japan is 6th highest coal producer and third highest consumer of electricity.

> It is pertinent to mention that the *coal production and electricity consumption pattern indicates that the worldwide coal alone is not considered as energy mineral, alternately other source of energy like shale gas, green energy (solar and wind energy) and atomic energy are to be tapped to meet energy requirement by 2022. India too is targeting a fivefold expansion of the electricity generated from renewable energy sources by 2030.*

It is pertinent to mention that coal mineralization in Korba Coalfield exists up to 600 m depth from the surface therefore underground mining for such deep deposits adopted; whereas *coal mineralization in Hasdeo-Arand coal field persist up to a depth of maximum 250 m from surface and partings between two coal seems do not exceed 25 m, therefore feasibility in terms of economic and environmental stability shall be explored in case of any underground mining is recommended for sustainable development in HAC.*

10.9 BIODIVERSITY CONSERVATION AREA

To address the concept of sustainable development in Hasdeo-Arand Coalfield (HAC), the present study involving spatio-temporal assessment of important biodiversity attributes of the area, conducted during 2019-2021, has contributed to integrate the cumulative impacts of mining in the identified 23 coal blocks, keeping in view the large-scale changes envisaged in the open cast type of coal mining in the central Indian moist-dry deciduous Sal dominated forest tracts. Under the long-term and high-intensity development of open cast coal mining, biodiversity and ecological integrity is a concern of great importance, as it involves large scale land use land cover changes leading to shrinking of forest quality/quantity as well as alteration of hydrological regimes. The spatio-temporal baseline data on biodiversity and ecology of the entire HAC, have therefore, contributed to significant findings in terms of delineating the impacted areas in the face of vulnerability in many respects and identifying the potential areas to be suggested for conservation and management. Based on the cumulative impacts envisaged out of the field study on various

environmental attributes, **Biodiversity Conservation Area (BCA)** are suggested in HAC as described below:

10.9.1 Biodiversity and Social value of HAC

In India, the sub-tropical Sal dominated forest is covering an area of almost 10.57 million ha and that lies in the Himalayan foothill belt in Kangra region of Himachal Pradesh, and north-western region in Uttarakhand, Uttar Pradesh, Bihar, Jharkhand, and foothills of north-west Bengal in north-central region; extends up to the Assam valley (including Meghalaya and Tripura) in the north-eastern Himalayas; Madhya Pradesh, Chhattisgarh, and Orissa in central region (Orwa *et al.*, 2009; Adhikari *et al.*, 2017). According to ISFR, 2015, the naturally occurring Sal forest in Siwaliks, Gangetic plains and central India occupies about 13.6%, 2.2% and 8.9% of the total geographical area respectively (Figure 10.20). During last three decades, the Sal forests in India have witnessed increasing anthropogenic pressure of various magnitudes, resulted in habitat destruction, fragmentation of its native range, the regeneration problems, etc. The area under Sal forest is most affected owing to various developmental efforts and as a result, these forests are considerably fragmented and the fringe effects are well known. In addition, the dependence of traditional forest dwelling communities on Sal forests for their livelihood such as for NTFPs, fuel wood and fodder, forage ground of domestic animals, etc., are well prominent.

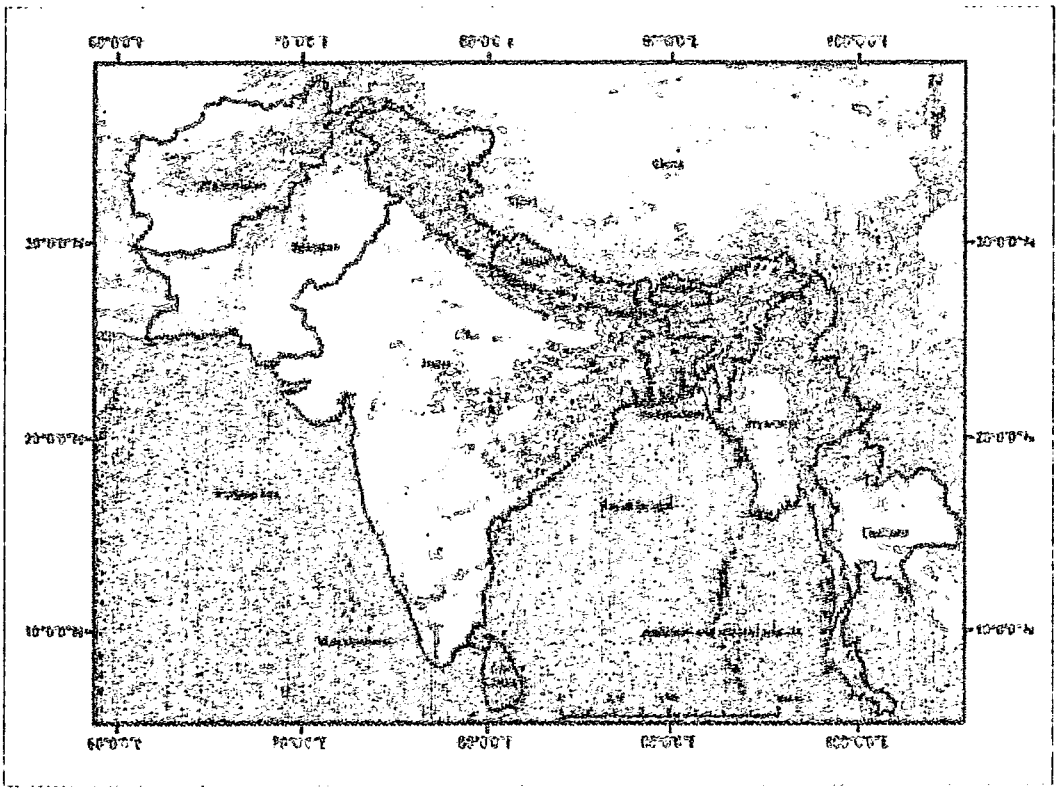


Figure 10.20: The area under Sal (*Shorea robusta*) distribution in the Indian Sub-continent (Source: *Mishra et.al.*, 2021)

Ever since the formation of Chhattisgarh state in the year November, 2000, the exploitation/sustainable utilization of mineral rich areas falling within the forests in its jurisdiction reported to face various challenges. The HAC (1879.6 sq.km) in Chhattisgarh is the third largest coal bearing area (5529 MT) which is about 9% of the coal of the state falling within the largest un-fragmented forests in central India consisting of pristine Sal and teak forests, outside the protected area network, and an important habitat for indigenous forest dwelling tribal communities and large mammals.

The large forest area under HAC with its amalgamated varied landscape/habitats like very dense forests, moderately dense forests, open forests, scrubland and riparian tracts supports rich and diverse floral and faunal components. Out of the total area under HAC (1879.6 sq.km), moderately dense forest occupies about 61.6% (1158.04 sq.km) followed by very dense forests of about 6.74% (126.72 sq.km). There are five forest types under the moist and dry deciduous forests classes reported to occur in the area characteristic to HAC (1400.95 sq.km). The study observed maximum dominance (based on high IVI) of *Shorea robusta* followed by *Diospyros melanoxylon* and *Madhuca longifolia* var. *latifolia* in HAC indicating the high regeneration capacity and greater ecological amplitude as compared to the operating PEKB and its surrounding coal blocks. Also, the stand density recorded for trees, shrub and herbs in PEKB and surround coal block recorded low as compared to the HAC indicating selective removal of lower girth class individuals in and around the operating PEKB coal block.The area under operating coal block (PEKB) and the other three contiguous coal blocks was observed with medium diverse in case of trees, indicating the overall impact due to opencast mining and allied activities in PEKB.

- Over all, the ecological processes of Sal forest in the HAC area the stand density clearly show rich diversity at the ground level, but decreasing diversity with shrub, and ultimately Sal dominance at the top canopy. Sal ecology favours a mixture of shrub species and saplings at lower level consisting of NTFPs on which the forest fringe villagers and the large mammals are dependent for livelihood and forage respectively.
- The livelihood of local communities Hasdeo-Arand area is closely dependent on forest resources and the therefore the current anthropogenic disturbance is confined to the population living in forest fringe villages for NTFPs from the forests, revenue land /forest and riparian land for agriculture purpose for their sustenance and fuel wood/fodder from forest.
- The HAC landforms are also home for rich avi-fauna and large mammals. Currently the occurrence of elephant in HAC (CSFD, 2018-19) are highly fragmented and degraded due to incompatible land use. In addition, there is continuous dispersal of elephant herd from the neighboring states of Jharkhand and Odisha. The study carried out by WII in association with Chhattisgarh Forest Department since 2017 clearly indicates that elephants have large home range because land use changes within HAC and neighboring area leading to forest fragmentation. Based on the WII findings (CSFD ,2018-2019) it is very

clear that the elephant home range is large and spreads over two or more states.

- The whole of HAC landscape comprise of 647 forest compartments spread over 12 forest ranges in 4 forest divisions. Of the 647 forest compartments, elephant occurrence is recorded in 148 compartments during the period 2018 – 2020 in all the 12 forest ranges located within HAC. Elephant occurrence is not limited to any particular part of the landscape, however it spread across in HAC landscape and surrounding.
- Home range size is a function of habitat quality- in areas that support good intact habitats, the elephant home ranges are relatively small. The study conducted by WII in collaboration with Chhattisgarh Forest Department reported that the elephants have large home ranges. Because, the forests where the elephants currently occur are highly fragmented and degraded due to incompatible landuse. Therefore the elephant herds are generally interlinked to home ranges resulting in continuous dispersal of elephant herds from the neighbouring states of Jharkhand, Madhya Pradesh and Odisha.
- The large home range results in human-wildlife conflict – in the form of crop, property and livestock losses is also a major concern.
- The estimated average monthly income was Rs. 7195/- out of which Rs. 1432/- from forest, Rs. 2365/- from agriculture and Rs. 3396/- from secondary sources such as labor in agriculture, etc. It is evident that there are 142 revenue fringe villages having 1.25 million population within HAC dependent on agriculture and forest produce for their livelihoods. For example, during the 2019 season Tendu leaves removal from HAC have accounted for Rs. 80 million indicating the rich resources and dependency on the forest produce by the local community.

10.9.2 Proposed Biodiversity Conservation Area (BCA)

The major part of HAC area forms the watershed of the Hasdeo-Bango reservoir on the Hasdeo River, which is a tributary of the Mahanadi River. A relatively smaller part of the HAC area is drained by Rehar River *i.e.*, part of the lower Ganges Basin. The major streams of HAC are of perennial in nature and are very important in maintaining the ecological services of the landscapes. The proposed biodiversity conservation of HAC falls primarily within the three watersheds *viz.*, **Gej-Jhink (north), Chornai (south) and Ton-Teti (west)**.

- **Chornai watershed** contributes the maximum flow into the **Hasdeo-Bango Dam**. Also, the area under the **Chornai watershed** assumes greater importance particularly of its driange density and forest cover in both upstream/downstream areas where thirteen (13) coal blocks are located. The forest and lanscape within the Chornai watershed observed to contibute signficant hydrological flow to the Hasdeo-Bango reservoir. In addition, relatively high rainfall in the area observed to enhance the rich and varied forest as well as riparian ecosystems.

- The cluster of four open cast coal blocks i.e., Kente Extension (12), Parsa (13), PEKB 14 & Tara (15) and other two contigous blocks i.e., Sarma (20) and Laxmangarh (21) are on the **Gej-Jhink watershed** with Atem Nadi and its headwater feeder streams flowing towards north. The cumulatve impact of land use land cover changes due to these coal blocks will have infleunece of magnitude on the forest ecosystem and the Hydrology considering the quite larger area under peril.

- The area under proposed coal blocks falling within the **Ton-Teti watershed** are quite significant in terms of its proximity to the Hasdeo River, which is running west of these coal block cluster and the Hasdeo-Bango reservoir. In addtion, the vegetation density and the stream networks are much significant in the area downstream to these catchments (Figure 10.22).

The proposed coal blocks falling within both the Chornai as well as Ton-Teti watersheds of the Hasdeo-River sub-basin, are as given below:

Sl. No.	Coal Block (No.)	Relative Occupancy (%) in Watersheds (approx.)	
		Chornai	Ton-Teti/Other streams
1	Nakiya-I, II & III (1)	100	--
2	Morga-I (3)	--	100
3	Morga-II (4)	--	100
4	Morga-III (5)	--	100
5	Morga-IV (6)	--	100
6	Morga South (7)	50	50
7	Gidmuri (8)	100	--
8	Paturia (9)	10	90
9	Madanpur North (10)	--	100
10	Madanpur South (11)	--	100
11	Puta Parogia (16)	70	30
12	Parogia (17)	100	-
13	Saidu (18)	100	--
14	Pindraki (19)	100	--

Open cast mining in the moderately dense and very dense sal-forested (moist-dry deciduous) sub-basins of the Hasdeo River in HAC is of great concern. The resultant land use land cover changes on account of open cast coal mining of this magnitude in the relatively moderately dense forest tracts intersected by numerous water courses will most likely to have significant cumulative impacts in terms of alteration of drainages and hydrological regime, etc., mainly due to reduced stream water flow, increased erosion due to high rain fall in the area resulting in increased sediment deposition on the river beds, reservoirs and other related environmental issues.

- Deterioration in the quality and quantity of surface water is of great concern and is most likely to increase further with the expansion of mining. The drainages are mainly comprising of primary and secondary feeder streams that fall within the

- core and buffer zone of the coal blocks and are likely to be severely affected due to retention, flow restriction, low discharge, reduced channel morphology, *etc.*
- Presently, two coal blocks such as Parsa East & Kanta Basan (PEKB 14) and Chotia (2A & 2B) are in operation. The land use land cover changes in terms forest cover changes due to mining in operational coal blocks of PEKB and Chotia 2A is quite evident. Therefore, cumulatively, mining, if allowed, in all the coal blocks proposed and identified, will contribute to a total loss of moderately dense forest (233.44 sq.km) and very dense forest (66.30 sq.km).
- In terms of occurrence of coal blocks within HAC, PEKB coal block is in contiguous with Tara (15) and Parsa (13) on the western side (draining to Gej-Jhink watershed); Kente Extension (12) and Pindraki (19) on the eastern side i.e., largely draining to Chornai (Figure 10.21). In addition, it is in contiguous with 10 other coal blocks of a large cluster south-westerly i.e., Morga-I (3), Morga-II (4), Morga South (7), Gidmuri (8), Paturia (9), Madanpur South (11) Madanpur North (10), Puta Parogia (16), Parogia (17), Saidu (18).
- Wildlife Institute of India has reported the occurrence of large mammals especially elephant in some of the prime biodiversity rich locations. It is evident that this area supports rich biodiversity with a multitude of mammalian species including tigers and harbours forest-dependent communities and therefore sustaining the forest cover to maintain its overall ecological integrity are essential pre-requisite for the overall wellbeing of the area. Therefore, WII has suggested:

  It is pertinent that the Chhattisgarh State Forest Department may identify the areas for declaration as Conservation Reserves with due consultation and involvement of local communities and all other relevant stakeholders. Under the ambit of a conservation reserve, habitat improvement activities such as restoration of grasslands and degraded forests; improving surface water availability for wildlife in relatively drier tracts during summer, regulating forest fires, and improving overall protection can benefit wildlife.

Considering the rich forest cover, floral biodiversity (640 plant species), occurrence of 33 Rare, Endangered and Threatened (RET) plant species and the different watersheds contributing the hydrological regime/hydrological flow; habitat for the fauna particularly mammals with large home ranges that is known to have established connectivity with proposed '*Lemru Elephant Reserve*' and livelihood dependence on non-wood forest products by the traditional forest dwelling community, the **ICFRE suggests Biodiversity Conservation area** comprising of 337 forest compartments (938 sq.km) in Chornai watershed; and 140 forest compartments (330.51 sq.km) in Ton-Teti watershed, where 14 proposed coal blocks are located, for a sustainable development and conservation (Figure 10.23- 10.25).

Further, keeping in view, the demand for coal and thereby, socio-economic and industrial development of the area under consideration for mining, it suggested that:

- *The allotted four contiguous coal blocks falling within the Gej-Jhink watershed viz., Tara (15), Parsa (13) PEKB (14) & Kente Extension (12) that are either already opened or in advance stage of getting the statutory clearances/ToR approved,* ***can be considered*** *for mining with strict environmental safe guards including appropriate conservation measures for management of surface water and biodiversity.*

- *The total extent of 4 coal blocks of Tara, Parsa, PEKB, Kente Extension put together comprises of 80.95 sq.km, having a mineable reserve of 1143.49 MT (geological reserve of 1475.81 MT) to meet the coal requirement from HAC.*

- *However, mining in Kente Extension (12)* ***may be decided appropriately*** *with strict environmental safe guards pertaining to surface water management and biodiversity conservation measures, considering the presence of relatively more very dense and moderately dense forest cover and wildlife occurrence, particularly, elephant movements. In addition, the MoEF&CC vide letter No. J-11015/48/2019.II(M) dated 8.01.2020 issued ToR for conducting EIA/EMP studies as this coal block is allotted through auction process to M/s Rajathan Rajya Utpadan Nigam Limited (RVUNL) and as per the condition No. 4(i) of the ToR, MoEF&CC has mandated to conduct Carrying Capacity study.*

- *A total of 337 forest compartments covering an area of 938 s.km from Chornai watershed and 140 forest compartments covering an area of 330.51 sq.km from Ton Teti watershed falls within the suggested* ***Biodiversity Conservation Area (BCA)*** **(Annexure 10.1)**.

    - *However, a part of BCA comprising of two forest compartments No. P2114 and P1998 that are falling within PEKB operational mine and allotted Parsa coal block are suggested to be exempted from BCA.*

- *There are two contagious coal blocks such as Sarma (20) and Laxmangarh (21) covering a total extent area of 41.82 sq.km with 10.53 sq.km under moderately dense forest (0.91% out of 1158.04 sq.km) and a relatively smaller area of 0.04 sq.km under very dense forest (0.04% out of 1158.04sq.km) falling within the Gaj Jhink watershed (upstream of Atem Nadi).*

- *Both Sarma (20) and Laxmangarh (21) coal blocks were observed to have high level of anthropogenic pressures and degraded forest due to extensive agriculture and allied activities and its close affinity/proximity to Udaipur – the tehsil headquarters, under Surguja district.*

- *Also, the other two contagious coal blocks i.e., Bhakurma Martinga (22) and Kedma (23) covering an extent of 44.95 sq.km with 27.15 sq.km area under moderately dense forest (2.34% out of 1158.04 sq.km) and 5.83 sq.km area under very dense forest (5.83% out of 1158.04 sq.km) falling within Rehar watershed (at upstream).*

- *These four coal blocks viz., **Sarma (20), Laxmangarh (21) falling in** Gej-Jhink watersheds; **Bhakurma-Martinga (22) and Kedma (23)** falling in Rehar watershed, as per the information received from CMPDI are only regionally promotionally explored and the boundary demarcation is yet to be carried out*

- *Hence mining in the identified four coal blocks viz., **Sarma (20), Laxmangarh (21), Bhakurma-Martinga (22) and Kedma (23)** may be kept in abeyance till complete exploration and boundary demarcation is finalized; and the detailed assessment of the catchment and drainage networks of the Rehar River as well as the prominent agriculture activity are made to understand the impact.*

*Overall, 14 projects, falling within both the Chornai (8) and Ton-Teti (9) watershed **may be not recommended** for mining keeping in view of conserving the relatively dense moist-dry deciduous sal dominated forest tracts that provide home range for elephant ; these forest are also intersected by dense stream channels of the higher order characteristic to the Chornai watersheds and considerable area under the coal blocks with relatively dense forests being influenced by the Hasdeo River/ Hasdeo-Bango Dam characteristic to the Ton Teti watershed.*

- *Based on the compliance condition stipulated in the Environmental Clearance (vide letter No.J-11015/03/2008-1A.II(M) dated, 21.12.2011) a 75 km dedicated Railway corridor of South East Central Railway (SECR) connecting Surajpur Railway Station on Bilaspur - Ambikapur to pit head of PEKB mine has been commissioned in April 2018. The same may be utilized by the adjacent coal blocks in the cluster. The coal transportation through the dedicated railway corridor from these coal blocks will likely to reduce the impacts of mining and transportation on the environment and human health.*

In addition, it is also recommended that a cumulative impact assessment of all the coal blocks mining on environment or a carrying capacity study involving physical, biological, social environment w.r.t. developmental intervention of the entire HAC shall be carried out for decision making and to achieve sustainable development.

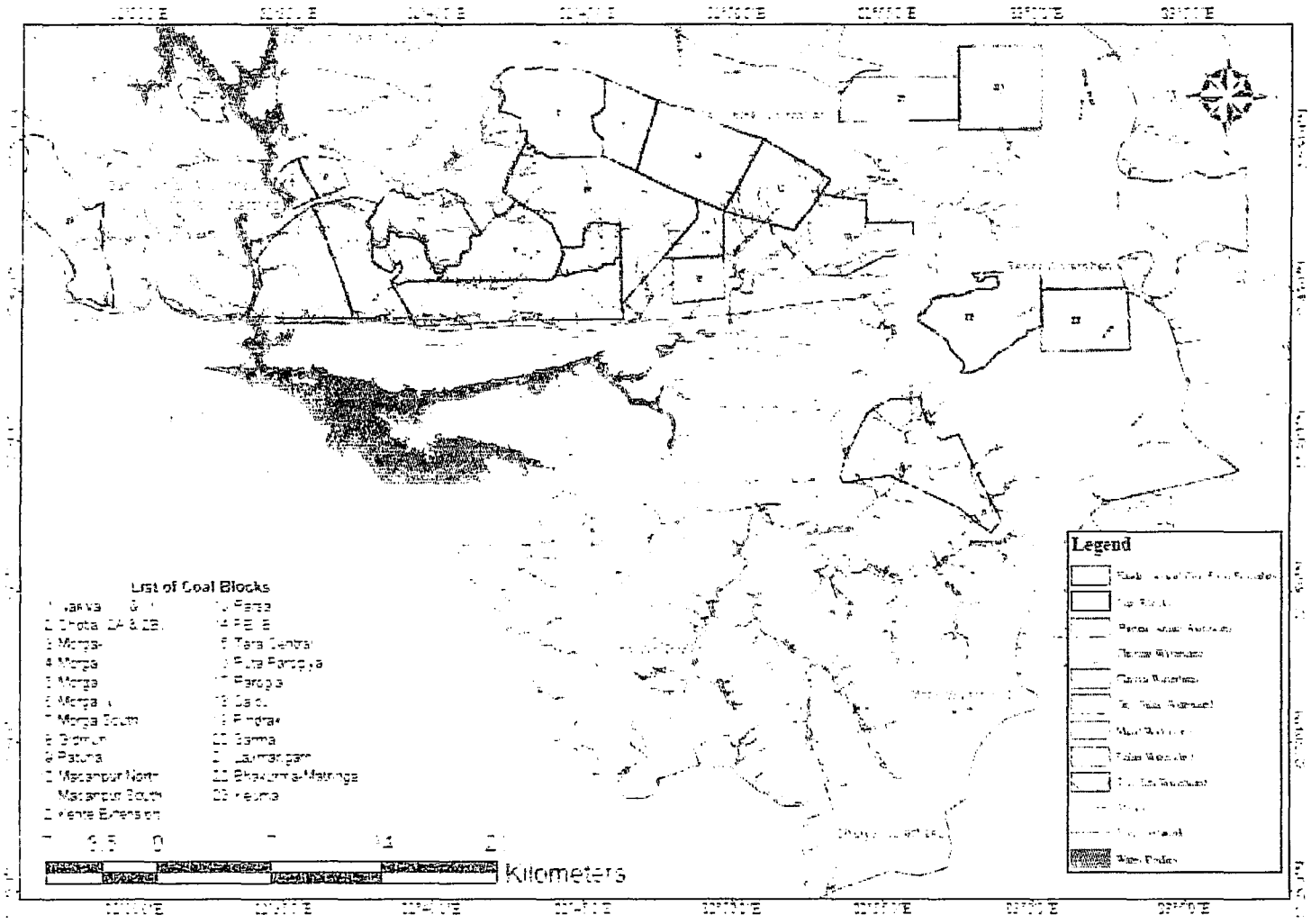


Figure 10.21: Map showing the Chornai and Ton, Teti watershed areas and drainage networks in Hasdeo-Arand Coalfield, Chhattisgarh

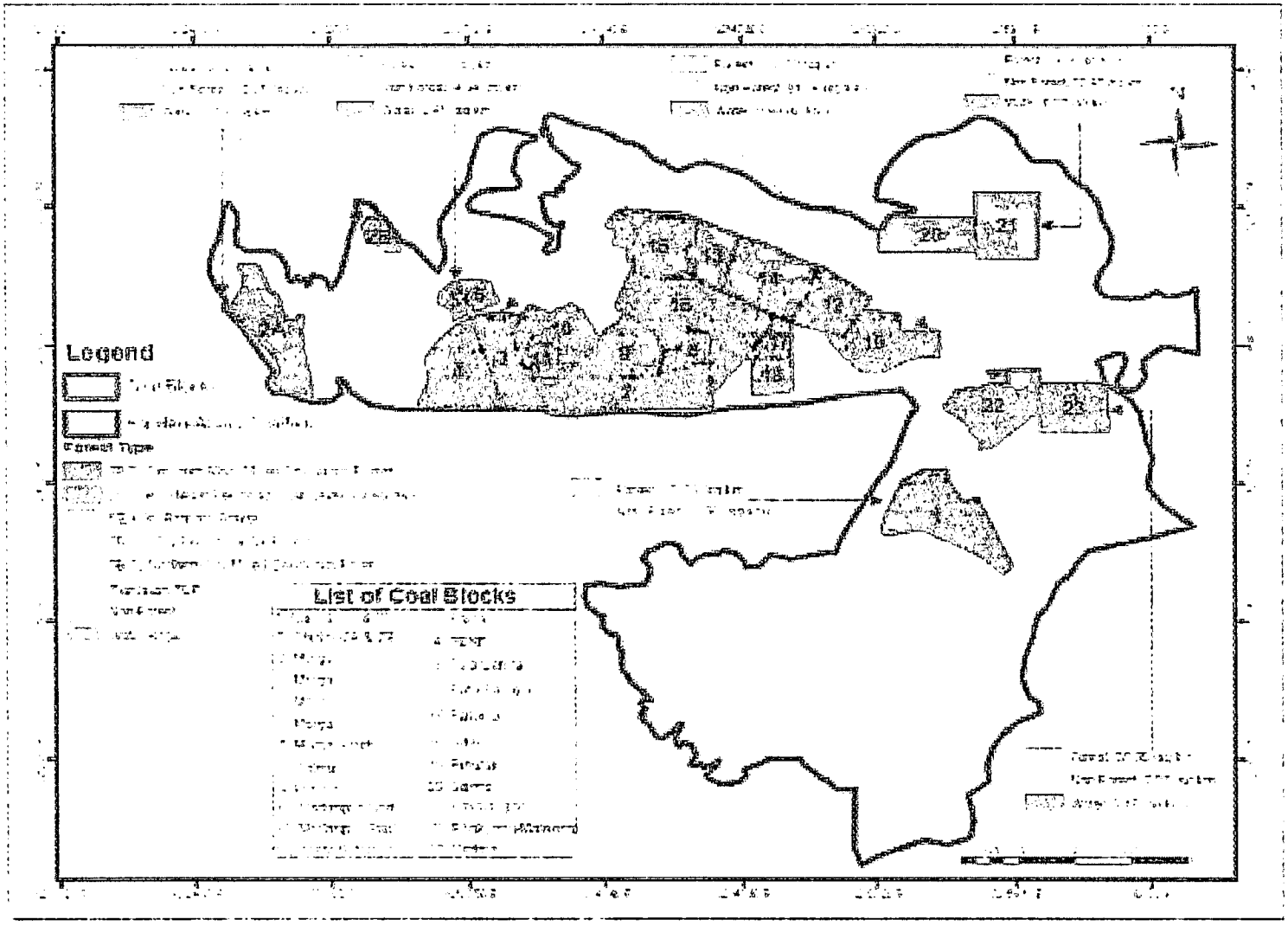


Figure 10.22: Map showing the cluster wise estimated area of forest type, non-forest, water and to be impacted due to mining in Hasdeo-Arand Coalfield in Chhattisgarh

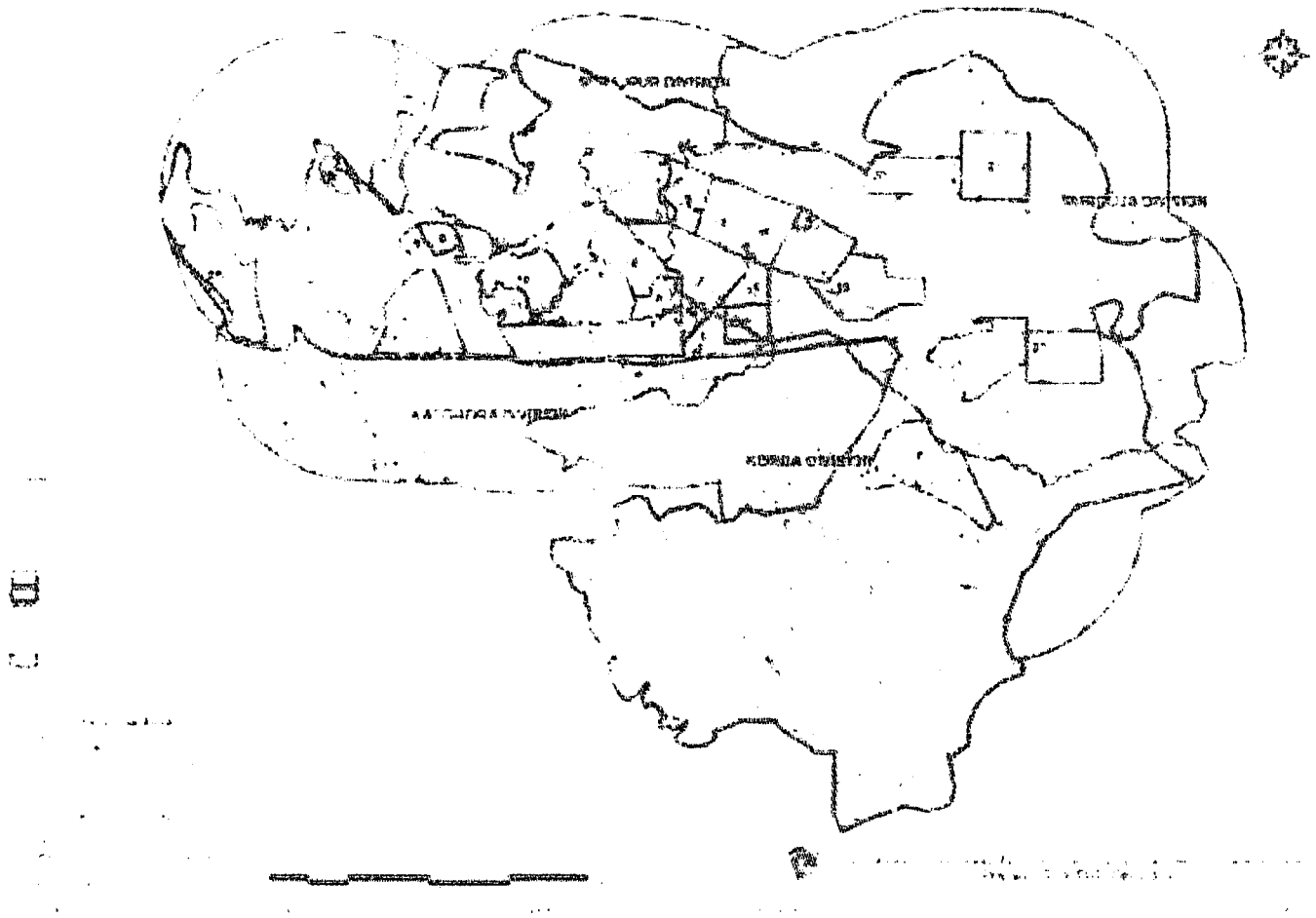


Figure 10.23: Map showing the drainage, elephant occurrence and suggested Biodiversity Conservation Area within the Hasdeo-Arand Coalfield in Chhattisgarh

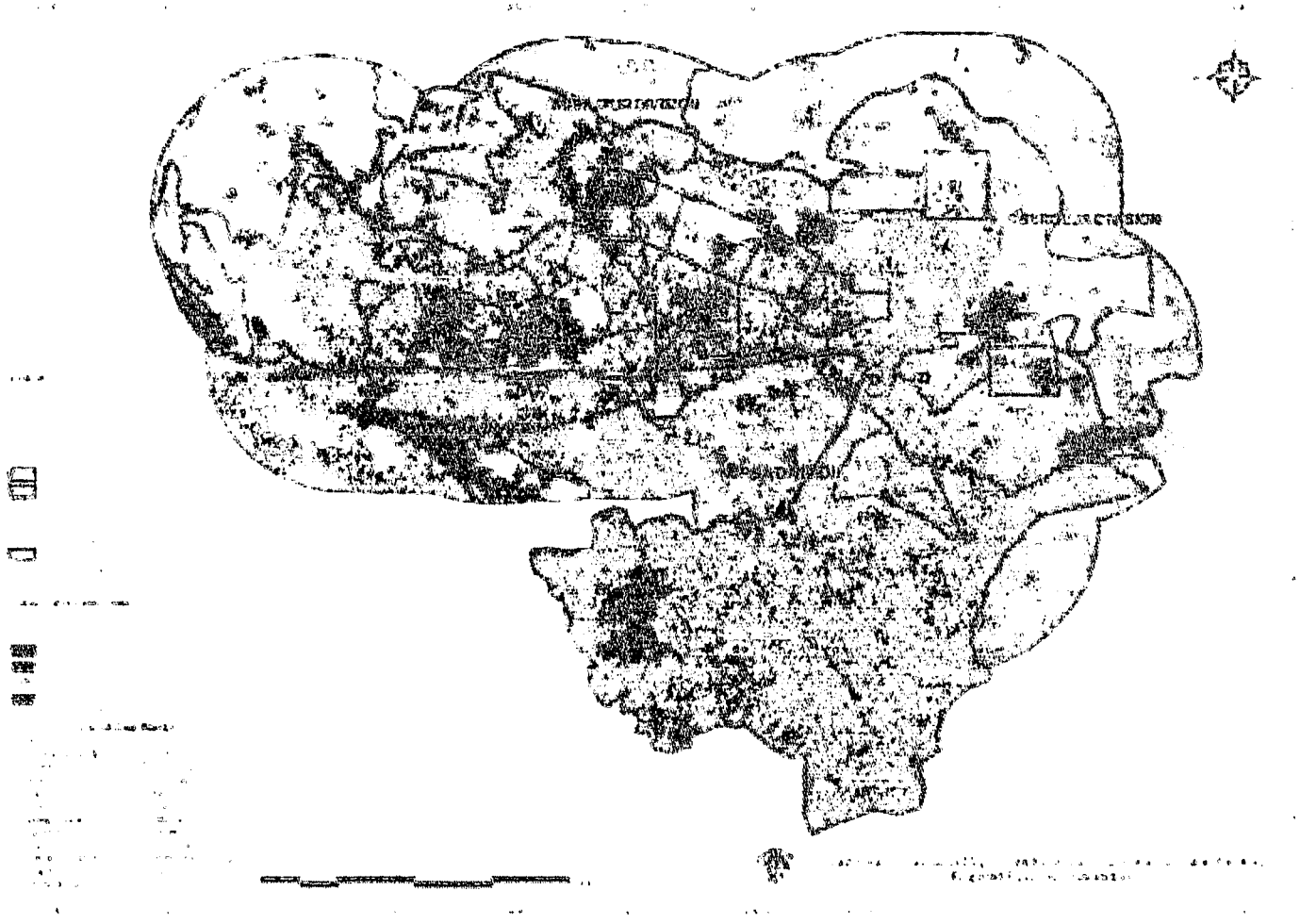


Figure 10.24: Map showing the forest cover and suggested Biodiversity Conservation Area within the Hasdeo-Arand Coalfield in Chhattisgarh

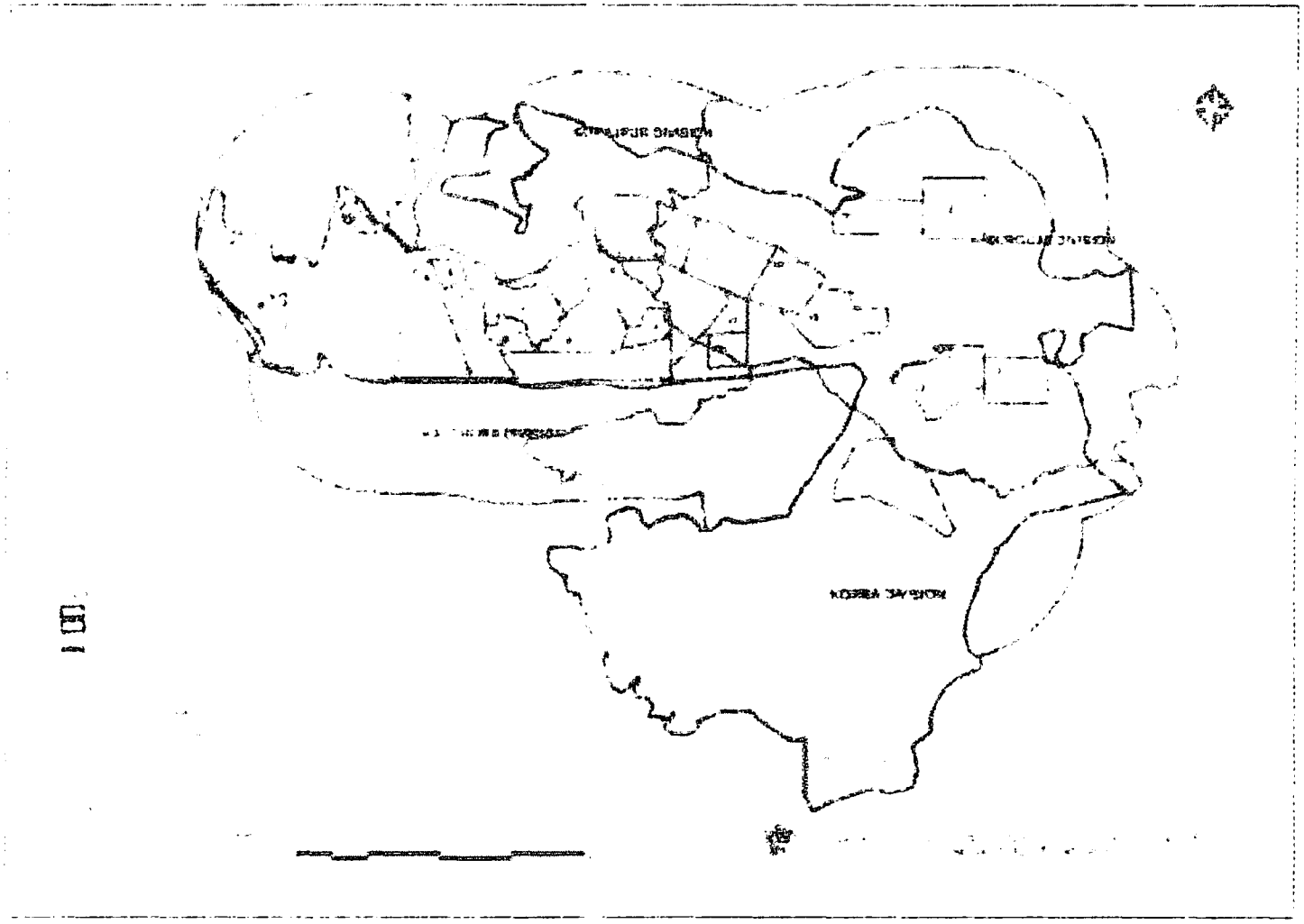


Figure 10.25: Map showing the forest compartments and suggested Biodiversity Conservation Area within the Hasdeo-Arand Coalfield in Chhattisgarh

10.10 QUERIES OF THE PRINCIPAL BENCH OF NATIONAL GREEN TRIBUNAL (NGT) ALONG WITH THE JUDGMENT ISSUED ON 24.03.2014 TO MOEF&CC

Queries of National Green Tribunal (NGT)	Observation /comments
1. What type of flora and fauna in terms of biodiversity and forest cover existed as on the date of the proposal in PEKB coal blocks.	*The pre-mining data on biodiversity are available in the EIA/EMP study report (as on December, 2016 for the PEKB Coal Block. However, the present study (2019-2021) in terms of floral and faunal biodiversity, forest cover and forest types for buffer area of PEKB and adjacent are detailed under the respective chapters.*
2. Is/was the PEKB coal block habitat to endemic or endangered species of flora and fauna.	Yes / was -the PEKB coal block habitat to ***rare, endangered and threatened flora and fauna.*** RET floral species observed in PEKB consists of *Aegle marmelos, Aristolochia indica, Drosera indica, Drosera burmanni, Uraria picta* and *Premna herbacea* RET faunal species - sloth bear (*Melursus ursinus*), four-horned antelope or Chousingha (*Tetracerus quadricornis*).
3. Whether the migratory route /corridor of any wild animal particularly elephant passes through the area.	*Elephant occurrence was reported in 148 out of 647 forest compartments in HAC and surrounding landscape during the period 2018 to 2020 by the State Forest Department. A conservative estimate of about 40 to 50 elephants could use different parts of the landscape at different times of the year. The HAC and the surrounding landscape are part of the elephant range in northern Chhattisgarh and serves as both habitat and corridor for movement.* *The Korba Forest Division had reported the occurrence of tigers in the vicinity of HAC and the surrounding landscape. The habitat connectivity between Hasdeo-Arand area and Achanakmar Tiger Reserve. Boramdeo Wildlife Sanctuary and Kanha Tiger Reserve is strong, and may support sporadic tiger dispersal.*

4. Whether the area of PEKB Block has that significant conservation /protection value so much so that the area cannot be compromised for coal mining with appropriate conservation /management strategies	*Presently as per FSI (2017) the PEKB coal block has 9.11 sq.km area under moderately dense forest 2.56 sq.km area under very dense forest. Shorea robusta is recorded to be dominant followed by Diospyros melanoxylon, Madhuca longifolia, etc., contributing to the highest IVI values. The diversity index value if low in both core and buffer area due to open cast mining operation disturbance. Therefore, it is suggested that the mining in PEKB may be allowed and to be continued with strict compliance / implementation of EC/FC conditions (detailed Reclamation and Rehabilitation plan, compliance to EC/FC and the observations/comments/recommendations made in this report under mine closure plan, sequential mining, biodiversity conservation, etc.)*
5. What is their opinion about opening the PEKB coal block for mining as per sequential mining, reclamation methods proposed for regeneration of the flora efficacy of mine closure plan and the tree translocated:	*Detailed observations pertaining to opinion for PEKB coal block is provided in Chapter 8 of this report for sequential mining reclamation and rehabilitation of the flora in the mine lease area and efficacy of tree translocated trees.*
6. What is their opinion about the Wildlife Management plan finally prescribed?	*The wildlife management plan is a legal document prepared for management of the notified protected areas under the Indian Wildlife (protection) Act, 1972. Since HAC is not a protected area, hence, the term wildlife conservation plan is more appropriate in this context. The wildlife conservation plan of Parsa East & Kanta Basan open cast coal mine and washery project prepared by the project proponent is basic and generic in nature. Due to this, it requires substantial revision and the management prescriptions need to be spatially explicit and closely consider the ecological, behavioural and social dimensions of the landscape. A detailed review of the same was carried out and specific comments to improve the plan have been provided in Annexure I of WII report enclosed as Volume-II.*

7. **What conditions and restriction do they propose on the mining in question *i.e.*, sequential mining, if they favour such mining?**	*ICFRE- Suggestion and recommendation for further improving the mining environment in PEKB coal block are detailed in the Chapter 3 and 8 of this report* *WII- As certain portions of the PEKB coal block has already been opened for mining, the mining operation may only be permitted in the already operational mine of the block.*
Answer to the above questions Sl. No. 1 – 3 are addressed in detailed in the Chapter-4, Chapter-5 and Chapter-6; question Sl. No. 4 pertains to compliance are discussed in the Chapter-4 floral diversity, Chapter-5 faunal diversity, Chapter-6 aquatic diversity and chapter -7socio-economic *vis-à-vis* biodiversity values, question Sl. No. 5 related to efficacy of mine closure plan are detailed in Chapter-8, efficacy of translocated trees in Chapter-9 and sequential mining in Chapter-8 of this report.	

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ANNEXURES

Annexure 1.1

F. No. 8-31/2010-FC
Government of India
Ministry of Environment and Forests
(FC Division)

Paryavaran Bhawan, CGO Complex,
Lodhi Road, New Delhi - 110 003
Dated, 6th July, 2011

To

The Principal Secretary (Forests),
Government of Chhattisgarh,
Raipur

Sub: Diversion of 1898.328 ha of forest land for Parsa East and Kete Basan captive coal block open cast mining project in favour of M/s Rajasthan Rajya Vidyut Utpadan Nigam Limited in South Surguja Forest Division in Surguja district of Chhattisgarh.

Sir,

I am directed to refer to the State Government's letter no. F - 5 - 4 / 2010 / 1D - 2 dated 28.04.2010 on the subject mentioned above seeking prior approval of the Central Government under section-2 of the Forest (Conservation) Act, 1980 and to say that the proposal has been examined by the Forest Advisory Committee constituted by the Central Government under section-3 of the said Act.

After careful examination of the proposal of the State Government, the Central Government hereby conveys the stage-I approval for diversion of 1898.328 ha of forest land (for mining in two phases) in Parsa East and Kete Basan captive coal block open cast mining project in favour of M/s Rajasthan Rajya Vidyut Utpadan Nigam Limited in South Surguja Forest Division in Surguja district of Chhattisgarh subject to fulfillment of the following conditions:

(i) The Compensatory Afforestation (CA) shall be raised and maintained over double degraded orange forest land in extent to the forest land proposed to be diverted.

(ii) The State Government shall immediately transfer and mutate the non-forest land identified for CA in favour of the State Forest Department.

(iii) The land identified for the purpose of CA shall be clearly depicted on a Survey of India toposheet of 1:50,000 scale.

(iv) The degraded orange forest land identified for raising Compensatory Afforestation shall be notified by the State Government as RF under Section-4 or PF under Section-29 of the Indian Forest Act, 1927 or under the relevant Section(s) of the local Forest Act, as the case may be, within a period of six months. The Nodal Officer (Forest Conservation) shall report compliance in this regard.

The User Agency shall create, fence and maintain a proper safety zone around the mining area. The User Agency shall deposit funds with the Forest Department for the creation, protection and regeneration of the safety zone area, and also shall bear the cost of afforestation over one and a half time of the safety zone area in degraded forest elsewhere.

The following activities shall be undertaken by the User Agency under supervision of the State Forest Department at the project cost:

Annexure 1.2

OR

विशेष सचिव

BEFORE THE NATIONAL GREEN TRIBUNAL
PRINCIPAL BENCH AT NEW DELHI,
NEW DELHI

Appeal no. 73/2012

In the matter of:

Sudiep Shrivastava
r/o Dharam Prakash Chawl
Mungeli Naka Bilaspur
Chhattisgarh- 495001 ..... Appellant

Versus

1. State of Chhattisgarh
Through the Principal Secretary (Forests)
Government of Chhattisgarh
Raipur

2. Union of India
Through the Secretary
Ministry of Environment and Forests
Government of India
Paryavaran Bhawan, C.G.O Complex
Lodhi Road, New Delhi – 110003

3. M/S Rajasthan Rajya Vidyut Utpadan Nigam Ltd
Vidyut Bhawan
Jyoti Nagar, Janpath
Jaipur- 302005

4. Kente Basan Coilleries co. Ltd
C/O M/S Rajasthan Rajya Vidyut Utpadan Nigam Ltd
Vidyut Bhawan
Jyoti Nagar, Janpath
Jaipur- 302005

.....Respondents

Counsel for appellant:
Mr. Raj Panjwani, sr. advocate along with
Mr. Rahul Choudhary, Mr. Ritwick Dutta
and Srilekha Advocate

Counsel for Respondents:
Mr. Atul Jha, Advocate for respondent no. 1
Ms. Neelam Rathore, Mr. Vikramjeet,
Ms. Syed Amber Advocates for respondent no. 2
Mr. Parag Tripathi sr. Advocate along with
Mr. Kunal Verma Advocates for respondent no. 3
Mr. Pinaki Mishra, sr. Advocate, Mr. Ravi Nair
and Mr. Arjun Khera, Advocates for respondent no. 4

Present:
Hon'ble Mr. Justice Swatanter Kumar (Chairperson)
Hon'ble Mr. U.D. Salvi (Judicial Member)
Hon'ble Dr. D.K. Agrawal (Expert Member)
Hon'ble Prof. A.R. Yousuf (Expert Member)
Hon'ble Dr. R. C. Trivedi (Expert Member)

JUDGMENT

Per U.D. Salvi J.(Judicial Member)

Dated: 24th March, 2014

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1. A diversion of 1898.328 hectares of forest land at Parsa East and Kante-Basan captive coal blocks (shortly referred to as PEKB Coal Blocks) situated in Hasdeo-Arand coal fields in Hasdeo-Arand forest- South Sarguja Forest Division, District Sarguja, Chhattisgarh in favour of M/s Rajasthan Rajya Vidyut Utpadan Nigam Ltd (shortly referred to as RVUNL) - the respondent no. 3 herein vide order no. F 5-4/2010/10-2 dated 28th March,2012 passed by the State of Chhattisgarh - the respondent no. 1 herein in pursuance to the approval under section 2 the Forest (conservation) Act 1980 (shortly referred to as FC Act) accorded by

4. All work commenced by the respondent no. 3 project proponent and respondent no. 4 pursuant to the order dated 28th March, 2012 passed by the respondent no. 1 State of Chhattisgarh under section 2 of the FC Act 1980, except the work of conservation of existing flora and fauna, shall stand suspended till such further orders are passed by the MoEF in accordance with law.

5. No order as to costs.

..... CP
(Swatanter Kumar)

..... JM
(U.D. Salvi)

..... EM
(Dr. D.K. Agrawal)

..... EM
(Prof. A.R. Yousuf)

...., EM
(Dr. R. C. Trivedi)

Annexure 1.4

F. No. 8-36/2017-FC

Sub: **Proposal for prospecting of 1745.883 ha of forest land of Kente Extention Coal Block in favour of Rajyasthan Rajya Vidyut Utpadan Nigam Limited for exploration of coal reserves by undertaking 153 boreholes of 4" Dia in Suguja District in the State of Chhattisgarh-reg.**

1. The State Government of Chhatisgarh vide their letter No F-5-44 2017 10-2 dated 07.07.2017 submitted the above mentioned proposal seeking prior approval of the Central Government under Secun-2 of the Forest (Conservation) Act. 1980.

2. This Ministry vide their letter dated 27.07.2017 was requested to Regional Office, Nagpur of this Ministry to carry out site inspection of the proposal area. Regional Office, Nagpur vide their letter no. FC-Misc-158/RON/2017-NGP/2301 dated 23.08.2017 has informed that examination of the proposal of the prospecting for coal mining in the Regional office revealed that actual area proposed for temporary change in land use is 6.12125 ha comprised of 6.12 ha drilling of 153 bore holes (0.04 ha per bore hole) and 0.00125 ha for sumps. No forest land has been proposed to be used for construction of road paths, etc. Total area proposed for temporary change in land use is less than 100 ha. In this connection, it is to inform that as per the provision of the guidelines dated 04.07.2014, wherein inter-alia it is stated that site inspection by the Regional Office concerned of this Ministry will be insisted only if the actual area of forest land proposed to be utilized for construction of new road/paths and for drilling of bore holes/sample collection pits etc. is more than 100 ha.

3. The facts of the proposal was placed before FAC in its meeting held on 30th August, 2017 for examination and appropriate recommendation please.

4. FAC after thorough deliberation and discussion with User agency, representative of Regional Office, Nagpur observed that the user agency is already working in the area adjoining to the proposed area before taking any decision on the instant proposal and the FAC recommended that

   (i) Regional Office Nagpur shall inspect the area and consider all facts in light of the decision of NGT, and Hon'ble Supreme court order in Civil Appeal No. 4395 of 2014 in the matter of Rajasthan Rajya Vidyut Nigam Ltd. Vs. Sudeep Shrivastava .

   (ii) Regional office shall also submit its report on compliance of the conditions imposed by MOEF and CC in the approval granted to the same user agency for Parsa East and Kete Basan captive coal block open cast mining project in favour of M/s Rajasthan Rajya Vidut Utpadan Nigam Limited in South Surguja Forest Division in Surguja District of Chhattisgarh. vide this Ministry's letter no. F. No. 8-31/2010 dated 15.03.2012.

   (iii) State government shall submit complete compliance of the conditions imposed by MOEF and CC in the approval granted to the same user agency for Parsa East and Kete Basan captive coal block open cast mining project in favour of M/s Rajasthan Rajya Vidut Utpadan Nigam Limited in South Surguja Forest Division in Surguja District of Chhattisgarh vide this Ministry's letter no. F. No 8-31/2010 dated 15.03.2012.

5. Accordingly, the State Govt. and Regional Office were requested to submit the compliance as sought vide this Ministry's letter dated 13.09.2017 on the recommendation of FAC held on 30.08.2017.

6. With regard to para 4 (i) & (ii) above the Regional Office vide their letter no. FC-Misc-158/RON/2017-NGP/2502 dated 18.09.2017 (F/N) has submitted their report and the same is reproduced below

BACKGROUND

(i) The Forest Advisory Committee (FAC) in its meeting held on 30.08.2017 has inter-alia recommended following

   a. Regional Office, Nagpur shall inspect the area and consider all facts in light of the decision of NGT and Hon'ble Supreme Court order in Civil Appeal No. 4395 of 2014 in the matter of Rajasthan Rajya Vidyut Utpadan Nigam Limited Vs. Sudeep Srivastava.

Proposal
Biodiversity Assessment Study in Hasdeo Arand Coal Field comprising of Tara, Parsa, Parsa East, Kanta Basan and Kente Extension Coal Blocks in Forest area of Surguja District of Chhattisgarh

1 BACKGROUND

The Ministry of Environment, Forest & Climate Change (MoEF& CC), Government of India (GoI) during the meeting held on 26th October 2017 in principle has granted approval of Stage I clearance for prospecting of coal in an area of 1745.888 ha in forest land of Kente Extension Coal Block in Surguja District of Chhattisgarh State to Rajasthan Rajya Vidyut Utpadan Nigam Limited based on the proposal submitted by State Government and on the basis of the recommendations of the Forest Advisory Committee (FAC). Accordingly, the user agency has been allowed for exploratory drilling of a 153 boreholes of 4" diameter over 1745.888 ha of forest land with the following condition:

- Biodiversity Assessment study to be conducted by the State Government in the entire Hasdeo Arand Coal Fields comprising Tara, Parsa,Parsa East, Kanta as per the FAC, MoEF&CC approved Terms of Reference (ToR) (Annexure-I)
- The Biodiversity Assessment study to be conducted by State Government by associating ICFRE, Dehradun as a nodal agency and associating Wildlife Institute of India Dehradun to add-on the sister states
- To develop Integrated Wildlife Management Plan (IWMP) and also conservation area and formulate mitigation measures
- The cost of biodiversity study and the implementation of the recommendations of the study will be borne by M/s Rajasthan Rajya Vidyut Utpadan Nigam Limited (RVUNL)
- The report to be submitted within two years to the State Government

Accordingly, the Additional PCCF (Land Management) and Nodal Officer, Forest Conservation(FC) Chhattisgarh, Raipur approached the Indian Council of Forestry and Education (ICFRE) Dehradun *vide* e-mail dated 07.12.2018 for conducting the above said study. Further, ICFRE approached the Wildlife Institute of India (WII), Dehradun for the faunal diversity aspect. Accordingly, Faculty of Wildlife Sciences WII vide letter no. WII/FWS/BIO Assessment/2018-2019 dated 20.08.2018 submitted its proposal (Annexure-II). The scope and objectives of the study as well as a consolidated group wise components such as Terrestrial floral, faunal, avi-faunal, aquatic ecosystem, socio economic values of the biodiversity are presented below.

2 OBJECTIVE/AIM OF THE STUDY

1. To prepare an Integrated Biodiversity and Wildlife Management Plan for the study area and identify Biodiversity Conservation Area for of the Hasdeo Arand Coal Fields comprising Tara, Parsa,Parsa East, Kanta.

2.1 Scope of the study

The study would be essentially carried in two ways:

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वरिष्ठ वानिकी (वानिकी शाखा)
Asst.Director General (Silviculture)
भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद
Indian Council of Forestry

2.1.1 Baseline data from secondary sources

Through review of literature published, desk review of Legal mandates, approved EC/ management plans, important data base including IBAs, Ramsar sites, IUCN lists etc for secondary sources of information and conservation status EIA/EMP of individual mines, mine closure plan, various notifications/ gazette, and other relevant study reports if available will also be reviewed

2.1.2 Baseline data from primary sources:

Real time seasonal data on terrestrial floristic, faunal and avi faunal, aquatic diversity and socio-economic dependency on biodiversity resources will be collected in the study area considering the key parameters such as

a) Details of flora & fauna with special reference to endemic/threatened species, population reported from the study area along with details of existing forest cover in the study area
b) Description of habitat for such endemic/threatened species, ecology and likely threats including, foraging pattern and its conservation
c) Details of migratory route/corridor of any wild animal particularly elephant migration through the study area, if any
d) Socio-economic values of the affected area Vis-a-Vis biodiversity values
e) Consultations with forest/wildlife officials, local communities, technical & managerial staff of proposed/ongoing mining projects of the Hasdeo Arand Coal Field
f) Identification of conservation areas

3. STUDY AREA

The proposed study include project affected area (proposed/ongoing mining projects) as a whole Hasdeo Arand Coal Field comprising of Tara, Parsa, Parsa East & Kanteman and Kente Extension Coal blocks falling in Lemru forest range of Surguja and Lemru range of Korba Forest Division , in Surguja District of Chhattisgarh State

4. PROPOSED METHODOLOGY

Field visits will be made seasonally by multi disciplinary teams constituting ecologists, taxonomist, wildlife experts, sociologist for collection of baseline data for the respective components outlined below

4.1 COMPONENT-I TERRESTRIAL FLORAL DIVERSITY ASSESSMENT (FOREST DEGRADATION)

Characterization of forest types and forest cover

The forest cover and forest type map will be prepared from the pre processed data used for India State of Forest Report 2017 and National Forest Type Report 2019, procured from Forest Survey of India, Dehradun. Thematic maps will be prepared using the Arc GIS software for the components under study. Also the satellite

(Dr. Sudhir [illegible])

area will be delineated keeping in view respective data requirements and sensitive areas within or around the study area

Vegetation survey

Primary baseline data on terrestrial floral diversity will be collected through intensive field survey in the study area during three seasons (pre-monsoon, monsoon and post-monsoon) for real time data using stratified sampling with GPS location. Quadrate method will be used for vegetation sampling for assessment of floristic composition/floral diversity. The phyto-sociological data for trees and shrubs will be collected from random quadrates of 10 m x 10 m and 5 m x 5 m size. Random quadrates of 1 m x 1 m size will be laid for the study of herb component. During the field survey, number of plants of different species in each quadrate will be identified and recorded. Based on the quadrate data, frequency, density and cover (basal area) of each species will be calculated (Misra, 1968). The importance value index (IVI) for three types of plant habits (tree, shrub and herb) will be determined by summing up the relative density, relative frequency and relative dominance values. To assess diversity of the species and to get clear picture of the plant community in the study area, Shannon-Wiener index (H') and Braya and Gibson's evenness index (E) will be computed.

With the vegetation surveyed rare, endangered and threatened category species (RET) will be identified referring to the Red Data Book of Botanical Survey of India, IUCN Red data list and other available literatures on flora and herbarium pertaining to the rare, endangered species of Chhattisgarh. The economic and endemic floral species will also be identified and listed.

Biodiversity value or socioeconomic values

The community dependency on the floral/aquatic diversity values as per the ToR will be made using Participatory Rural Appraisal (PRA) tools and focus group discussion with villagers and consultation with forest department officials for terrestrial floral biodiversity values.

Assess the efficacy of mine closure Plans and conservation measures proposed

Mine closure plans will be reviewed to assess the efficacy conservation measures for the floral and aquatic diversity stipulated.

6.2 COMPONENT-II AQUATIC FAUNAL & FLORAL DIVERSITY ASSESSMENT

Primary baseline data on aquatic biodiversity will be collected through field survey for real time three seasons (pre-monsoon, monsoon and post-monsoon) following standard methodologies from the natural water bodies (rivers and streams). Sampling of fish fauna will be carried out using cast net and drag net in the sample sites. Survey of local fish market to know the species composition dependency of the local people in the study area.

Development of integrated biodiversity Management Plan: Based on the baseline data on conservation value for terrestrial flora and aquatic floral fauna diversity, suitable integrated terrestrial floral and aquatic biodiversity management plan [illegible]

[illegible]/(Dr. Sudhir Kumar)
[illegible] (पर्यावरण प्रबंधन)
Scientist-E & Head (Environmental Management)
भारतीय वन्य जीवन संस्थान, पो. बॉक्स 18, चन्दरबनी
Indian Council of Forestry Research and Education
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[illegible] Corridor Areas] comprising of Tara, Patna, Patna east & Kanta Bhan & [illegible] will be prepared for ensuring adequate compensation, mitigation and [illegible] measures with budgetary provision for the impact perceived. In addition [illegible] of important resources, corresponding avoidance [illegible] [illegible] specific project activities/components [illegible] [illegible] will also be highlighted.

6.3 COMPONENT III TERRESTRIAL FAUNAL & AVI FAUNAL DIVERSITY ASSESSMENT (WII, DEHRADUN)

To prepare faunal inventory of large mammals Systematic field surveys (intended to be carried out for other objectives), brainstorming with experienced forest department staff and interview surveys with local villagers will be used to prepare a checklist of different species of large mammals that occur in the area.

To assess the patterns of habitat use for large carnivores, herbivores and meso-carnivores: The metric of "intensity of habitat use" is measured at a scale much smaller than the expected maximum expected home range sizes of the target species. Since this is a multi-species study involving animals of varying guilds, body sizes and home ranges, grids of 1.0 km² will be used to capture the fine-scale details of habitat use. Occupancy modeling approach permits estimation of "probability of habitat use" while explicitly accounting for detection probability though repeat surveys (spatial or temporal).

- **For assessing habitat use of herbivores**, with a the grids equal number of points will be generated using a uniform sampling approach. In the field, the survey teams will walk connecting all the points. Distance between each point shall be treated as a segment and within each segment, the survey teams will record animal signs (dung, scat, tracks, feeding signs) and covariate data (site and detect ability covariates). Within each segment, the teams will record number of signs encountered for each species.

- **For assessing habitat use of carnivores and meso-carnivores**, camera traps shall be deployed in strategic localities and habitat use shall be estimated based on photo capture rates. Additionally, for species that can be individually identified using unique body marks such as stripes, spots and rosettes, wherever capture rates are adequate, we shall be estimating absolute densities using "capture-recapture" sampling approach.

To evaluate the status of wildlife habitats and threats:

[illegible] shall be used to map the forest cover and land use and land cover [illegible] And [illegible] during field surveys habitat variables and anthropogenic pressures will be recorded. This shall be used along with grid specific estimates of probability of habitat use data derived from occupancy modelling of identify the status of wildlife habitat. This exercise shall help in identifying priority areas for conservation (high habitat use and low threats) and preparation of appropriate management plans.

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Indian Institute of Wildlife Research and Education
Ministry of Environment & Forests
P.O. New Forest, Dehradun-248006

To prepare the faunal inventory of birds

With the help of point count surveys shall be carried out by a species avian species richness and evenness. Bird communities diversity shall be categorized in terms of species detected per grid. Species rank abundance curves shall be prepared to represent the dominance of selective species (such as Shannon Wiener index of species richness shall be used to compare species richness of birds across different strata and anthropogenic and ecological variables. Checklist of birds will be prepared for the larger study area.

To assess the migratory routes/Corridor for wild animal particularly elephant migration

The study area would be surveyed extensively to identify the potential wildlife corridors and movement paths of large mammals especially Asian elephant through direct and indirect methods. Observations will be made on the indirect evidences of habitat use by elephants in the form of feeding signs and dung in the study area. Local people would be interviewed to ascertain the presence or absence of elephant herds in recent years, duration of their stay in each area, seasonality of their movement etc. Based on these parameters, water resources available in the area and presence of elephant in the landscape a tentative route of their movement would be plotted on a map. Once the possible path of movement and potential corridors are identified, camera traps would be placed in the area in order to confirm the presence/absence of elephants and other faunal groups.

To develop integrated wildlife biodiversity and management plan:

Based on the mammal and avian field studies (objectives 1 – 4) literature surveys and reconnaissance observations and detailed study on the habitat and the wild animal presence. A detailed integrated biodiversity and wildlife management plan will be prepared by describing adequate compensation, mitigation and Management measures with respect to the identified impacts with budgetary provisions will be prepared for the study area. Plan will be focused on the avi fauna of the region, likely impact due to mining, measures to be taken for maintaining alternative habitat for birds, nesting including design of artificially made eco-friendly nests. Measures to minimize the impacts recommending avoidance of impacts by modifying project activities, selective components, technology found to be feasible shall be highlighted appropriately.

To assess the efficacy of mine closure Plans and conservation measures proposed

The mine closure and restoration plan prepared by the project proponent would be evaluated against various parameters such as funds and time allocated for the plan, expertise and knowledge of the agency identified for the restoration of the mine, species proposed for plantation and native vegetation found in and around the mined area. Detailed discussions would be held with the implementing agencies about the feasibility of such an operation. Accordingly, the suggestions if any would be given.

(of [illegible])

the agencies involved in the preparation of restoration and implementation plans

Study environmental and socio economic impacts:

The study will be concentrated on the possible impacts on flora and fauna and [illegible] of community ecology and fragmentation of the habitat due to mining activities. Other aspects related to access of road to project site and other resources and its impact on biodiversity of the area will highlighted.

7. INFORMATION/DATA / INPUTS REQUIRED FROM STUDY IMPLEMENTING AGENCY

Following details will be required and need to be provided by the project proponent through SEIAA

1. Copy of EC FC clearances of existing and proposed mines
2. Concerned coal block area / land use detail, surface map, etc.
3. EIA and EMP reports of existing and proposed coal mine
4. Shape files / boundary map of the whole Hasdeo-Arand Coal Field
5. Shape files of all individual coal block Tara, Parsa, Parsa East & Kanteaman and Kente Extension Coal blocks with boundary
6. Shape files of all facilities /infrastructure including active reclaimed dump mine pits voids etc
7. GPS location/shape files of the biologically reclaimed areas of each mine
8. Periodical recorded/modeled data for various environmental parameters for the existing mines
9. Progress report submitted to SPCB for existing mines and any other report relevant to the study area
10. Copy of working Plans relevant to the study area Surguja Forest Division and Korba Forest Division)
11. Details of proposed/undergoing mining sites, activities, schedule of activities frequency of operations
12. Details of access road (Maps if any) and transport road
13. Mine Closure Plans and Conservation measures proposed in operational/upcoming coal blocks
14. Information related to the protected/sensitive areas in the area of Hasdeo-Arand Coal Field
15. Soft copy of the toposheet for individual and for the entire study area.
16. Information on the river drainage and catchment area maps
17. Other relevant information as and when required

4 COST ESTIMATES

S No	Budget Head	Amount (Rs Lakhs)		
		ICFRE	WII	Total
1	Cost of man days of officials deputed	28.00	[illegible]	[illegible]
2	Contingency expenditure including purchase/ hiring of instruments, raw material, consumables, engagement of project staff and semi-skilled person, office expenses, vehicle running, meeting and report writing etc.)	38.00	8.00	
3	External payment envisaged e.g. to outside Sub-consultants and Domain Experts	18.00	0	
4	Travel Expenses (TA/DA)	26.00	10.00	36.00
5	Contingencies	5.00	2.00	7.00
6	Sub-Total expenses (sum of 1 to 5)	104.00	69.99	142.49
7	Overhead charges @ 13% of above (1 to 5)	14.12	[illegible]	[illegible]
8	Total cost (excluding GST)	138	69.91	178.87
	GST @18%	25		19.[illegible]
	GRAND TOTAL	163.00	69.91	232.91

*(Rs. Two crore thirty two lakhs and ninety one thousand only)

*The above estimate does not include the local logistic support and transport to the study area during the field visit which will be provided by the project proponent.

5 PAYMENT SCHEDULE

SN	Activities	% of payment
	On acceptance of Work Order	[illegible]
	On completion of field work and submission of draft report	[illegible]
	On Submission and acceptance of Final report	[illegible]

6 TIME SCHEDULE

The time schedule for completing the task will be eighteen (18) months from the date of issue of work order subject to the field conditions and requirement of data from the project proponent. The tentative schedules are as under:

SN	Particulars	Duration*
	Award of work, Signing of MoU, Project Inception Meeting	[illegible]
	Baseline field data collection for season-I, analysis of data, interpretation of results, compilation of results and preparation of draft report based on one season	[illegible] Months
	Baseline field data collection of season-II, analysis of data, interpretation of results, compilation of results and preparation of draft report based on two seasons	[illegible]
	Baseline field data collection of season-III, analysis of data, interpretation of results, compilation of results, preparation and submission of Draft report	[illegible]
	Submission of Final Report after incorporation of comments/observations, if any, from project proponent	[illegible]

[illegible] Sudhir Kumar)
[illegible]

[illegible]

[illegible]

LOGISTIC ARRANGEMENT

[illegible]

EXPECTED OUTCOME/DELIVERABLES

a) Comprehensive biodiversity assessment report including integrated biodiversity and wildlife management plan covering following aspects

- Baseline status of diversity values of project affected area (proposed [illegible] projects)
- Study of [illegible] environmental and socio-economic impacts
- Study of efficacy of [illegible] climate plans and conservation measures proposed in [illegible] upcoming and their cost and recommendation if any
- Integrated biodiversity and wildlife management plan for wetlands & biodiversity conservation with budgetary provision

[illegible]

कार्यालय प्रधान मुख्य वन संरक्षक एवं वन बल प्रमुख, छत्तीसगढ़

प्रथम तल, ब्लॉक-12, नवीन प्रशासकीय कार्यालय भवन, अटल नगर, रायपुर - 492007
दूरभाष 0771-2512840

[illegible]

प्रति,

श्री सुधीर कुमार
MS (IM)
भारतीय वन्यजीव संस्थान, देहरादून

विषय : **Proposal for Biodiversity Assessment Study with respect to the proposal for prospecting of 1745.833 hectares of forest land of Kente extension coal block in favour of M/s Rajasthan Rajya Vidyut Utpadan Nigam Limited for exploration of coal reserves by undertaking Bore holes of 4" dia in Surguja District in the State of Chhattisgarh - reg**

संदर्भ : १. भारत सरकार पर्यावरण वन एवं जलवायु परिवर्तन मंत्रालय नई दिल्ली का पत्र क्रमांक F. No. 8-16/2017-FC दिनांक 19.12.2017 (प्रतिलग्न)

२. भारतीय वन्यजीव एवं अनुसंधान परिषद, देहरादून का पत्र क्रमांक No. [illegible] dt. 02.07.2018

३. [illegible] का पत्र क्रमांक, [illegible] dt. [illegible]

* * * * *

१. [illegible] द्वारा कोयला एवं जलवायु परिवर्तन मंत्रालय नई दिल्ली के संदर्भित पत्र द्वारा [illegible] के आवेदित prospecting हेतु उक्त वनभूमि की वन्यजीव [illegible] निम्नानुसार है।

"Biodiversity assessment study is to be conducted by state government through WII, Dehradun in consultation with Wildlife institute of India, Dehradun for the whole Hasdeo Stand coal bearing forests comprising of Tara, Parsa, Parsa East, Kente to be leased by M/s Rajasthan Rajya Vidyut Utpadan Nigam Ltd. (RVUNL). The study is to be awarded by State Government by associating the nodal Council of Forestry Research and Education (ICFRE), Dehradun and Wildlife Institute of India (WII), Dehradun and integrated wildlife management plan (IWMP) will be prepared and conservation area will be identified and mitigation measures will be recommended by the expert committee. The cost of study and cost of implementation of recommendations shall be borne by M/s Rajasthan RajyaVidyut Utpadan Nigam Ltd (RRVUNL). The report will be submitted within two years."

२. [illegible] के संदर्भ में भारत सरकार से प्राप्त पत्र [illegible] के [illegible] हेतु [illegible] के [illegible] वन एवं जलवायु परिवर्तन मंत्रालय नई दिल्ली [illegible] No. 8-16/2017-FC दिनांक [illegible] के अनुसार Biodiversity assessment study एवं integrated wildlife management plan (IWMP) तैयार करने हेतु राजस्थान राज्य विद्युत उत्पादन निगम को अनुमोदित किया गया था।

३. संदर्भ २ के क्रम में प्राप्त अनुमोदन के अनुक्रम में मांगित जानकारी एवं भारतीय वन्यजीव संस्थान देहरादून के MOU की प्रति संलग्न है।

४. पत्र के माध्यम से अवगत कराना है कि [illegible] के लिये श्री एस.पी. यादव, IFS Wildlife Institute of India (WII), Dehradun द्वारा [illegible] के [illegible] [illegible]

[illegible]

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कार्यालय वनमण्डलाधिकारी, सरगुजा वनमण्डल, अम्बिकापुर (छ.ग.)
(प्रतापपुर रोड, फारेस्ट कैम्पस, अम्बिकापुर, जिला-सरगुजा)
☎ 07774-240238 (O), 240236 (R), 240238 (F) E-Mail :- dfosouthsurguja_200@rediffmail.com

क्रमांक / तक अधि / 520 अम्बिकापुर दि. 04 / 2019

प्रति

अपर प्रधान मुख्य वन संरक्षक
(मू–प्रबंध) छत्तीसगढ़
अरण्य भवन, अटल नगर रायपुर

विषय :– पी.डी. खाता से राशि रूपये 1,74,68,000.00 (एक करोड़ चौहत्तर लाख अड़सठ हजार मात्र) का भारतीय वानिकी एवं अनुसंधान परिषद् देहरादून को भुगतान बाबत्।

(Proposal for Biodiversity Assessment Study With respect to the Proposal for prospecting of 1745.883 hectares of forest land of Kete Extention Coal Block in favour of M/s Rajasthan Rajya Vidyut Utpadan Nigam Limited for exploration of coal reserves by undertaking Bore holes of 4" dia in Surguja District in the State of Chhattisgarh-reg.)

संदर्भ :– 1. अपर प्रधान मुख्य वन संरक्षक (मू–प्रबंध/व.सं.अ.) छ.ग. रायपुर का पृ. क्रमांक/भू–प्रबंध/खनिज/331–228/375 दिनांक 29.01.2019
2. कार्यालयीन पत्र क्रमांक/तक.अधि./468 दिनांक 28.03.2019

—00—

विषयांतर्गत संदर्भित पत्र द्वारा वन संरक्षण अधिनियम 1980 अन्तर्गत केते एक्सटेंशन कोल परियोजना में Biodiversity Assessment study and Integrated wild life management Plan हेतु "पीडी खाते से रूपये 1746 8 लाख की राशि का भुगतान भारतीय वानिकी एवं अनुसंधान परिषद्, देहरादून को किये जाने हेतु अनुमति प्रदान की गई है।

भारतीय वानिकी एवं अनुसंधान परिषद् देहरादून के पत्र दिनांक 27.3.2019 द्वारा प्रकरण अन्तर्गत M/s BIODIVERSITY ASSESSMENT SURGUJA, मेसर्स बायोडायवर्सिटी एसेसमेंट सरगुजा के लिये धनादेश क्रमांक 115871 दिनांक 04.04.2019 राशि रूपये 1746 8 लाख जारी कर खाते में जमा किया गया है।

प्रतिवेदन सूचनार्थ एवं आवश्यक कार्यवाही हेतु सम्प्रेषित है।

वनमण्डलाधिकारी
सरगुजा वनमण्डल, अम्बिकापुर

पृ.क्रमांक/तक अधि/ 521 अम्बिकापुर, दिनांक/05/04/2019

प्रतिलिपि :–

1. एडीजी (ई.एम.) भारतीय वानिकी एवं अनुसंधान परिषद्, पी.ओ.–न्यू फारेस्ट, देहरादून को सूचनार्थ एवं आवश्यक कार्यवाही हेतु सम्प्रेषित।
2. मुख्य वन संरक्षक सरगुजा वनवृत्त अम्बिकापुर को सूचनार्थ एवं आवश्यक कार्यवाही हेतु सम्प्रेषित।

वनमण्डलाधिकारी
सरगुजा वनमण्डल, अम्बिकापुर

Annexure 1.8

Attendance Sheet

Meeting w.r.t "Biodiversity Assessment Study in Hasdeo Arand Coal Field comprising of Tara, Parsa, Parsa East, Kanta Basan and Kente Extension Coal Blocks in Forest area of Surguja District of Chhattisgarh" held on 15.04.2019 at 3:00 PM at ICFRE Dehradun

SN	Name	Address	E-mail	Mobile no.	Signature
1.	Sh. Vipin Chauhan DDG (Extn.)	ICFRE			
2.	Dr. Sudhir Kumar ADG (EM)	ICFRE			
3.	Dr. A.N. Singh Sc-F, EM Div	ICFRE	singhan@icfre.org	9411173674	
4.	Dr. Bivash PA-NJDAV	WII			
5.	Dr. V. Jeeva	ICFRE	vjeeva@icfre	0135-2464	
6.	Dr. Vibhuti	ICFRE			

Annexure 1.9

Draft Minutes of the Consultative Meeting w.r.t Biodiversity Assessment Study for Whole Hasdeo Arand Coalfields Comprising Tara, Parsa, Parsa East, Kete Basan and Kete Extension held at ICFRE, Dehradun on 18.12.2019

A consultative meeting with officials from Wildlife Institute of India (WII), Dehradun and Environment Management (EM) Division, Directorate of Extension, ICFRE Dehradun including ICFRE Domain Experts, whose services are being taken under the project, and study team experts from IFGTB, Coimbatore (Annexure-I) was held on 18.12.2019 at the ICFRE, Dehradun in order to review the progress on baseline data collection on different aspects of biodiversity for preparation of Integrated Biodiversity and Wildlife Management Plan for the whole of Hasdeo Arand coalfield including Tara, Parsa, Parsa East, Kete Basan and Kete Extension coal blocks and preparation of draft report. At the outset Dr. Sridhar Kumar, AIG (EM), ICFRE & Project Coordinator of the study briefed about the agenda of the meeting. Thereafter, the progress made on the study by WII, Dehradun was presented and discussed in details.

Following were decided with consensus:

1. It was intimated by the official from the WII that works under the projects are in progress and the Preliminary Report based on primary baseline data especially on large mammals, dependency of locals on forest and man-animal conflict will be submitted to ICFRE in January 2020. **Action- WII, Dehradun**

2. The baseline data collection on avifaunal diversity and related aspects by WII study team is in progress and likely to be concluded by Jan- Feb, 2020. The draft report based on baseline data on large mammals dependency of locals on forest, man-animal conflict and avifauna diversity will be submitted to ICFRE in March, 2020. **Action- WII, Dehradun**

3. The baseline data on herpetofauna (amphibian &reptiles) diversity is yet to be collected. The same will be collected by the team of WII for needful as per ToR. **Action- WII, Dehradun**

4. The study area of whose of Hasdeo Arand coalfield is to be considered for the faunal diversity with special emphasis on operational coal mines like PEKB, Chotia and coal mines in different stages of clearance viz. Parsa, Tara, Kete Extension apart from other demarcated coal blocks (out of total 23 coal blocks) in the coalfield area. **Action- WII &ICFRE.**

5. The expected deliverables as per ToR of the study and NGT Order against Appeal No. 73/2012 and as per minutes of meeting of Forest Advisory Committee of MoEF&CC, held on dated 25.01.2018 are to be taken into account while collecting baseline data and need to be duly addressed while preparing the study report. **Action- WII &ICFRE**

6 The ICFRE has collected baseline data for two seasons i.e. pre monsoon and post monsoon on terrestrial and aquatic diversity covering whole of the Hasdeo Arand coalfield area and 23 proposed dumari coal blocks. The winter season data will be collected in the months of Jan. Feb. 2020. The data analysis and report preparation based on two season baseline data is in progress and will be ready by Jan., 2021. Action- ICFRE, Dehradun

7 The geological reports of demarcated coal blocks (18 nos.) and Mine Closure Plans of operative coal mines in Parsa East & Kanta Basan and Chotia coal blocks and coal blocks (viz. Parsa and Kete Extension) in different stages of clearance existing in Hasdeo Arand coalfield is to be obtained from Govt. of Chhattisgarh and respective stakeholders. The ICFRE is in constant touch with the concerned office of the Govt. of Chhattisgarh and may expedite the procurement of the required information for preparation of the study report. Action- ICFRE, Dehradun

8 The shape files of Hasdeo Arand coalfield and coal blocks requested by official from WII is being shared through e-mail for needful as discussed in the meeting. Action- ICFRE, Dehradun

9 It was decided that the next consultative meeting is proposed to be held in the month of Feb., 2020

The meeting concluded with thanks to all the participants.

(Dr. Sudhir Kumar)
AIDG (EM) ICFRE Dehradun &
Coordinator of the study

Copy for information and needful to-

1 Director, WII, Dehradun
2 All of participating members as per annexure-I
3 Dr. Bivash Pandav, Scientist 'F' and PI of the study from WII, Dehradun
4 PS to DIDG (Ext.) ICFRE for information to DIDG (Ext.), ICFRE pl

ATTENDANCE SHEET

Consultative Meeting *Biodiversity Assessment Study with respect to the whole Hasdeo-Arand Coalfields comprising Tara, Parsa, Parsa East, Kente extension an coal block area in Surguja District Chhattisgarh* held on 18.12.2019 at 11 AM at IC FRE Dehradun

SN	Name	Address	E mail	Mobile no	Signature
1	Dr [illegible]	CMD Corporation ICFRE D. Dun			
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	Dr A N Singh Scientist F	EMD Div TCFRE	singhan@icfre.org	[illegible]	[illegible]
7	Dr. Abhijit Das Scientist - D	WII, Dehradun	abhijit@wii.gov.in	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Annexure 1.10

Minutes of the meeting on 'Biodiversity Assessment Study for Whole Hasdeo Arand Coalfiled comprising of Tara,Parsa, Parsa East,Kanta Basan and Kente Extension in Surguja District of Chhattisgarh' held at ICFRE, Dehradun on 27.11.2020

The Working group meeting was held on 27.11.2020 at the Indian Council of Forestry Research and Education (ICFRE), Dehradun with the team consisting of scientists from ICFRE, Domain experts and Wild Life Institute of India list of participants is enclosed as Annexture I) to review the progress on the draft report under preparation. The meeting was chaired by Dr. Sudhir Kumar, Deputy Director General (Extn.) ICFRE. Dr Bivash Pandav, Scientist F&PI of the study from partner institute Wildlife Institute of India (WII) could not participate in the meeting due to his pre-engagement.

Dr. A. N. Singh, Assistant Director General (E.M), ICFRE welcomed the Chairman, Domain Experts and the representative from WII and briefed about the agenda of the meeting.

Thereafter, the progress on the draft report was discussed and the representative from WII Dr. N. Lakhminarayanan made a presentation on the draft report under preparation at WII. Detailed deliberation was held after the presentation and following are the points identified that require careful consideration by WII

1. The draft faunal report which is under preparation at WII was found to be mainly focusing on the large mammal diversity, their habitat suitability and modelling with reference to core and buffer zone (10 Km radius) of Tara, Parsa, Parsa East and Kanta Basan and Extension that span in 900 sq.km. Other faunal aspects such as herbivores, mesocarnivores and the avi-fauna are not reflected in the report as outlined in the ToR.

2. In addition, it is also informed that there are about 23 mining blocks that include mine in operation and proposed. Based on the baseline study, the WII should provide impact due to the proposed activity, identification of conservation area and management plan.

3. As per the ToR the Whole entire Hasdeo Arand coal filed comprises of 1879.58 sq.Km (within which the 23 mine consisting both in operation and proposed is situated) an Integrated Wildlife Management Plan for the entire area (1879.58 sq.km) needs to be prepared by WII for the conservation of faunal biodiversity based on the finding, impact perceived including the avifauna of the region, measure for maintaining alternative habitat/home for avifauna including the design of artificially made eco friendly nest, measure for conservation of important resources, recommending avoidance of impacts by modifying specific project activities, components, technology (if feasible & practicable) should be categorically addressed in the report.

4. In addition, the efficacy of the mine closure plan and conservation measures with reference to wild life for the mine lease for which the mine plan is available needs to addressed in the report.

- ... ToR is again enclosed herewith for ready reference. Minutes are [illegible]. The complete report in compliance to the ToR and to address the observations of NGT and EAC (FAE to MoEF&CC) may be expedited as early as possible.

Meeting ended with vote of thanks to the participants.

(Dr. A. N. Singh) 01/12/2
Member (S)

Distribution:

1. The Director, WII, Dehradun for kind information and needful action.
2. Dr. Bivash Pandav, Scientist F and PI of the study, WII, Dehradun with the request to expedite the completion of the report as per ToR at the earliest.
3. All participants.
4. PS to DDG (Env.), ICFRE for information to DDG (Env.), ICFRE, Dehradun.

Annexure 1.11

Minutes of the fourth working group Meeting of officials from the ICFRE and WII held on 13.01.2021 at ICFRE, Dehradun

[illegible] working group meeting with reference to the Biodiversity assessment study in the coal bearing Areas [illegible] (HAC) and 24 coal mines in Korba, Korba (Company), Tara, Parsa, Parsa East and Kanta Basan and Korea Chhattisgarh coal bearing areas in Surguja district, Chhattisgarh was held on 13.01.2021 at Indian Council of Forestry Research and Education (ICFRE) under the Chairmanship of Dr. Sudhir Kumar (DDG (Extension) Dehradun to discuss the queries raised by ICFRE and the response received from the Director, Wildlife Institute of India (WII) on draft report "*Biodiversity Assessment in Hasdeo Arand Landscape, Northern Chhattisgarh*" provided to ICFRE. Further discussions were held to work out the modalities to finalize activities early possible. The team member participated in the meeting is enclosed as Annexure-I.

Dr. A. K. Singh, ADG (FM), ICFRE briefed about the agenda of the meeting followed by a detailed point wise presentation by Dr. V. Leeva, Sr. Consultant, ICFRE. Thereafter, clarifications to the comments and queries on the WII draft report were deliberated in detail. Following are decision made with consensus:

1. Reframe the report in response to the proposal submitted by WII to ICFRE to comply with the ToR. Action- WII, Dehradun

2. The methodology and the sampling process shall be adequately discussed under respective components supported with adequate reference. Action- WII, Dehradun

3. It was pointed out that the WII draft report has mainly dependent on the secondary sources of information to emphasis the overall presence of avi-fauna in the State /HAC and therefore lack authenticity wrt to the study area to address the ToR. Therefore, it was suggested by ICFRE that, two season's baseline data on avifauna diversity with GPS location from Hasdeo Arand coalfield and 24 coal mine area/block collected by Dr. Arun Pratap Singh Scientist-E, team member from ICFRE shall be shared to WII for further analysis and incorporation in the report suitably to comply the ToR specific to avi fauna. In addition the ICFRE report also has other faunal diversity with GPS location shall be suitably used to finalize the report by WII. Action- WII, Dehradun

4. As pointed out during deliberation, the impact assessment due to ongoing /operational coal mine with special emphasis to PEKB and Gevra and Parsa, Tara, Kente Extension re-allotted was identified core blocks in different fauna groups needs to be specifically addressed to comply with the ToR and MoEF observation. In addition considering the risk on fragmented forest ecosystem within HAC and the large mammals, conservation action needs to be identified by WII with logical framework. Team from WII was of the opinion that field assessment of impact on all faunal groups is practically impossible and hence would be limited to the extent of area that would be lost to select key faunal groups (active loss + degradation + area of denial). This will be done by re-examining literature review to examining this in the field with respect long term experiments. Action- WII, Dehradun

5 Based on the finding and report assessed appropriate Integrated Wildlife Management Plan with budgetary provisions shall be adequately incorporated in the report to comply with the ToR. Action: WII, Dehradun

6 [illegible] plan which needs to be evaluated by WII for its effectiveness and appropriateness with reference to wildlife conservation. Of which only one has been addressed in the draft report. WII may like to approach and receive the same from the ICFRE. Action: WII, Dehradun

7 Certain discrepancies pointed in the draft WII report and discussed in detail shall be suitably addressed in the final report. Comments to this effect are enclosed as Annexure II. Action: WII, Dehradun

8 The expected deliverables in the report should strictly comply with the ToR of the study and WCI Order against Appeal No. 75/2013 and as per minutes of meeting of Forest Advisory Committee of MoEF&CC, GoI dated 25.01.2018. In this regard, minutes of the meeting dated 18.12.2019 circulated to WII may also be referred. Action: WII, Dehradun

9 As requested by Dr. G. S. Gupta, Scientist F, WII, Dehradun, a hard copy of all the correspondences related to the scope of the study, communicated earlier to the Director, WII, Dean (Academics), WII-nominated PI/Coordinator of the study, were shared for further needful.

10 It was also requested by the MOC (I/M), ICFRI, that in place of Dr. Bhavesh Padav, Scientist F and PI/Co-ordinator, who has since on deputation, the contact name and phone number of the new PI/Coordinator from WII, Dehradun shall be intimated for further effective coordination and consultation. Action: WII, Dehradun

11 The concerned authority is pressing hard for early submission of the report, therefore ICFRI requested the WII team members to submit the final report latest by 31.01.2021 for further compilation at the end of ICFRI. Action: WII, Dehradun

The meeting ended with thanks to all the participants.

(Dr. A. V. Singh) 25.01.2021

MOC-(I/M) ICFRI, Dehradun &
Coordinator of the study

Copy for information and needful to:

1. Director, WII, Dehradun
2. All the participating members as per mailing list
3. PS to DDG (Ext.), ICFRI, for information to DDG (Ext.), ICFRI, pl.

Page 2

ATTENDANCE SHEET

Working Group Meeting on
Biodiversity Assessment Study with respect to the whole Hasdeo Arand Coalfields comprising
Tara, Parsa, Parsa East, Kente extension coal blocks in Surguja District, Chattisgarh
[illegible] AM at ICFRE, Dehradun

SN	Name & Designation	Contact Address	Email & Mobile no.	Signature
1				
2				
3				
4				
5		WII, Dehradun	9411205769 / 9445339042	
6				
7				

(243)

No WII/ESM/BP/CR/Hasdeo-Arand Assessment 28-01-2021

To

Dr. Sudhir Kumar,
Deputy Director General (Extension)
Indian Council of Forestry Research and Education
Environmental Management Division
New Forest, Dehradun – 248 006

उप महा नि० (विस्तार)

Subject. Finalization of the report "Biodiversity assessment in Hasdeo-Arand landscape, Northern Chhattisgarh" and response to points flagged in the Minutes of Meeting between WII and ICFRE dated 13/01/2021: reg

Reference Email from Dr. A.N. Singh (ADG – EM, ICFRE) to Director, WII dated 15/01/2021

Dear Dr. Sudhir Kumar,

This bears reference to the aforementioned Minutes of Meeting (MoM) regarding finalization of the report on biodiversity assessment in Hasdeo-Arand landscape in Chhattisgarh.

The specific points highlighted in the MoM which requires consideration while finalizing the report have been noted. The responses are as follows:

1. The draft report submitted by WII would be re-structured as per the Terms of Reference (ToR) provided by Chhattisgarh Forest Department.

2. Wherever gaps exist with respect to sampling and analytical methods, the same would be elaborated in the final report. In the draft report, the methods section was provided as a separate chapter. In the revised final report, the methods would be incorporated along with the respective chapters as appropriate.

3. Summer data collection in the field was hampered by Covid-related restrictions forcing us to withdraw field researchers in mid-march 2020 just before the start of the summer season. The avifaunal data would be finalized by augmenting the primary data collected by Dr. Arun Pratap Singh, Scientist F and team members, ICFRE, which may be provided at the earliest and revalidating it with the details submitted by WII in the draft report.

4. WII would focus on assessing the potential impact of the mines on select fauna groups that effectively serve as flagships, umbrellas or keystones in biodiversity conservation. The impact would focus on the area of habitat that would be lost for such species and the likely impacts.

5. WII would chart an appropriate wildlife management plan targeting select fauna groups identified as flagship species under which an array of biodiversity would be protected. The overall integrated wildlife management plan with financial outlay is best done as a joint exercise between ICFRE and WII after due consideration of floral and ethnographic diversity of the landscape.

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6 WII had reviewed two of the mine closure plans and included them in the report ICFRE is requested to send the other two mine-closure plans so that they can be reviewed from fauna conservation aspects

7 The discrepancies of WII's draft report as mentioned in the MoM would be thoroughly reviewed and wherever appropriate, would be addressed

8 The completeness of the report with respect to the ToR and MoEF&CC and court advisories thereof would be evaluated from WII side and the working draft of the report will be shared with ICFRE before finalization of the report

9 Since this is a joint project of ICFRE and WII, it is requested that the draft report prepared by ICFRE may be shared with WII so that the recommendations of both ICFRE and WII are in tandem

Considering the extensive revisions required in the final report particularly with respect to impact assessment, practical mitigation strategies and financial outlay for the wildlife management plan, this might take another three months until 31.03.2021. As Dr. Bivash Pandav, who was the Principal Investigator of the study has gone on deputation to BNHS for a period of three years starting 01/01/2021, WII has constituted a new project team to complete the envisaged project deliverables. Dr. G.V. Gopi, Scientist E would be leading the team

Thanking you

Yours faithfully

(Dr. Dhananjai Mohan, IFS)
Director

Annexure 4.1

List of plant species in Hasdeo-Arand Coalfield falls within Korba, Surguja and Surajpur districts of Chhattisgarh

S.N.	Name of the Plant species	Family	Habit
1	*Abelmoschus crinitus* Wall.	Malvaceae	Shrub
2	*Abelmoschus ficulneus* (L.) Wight & Arn.	Malvaceae	Shrub
3	*Abrus precatorius* L.	Fabaceae	Climbing shrub
4	*Abutilon indicum* (L.) Sweet	Malvaceae	Shrub
5	*Acacia chundra* (Roxb. ex Rottl.) Willd.	Mimosaceae	Tree
6	*Acacia leucophloea* (Roxb.) Willd.	Mimosaceae	Tree
7	*Acacia nilotica* (L.) Willd. ex Delile	Mimosaceae	Tree
8	*Acacia pennata* (L.) Willd.	Mimosaceae	Woody climber
9	*Acacia torta* (Roxb.) Craib.	Mimosaceae	Woody climber
10	*Acacia auriculiformis* A. Cunn. ex Benth.	Mimosaceae	Tree
11	*Acacia caesia* (L.) Willd.	Mimosaceae	Woody climber
12	*Acacia catechu* (L.f.) Willd.	Mimosaceae	Tree
13	*Acalypha indica* L.	Euphorbiaceae	Herb
14	*Acanthospermum hispidum* DC.	Asteraceae	Herb
15	*Achyranthes aspera* L.	Amaranthaceae	Herb
16	*Achyranthes bidentata* Bl.	Amaranthaceae	Herb
17	*Acilepis squarrosa* D. Don	Asteraceae	Herb
18	*Acrocephalus hispidus* (L.) Nicolson & Sivad.	Lamiaceae	Herb
19	*Adenosma indianum* (Lour.) Merr.	Scrophulariaceae	Herb
20	*Adiantum caudatum* Klotzsch	Adiantaceae	Herb
21	*Adiantum incisum* Forssk.	Adiantaceae	Herb
22	*Adiantum philippense* L.	Adiantaceae	Herb
23	*Aegle marmelos* (L.) Correa	Rutaceae	Tree
24	*Aerva lanata* (L.) Juss. ex Schultes	Amaranthaceae	Herb
25	*Aerva sanguinolenta* (L.) Blume	Amaranthaceae	Herb
26	*Aeschynomene indica* L.	Fabaceae	Herb
27	*Ageratum conyzoides* L.	Asteraceae	Herb
28	*Ailanthus excelsa* Roxb.	Simaroubaceae	Tree
29	*Alangium salvifolium* (L.f.) Wang	Alangiaceae	Tree
30	*Albizia amara* (Roxb.) Bioven	Mimosaceae	Tree

S.N.	Name of the Plant species	Family	Habit
31	*Albizia lebbeck* (L.) Benth.	Mimosaceae	Tree
32	*Albizia odoratissima* (L.f.) Benth.	Mimosaceae	Tree
33	*Albizia procera* (Roxb.) Benth.	Mimosaceae	Tree
34	*Allmania nodiflora* (L.) R. Br. ex Wight	Amaranthaceae	Herb
35	*Alloteropsis cimicina* (L.) Stapf	Poaceae	Herb
36	*Alocasia fornicata* (Roxb.) Schott	Araceae	Herb
37	*Aloe vera* (L.) Burm.f.	Liliaceae	Herb
38	*Alstonia scholaris* (L.) R.Br.	Apocynaceae	Tree
39	*Alternanthera sessilis* (L.) R,Br. ex DC.	Amarantheceae	Herb
40	*Alternanthera ficoidea* (L.) Sm.	Amarantheceae	Herb
41	*Alysicarpus monilifer* (L.) DC.	Fabaceae	Herb
42	*Alysicarpus tetragonolobus* Edgew.	Fabaceae	Herb
43	*Alysicarpus vaginalis* (L.) DC.	Fabaceae	Herb
44	*Alysicarpus bupleurifolius* (L.) DC.	Fabaceae	Herb
45	*Alysicarpus glumaceus* (Vahl) DC.	Fabaceae	Herb
46	*Alysicarpus hamosus* Edgew.	Fabaceae	Herb
47	*Alysicarpus heterophyllus* (Baker) Jafri & Ali	Fabaceae	Herb
48	*Amaranthus spinosus* L.	Amaranthaceae	Herb
49	*Amaranthus viridis* L.	Amaranthaceae	Herb
50	*Ammannia baccifera* L.	Lythraceae	Herb
51	*Ampelocissus latifolia* (Roxb.) Planch.	Vitiaceae	Climbing shrub
52	*Ampelocissus tomentosa* (B.Heyne & Roth) Planch.	Vitiaceae	Climbing shrub
53	*Anacardium occidentale* L.	Anacardiaceae	Tree
54	*Andrographis paniculata* (Burm.f.) Wall. ex Nees	Acanthaceae	Herb
55	*Andropogon pumilus* Roxb.	Poaceae	Herb
56	*Anisomeles indica* (L.) Kuntze	Lamiaceae	Shrub
57	*Annona reticulata* L.	Annonaceae	Tree
58	*Annona squamosa* L.	Annonaceae	Tree
59	*Anogeissus acuminata* (Roxb. ex DC.) Wall. ex Guill.	Combretaceae	Tree
60	*Anogeissus latifolia* (Roxb. ex DC.) Wall. ex Guill.	Combretaceae	Tree
61	*Anogeissus pendula* Edgew.	Combretaceae	Tree
62	*Antidesma acidum* Retz.	Euphorbiaceae	Tree
63	*Antidesma ghaesembilla* Gaertn.	Euphorbiaceae	Tree

S.N.	Name of the Plant species	Family	Habit
64	*Apluda mutica* L.	Poaceae	Herb
65	*Ardisia solanacea* Roxb.	Myrsinaceae	Shrub
66	*Argemone mexicana* L.	Papavaraceae	Herb
67	*Arisaema* sp.	Araceae	Herb
68	*Arisaema tortuosum* (Wall.) Schott	Araceae	Herb
69	*Aristida adscensionis* L.	Poaceae	Herb
70	*Aristida setacea* Retz.	Poaceae	Herb
71	*Aristida hystrix* L.f.	Poaceae	Herb
72	*Aristolochia indica* L.	Aristolochiaceae	Climbing shrub
73	*Arthocarpus heterophyllus* Lam.	Moraceae	Tree
74	*Arthraxon hispidus* (Thunb.) Makino	Poaceae	Herb
75	*Arthraxon lancifolius* (Trin.) Hochst.	Poaceae	Herb
76	*Arundinella pumila* (Hochst.ex A. Rich.) Steud.	Poaceae	Herb
77	*Arundinella setosa* Trin.	Poaceae	Herb
78	*Asparagus racemosus* Willd.	Liliaceae	Climbing shrub
79	*Azadirachta indica* A. Juss.	Meliaceae	Tree
80	*Bacopa monnieri* (L.) Wettst.	Scrophulariaceae	Herb
81	*Bacopa floribunda* (R.Br.) Wettst.	Scrophulariaceae	Herb
82	*Bambusa bambos* (L.) Voss	Poaceae	Shrub
83	*Bambusa vulgaris* Schrad.	Poaceae	Shrub
84	*Barleria cristata* L.	Acanthaceae	Herb
85	*Barleria prionites* L.	Acanthaceae	Shrub
86	*Barleria strigosa* Willd.	Acanthaceae	Shrub
87	*Barringtonia acutangula* (L.) Gaertn.	Lecythidaceae	Tree
88	*Basilicum polystachyon* (L.) Moench	Lamiaceae	Herb
89	*Bauhinia malabarica* Roxb.	Caesalpiniaceae	Tree
90	*Bauhinia pupurea* L.	Caesalpiniaceae	Tree
91	*Bauhinia racemosa* Lam.	Caesalpiniaceae	Tree
92	*Bauhinia semla* Wunderlin	Caesalpiniaceae	Tree
93	*Bauhinia vahlii* Wight & Arn.	Caesalpiniaceae	Woody climber
94	*Bauhinia variegata* L.	Caesalpiniaceae	Tree
95	*Begonia picta* Sm.	Begoniaceae	Herb
96	*Bidens biternata* (Lour.) Merr. & Scherff	Asteraceae	Herb

S.N.	Name of the Plant species	Family	Habit
97	*Bidens pilosa* L.	Asteraceae	Herb
98	*Biophytum sensitivum* (L.) DC.	Oxalidaceae	Herb
99	*Biophytum reinwardtii* (Zucc.) Klotzsch	Oxalidaceae	Herb
100	*Biophytum umbraculum* Welw.	Oxalidaceae	Herb
101	*Bixa orellana* Lam.	Bixaceae	Tree
102	*Blepharis maderaspatensis* (L.) B.Heyne ex Roth	Acanthaceae	Herb
103	*Blumea flava* DC.	Asteraceae	Herb
104	*Blumea mollis* (D. Don) Merr.	Asteraceae	Herb
105	*Blumea* sp.	Asteraceae	Herb
106	*Blumea laciniata* (Wall. ex Roxb.) DC.	Asteraceae	Herb
107	*Blumea oxyodonta* DC.	Asteraceae	Herb
108	*Boerhavia diffusa* L.	Nyctaginaceae	Herb
109	*Bombax ceiba* L.	Bombacaceae	Tree
110	*Borassus flabellifer* L.	Arecaceae	Tree
111	*Boswellia serrata* Roxb. ex Colebr.	Burseraceae	Tree
112	*Bothriochloa odorata* (Lisboa) A. Camus	Poaceae	Herb
113	*Bothriochloa pertusa* (L.) A.Camus	Poaceae	Herb
114	*Brachiaria ramosa* (L.) Stapf	Poaceae	Herb
115	*Brachiaria reptans* (L.) C.A.Gardner & C.E.Hubb.	Poaceae	Herb
116	*Bridelia retusa* (L.) Spreng.	Euphorbiaceae	Tree
117	*Buchanania lanzan* Spreng.	Anacardiaceae	Tree
118	*Bulbophyllum* sp.	Orchidaceae	Herb
119	*Bulbostylis barbata* (Rottb.) C. B. Clarke	Cyperaceae	Herb
120	*Butea monosperma* (Lam.) Taub.	Fabaceae	Tree
121	*Butea superba* Roxb.	Fabaceae	Woody climber
122	*Byttneria herbacea* Roxb.	Sterculiaceae	Herb
123	*Caesalpinia bonduc* (L.) Roxb.	Caesalpiniaceae	Woody climber
124	*Caesalpinia cucullata* Roxb.	Caesalpiniaceae	Woody climber
125	*Caesulia axillaris* Roxb.	Asteraceae	Herb
126	*Cajanus scarabaeoides* (L.) Benth.	Fabaceae	Climbing shrub
127	*Calotropis gigantea* (L.) R.Br.	Asclepiadaceae	Shrub
128	*Calotropis procera* (Aiton) Dryand.	Asclepiadaceae	Shrub
129	*Canna indica* L.	Cannaceae	Herb

S.N.	Name of the Plant species	Family	Habit
130	*Canscora decussata* (Roxb.) Shult. & Shult. f.	Gentianaceae	Herb
131	*Canscora diffusa* (Vahl) R. Br.	Gentianaceae	Herb
132	*Canscora pauciflora* Dalzell	Gentianaceae	Herb
133	*Canthium dicoccum* (Gaertn.) Teijsm.	Rubiaceae	Shrub
134	*Canthium coromandelicum* (Burm.f.) Alston	Rubiaceae	Shrub
135	*Capparis zeylanica* L.	Capparidaceae	Woody climber
136	*Cardiospermum halicacabum* L.	Sapindaceae	Climbing shrub
137	*Careya arborea* Roxb.	Lecythidaceae	Tree
138	*Carissa spinarum* L.	Apocynaceae	Shrub
139	*Carissa carandas* L.	Apocynaceae	Shrub
140	*Casearia graveolens* Dalz.	Flacourtiaceae	Tree
141	*Casearia tomentosa* Roxb.	Flacourtiaceae	Tree
142	*Cassia fistula* L.	Caesalpiniaceae	Tree
143	*Cassine glauca* (Rottb.) Kuntze	Celastraceae	Tree
144	*Cassytha filiformis* L.	Lauraceae	Climbing shrub
145	*Catharanthus pusillus* (Murr.) G.Don	Apocynaceae	Herb
146	*Catunaregam spinosa* (Thunb.) Tirvegadum	Rubiaceae	Tree
147	*Cayratia pedata* (Lour.) Juss. ex.Gagnup.	Vitaceae	Climbing shrub
148	*Cayratia trifolia* (L.) Domin	Vitiaceae	Climbing shrub
149	*Ceiba pentandra* (L.) Gaertn.	Bombacaceae	Tree
150	*Celastrus paniculatus* Willd.	Celastraceae	Climbing shrub
151	*Celosia argentea* L.	Amaranthaceae	Herb
152	*Centella asiatica* (L.) Urban	Apiaceae	Herb
153	*Centipeda minima* (L.) A. Braun & Asch.	Asteraceae	Herb
154	*Ceriscoides turgida* (Roxb.) Tirvengadum	Rubiaceae	Tree
155	*Chamaecrista mimosoides* (L.) Greene	Caesalpiniaceae	Herb
156	*Chamaecrista pumila* (Lam.) K.Larsen	Caesalpiniaceae	Herb
157	*Cheilanthes farinosa* (Forssk.) Kaulf.	Pteridaceae	Herb
158	*Cheilanthes* sp.	Pteridaceae	Herb
159	*Cheilocostus speciosus* (J.Koenig) C.D.Specht	Costaceae	Herb
160	*Chloris barbata* Sw.	Poaceae	Herb
161	*Chlorophytum arundinaceum* Baker	Liliaceae	Herb
162	*Chlorophytum laxum* R.Br.	Liliaceae	Herb

S.N.	Name of the Plant species	Family	Habit
163	*Chlorophytum tuberosum* (Roxb.) Baker	Liliaceae	Herb
164	*Chloroxylon swietenia* DC.	Flindersiaceae	Tree
165	*Chromolaena odorata* (L.) King & Robins	Asteraceae	Shrub
166	*Chrysopogon aciculatus* (Retz.) Trin.	Poaceae	Herb
167	*Chrysopogon fulvus* (Spring.) Chiov.	Poaceae	Herb
168	*Cipadessa baccifera* (Roxb.) Miq.	Meliaceae	Shrub
169	*Cissampelos pareira* L.	Menispermaceae	Climbing shrub
170	*Cissus quadrangularis* L.	Vitiaceae	Climbing shrub
171	*Cissus repanda* Vahl.	Vitaceae	Climbing shrub
172	*Cleistanthus collinus* (Roxb.) Benth. ex Hook.	Euphorbiaceae	Tree
173	*Cleome gynandra* L.	Cleomaceae	Herb
174	*Cleome viscosa* L.	Cleomaceae	Herb
175	*Cleome monophylla* L.	Cleomaceae	Herb
176	*Clerodendrum infortunatum* L.	Verbenaceae	Shrub
177	*Clerodendrum serratum* (L.) Moon	Verbenaceae	Shrub
178	*Cocculus hirsutus* (L.) Diels	Menispermaceae	Climbing shrub
179	*Cochlospermum religiosum* (L.) Alston	Cochlospermaceae	Tree
180	*Colebrookia oppositifolia* Sm.	Lamiaceae	Shrub
181	*Colocasia esculenta* (L.) Schott	Araceae	Herb
182	*Combretum roxburghii* Roxb.	Combretaceae	Woody climber
183	*Commelina benghalensis* L.	Commelinaceae	Herb
184	*Commelina diffusa* Burm.f.	Commelinaceae	Herb
185	*Corchorus aestuans* L.	Tiliaceae	Herb
186	*Corchorus capsularis* L.	Tiliaceae	Herb
187	*Corchorus olitorius* L.	Tiliaceae	Herb
188	*Cordia obliqua* Willd.	Ehretiaceae	Tree
189	*Crinum latifolium* L.	Amaryllidaceae	Herb
190	*Crotalaria juncea* L.	Fabaceae	Herb
191	*Crotalaria linifolia* L.f.	Fabaceae	Herb
192	*Crotalaria pallida* Dryand.	Fabaceae	Herb
193	*Crotalaria prostrata* Rottl. ex. Willd.	Fabaceae	Herb
194	*Crotalaria alata* D.Don	Fabaceae	Herb
195	*Crotalaria calycina* Schrank	Fabaceae	Herb

S.N.	Name of the Plant species	Family	Habit
196	*Crotalaria evolvuloides* Benth.	Fabaceae	Herb
197	*Crotalaria retusa* L.	Fabaceae	Herb
198	*Crotalaria verrucosa* L.	Fabaceae	Herb
199	*Croton bonplandianus* Baill.	Euphorbiaceae	Herb
200	*Croton persimilis* Muell.-Arg.	Euphorbiaceae	Tree
201	*Cryptolepis buchananii* Roem. & Schultes	Periplocaceae	Climbing shrub
202	*Curculigo orchioides* Gaertn.	Hypoxidaceae	Herb
203	*Curcuma pseudomontana* Graham	Zingiberaceae	Herb
204	*Curcuma angustifolia* Roxb.	Zingiberaceae	Herb
205	*Curcuma longa* L.	Zingiberaceae	Herb
206	*Cuscuta reflexa* Roxb.	Convolvulaceae	Climbing shrub
207	*Cyanotis cristata* (L.) D. Don	Commelinaceae	Herb
208	*Cyanotis axillaris* (L.) D.Don ex Sweet	Commelinaceae	Herb
209	*Cymbopogon martini* (Roxb.) W.Watson	Poaceae	Herb
210	*Cynodon dactylon* (L.) Pers.	Poaceae	Herb
211	*Cyperus iria* L.	Cyperaceae	Herb
212	*Cyperus niveus* Retz.	Cyperaceae	Herb
213	*Cyperus rotundus* L.	Cyperaceae	Herb
214	*Cyperus cephalotes* Vahl	Cyperaceae	Herb
215	*Cyperus compressus* L.	Cyperaceae	Herb
216	*Cyperus corymbosus* Rottb.	Cyperaceae	Herb
217	*Cyperus cyperinus* (Retz.) Suringar	Cyperaceae	Herb
218	*Cyrtococcum patens* (L.) A.Camus	Poaceae	Herb
219	*Dactyloctenium aegyptium* (L.) Willd.	Poaceae	Herb
220	*Dalbergia latifolia* Roxb.	Fabaceae	Tree
221	*Dalbergia paniculata* Roxb.	Fabaceae	Tree
222	*Dalbergia sissoo* Roxb.	Fabaceae	Tree
223	*Datura metel* L.	Solanaceae	Shrub
224	*Debia ovatifolia* (Cav.) Neupane & N.Wikstr.	Rubiaceae	Herb
225	*Delonix regia* Roxb.	Caesalpiniaceae	Tree
226	*Dendrobium* sp.	Orchidaceae	Herb
227	*Dendrocalamus strictus* (Roxb.) Nees	Poaceae	Shrub
228	*Dendrophthoe falcata* (L.f.) Etting.	Loranthaceae	Shrub

S.N.	Name of the Plant species	Family	Habit
229	*Desmodium gangeticum* (L.) DC.	Fabaceae	Herb
230	*Desmodium heterocarpon* (L.) DC.	Fabaceae	Herb
231	*Desmodium laxiflorum* DC.	Fabaceae	Herb
232	*Desmodium motorium* (Houtt.) Merr.	Fabaceae	Shrub
233	*Desmodium pulchellum* (L.) Benth.	Fabaceae	Shrub
234	*Desmodium triflorum* (L.) DC.	Fabaceae	Herb
235	*Desmodium velutinum* (Willd.) DC.	Fabaceae	Shrub
236	*Dichanthium annulatum* (Forssk.) Stapf	Poaceae	Herb
237	*Dichanthium caricosum* (L.) A.Camus	Poaceae	Herb
238	*Dichrostachys cinerea* (L.) Wight & Arn.	Mimosaceae	Tree
239	*Dicliptera paniculata* (Forssk.) I.Darbysh.	Acanthaceae	Herb
240	*Dicranopteris linearis* (Burm. f.) Underw.	Gleicheniaceae	Herb
241	*Digeria muricata* (L.) Mart.	Amaranthaceae	Herb
242	*Digitaria ciliaris* (Retz.) Koeler	Poaceae	Herb
243	*Digitaria longiflora* (Retz.) Pers.	Poaceae	Herb
244	*Digitaria abludens* (Roem. & Schult.) Veldkamp	Poaceae	Herb
245	*Digitaria stricta* Roth	Poaceae	Herb
246	*Dillenia pentagyna* Roxb.	Dilleniaceae	Tree
247	*Dimeria ornithopoda* Trin.	Poaceae	Herb
248	*Dimeria* sp.	Poaceae	Herb
249	*Dioscorea belophylla* Voigt ex Haines	Dioscoreaceae	Climbing shrub
250	*Dioscorea bulbifera* L.	Dioscoreaceae	Climbing shrub
251	*Dioscorea hispida* Dennst.	Dioscoreaceae	Climbing shrub
252	*Dioscorea oppositifolia* L.	Dioscoreaceae	Climbing shrub
253	*Dioscorea pentaphylla* L.	Dioscoreaceae	Climbing shrub
254	*Dioscorea tomentosa* J.Koenig ex Spreng.	Dioscoreaceae	Climbing shrub
255	*Diospyros melanoxylon* Roxb.	Ebenaceae	Tree
256	*Diospyros montana* Roxb.	Ebenaceae	Tree
257	*Diospyros sylvatica* Roxb	Ebenaceae	Tree
258	*Diplocyclos palmatus* (L.) Jeffrey	Cucurbitaceae	Climbing shrub
259	*Dodonaea viscosa* (L.) Jacq.	Sapindaceae	Shrub
260	*Drimia indica* (Roxb.) Jessop	Asperagaceae	Herb
261	*Drosera indica* L.	Droseraceae	Herb

S.N.	Name of the Plant species	Family	Habit
262	*Drosera burmanni* Vahl	Droseraceae	Herb
263	*Duranta repens* L.	Verbenaceae	Shrub
264	*Eclipta prostrata* (L.) L.	Asteraceae	Herb
265	*Ehretia laevis* Roxb.	Ehretiaceae	Tree
266	*Eleiotis sororia* (L.) DC.	Fabaceae	Herb
267	*Elephantopus scaber* L.	Asteraceae	Herb
268	*Eleusine indica* (L.) Gaertn.	Poaceae	Herb
269	*Eleusine coracana* (L.) Gaertn.	Poaceae	Herb
270	*Embelia tsjeriam-cottam* (Roem. & Schult.) DC.	Myrsinaceae	Shrub
271	*Emilia sonchifolia* (L.) DC.	Asteraceae	Herb
272	*Enicostema axillare* (Lam.) Raynal	Gentianaceae	Herb
273	*Entada rheedii* Spreng.	Mimosaceae	Woody climber
274	*Enteropogon dolichostachyus* (Lag.) Keng	Poaceae	Herb
275	*Equisetum diffusum* D. Don	Equisetaceae	Herb
276	*Equisetum ramosissimum* Desf.	Equisetaceae	Herb
277	*Eragrostiella bifaria* (Vahl) Bor	Poaceae	Herb
278	*Eragrostiella nardoides* (Trin.) Bor	Poaceae	Herb
279	*Eragrostis ciliaris* (L.) R.Br.	Poaceae	Herb
280	*Eragrostis nutans* (Retz.) Nees ex Steud.	Poaceae	Herb
281	*Eragrostis tenella* (L.) P.Beauv. ex Roem. & Schultes	Poaceae	Herb
282	*Eragrostis unioloides* (Retz.) Nees ex Steud.	Poaceae	Herb
283	*Eragrostis viscosa* (Retz.) Trin.	Poaceae	Herb
284	*Eragrostis japonica* (Thunb.) Trin.	Poaceae	Herb
285	*Eragrostis pilosa* (L.) P.Beauv.	Poaceae	Herb
286	*Eranthemum roseum* (Vahl) R. Br.	Acantheceae	Shrub
287	*Eranthemum purpurascens* Wight ex Nees	Acantheceae	Shrub
288	*Eriocaulon* sp.	Eriocaulaceae	Herb
289	*Eriolaena hookeriana* Wight & Arn.	Malvaceae	Tree
290	*Erycibe paniculata* Roxb.	Convolvulaceae	Woody climber
291	*Erythrina suberosa* Roxb.	Fabaceae	Tree
292	*Erythrina variegata* L.	Fabaceae	Tree
293	*Eucalyptus* sp.	Myrtaceae	Tree
294	*Eulaliopsis binata* (Retz.) Hubbard	Poaceae	Herb

S.N.	Name of the Plant species	Family	Habit
295	*Eulophia* sp.	Orchidaceae	Herb
296	*Eulophia epidendraea* (J.Koenig ex Retz.) C.E.C.Fisch.	Orchidaceae	Herb
297	*Euphorbia hirta* L.	Euphorbiaceae	Herb
298	*Euphorbia prostrata* Aiton	Euphorbiaceae	Herb
299	*Evolvulus alsinoides* (L.) L.	Convolvulaceae	Herb
300	*Evolvulus nummularius* (L.) L.	Convolvulaceae	Herb
301	*Ficus benghalensis* L.	Moraceae	Tree
302	*Ficus hispida* L.f.	Moraceae	Tree
303	*Ficus racemosa* L.	Moraceae	Tree
304	*Ficus religiosa* L.	Moraceae	Tree
305	*Ficus tinctoria* Forst.	Moraceae	Tree
306	*Ficus mollis* Vahl	Moraceae	Tree
307	*Fimbristylis* sp.	Cyperaceae	Herb
308	*Fimbristylis dichotoma* (L.) Vahl	Cyperaceae	Herb
309	*Fimbristylis ferruginea* (L.) Vahl	Cyperaceae	Herb
310	*Fimbristylis quinquangularis* (Vahl) Kunth	Cyperaceae	Herb
311	*Fimbristylis umbellaris* (Lam.) Vahl	Cyperaceae	Herb
312	*Flacourtia indica* (Burm.f.) Merr.	Flacourtiaceae	Tree
313	*Flemingia chappar* Buch.-Ham. ex Benth.	Fabaceae	Shrub
314	*Flemingia nana* Roxb.	Fabaceae	Herb
315	*Flemingia strobilifera* (L.) R.Br. ex Ait.	Fabaceae	Shrub
316	*Flemingia semialata* Roxb.	Fabaceae	Shrub
317	*Flueggea virosa* (Roxb. ex Willd.) Royle	Euphorbiaceae	Shrub
318	*Gardenia gummifera* L.f.	Rubiaceae	Tree
319	*Gardenia latifolia* Ait.	Rubiaceae	Tree
320	*Gardenia resinifera* Roth	Rubiaceae	Tree
321	*Garuga pinnata* Roxb.	Burseraceae	Tree
322	*Geodorum densiflorum* (Lam.) Schltr.	Orchidaceae	Herb
323	*Glinus oppositifolius* (L.) A. DC.	Molluginaceae	Herb
324	*Gliricidia sepium* (Jacq.) Kunth. ex Walp.	Fabaceae	Tree
325	*Glochidion zeylanicum* (Gaertn.) Juss.	Euphorbiaceae	Tree
326	*Gloriosa superba* L.	Liliaceae	Herb
327	*Gmelina arborea* Roxb.	Verbenaceae	Tree

S.N.	Name of the Plant species	Family	Habit
328	*Gmelina asiatica* L.	Verbenaceae	Shrub
329	*Grangea maderaspatana* (L.) Poir.	Asteraceae	Herb
330	*Grewia hirsuta* Vahl.	Tiliaceae	Shrub
331	*Grewia rothii* DC.	Tiliaceae	Shrub
332	*Grewia tiliaefolia* Vahl	Tiliaceae	Tree
333	*Grewia optiva* J.R.Drumm. ex Burret	Tiliaceae	Tree
334	*Grewia orbiculata* Rottler	Tiliaceae	Shrub
335	*Gymnosporia emarginata* (Willd.) Thwaites	Tiliaceae	Shrub
336	*Habenaria plantaginea* Lindl.	Orchidaceae	Herb
337	*Habenaria commelinifolia* (Roxb.) Wall. ex Lindl.	Orchidaceae	Herb
338	*Habenaria diphylla* (Nimmo) Dalzell	Orchidaceae	Herb
339	*Hackelochloa granularis* (L.) Kuntze	Poaceae	Herb
340	*Haldina cordifolia* (Roxb.) Ridsdale	Rubiaceae	Tree
341	*Hardwickia binata* Roxb.	Caesalpiniaceae	Tree
342	*Hedyotis auricularia* L.	Rubiaceae	Herb
343	*Hedyotis* sp.	Rubiaceae	Herb
344	*Helicteres isora* L.	Sterculiaceae	Shrub
345	*Heliotropium indicum* L.	Boraginaceae	Herb
346	*Hemidesmus indicus* (L.) R.Br.	Periplocaceae	Climbing shrub
347	*Hemigraphis latebrosa* (Heyne ex Roth) Nees	Acanthaceae	Herb
348	*Heteropogon contortus* (L.) P.Beauv.	Poaceae	Herb
349	*Hibiscus lobatus* (Murr.) Kuntze	Malvaceae	Herb
350	*Holarrhena pubescens* (Buch.-Ham.) Wall. ex G. Don	Apocynaceae	Tree
351	*Holoptelea integrifolia* (Roxb.) Planch.	Ulmaceae	Tree
352	*Holostemma ada-kodien* Schult.	Asclepiadaceae	Climbing shrub
353	*Homalium nepalense* Benth.	Flacourtiaceae	Tree
354	*Homonoia riparia* Lour	Euphorbiaceae	Shrub
355	*Hybanthus enneaspermus* (L.) F.v.Muell.	Violaceae	Herb
356	*Hymenodictyon orixense* (Roxb.) Mabb.	Rubiaceae	Tree
357	*Hyptis suaveolens* (L.) Poit.	Lamiaceae	Herb
358	*Ichnocarpus frutescens* (L.) R.Br.	Apocynaceae	Climbing shrub
359	*Imperata cylindrica* (L.) Raeuschal	Poaceae	Herb
360	*Indigofera cassioides* Rottl. ex DC.	Fabaceae	Shrub

S.N.	Name of the Plant species	Family	Habit
361	*Indigofera linifolia* (L.f.) Retz.	Fabaceae	Herb
362	*Indigofera linnaei* Ali	Fabaceae	Herb
363	*Indigofera cordifolia* Roth	Fabaceae	Herb
364	*Indigofera hirsuta* L.	Fabaceae	Herb
365	*Indigofera nummulariifolia* (L.) Alston	Fabaceae	Herb
366	*Indoneesiella echioides* (L.) Sreemadh.	Acanthaceae	Herb
367	*Iphigenia indica* (L.) A.Gray ex Kunth	Colchicaceae	Herb
368	*Ipomoea carnea* Jacq.	Convolvulaceae	Shrub
369	*Ipomoea pes-tigridis* L.	Convolvulaceae	Climbing shrub
370	*Ipomoea aquatica* Forssk.	Convolvulaceae	Herb
371	*Iseilema laxum* Hack.	Poaceae	Herb
372	*Ixora pavetta* Andr.	Rubiaceae	Tree
373	*Jasminum arborescens* Roxb.	Oleaceae	Climbing shrub
374	*Jasminum multiflorum* (Burm. f.) Andr.	Oleaceae	Climbing shrub
375	*Jasminum coarctatum* Roxb.	Oleaceae	Climbing shrub
376	*Jatropha curcas* L.	Euphorbiaceae	Shrub
377	*Jatropha gossypiifolia* L.	Euphorbiaceae	Shrub
378	*Justicia adhatoda* L.	Acanthaceae	Shrub
379	*Justicia diffusa* Willd.	Acanthaceae	Herb
380	*Justicia glauca* Rottl.	Acanthaceae	Herb
381	*Justicia japonica* Thunb.	Acanthaceae	Herb
382	*Justicia procumbens* L.	Acanthaceae	Herb
383	*Justicia quinqueangularis* Koenig ex Roxb.	Acanthaceae	Herb
384	*Knoxia sumatrensis* (Retz.) DC.	Rubiaceae	Herb
385	*Kydia calycina* Roxb.	Malvaceae	Tree
386	*Kyllinga nemoralis* (Forst.) Dandy & Hutch.	Cyperaceae	Herb
387	*Kyllinga bulbosa* P.Beauv.	Cyperaceae	Herb
388	*Lagascea mollis* Cav.	Asteraceae	Herb
389	*Lagerstroemia parviflora* Roxb.	Lythraceae	Tree
390	*Lannea coromandelica* (Houtt.) Merr.	Anacardiaceae	Tree
391	*Lantana camara* L.	Verbenaceae	Shrub
392	*Launaea acaulis* (Roxb.) Babc. ex Kerr	Asteraceae	Herb
393	*Launaea nudicaulis* (L.) Hook.f.	Asteraceae	Herb

S.N.	Name of the Plant species	Family	Habit
394	*Leea indica* (Burm.f.) Merr.	Leeaceae	Shrub
395	*Leea macrophylla* Roxb. ex. Hornem.	Leeaceae	Shrub
396	*Leea asiatica* (L.) Ridsdale	Leeaceae	Shrub
397	*Leonotis nepetifolia* (L.) R.Br.	Lamiaceae	Herb
398	*Lepidagathis fasciculata* (Retz.) Nees	Acanthaceae	Herb
399	*Lepidagathis incurva* Buch.-Ham.ex. D.Don	Acanthaceae	Herb
400	*Lepidagathis trinervis* Nees	Acanthaceae	Herb
401	*Leucas aspera* (Willd.) Link	Lamiaceae	Herb
402	*Leucas cephalotes* (Roth) Spreng.	Lamiaceae	Herb
403	*Leucas angularis* Benth.	Lamiaceae	Herb
404	*Leucas biflora* (Vahl) Sm.	Lamiaceae	Herb
405	*Limnophylla repens* (Benth.) Benth.	Scrophulariaceae	Herb
406	*Limonia acidissima* L.	Rutaceae	Tree
407	*Lindernia ciliata* (Colsm.) Pennell	Scrophulariaceae	Herb
408	*Lindernia crustacea* (L.) F. v. Muell.	Scrophulariaceae	Herb
409	*Lindernia caespitosa* (Blume) Panigrahi	Scrophulariaceae	Herb
410	*Lobelia alsinoides* Lam.	Campanulaceae	Herb
411	*Ludwigia octovalvis* (Jacq.) Raven	Onagraceae	Herb
412	*Ludwigia hyssopifolia* (G.Don) Exell	Onagraceae	Herb
413	*Ludwigia peruviana* (L.) H.Hara	Onagraceae	Herb
414	*Lygodium flexuosum* (L.) Sw.	Lygodiaceae	Herb
415	*Madhuca longifolia* (Koen.)Macbr.var. *latifolia* (Roxb.) A.Cheval	Sapotaceae	Tree
416	*Mallotus philippensis* (L.) Muell.-Arg.	Euphorbiaceae	Tree
417	*Mangifera indica* L.	Anacardiaceae	Tree
418	*Manilkara hexandra* (Roxb.) Dubard	Sapotaceae	Tree
419	*Marsdenia tenacissima* (Roxb.) Moon.	Asclepiadaceae	Climbing shrub
420	*Martynia annua* L.	Martyniceae	Herb
421	*Mecardonia procumbens* (Mill.) Small	Scrophulariaceae	Herb
422	*Melanocenchris jacquemontii* Jaub. & Spach	Poaceae	Herb
423	*Melastoma malabathricum* L.	Melastomataceae	Shrub
424	*Melaxis* sp.	Orchidaceae	Herb
425	*Melia azedarach* L.	Meliaceae	Tree

S.N.	Name of the Plant species	Family	Habit
426	*Melochia corchorifolia* L.	Malvaceae	Herb
427	*Merremia emarginata* (Burm.) Hall.f.	Convolvulaceae	Climbing shrub
428	*Merremia tridentata* (L.) Hall.f.	Convolvulaceae	Climbing shrub
429	*Microchloa indica* (L.f.) P.Beauv.	Poaceae	Herb
430	*Micromeria biflora* (Buch.-Ham.ex D.Don) Benth.	Lamiaceae	Herb
431	*Microstachys chamaelea* (L.) Müll.Arg.	Euphorbiaceae	Herb
432	*Miliusa tomentosa* (Roxb.) Sinclair	Annonaceae	Tree
433	*Milletia extensa* (Benth.) Baker	Fabaceae	Woody climber
434	*Millettia racemosa* (Roxb.) Benth.	Fabaceae	Woody climber
435	*Mimosa pudica* L.	Mimosaceae	Herb
436	*Mitracarpus hirtus* (L.) DC.	Rubiaceae	Herb
437	*Mitragyna parvifolia* (Roxb.) Korth.	Rubiaceae	Tree
438	*Mitrasacme indica* Wight	Loganiaceae	Herb
439	*Mitrasacme pygmaea* R. Br.	Loganiaceae	Herb
440	*Molineria capitulata* (Lour.) Herb.	Hypoxidaceae	Herb
441	*Molineria trichocarpa* (Wight) N.P.Balakr.	Hypoxidaceae	Herb
442	*Mollugo nudicaulis* Lam.	Molluginaceae	Herb
443	*Mollugo pentaphylla* L.	Molluginaceae	Herb
444	*Morinda pubescens* J.E.Smith	Rubiaceae	Tree
445	*Mucuna pruriens* (L.) DC.	Convolvulaceae	Climbing shrub
446	*Mukia maderaspatana* (L.) Roem.	Cucurbitaceae	Herb
447	*Murdannia edulis* (Stokes) Faden	Commelinaceae	Herb
448	*Murdannia nudiflora* (L.) Brenan	Commelinaceae	Herb
449	*Murdannia spirata* (L.) G.Brückn.	Commelinaceae	Herb
450	*Murraya paniculata* (L.) Jack.	Rutaceae	Shrub
451	*Naringi crenulata* (Roxb.) Nicolson	Rutaceae	Tree
452	*Nelsonia canescens* (Lam.) Spreng.	Acantheceae	Herb
453	*Neolamarckia cadamba* (Roxb.) Bosser	Rubiaceae	Tree
454	*Nepeta hindostana* (B.Heyne ex Roth) Haines	Lamiaceae	Herb
455	*Nyctanthes arbor-tristis* L.	Nyctanthaceae	Tree
456	*Ochna gamblei* King ex Brandis	Ochnaceae	Tree
457	*Ocimum americanum* L.	Lamiaceae	Herb
458	*Oldenlandia corymbosa* L.	Rubiaceae	Herb

S.N.	Name of the Plant species	Family	Habit
459	*Oldenlandia herbacea* (L.) Roxb.	Rubiaceae	Herb
460	*Operculina turpethum* (L.) Silva Manso	Convolvulaceae	Climbing shrub
461	*Ophioglossum* sp.	Ophioglossaceae	Herb
462	*Ophioglossum reticulatum* L.	Ophioglossaceae	Herb
463	*Oplismenus burmannii* (Retz.) P. Beauv.	Poaceae	Herb
464	*Oplismenus compositus* (L.) P. Beauv.	Poaceae	Herb
465	*Oroxylum indicum* (L.) Vent.	Bignoniaceae	Tree
466	*Orthosiphon pallidus* Benth.	Lamiaceae	Herb
467	*Ougeinia oojeinensis* (Roxb.) Hochr.	Fabaceae	Tree
468	*Oxalis corniculata* L.	Oxalidaceae	Herb
469	*Panicum maximum* Jacq.	Poaceae	Herb
470	*Parthenium hysterophorus* L.	Asteraceae	Herb
471	*Paspalidium flavidum* (Retz.) A.Camus	Poaceae	Herb
472	*Paspalidium geminatum* (Forssk.) Stapf	Poaceae	Herb
473	*Paspalidium punctatum* (Burm.) A.Camus	Poaceae	Herb
474	*Paspalum scrobiculatum* L.	Poaceae	Herb
475	*Pavetta indica* L.	Rubiaceae	Shrub
476	*Pedalium murex* L.	Pedaliaceae	Herb
477	*Peltophorum pterocarpum* (DC.) Baker ex Heyne	Caesalpiniaceae	Tree
478	*Pennisetum pedicillatum* Trin.	Poaceae	Herb
479	*Pergularia daemia* (Forssk.) Chiov.	Asclepiadaceae	Climbing shrub
480	*Persicaria glabra* (Willd.) M.Gómez	Polygonaceae	Herb
481	*Petalidium barlerioides* (Roth) Nees	Acanthaceae	Shrub
482	*Peucedanum nagpurense* Prain	Apiaceae	Herb
483	*Phoenix loureirii* Kunth	Arecaceae	Shrub
484	*Phoenix sylvestris* (L.) Roxb.	Arecaceae	Tree
485	*Phyla nodiflora* (l.) Greene	Verbenaceae	Herb
486	*Phyllanthus amarus* Schum. & Thonn.	Euphorbiaceae	Herb
487	*Phyllanthus emblica* L.	Euphorbiaceae	Tree
488	*Phyllanthus maderaspatensis* L.	Euphorbiaceae	Herb
489	*Phyllanthus urinaria* L.	Euphorbiaceae	Herb
490	*Phyllanthus virgatus* Forst. f.	Euphorbiaceae	Herb
491	*Phyllanthus rheedei* Wight	Euphorbiaceae	Herb

S.N.	Name of the Plant species	Family	Habit
492	*Physalis minima* L.	Solanaceae	Herb
493	*Pithecellobium dulce* (Roxb.) Benth.	Mimosaceae	Tree
494	*Pityrogramma calomelanos* (L.) Link	Pteridaceae	Herb
495	*Plectranthus mollis* (Aiton) Spreng.	Lamiaceae	Herb
496	*Pogostemon benghalensis* (Burm.f.) O. Ktze	Lamiaceae	Shrub
497	*Polyalthia cerasoides* (Roxb.) Bedd.	Annonaceae	Tree
498	*Polygala erioptera* DC.	Polygalaceae	Herb
499	*Polygala arvensis* Willd.	Polygalaceae	Herb
500	*Polygala chinensis* L.	Polygalaceae	Herb
501	*Polygala persicariifolia* DC.	Polygalaceae	Herb
502	*Polygonum hydropiper* L.	Polygonaceae	Herb
503	*Polygonum plebeium* R. Br.	Polygonaceae	Herb
504	*Pongamia pinnata* (L.) Pierre	Fabaceae	Tree
505	*Portulaca oleracea* L.	Portulacaceae	Herb
506	*Premna herbacea* Roxb.	Verbenaceae	Herb
507	*Prosopis juliflora* (Sw.) DC.	Mimosaceae	Tree
508	*Pterocarpus marsupium* Roxb.	Fabaceae	Tree
509	*Pterspermum xylocarpum* (Gaertn.) Sant. & Wagh	Sterculiaceae	Tree
510	*Pueraria tuberosa* (Roxb. ex Willd.) DC.	Fabaceae	Climbing shrub
511	*Rauvolfia serpentina* (L.) Benth ex Kurz	Apocynaceae	Shrub
512	*Rhus* sp.	Anacardiaceae	Tree
513	*Rhynchosia minima* (L.) DC.	Fabaceae	Herb
514	*Rhynchosia rufescens* (Willd.) DC.	Fabaceae	Herb
515	*Rhynchospora wightiana* (Nees) Steud.	Cyperaceae	Herb
516	*Rhyncostylis retusa* (L.) Bl.	Orchidaceae	Herb
517	*Richardia scabra* L.	Rubiaceae	Herb
518	*Rivea hypocrateriformis* Choisy	Convolvulaceae	Climbing shrub
519	*Rotala rotundifolia* (Buch.-Ham. ex Roxb.) Koehne	Lythraceae	Herb
520	*Rotala* sp.	Lythraceae	Herb
521	*Rubia cordifolia* L.	Rubiaceae	Climbing shrub
522	*Rungia pectinata* (L.) Nees	Acanthaceae	Herb
523	*Saccharum spontaneum* L.	Poaceae	Herb
524	*Sacciolepis indica* (L.) Chase	Poaceae	Herb

S.N.	Name of the Plant species	Family	Habit
525	*Salix tetrasperma* Roxb	Salicaceae	Tree
526	*Salomonia cantoniensis* Lour.	Polygalaceae	Herb
527	*Sapindus emarginatus* Vahl	Sapindaceae	Tree
528	*Schleichera oleosa* (Lour.) Oken	Sapindaceae	Tree
529	*Schrebera swietenioides* Roxb.	Oleaceae	Tree
530	*Scleria lithosperma* (L.) Sw.	Cyperaceae	Herb
531	*Scleria parvula* Steud.	Cyperaceae	Herb
532	*Scoparia dulcis* L.	Scrophulariaceae	Herb
533	*Selaginella* sp.	Selaginellaceae	Herb
534	*Semecarpus anacardium* L.f.	Anacardiaceae	Tree
535	*Senna hirsuta* (L.) H. S. Irwin & Barneby	Caesalpiniaceae	Herb
536	*Senna occidentalis* (L.) Link	Caesalpiniaceae	Herb
537	*Senna siamea* (Lam.) Irwin & Barneby	Caesalpiniaceae	Tree
538	*Senna tora* (L.) Roxb.	Caesalpiniaceae	Herb
539	*Senna auriculata* (L.) Roxb.	Caesalpiniaceae	Shrub
540	*Setaria pumila* (Poir) Roem. & Schultes	Poaceae	Herb
541	*Setaria verticillata* (L.) P.Beauv.	Poaceae	Herb
542	*Shorea robusta* Gaertn.f.	Dipterocarpaceae	Tree
543	*Sida acuta* Burm.f.	Malvaceae	Herb
544	*Sida cordata* (Burm.f.) Borssum	Malvaceae	Herb
545	*Sida cordifolia* L.	Malvaceae	Herb
546	*Sida rhombifolia* L.	Malvaceae	Herb
547	*Sida spinosa* L.	Malvaceae	Herb
548	*Smilax perfoliata* Lour.	Smilacaceae	Climbing shrub
549	*Smilax zeylanica* L.	Smilacaceae	Climbing shrub
550	*Smithia conferta* Sm.	Fabaceae	Herb
551	*Solanum melongena* L.	Solanaceae	Shrub
552	*Solanum nigrum* L.	Solanaceae	Herb
553	*Solena amplexicaulis* (Lam.) Gandhi	Cucurbitaceae	Climbing shrub
554	*Sopubia delphiniifolia* (L.) G.Don	Scrophulariaceae	Herb
555	*Sorghum halepense* (L.) Pers.	Poaceae	Herb
556	*Soymida febrifuga* (Roxb.) A.Juss.	Meliaceae	Tree
557	*Spatholobus parviflorus* (DC.) Kuntze	Fabaceae	Woody climber

S.N.	Name of the Plant species	Family	Habit
558	*Spermacoce articularis* L. f.	Rubiaceae	Herb
559	*Spermacoce hispida* L.	Rubiaceae	Herb
560	*Spermacoce latifolia* Aubl.	Rubiaceae	Herb
561	*Spermacoce pusilla* Wall.	Rubiaceae	Herb
562	*Spermacoce scrmoides* Burm.f.	Rubiaceae	Herb
563	*Sphaeranthes indicus* L.	Asteraceae	Herb
564	*Spilanthes calva* DC.	Asteraceae	Herb
565	*Sporobolus indicus* (L.) R. Br.	Poaceae	Herb
566	*Sporobolus coromandelianus* (Retz.) Kunth	Poaceae	Herb
567	*Stachytarpheta jamaicensis* (L.) Vahl	Verbenaceae	Herb
568	*Sterculia urens* Roxb.	Sterculiaceae	Tree
569	*Stereospermum chelonoides* (L. f.) DC.	Bignoniaceae	Tree
570	*Stereospermum tetragonum* DC.	Bignoniaceae	Tree
571	*Streblus asper* Lour.	Moraceae	Tree
572	*Striga asiatica* (L.) Kuntze	Scrophulariaceae	Herb
573	*Striga angustifolia* (D. Don) C.J. Saldanha	Scrophulariaceae	Herb
574	*Strychnos nux-vomica* L.	Loganiaceae	Tree
575	*Strychnos potatorum* L. f.	Loganiaceae	Tree
576	*Stylidium tenellum* Sw. ex Willd.	Stylidiaceae	Herb
577	*Swertia angustifolia* Buch.-Ham. ex D. Don	Gentianaceae	Herb
578	*Symphorema involucratum* Roxb.	Symphoremataceae	Woody climber
579	*Symplocos racemosa* Roxb.	Symplocaceae	Tree
580	*Syzygium cumini* (L.) Skeels	Myrtaceae	Tree
581	*Syzygium heyneanum* A. Gunn. ex DC.	Myrtaceae	Tree
582	*Syzygium salicifolium* (Wight) J. Graham	Myrtaceae	Shrub
583	*Syzygium* sp.	Myrtaceae	Tree
584	*Tacca leontopetaloides* (L.) Kuntze	Taccaceae	Herb
585	*Tamarindus indica* L.	Caesalpiniaceae	Tree
586	*Tamilnadia uliginosa* (Retz.) Tirvengadum & Sastre	Rubiaceae	Tree
587	*Tarenna asiatica* (L.) Kuntze ex K.Schum.	Rubiaceae	Shrub
588	*Tecoma stans* (L.) Juss. ex Kunth	Bignoniaceae	Tree
589	*Tectona grandis* L. f.	Verbenaceae	Tree
590	*Tephrosia purpurea* (L.) Pers.	Fabaceae	Herb

S.N.	Name of the Plant species	Family	Habit
591	*Tephrosia villosa* (L.) Pers.	Fabaceae	Herb
592	*Tetrastigma lanceolarium* (Roxb.) Planch.	Fabaceae	Climbing shrub
593	*Terminalia arjuna* (Roxb. ex DC.) Wight & Arn.	Combretaceae	Tree
594	*Terminalia belerica* (Gaertn.) Roxb.	Combretaceae	Tree
595	*Terminalia chebula* Retz.	Combretaceae	Tree
596	*Terminalia elliptica* Willd.	Combretaceae	Tree
597	*Themeda quadrivalvis* (L.) Kuntze	Poaceae	Herb
598	*Themeda triandra* Forssk.	Poaceae	Herb
599	*Thespesia lampas* (Cav.) Dalzell	Malvaceae	Shrub
600	*Thysanolaena maxima* (Roxb.) Kuntze	Poaceae	Herb
601	*Tinospora cordifolia* (Willd.) Miers ex Hook.f. & Thoms.	Menispermaceae	Climbing shrub
602	*Torenia asiatica* L.	Scrophulariaceae	Herb
603	*Torenia violacea* (Azaola ex. Blanco) Pennell	Scrophulariaceae	Herb
604	*Torenia vitalba* C.J.Saldanha	Scrophulariaceae	Herb
605	*Tragia involucrata* L.	Euphorbiaceae	Climbing shrub
606	*Trema orientalis* (L.) Bl.	Ulmaceae	Tree
607	*Tribulus terrestris* L.	Zygophyllaceae	Herb
608	*Tridax procumbens* L.	Asteraceae	Herb
609	*Tripogon jacquemontii* Stapf	Poaceae	Herb
610	*Triumfetta rhomboidea* Jacq.	Tiliaceae	Herb
611	*Triumfetta annua* L.	Malvaceae	Herb
612	*Triumfetta rotundifolia* Lam.	Tiliaceae	Herb
613	*Tylophora fasciculata* Buch.-Ham. ex Wight	Asclepiadaceae	Climbing shrub
614	*Uraria lagopodioides* (L.) Desv. ex DC.	Fabaceae	Herb
615	*Uraria picta* (Jacq.) DC.	Fabaceae	Herb
616	*Urena lobata* L.subsp. *lobata* Mast.	Malvaceae	Herb
617	*Urena sinuata* L.	Malvaceae	Herb
618	*Urochloa panicoides* P.Beauv.	Poaceae	Herb
619	*Utricularia* sp.	Utriculariaceae	Herb
620	*Vanda tessellata* (Roxb.) Hook. ex G.Don	Orchidaceae	Herb
621	*Ventilago madraspatana* Gaertn.	Rhamnaceae	Woody climber
622	*Vernonia cinerea* (L.) Less.	Asteraceae	Herb
623	*Vetiveria zizanioides* (L.) Nash	Poaceae	Herb

S.N.	Name of the Plant species	Family	Habit
624	*Vernonia cinerea* (L.) DC	Asteraceae	Herb
625	*Vigna adenantha* (L.) Verdc.	Fabaceae	Herb
626	*Vigna dalzelliana* (Kuntze) Verdc	Fabaceae	Herb
627	*Vigna vexillata* (L.) A.Rich	Fabaceae	Herb
628	*Viscum articulatum* Burm.f.	Loranthaceae	Shrub
629	*Vitex negundo* L.	Verbenaceae	Shrub
630	*Waltheria indica* L.	Malvaceae	Herb
631	*Wendlandia heynei* (Schult. Santapau & Merchant	Rubiaceae	Tree
632	*Woodfordia fruticosa* (L.) Kurz	Lythraceae	Shrub
633	*Wrightia arborea* (Roxb.) R.Br.	Apocynaceae	Tree
634	*Xanthium strumarium* L.	Asteraceae	Herb
635	*Xylia xylocarpa* (Roxb.) Taub.	Mimosaceae	Tree
636	*Ziziphus mauritiana* Lam.	Rhamnaceae	Tree
637	*Ziziphus oenoplia* (L.) Mill	Rhamnaceae	Climbing shrub
638	*Ziziphus rugosa* Lam.	Rhamnaceae	Woody climber
639	*Ziziphus xylopyrus* (Retz.) Willd.	Rhamnaceae	Tree
640	*Zornia gibbosa* Span.	Fabaceae	Herb

Annexure 4.2

Floristic composition in Hasdeo-Arand Coalfield falls within Korba, Surguja and Surajpur districts of Chhattisgarh

S.N.	Family	Genera	Species	S.N.	Family	Genera	Species
1	Poaceae	44	72	44	Ehretiaceae	2	2
2	Fabaceae	26	64	45	Equisetaceae	1	2
3	Rubiaceae	22	31	46	Hypoxidaceae	2	3
4	Asteraceae	21	27	47	Lecythidaceae	2	2
5	Euphorbiaceae	14	23	48	Loganiaceae	2	4
6	Acanthaceae	12	22	49	Loranthaceae	2	2
7	Lamiaceae	12	16	50	Molluginaceae	2	3
8	Malvaceae	11	17	51	Myrsinaceae	2	2
9	Caesalpiniaceae	9	20	52	Myrtaceae	2	5
10	Scrophulariaceae	9	15	53	Oleaceae	2	4
11	Verbenaceae	9	11	54	Oxalidaceae	2	4
12	Convolvulaceae	8	12	55	Periplocaceae	2	2
13	Mimosaceae	8	18	56	Polygalaceae	2	5
14	Orchidaceae	8	11	57	Polygonaceae	2	3
15	Amaranthaceae	7	11	58	Pteridaceae	2	3
16	Apocynaceae	7	8	59	Rhamnaceae	2	5
17	Anacardiaceae	6	6	60	Sapotaceae	2	2
18	Cyperaceae	6	18	61	Ulmaceae	2	2
19	Asclepiadaceae	5	6	62	Adiantaceae	1	3
20	Liliaceae	4	6	63	Alangiaceae	1	1
21	Lythraceae	4	5	64	Amaryllidaceae	1	1
22	Meliaceae	4	4	65	Aristolochiaceae	1	1
23	Rutaceae	4	4	66	Asparagaceae	1	1
24	Sapindaceae	4	4	67	Begoniaceae	1	1
25	Sterculiaceae	4	4	68	Bixaceae	1	1
26	Tiliaceae	4	11	69	Boraginaceae	1	1
27	Annonaceae	3	4	70	Campanulaceae	1	1
28	Araceae	3	4	71	Cannaceae	1	1
29	Bignoniaceae	3	4	72	Capparidaceae	1	1
30	Commelinaceae	3	7	73	Cleomaceae	1	3
31	Cucurbitaceae	3	3	74	Cochlospermaceae	1	1
32	Flacourtiaceae	3	4	75	Colchicaceae	1	1
33	Gentianaceae	3	5	76	Costaceae	1	1
34	Menispermaceae	3	3	77	Dilleniaceae	1	1
35	Moraceae	3	8	78	Dioscoreaceae	1	6
36	Solanaceae	3	4	79	Dipterocarpaceae	1	1
37	Vitaceae	3	6	80	Droseraceae	1	2
38	Apiaceae	2	2	81	Ebenaceae	1	3
39	Arecaceae	2	3	82	Ferocactaceae	1	1
40	Bombacaceae	2	2	83	Flindersiaceae	1	1
41	Burseraceae	2	2	84	Gleicheniaceae	1	1
42	Celastraceae	2	2	85	Lauraceae	1	1
43	Combretaceae	2	8	86	Leeaceae	1	3

S.N.	Family	Genera	Species	S.N.	Family	Genera	Species
87	Lygodiaceae	1	1	99	Selaginellaceae	1	1
88	Martyniaceae	1	1	100	Simaroubaceae	1	1
89	Melastomataceae	1	1	101	Smilacaceae	1	2
90	Nyctaginaceae	1	1	102	Stylidiaceae	1	1
91	Nyctanthaceae	1	1	103	Symphoremataceae	1	1
92	Ochnaceae	1	1	104	Symplocaceae	1	1
93	Onagraceae	1	3	105	Taccaceae	1	1
94	Ophioglossaceae	1	2	106	Utriculariaceae	1	1
95	Papavaraceae	1	1	107	Violaceae	1	1
96	Pedaliaceae	1	1	108	Zingiberaceae	1	3
97	Portulacaceae	1	1	109	Zygophyllaceae	1	1
98	Salicaceae	1	1			400	640

Annexure 4.3

Habit wise plant species in Hasdeo-Arand Coalfield falls within Korba, Surguja and Surajpur districts of Chhattisgarh

S.N.	Name of the Plant species	Family	Habit
1.	*Abrus precatorius* L.	Fabaceae	Climbing shrub
2.	*Ampelocissus latifolia* (Roxb.) Planch.	Vitiaceae	Climbing shrub
3.	*Ampelocissus tomentosa* (B.Heyne & Roth) Planch.	Vitiaceae	Climbing shrub
4.	*Aristolochia indica* L.	Aristolochiaceae	Climbing shrub
5.	*Asparagus racemosus* Willd.	Liliaceae	Climbing shrub
6.	*Cajanus scarabaeoides* (L.) Benth.	Fabaceae	Climbing shrub
7.	*Cardiospermum halicacabum* L.	Sapindaceae	Climbing shrub
8.	*Cassytha filiformis* L.	Lauraceae	Climbing shrub
9.	*Cayratia pedata* (Lour.) Juss. ex Gagnep.	Vitaceae	Climbing shrub
10.	*Cayratia trifolia* (L.) Domin	Vitiaceae	Climbing shrub
11.	*Celastrus paniculatus* Willd.	Celastraceae	Climbing shrub
12.	*Cissampelos pareira* L.	Menispermaceae	Climbing shrub
13.	*Cissus quadrangularis* L.	Vitiaceae	Climbing shrub
14.	*Cissus repanda* Vahl.	Vitaceae	Climbing shrub
15.	*Coccullus hirsutus* (L.) Diels	Menispermaceae	Climbing shrub
16.	*Cryptolepis buchananii* Roem. & Schultes	Periplocaceae	Climbing shrub
17.	*Cuscuta reflexa* Roxb.	Convolvulaceae	Climbing shrub
18.	*Dioscorea belophylla* Voigt ex Haines	Dioscoreaceae	Climbing shrub
19.	*Dioscorea bulbifera* L.	Dioscoreaceae	Climbing shrub
20.	*Dioscorea hispida* Dennst.	Dioscoreaceae	Climbing shrub
21.	*Dioscorea oppositifolia* L.	Dioscoreaceae	Climbing shrub
22.	*Dioscorea pentaphylla* L.	Dioscoreaceae	Climbing shrub
23.	*Dioscorea tomentosa* J.Koenig ex Spreng.	Dioscoreaceae	Climbing shrub
24.	*Diplocyclos palmatus* (L.) Jeffrey	Cucurbitaceae	Climbing shrub
25.	*Hemidesmus indicus* (L.) R.Br.	Periplocaceae	Climbing shrub
26.	*Holostemma ada-kodien* Schult.	Asclepiadaceae	Climbing shrub
27.	*Ichnocarpus frutescens* (L.) R.Br.	Apocynaceae	Climbing shrub
28.	*Ipomoea pes-tigridis* L.	Convolvulaceae	Climbing shrub
29.	*Jasminum arborescens* Roxb.	Oleaceae	Climbing shrub
30.	*Jasminum multiflorum* (Burm. f.) Andr.	Oleaceae	Climbing shrub
31.	*Jasminum scandens* Roxb.	Oleaceae	Climbing shrub
32.	*Marsdenia tenacissima* (Roxb.) Moon.	Asclepiadaceae	Climbing shrub
33.	*Merremia emarginata* (Burm.) Hall f.	Convolvulaceae	Climbing shrub
34.	*Merremia tridentata* (L.) Hall f.	Convolvulaceae	Climbing shrub
35.	*Mucuna pruriens* (L.) DC.	Convolvulaceae	Climbing shrub
36.	*Operculina turpethum* (L.) Silva Manso	Convolvulaceae	Climbing shrub
37.	*Pergularia daemia* (Forssk.) Chiov.	Asclepiadaceae	Climbing shrub
38.	*Pueraria tuberosa* (Roxb. ex Willd.) DC.	Fabaceae	Climbing shrub
39.	*Rivea hypocrateriformis* Choisy	Convolvulaceae	Climbing shrub
40.	*Rubia cordifolia* L.	Rubiaceae	Climbing shrub
41.	*Smilax perfoliata* Lour.	Smilacaceae	Climbing shrub
42.	*Smilax zeylanica* L.	Smilacaceae	Climbing shrub

S.N.	Name of the Plant species	Family	Habit
43.	*Solena amplexicaulis* (Lam.) Gandhi	Cucurbitaceae	Climbing shrub
44.	*Teramnus labialis* (L.f.) Spreng.	Fabaceae	Climbing shrub
45.	*Tinospora cordifolia* (Willd.) Miers ex Hook.f. & Thoms.	Menispermaceae	Climbing shrub
46.	*Tragia involucrata* L.	Euphorbiaceae	Climbing shrub
47.	*Tylophora fasciculata* Buch.-Ham. ex Wight	Asclepiadaceae	Climbing shrub
48.	*Ziziphus oenoplia* (L.) Mill.	Rhamnaceae	Climbing shrub
49.	*Acalypha indica* L.	Euphorbiaceae	Herb
50.	*Acanthospermum hispidum* DC.	Asteraceae	Herb
51.	*Achyranthes aspera* L.	Amaranthaceae	Herb
52.	*Achyranthes bidentata* Bl.	Amaranthaceae	Herb
53.	*Acilepis squarrosa* D. Don	Asteraceae	Herb
54.	*Actocephalus hispidus* (L.) Nicolson & Sivad.	Lamiaceae	Herb
55.	*Adenosma indianum* (Lour.) Merr.	Scrophulariaceae	Herb
56.	*Adiantum caudatum* Klotzsch	Adiantaceae	Herb
57.	*Adiantum incisum* Forssk.	Adiantaceae	Herb
58.	*Adiantum philippense* L.	Adiantaceae	Herb
59.	*Aerva lanata* (L.) Juss. ex Schultes	Amaranthaceae	Herb
60.	*Aerva sanguinolenta* (L.) Blume	Amaranthaceae	Herb
61.	*Aeschynomene indica* L.	Fabaceae	Herb
62.	*Ageratum conyzoides* L.	Asteraceae	Herb
63.	*Alhamda nodiflora* (L.) R. Br. ex Wight	Amaranthaceae	Herb
64.	*Alloteropsis cimicina* (L.) Stapf	Poaceae	Herb
65.	*Alocasia fornicata* (Roxb.) Schott	Araceae	Herb
66.	*Aloe vera* (L.) Burm.f.	Liliaceae	Herb
67.	*Alternanthera sessilis* (L.) R.Br. ex DC.	Amaranthaceae	Herb
68.	*Alternanthera ficoidea* (L.) Sm.	Amaranthaceae	Herb
69.	*Alysicarpus monilifer* (L.) DC.	Fabaceae	Herb
70.	*Alysicarpus tetragonolobus* Edgew.	Fabaceae	Herb
71.	*Alysicarpus vaginalis* (L.) DC.	Fabaceae	Herb
72.	*Alysicarpus bupleurifolius* (L.) DC.	Fabaceae	Herb
73.	*Alysicarpus glumaceus* (Vahl) DC.	Fabaceae	Herb
74	*Alysicarpus hamosus* Edgew.	Fabaceae	Herb
75	*Alysicarpus heterophyllus* (Baker) Jafri & Ali	Fabaceae	Herb
76.	*Amaranthus spinosus* L.	Amaranthaceae	Herb
77	*Amaranthus viridis* L.	Amaranthaceae	Herb
78.	*Ammannia baccifera* L.	Lythraceae	Herb
79.	*Andrographis paniculata* (Burm.f.) Wall. ex Nees	Acanthaceae	Herb
80.	*Andropogon pumilus* Roxb.	Poaceae	Herb
81.	*Aristida mutica* L.	Poaceae	Herb
82.	*Argemone mexicana* L.	Papavaraceae	Herb
83.	*Arisaema* sp.	Araceae	Herb
84.	*Arisaema tortuosum* (Wall.) Schott	Araceae	Herb

S.N.	Name of the Plant species	Family	Habit
85.	*Aristida adscensionis* L.	Poaceae	Herb
86.	*Aristida setacea* Retz.	Poaceae	Herb
87.	*Aristida hystrix* L.f.	Poaceae	Herb
88.	*Arthraxon hispidus* (Thunb.) Makino	Poaceae	Herb
89.	*Arthraxon lancifolius* (Trin.) Hochst.	Poaceae	Herb
90.	*Arundinella pumila* (Hochst.ex A. Rich.) Steud.	Poaceae	Herb
91.	*Arundinella setosa* Trin.	Poaceae	Herb
92.	*Bacopa monnieri* (L.) Wettst.	Scrophulariaceae	Herb
93.	*Bacopa floribunda* (R.Br.) Wettst.	Scrophulariaceae	Herb
94.	*Barleria cristata* L.	Acanthaceae	Herb
95.	*Basilicum polystachyon* (L.) Moench	Lamiaceae	Herb
96.	*Begonia picta* Sm.	Begoniaceae	Herb
97.	*Bidens biternata* (Lour.) Merr. & Scherff	Asteraceae	Herb
98.	*Bidens pilosa* L.	Asteraceae	Herb
99.	*Biophytum sensitivum* (L.) DC.	Oxalidaceae	Herb
100.	*Biophytum reinwardtii* (Zucc.) Klotzsch	Oxalidaceae	Herb
101.	*Biophytum umbraculum* Welw.	Oxalidaceae	Herb
102.	*Blepharis maderaspatensis* (L.) B.Heyne ex Roth	Acanthaceae	Herb
103.	*Blumea flava* DC.	Asteraceae	Herb
104.	*Blumea mollis* (D. Don) Merr.	Asteraceae	Herb
105.	*Blumea* sp.	Asteraceae	Herb
106.	*Blumea lacinata* (Wall. ex Roxb.) DC.	Asteraceae	Herb
107.	*Blumea oxyodonta* DC.	Asteraceae	Herb
108.	*Boerhavia diffusa* L.	Nyctaginaceae	Herb
109.	*Bothriochloa odorata* (Lisboa) A. Camus	Poaceae	Herb
110.	*Bothriochloa pertusa* (L.) A.Camus	Poaceae	Herb
111.	*Brachiaria ramosa* (L.) Stapf	Poaceae	Herb
112.	*Brachiaria reptans* (L.) C.A.Gardner & C.E.Hubb.	Poaceae	Herb
113.	*Bulbophyllum* sp.	Orchidaceae	Herb
114.	*Bulbostylis barbata* (Rottb.) C. B. Clarke	Cyperaceae	Herb
115.	*Byttneria herbacea* Roxb.	Sterculiaceae	Herb
116.	*Caesulia axillaris* Roxb.	Asteraceae	Herb
117.	*Canna indica* L.	Cannaceae	Herb
118.	*Canscora decussata* (Roxb.) Shuh. & Shuh. f.	Gentianaceae	Herb
119.	*Canscora diffusa* (Vahl) R. Br.	Gentianaceae	Herb
120.	*Canscora pauciflora* Dalzell	Gentianaceae	Herb
121.	*Catharanthus pusillus* (Murr.) G.Don	Apocynaceae	Herb
122.	*Celosia argentea* L.	Amaranthaceae	Herb
123.	*Centella asiatica* (L.) Urban	Apiaceae	Herb
124.	*Centipeda minima* (L.) A. Braun & Asch.	Asteraceae	Herb
125.	*Chamaecrista mimosoides* (L.) Greene	Caesalpiniaceae	Herb
126.	*Chamaecrista pumila* (Lam.) K.Larsen	Caesalpiniaceae	Herb
127.	*Cheilanthes farinosa* (Forssk.) Kaulf.	Pteridaceae	Herb

S.N.	Name of the Plant species	Family	Habit
128.	*Cheilanthes* sp.	Pteridaceae	Herb
129.	*Cheilocostus speciosus* (J.Koenig) C.D.Specht	Costaceae	Herb
130.	*Chloris barbata* Sw.	Poaceae	Herb
131.	*Chlorophytum arundinaceum* Baker	Liliaceae	Herb
132.	*Chlorophytum laxum* R.Br.	Liliaceae	Herb
133.	*Chlorophytum tuberosum* (Roxb.) Baker	Liliaceae	Herb
134.	*Chrysopogon aciculatus* (Retz.) Trin.	Poaceae	Herb
135.	*Chrysopogon fulvus* (Spring.) Chiov.	Poaceae	Herb
136.	*Cleome gynandra* L.	Cleomaceae	Herb
137.	*Cleome viscosa* L.	Cleomaceae	Herb
138.	*Cleome monophylla* L.	Cleomaceae	Herb
139	*Colocasia esculenta* (L.) Schott	Araceae	Herb
140.	*Commelina benghalensis* L.	Commelinaceae	Herb
141.	*Commelina diffusa* Burm.f.	Commelinaceae	Herb
142.	*Corchorus aestuans* L.	Tiliaceae	Herb
143.	*Corchorus capsularis* L.	Tiliaceae	Herb
144.	*Corchorus olitorius* L.	Tiliaceae	Herb
145.	*Crinum latifolium* L.	Amaryllidaceae	Herb
146.	*Crotalaria juncea* L.	Fabaceae	Herb
147.	*Crotalaria linifolia* L.f.	Fabaceae	Herb
148.	*Crotalaria pallida* Dryand.	Fabaceae	Herb
149.	*Crotalaria prostrata* Rottl. ex. Willd.	Fabaceae	Herb
150.	*Crotalaria alata* D.Don	Fabaceae	Herb
151.	*Crotalaria calycina* Schrank	Fabaceae	Herb
152.	*Crotalaria cytisoides* Benth.	Fabaceae	Herb
153.	*Crotalaria retusa* L.	Fabaceae	Herb
154.	*Crotalaria verrucosa* L.	Fabaceae	Herb
155	*Croton bonplandianus* Baill.	Euphorbiaceae	Herb
156	*Curculigo orchioides* Gaertn.	Hypoxidaceae	Herb
157	*Curcuma pseudomontana* Graham	Zingiberaceae	Herb
158.	*Curcuma angustifolia* Roxb.	Zingiberaceae	Herb
159.	*Curcuma longa* L.	Zingiberaceae	Herb
160	*Cyanotis cristata* (L.) D. Don	Commelinaceae	Herb
161	*Cyanotis axillaris* (L.) D.Don ex Sweet	Commelinaceae	Herb
162.	*Cymbopogon martini* (Roxb.) W.Watson	Poaceae	Herb
163.	*Cynodon dactylon* (L.) Pers.	Poaceae	Herb
164.	*Cyperus iria* L.	Cyperaceae	Herb
165.	*Cyperus niveus* Retz.	Cyperaceae	Herb
166.	*Cyperus rotundus* L.	Cyperaceae	Herb
167.	*Cyperus cephalotes* Vahl	Cyperaceae	Herb
168.	*Cyperus compressus* L.	Cyperaceae	Herb
169.	*Cyperus corymbosus* Rottb.	Cyperaceae	Herb
170.	*Cyperus cyperinus* (Retz.) Suringar	Cyperaceae	Herb
171.	*Cyrtococcum patens* (L.) A.Camus	Poaceae	Herb
172	*Dactyloctenium aegyptium* (L.) Willd.	Poaceae	Herb
173.	*Debia ovatifolia* (Cav.) Neupane &	Rubiaceae	Herb

S.N.	Name of the Plant species	Family	Habit
	N.Wikstr.		
174.	*Dendrobium* sp.	Orchidaceae	Herb
175.	*Desmodium gangeticum* (L.) DC.	Fabaceae	Herb
176.	*Desmodium heterocarpon* (L.) DC.	Fabaceae	Herb
177.	*Desmodium laxiflorum* DC.	Fabaceae	Herb
178.	*Desmodium triflorum* (L.) DC.	Fabaceae	Herb
179.	*Dichanthium annulatum* (Forssk.) Stapf	Poaceae	Herb
180.	*Dichanthium caricosum* (L.) A.Camus	Poaceae	Herb
181.	*Dicliptera paniculata* (Forssk.) I.Darbysh.	Acanthaceae	Herb
182.	*Dicranopteris linearis* (Burm. f.) Underw.	Gleicheniaceae	Herb
183.	*Digeria muricata* (L.) Mart.	Amaranthaceae	Herb
184.	*Digitaria ciliaris* (Retz.) Koeler	Poaceae	Herb
185.	*Digitaria longiflora* (Retz.) Pers.	Poaceae	Herb
186.	*Digitaria abludens* (Roem. & Schult.) Veldkamp	Poaceae	Herb
187.	*Digitaria stricta* Roth	Poaceae	Herb
188	*Dimeria ornithopoda* Trin.	Poaceae	Herb
189.	*Dimeria* sp.	Poaceae	Herb
190.	*Drimia indica* (Roxb.) Jessop	Asparagaceae	Herb
191.	*Drosera indica* L.	Droseraceae	Herb
192.	*Drosera burmanni* Vahl	Droseraceae	Herb
193.	*Eclipta prostrata* (L.) L.	Asteraceae	Herb
194.	*Eleiotis sorongia* (L.) DC	Fabaceae	Herb
195.	*Elephantopus scaber* L.	Asteraceae	Herb
196.	*Eleusine indica* (L.) Gaertn.	Poaceae	Herb
197.	*Eleusine coracana* (L.) Gaertn.	Poaceae	Herb
198	*Emilia sonchifolia* (L.) DC.	Asteraceae	Herb
199	*Enicostema axillare* (Lam.) Raynal	Gentianaceae	Herb
200.	*Eriopogon dolichostachyus* (Lag.) Keng	Poaceae	Herb
201	*Equisetum diffusum* D. Don	Equisetaceae	Herb
202	*Equisetum ramosissimum* Desf.	Equisetaceae	Herb
203.	*Eragrostiella bifaria* (Vahl) Bor	Poaceae	Herb
204	*Eragrostiella nardoides* (Trin.) Bor	Poaceae	Herb
205.	*Eragrostis ciliaris* (L.) R.Br	Poaceae	Herb
206	*Eragrostis minus* (Retz.) Nees ex Steud.	Poaceae	Herb
207	*Eragrostis tenella* (L.) P.Beauv. ex Roem. & Schultes	Poaceae	Herb
208	*Eragrostis unioloides* (Retz.) Nees ex Steud.	Poaceae	Herb
209	*Eragrostis viscosa* (Retz.) Trin.	Poaceae	Herb
210.	*Eragrostis japonica* (Thunb.) Trin.	Poaceae	Herb
211	*Eragrostis pilosa* (L.) P.Beauv.	Poaceae	Herb
212	*Eriocaulon* sp.	Eriocaulaceae	Herb
213	*Eulaliopsis binata* (Retz.) Hubbard	Poaceae	Herb
214.	*Eulophia* sp.	Orchidaceae	Herb
215	*Eulophia epidendraea* (J.Koenig ex Retz.) C.E.C.Fisch.	Orchidaceae	Herb

S.N.	Name of the Plant species	Family	Habit
216.	*Euphorbia hirta* L.	Euphorbiaceae	Herb
217.	*Euphorbia prostrata* Aiton	Euphorbiaceae	Herb
218.	*Evolvulus alsinoides* (L.) L.	Convolvulaceae	Herb
219.	*Evolvulus nummularius* (L.) L.	Convolvulaceae	Herb
220.	*Fimbristylis* sp.	Cyperaceae	Herb
221.	*Fimbristylis dichotoma* (L.) Vahl	Cyperaceae	Herb
222.	*Fimbristylis ferruginea* (L.) Vahl	Cyperaceae	Herb
223.	*Fimbristylis quinquangularis* (Vahl) Kunth	Cyperaceae	Herb
224.	*Fimbristylis umbellaris* (Lam.) Vahl	Cyperaceae	Herb
225.	*Flemingia nana* Roxb.	Fabaceae	Herb
226.	*Geodorum densiflorum* (Lam.) Schltr.	Orchidaceae	Herb
227.	*Glinus oppositifolius* (L.) A. DC.	Molluginaceae	Herb
228.	*Gloriosa superba* L.	Liliaceae	Herb
229.	*Grangea maderaspatana* (L.) Poir.	Asteraceae	Herb
230.	*Habenaria plantaginea* Lindl.	Orchidaceae	Herb
231.	*Habenaria commelinifolia* (Roxb.) Wall. ex Lindl.	Orchidaceae	Herb
232.	*Habenaria diphylla* (Nimmo) Dalzell	Orchidaceae	Herb
233.	*Hackelochloa granularis* (L.) Kuntze	Poaceae	Herb
234.	*Hedyotis auricularia* L.	Rubiaceae	Herb
235.	*Hedyotis* sp.	Rubiaceae	Herb
236.	*Heliotropium indicum* L.	Boraginaceae	Herb
237.	*Hemigraphis hirsuta* (Heyne ex Roth) Nees	Acanthaceae	Herb
238.	*Heteropogon contortus* (L.) P.Beauv.	Poaceae	Herb
239.	*Hibiscus lobatus* (Murr.) Kuntze	Malvaceae	Herb
240.	*Hybanthus enneaspermus* (L.) F.v.Muell.	Violaceae	Herb
241.	*Hyptis suaveolens* (L.) Poit.	Lamiaceae	Herb
242.	*Imperata cylindrica* (L.) Raeuschel	Poaceae	Herb
243.	*Indigofera linifolia* (L.f.) Retz.	Fabaceae	Herb
244.	*Indigofera linnaei* Ali	Fabaceae	Herb
245.	*Indigofera cordifolia* Roth	Fabaceae	Herb
246	*Indigofera hirsuta* L.	Fabaceae	Herb
247.	*Indigofera nummulariifolia* (L.) Alston	Fabaceae	Herb
248.	*Indoneesiella echioides* (L.) Sreemadh.	Acanthaceae	Herb
249.	*Iphigenia indica* (L.) A.Gray ex Kunth	Colchicaceae	Herb
250.	*Ipomoea aquatica* Forssk.	Convolvulaceae	Herb
251	*Iseilema laxum* Hack.	Poaceae	Herb
252.	*Justicia diffusa* Willd.	Acanthaceae	Herb
253.	*Justicia glauca* Rottl.	Acanthaceae	Herb
254.	*Justicia japonica* Thunb.	Acanthaceae	Herb
255.	*Justicia procumbens* L.	Acanthaceae	Herb
256.	*Justicia quinquangularis* Koenig ex Roxb.	Acanthaceae	Herb
257	*Knoxia sumatrensis* (Retz.) DC.	Rubiaceae	Herb
258.	*Kyllinga nemoralis* (Forst.) Dandy & Hutch.	Cyperaceae	Herb
259.	*Kyllinga bulbosa* P.Beauv.	Cyperaceae	Herb

S.N.	Name of the Plant species	Family	Habit
260.	*Lagascea mollis* Cav.	Asteraceae	Herb
261.	*Launaea acaulis* (Roxb.) Babc. ex Kerr	Asteraceae	Herb
262.	*Launaea nudicaulis* (L.) Hook.f.	Asteraceae	Herb
263.	*Leonotis nepetifolia* (L.) R.Br.	Lamiaceae	Herb
264.	*Lepidagathis fasciculata* (Retz.) Nees	Acanthaceae	Herb
265.	*Lepidagathis incurva* Buch.-Ham.ex. D.Don	Acanthaceae	Herb
266.	*Lepidagathis trinervis* Nees	Acanthaceae	Herb
267.	*Leucas aspera* (Willd.) Link	Lamiaceae	Herb
268.	*Leucas cephalotes* (Roth) Spreng.	Lamiaceae	Herb
269.	*Leucas angularis* Benth.	Lamiaceae	Herb
270.	*Leucas biflora* (Vahl) Sm.	Lamiaceae	Herb
271.	*Limnophyla repens* (Benth.) Benth.	Scrophulariaceae	Herb
272.	*Lindernia ciliata* (Colsm.) Pennell	Scrophulariaceae	Herb
273.	*Lindernia crustacea* (L.) F. v. Muell.	Scrophulariaceae	Herb
274.	*Lindernia caespitosa* (Blume) Panigrahi	Scrophulariaceae	Herb
275.	*Lobelia alsinoides* Lam.	Campanulaceae	Herb
276.	*Ludwigia octovalvis* (Jacq.) Raven	Onagraceae	Herb
277.	*Ludwigia hyssopifolia* (G.Don) Exell	Onagraceae	Herb
278.	*Ludwigia perunviana* (L.) H.Hara	Onagraceae	Herb
279.	*Lygodium flexuosum* (L.) Sw.	Lygodiaceae	Herb
280.	*Martynia annua* L.	Martyniceae	Herb
281	*Mecardonia procumbens* (Mill.) Small	Scrophulariaceae	Herb
282.	*Melanocenchris jacquemontii* Jaub. & Spach	Poaceae	Herb
283.	*Melaxis* sp.	Orchidaceae	Herb
284.	*Melochia corchorifolia* L.	Malvaceae	Herb
285.	*Microchloa indica* (L.f.) P.Beauv.	Poaceae	Herb
286	*Micromeria biflora* (Buch.-Ham.ex D.Don) Benth.	Lamiaceae	Herb
287	*Microstachys chamaelea* (L.) Müll.Arg.	Euphorbiaceae	Herb
288.	*Mimosa pudica* L.	Mimosaceae	Herb
289.	*Mitracarpus hirtus* (L.) DC.	Rubiaceae	Herb
290.	*Mitrasacme indica* Wight	Loganiaceae	Herb
291	*Mitrasacme pygmaea* R. Br.	Loganiaceae	Herb
292	*Molineria capitulata* (Lour.) Herb.	Hypoxidaceae	Herb
293.	*Molineria trichocarpa* (Wight) N.P Balakr.	Hypoxidaceae	Herb
294.	*Mollugo nudicaulis* Lam.	Molluginaceae	Herb
295.	*Mollugo pentaphylla* L.	Molluginaceae	Herb
296.	*Mukia maderaspatana* (L.) Roem.	Cucurbitaceae	Herb
297.	*Murdannia edulis* (Stokes) Faden	Commelinaceae	Herb
298.	*Murdannia nudiflora* (L.) Brenan	Commelinaceae	Herb
299.	*Murdannia spirata* (L.) G.Brückn.	Commelinaceae	Herb
300.	*Nelsonia canescens* (Lam.) Spreng.	Acanthaceae	Herb
301.	*Nepeta hindostana* (B.Heyne ex Roth) Haines	Lamiaceae	Herb
302.	*Ocimum americanum* L.	Lamiaceae	Herb

S.N.	Name of the Plant species	Family	Habit
303.	*Oldenlandia corymbosa* L.	Rubiaceae	Herb
304.	*Oldenlandia herbacea* (L.) Roxb.	Rubiaceae	Herb
305.	*Ophioglossum* sp.	Ophioglossaceae	Herb
306.	*Ophioglossum reticulatum* L.	Ophioglossaceae	Herb
307.	*Oplismenus burmannii* (Retz.) P. Beauv.	Poaceae	Herb
308.	*Oplismenus compositus* (L.) P. Beauv.	Poaceae	Herb
309.	*Orthosiphon pallidus* Benth.	Lamiaceae	Herb
310.	*Oxalis corniculata* L.	Oxalidaceae	Herb
311.	*Panicum maximum* Jacq.	Poaceae	Herb
312.	*Parthenium hysterophorus* L.	Asteraceae	Herb
313.	*Paspalidium flavidum* (Retz.) A.Camus	Poaceae	Herb
314.	*Paspalidium geminatum* (Forssk.) Stapf	Poaceae	Herb
315.	*Paspalidium punctatum* (Burm.) A.Camus	Poaceae	Herb
316.	*Paspalum scrobiculatum* L.	Poaceae	Herb
317.	*Pedalium murex* L.	Pedaliaceae	Herb
318.	*Pennisetum pedicillatum* Trin.	Poaceae	Herb
319.	*Persicaria glabra* (Willd.) M.Gomez	Polygonaceae	Herb
320.	*Peucedanum nagpurense* Prain	Apiaceae	Herb
321.	*Phyla nodiflora* (L.) Greene	Verbenaceae	Herb
322.	*Phyllanthus amarus* Schum. & Thonn.	Euphorbiaceae	Herb
323.	*Phyllanthus maderaspatensis* L.	Euphorbiaceae	Herb
324.	*Phyllanthus urinaria* L.	Euphorbiaceae	Herb
325.	*Phyllanthus virgatus* Forst. f.	Euphorbiaceae	Herb
326.	*Phyllanthus wheeleri* Wight	Euphorbiaceae	Herb
327.	*Physalis minima* L.	Solanaceae	Herb
328.	*Pityrogramma calomelanos* (L.) Link	Pteridaceae	Herb
329.	*Plectranthus mollis* (Aiton) Spreng.	Lamiaceae	Herb
330.	*Polygala erioptera* DC.	Polygalaceae	Herb
331.	*Polygala arvensis* Willd.	Polygalaceae	Herb
332.	*Polygala chinensis* L.	Polygalaceae	Herb
333.	*Polygala persicariifolia* DC.	Polygalaceae	Herb
334	*Polygonum hydropiper* L.	Polygonaceae	Herb
335.	*Polygonum plebeium* R. Br.	Polygonaceae	Herb
336	*Portulaca oleracea* L	Portulacaceae	Herb
337	*Premna herbacea* Roxb.	Verbenaceae	Herb
338.	*Rhynchosia minima* (L.) DC.	Fabaceae	Herb
339.	*Rhynchosia rufescens* (Willd.) DC.	Fabaceae	Herb
340.	*Rhynchospora wightiana* (Nees) Steud.	Cyperaceae	Herb
341.	*Rhynchostylis retusa* (L.) Bl.	Orchidaceae	Herb
342.	*Richardia scabra* L.	Rubiaceae	Herb
343	*Rotala rotundifolia* (Buch. Ham. ex Roxb.) Koehne	Lythraceae	Herb
344.	*Rotala* sp.	Lythraceae	Herb
345.	*Rungia pectinata* (L.) Nees	Acanthaceae	Herb
346.	*Saccharum spontaneum* L.	Poaceae	Herb
347.	*Sacciolepis indica* (L.) Chase	Poaceae	Herb
348.	*Salomonia cantoniensis* Lour.	Polygalaceae	Herb

S.N.	Name of the Plant species	Family	Habit
349.	*Scleria lithosperma* (L.) Sw.	Cyperaceae	Herb
350.	*Scleria parvula* Steud.	Cyperaceae	Herb
351.	*Scoparia dulcis* L.	Scrophulariaceae	Herb
352.	*Selaginella* sp.	Selaginellaceae	Herb
353.	*Senna hirsuta* (L.) H. S. Irwin & Barneby	Caesalpiniaceae	Herb
354.	*Senna occidentalis* (L.) Link	Caesalpiniaceae	Herb
355.	*Senna tora* (L.) Roxb.	Caesalpiniaceae	Herb
356.	*Setaria pumila* (Poir) Roem. & Schultes	Poaceae	Herb
357.	*Setaria verticillata* (L.) P.Beauv.	Poaceae	Herb
358.	*Sida acuta* Burm.f.	Malvaceae	Herb
359.	*Sida cordata* (Burm.f.) Borssum	Malvaceae	Herb
360.	*Sida cordifolia* L.	Malvaceae	Herb
361.	*Sida rhombifolia* L.	Malvaceae	Herb
362.	*Sida spinosa* L.	Malvaceae	Herb
363.	*Smithia conferta* Sm.	Fabaceae	Herb
364.	*Solanum nigrum* L.	Solanaceae	Herb
365.	*Sopubia delphiniifolia* (L.) G.Don	Scrophulariaceae	Herb
366.	*Sorghum halepense* (L.) Pers.	Poaceae	Herb
367.	*Spermacoce articularis* L. f.	Rubiaceae	Herb
368.	*Spermacoce hispida* L.	Rubiaceae	Herb
369.	*Spermacoce latifolia* Aubl.	Rubiaceae	Herb
370.	*Spermacoce pusilla* Wall.	Rubiaceae	Herb
371.	*Spermacoce oxymoides* Burm.f.	Rubiaceae	Herb
372.	*Sphaeranthus indicus* L.	Asteraceae	Herb
373.	*Spilanthes calva* DC	Asteraceae	Herb
374.	*Sporobolus indicus* (L.) R. Br.	Poaceae	Herb
375.	*Sporobolus coromandelianus* (Retz.) Kunth	Poaceae	Herb
376.	*Stachytarpheta jamaicensis* (L.) Vahl.	Verbenaceae	Herb
377.	*Striga asiatica* (L.) Kuntze	Scrophulariaceae	Herb
378.	*Striga angustifolia* (D. Don) C. J. Saldanha	Scrophulariaceae	Herb
379.	*Stylidium tenellum* Sw. ex Willd.	Stylidiaceae	Herb
380.	*Swertia angustifolia* Buch. Ham. ex D. Don	Gentianaceae	Herb
381.	*Tacca leontopetaloides* (L.) Kuntze	Taccaceae	Herb
382.	*Tephrosia purpurea* (L.) Pers.	Fabaceae	Herb
383.	*Tephrosia villosa* (L.) Pers.	Fabaceae	Herb
384.	*Themeda quadrivalvis* (L.) Kuntze	Poaceae	Herb
385.	*Themeda triandra* Forssk.	Poaceae	Herb
386.	*Thysanolaena maxima* (Roxb.) Kuntze	Poaceae	Herb
387.	*Torenia asiatica* L.	Scrophulariaceae	Herb
388.	*Torenia violacea* (Azaola ex. Blanco) Pennell	Scrophulariaceae	Herb
389.	*Torenia indica* C.J.Saldanha	Scrophulariaceae	Herb
390.	*Tribulus terrestris* L.	Zygophyllaceae	Herb
391.	*Tridax procumbens* L	Asteraceae	Herb
392.	*Tripogon jacquemontii* Stapf	Poaceae	Herb
393.	*Triumfetta rhomboidea* Jacq.	Tiliaceae	Herb

S.N.	Name of the Plant species	Family	Habit
394.	*Triumfetta annua* L.	Malvaceae	Herb
395.	*Triumfetta rotundifolia* Lam.	Tiliaceae	Herb
396.	*Uraria lagopodioides* (L.) Desv. ex. DC.	Fabaceae	Herb
397.	*Uraria picta* (Jacq.) DC.	Fabaceae	Herb
398.	*Urena lobata* L.subsp. *lobata* Mast	Malvaceae	Herb
399.	*Urena sinuata* L.	Malvaceae	Herb
400.	*Urochloa panicoides* P.Beauv.	Poaceae	Herb
401.	*Utricularia* sp.	Utriculariaceae	Herb
402.	*Vanda tessellata* (Roxb.) Hook. ex G.Don	Orchidaceae	Herb
403.	*Vernonia cinerea* (L.) Less	Asteraceae	Herb
404.	*Vetiveria zizanioides* (L.) Nash	Poaceae	Herb
405.	*Vicoa indica* (L.) DC.	Asteraceae	Herb
406.	*Vigna trilobata* (L.) Verdc.	Fabaceae	Herb
407.	*Vigna dalzelliana* (Kuntze) Verdc.	Fabaceae	Herb
408.	*Vigna vexillata* (L.) A.Rich.	Fabaceae	Herb
409.	*Waltheria indica* L.	Malvaceae	Herb
410.	*Xanthium strumarium* L.	Asteraceae	Herb
411.	*Zornia gibbosa* Span	Fabaceae	Herb
412.	*Abelmoschus crinitus* Wall.	Malvaceae	Shrub
413.	*Abelmoschus ficulneus* (L.) Wight & Arn.	Malvaceae	Shrub
414.	*Abutilon indicum* (L.) Sweet	Malvaceae	Shrub
415.	*Anisomeles indica* (L.) Kuntze	Lamiaceae	Shrub
416.	*Ardisia solanacea* Roxb.	Myrsinaceae	Shrub
417.	*Bambusa bambos* (L.) Voss	Poaceae	Shrub
418.	*Bambusa vulgaris* Schrad.	Poaceae	Shrub
419.	*Barleria prionitis* L	Acanthaceae	Shrub
420.	*Barleria strigosa* Willd.	Acanthaceae	Shrub
421.	*Calotropis gigantea* (L.) R.Br.	Asclepiadaceae	Shrub
422.	*Calotropis procera* (Aiton) Dryand.	Asclepiadaceae	Shrub
423.	*Canthium dicoccum* (Gaertn.) Teijsm.	Rubiaceae	Shrub
424.	*Canthium coromandelicum* (Burm.f) Alston	Rubiaceae	Shrub
425.	*Carissa spinarum* L.	Apocynaceae	Shrub
426.	*Carissa carandas* L.	Apocynaceae	Shrub
427.	*Chromolaena odorata* (L.) King & Robins	Asteraceae	Shrub
428.	*Cipadessa baccifera* (Roxb.) Miq.	Meliaceae	Shrub
429.	*Clerodendrum infortunatum* L.	Verbenaceae	Shrub
430.	*Clerodendrum serratum* (L.) Moon	Verbenaceae	Shrub
431.	*Colebrookia oppositifolia* Sm.	Lamiaceae	Shrub
432.	*Datura metel* L	Solanaceae	Shrub
433.	*Dendrocalamus strictus* (Roxb.) Nees	Poaceae	Shrub
434.	*Dendrophthoe falcata* (L.f) Etting.	Loranthaceae	Shrub
435.	*Desmodium motorium* (Houtt.) Merr.	Fabaceae	Shrub
436.	*Desmodium pulchellum* (L.) Benth.	Fabaceae	Shrub
437.	*Desmodium velutinum* (Willd.) DC.	Fabaceae	Shrub
438.	*Dodonaea viscosa* (L.) Jacq.	Sapindaceae	Shrub
439.	*Duranta repens* L.	Verbenaceae	Shrub

S.N.	Name of the Plant species	Family	Habit
440.	*Embelia tsjeriam cottam* (Roem. & Schult.) DC.	Myrsinaceae	Shrub
441.	*Eranthemum roseum* (Vahl) R. Br.	Acanthaceae	Shrub
442.	*Eranthemum purpurascens* Wight ex Nees	Acanthaceae	Shrub
443.	*Flemingia chappar* Buch.-Ham. ex Benth.	Fabaceae	Shrub
444.	*Flemingia strobilifera* (L.) R.Br. ex Ait.	Fabaceae	Shrub
445.	*Flemingia semialata* Roxb.	Fabaceae	Shrub
446.	*Flueggea virosa* (Roxb. ex Willd.) Royle	Euphorbiaceae	Shrub
447.	*Gmelina asiatica* L.	Verbenaceae	Shrub
448.	*Grewia hirsuta* Vahl.	Tiliaceae	Shrub
449.	*Grewia rothii* DC.	Tiliaceae	Shrub
450.	*Grewia orbiculata* Rottler	Tiliaceae	Shrub
451.	*Gymnosporia emarginata* (Willd.) Thwaites	Tiliaceae	Shrub
452.	*Helicteres isora* L.	Sterculiaceae	Shrub
453.	*Homonoia riparia* Lour	Euphorbiaceae	Shrub
454.	*Indigofera cassioides* Rottl. ex DC	Fabaceae	Shrub
455.	*Ipomoea carnea* Jacq.	Convolvulaceae	Shrub
456.	*Jatropha curcas* L.	Euphorbiaceae	Shrub
457.	*Jatropha gossypiifolia* L.	Euphorbiaceae	Shrub
458.	*Justicia adhatoda* L.	Acanthaceae	Shrub
459.	*Lantana camara* L.	Verbenaceae	Shrub
460.	*Leea indica* (Burm.f.) Merr.	Leeaceae	Shrub
461.	*Leea macrophylla* Roxb. ex. Hornem.	Leeaceae	Shrub
462.	*Leea asiatica* (L.) Ridsdale	Leeaceae	Shrub
463.	*Melastoma malabathricum* L.	Melastomataceae	Shrub
464.	*Murraya paniculata* (L.) Jack.	Rutaceae	Shrub
465.	*Paretta indica* L.	Rubiaceae	Shrub
466.	*Peristrophe bicalyculata* (Retz) Nees	Acanthaceae	Shrub
467.	*Phoenix loureiri* Kunth	Arecaceae	Shrub
468.	*Pogostemon benghalensis* (Burm.f.) O. Ktze	Lamiaceae	Shrub
469.	*Rauvolfia serpentina* (L.) Benth ex Kurz	Apocynaceae	Shrub
470.	*Senna auriculata* (L.) Roxb.	Caesalpiniaceae	Shrub
471.	*Solanum nigrum* L.	Solanaceae	Shrub
472.	*Syzygium salicifolium* (Wight) J. Graham	Myrtaceae	Shrub
473.	*Tarenna asiatica* (L.) Kuntze ex K.Schum.	Rubiaceae	Shrub
474.	*Thespesia lampas* (Cav.) Dalzell	Malvaceae	Shrub
475.	*Viscum articulatum* Burm.f.	Loranthaceae	Shrub
476.	*Vitex negundo* L.	Verbenaceae	Shrub
477.	*Woodfordia fruticosa* (L.) Kurz	Lythraceae	Shrub
478.	*Acacia chundra* (Roxb. ex Rottl.) Willd.	Mimosaceae	Tree
479.	*Acacia leucophloea* (Roxb.) Willd.	Mimosaceae	Tree
480.	*Acacia nilotica* (L.) Willd. ex Delile	Mimosaceae	Tree
481.	*Acacia auriculiformis* A. Cunn. ex Benth.	Mimosaceae	Tree
482.	*Acacia catechu* (L.f.) Willd.	Mimosaceae	Tree
483.	*Aegle marmelos* (L.) Correa	Rutaceae	Tree

S.N.	Name of the Plant species	Family	Habit
484.	*Ailanthus excelsa* Roxb.	Simaroubaceae	Tree
485.	*Alangium salvifolium* (L.f.) Wang	Alangiaceae	Tree
486.	*Albizia amara* (Roxb.) Bioven	Mimosaceae	Tree
487.	*Albizia lebbeck* (L.) Benth.	Mimosaceae	Tree
488.	*Albizia odoratissima* (L.f.) Benth.	Mimosaceae	Tree
489.	*Albizia procera* (Roxb.) Benth.	Mimosaceae	Tree
490.	*Alstonia scholaris* (L.) R.Br.	Apocynaceae	Tree
491.	*Anacardium occidentale* L.	Anacardiaceae	Tree
492.	*Annona reticulata* L.	Annonaceae	Tree
493.	*Annona squamosa* L.	Annonaceae	Tree
494.	*Anogeissus acuminata* (Roxb. ex DC.) Wall. ex Guill.	Combretaceae	Tree
495.	*Anogeissus latifolia* (Roxb. ex DC.) Wall. ex Guill.	Combretaceae	Tree
496.	*Anogeissus pendula* Edgew.	Combretaceae	Tree
497.	*Antidesma acidum* Retz.	Euphorbiaceae	Tree
498.	*Antidesma ghaesembilla* Gaertn.	Euphorbiaceae	Tree
499.	*Arthocarpus heterophyllus* Lam.	Moraceae	Tree
500.	*Azadirachta indica* A. Juss.	Meliaceae	Tree
501.	*Barringtonia acutangula* (L.) Gaertn.	Lecythidaceae	Tree
502.	*Bauhinia malabarica* Roxb.	Caesalpiniaceae	Tree
503.	*Bauhinia pupurea* L.	Caesalpiniaceae	Tree
504.	*Bauhinia racemosa* Lam.	Caesalpiniaceae	Tree
505.	*Bauhinia semla* Wunderlin	Caesalpiniaceae	Tree
506.	*Bauhinia variegata* L.	Caesalpiniaceae	Tree
507.	*Bixa orellana* Lam.	Bixaceae	Tree
508.	*Bombax ceiba* L.	Bombacaceae	Tree
509.	*Borassus flabellifer* L.	Arecaceae	Tree
510.	*Boswellia serrata* Roxb. ex Colebr.	Burseraceae	Tree
511.	*Bridelia retusa* (L.) Spreng.	Euphorbiaceae	Tree
512.	*Buchanania lanzan* Spreng.	Anacardiaceae	Tree
513.	*Butea monosperma* (Lam.) Taub.	Fabaceae	Tree
514.	*Careya arborea* Roxb.	Lecythidaceae	Tree
515.	*Casearia graveolens* Dalz.	Flacourtiaceae	Tree
516.	*Casearia tomentosa* Roxb.	Flacourtiaceae	Tree
517.	*Cassia fistula* L.	Caesalpiniaceae	Tree
518.	*Cassine glauca* (Rottb.) Kuntze	Celastraceae	Tree
519.	*Catunaregam spinosa* (Thunb.) Tirvegadum	Rubiaceae	Tree
520.	*Ceiba pentandra* (L.) Gaertn.	Bombacaceae	Tree
521.	*Ceriscoides turgida* (Roxb.) Tirvengadum	Rubiaceae	Tree
522.	*Chloroxylon swietenia* DC.	Flindersiaceae	Tree
523.	*Cleistanthus collinus* (Roxb.) Benth. ex Hook.	Euphorbiaceae	Tree
524.	*Cochlospermum religiosum* (L.) Alston	Cochlospermaceae	Tree
525.	*Cordia obliqua* Willd.	Ehretiaceae	Tree
526.	*Croton persimilis* Muell.-Arg.	Euphorbiaceae	Tree

S.N.	Name of the Plant species	Family	Habit
527.	*Dalbergia latifolia* Roxb.	Fabaceae	Tree
528.	*Dalbergia paniculata* Roxb.	Fabaceae	Tree
529.	*Dalbergia sissoo* Roxb.	Fabaceae	Tree
530.	*Delonix regia* Roxb.	Caesalpiniaceae	Tree
531.	*Dichrostachys cinerea* (L.) Wight & Arn.	Mimosaceae	Tree
532.	*Dillenia pentagyna* Roxb.	Dilleniaceae	Tree
533.	*Diospyros melanoxylon* Roxb.	Ebenaceae	Tree
534.	*Diospyros montana* Roxb.	Ebenaceae	Tree
535.	*Diospyros sylvatica* Roxb	Ebenaceae	Tree
536.	*Ehretia laevis* Roxb.	Ehretiaceae	Tree
537.	*Eriolaena hookeriana* Wight & Arn.	Malvaceae	Tree
538.	*Erythrina suberosa* Roxb.	Fabaceae	Tree
539.	*Erythrina variegata* L.	Fabaceae	Tree
540.	*Eucalyptus* sp.	Myrtaceae	Tree
541.	*Ficus benghalensis* L.	Moraceae	Tree
542.	*Ficus hispida* L.f.	Moraceae	Tree
543.	*Ficus racemosa* L.	Moraceae	Tree
544.	*Ficus religiosa* L.	Moraceae	Tree
545.	*Ficus tinctoria* Forst.	Moraceae	Tree
546.	*Ficus mollis* Vahl	Moraceae	Tree
547.	*Flacourtia indica* (Burm.f.) Merr.	Flacourtiaceae	Tree
548.	*Gardenia gummifera* L.f.	Rubiaceae	Tree
549.	*Gardenia latifolia* Ait.	Rubiaceae	Tree
550.	*Gardenia resinifera* Roth	Rubiaceae	Tree
551.	*Garuga pinnata* Roxb.	Burseraceae	Tree
552.	*Gliricidia sepium* (Jacq.) Kunth. ex Walp.	Fabaceae	Tree
553.	*Glochidion zeylanicum* (Gaertn.) Juss.	Euphorbiaceae	Tree
554.	*Gmelina arborea* Roxb.	Verbenaceae	Tree
555.	*Grewia tiliaefolia* Vahl	Tiliaceae	Tree
556.	*Grewia optiva* J.R.Drumm. ex Burret	Tiliaceae	Tree
557.	*Haldina cordifolia* (Roxb.) Ridsdale	Rubiaceae	Tree
558.	*Hardwickia binata* Roxb.	Caesalpiniaceae	Tree
559.	*Holarrhena pubescens* (Buch.-Ham.) Wall. ex G. Don	Apocynaceae	Tree
560.	*Holoptelea integrifolia* (Roxb.) Planch.	Ulmaceae	Tree
561.	*Homalium nepalense* Benth.	Flacourtiaceae	Tree
562.	*Hymenodictyon orixense* (Roxb.) Mabb.	Rubiaceae	Tree
563.	*Ixora pavetta* Andr.	Rubiaceae	Tree
564.	*Kydia calycina* Roxb.	Malvaceae	Tree
565.	*Lagerstroemia parviflora* Roxb.	Lythraceae	Tree
566.	*Lannea coromandelica* (Houtt.) Merr.	Anacardiaceae	Tree
567.	*Limonia acidissima* L.	Rutaceae	Tree
568.	*Madhuca longifolia* (Koen.)Macbr.var. *latifolia* (Roxb.) A.Cheval	Sapotaceae	Tree
569.	*Mallotus philippensis* (L.) Muell.-Arg.	Euphorbiaceae	Tree
570.	*Mangifera indica* L.	Anacardiaceae	Tree
571.	*Manilkara hexandra* (Roxb.) Dubard	Sapotaceae	Tree

S.N.	Name of the Plant species	Family	Habit
572.	*Melia azedarach* L.	Meliaceae	Tree
573.	*Miliusa tomentosa* (Roxb.) Sinclair	Annonaceae	Tree
574.	*Mitragyna parvifolia* (Roxb.) Korth.	Rubiaceae	Tree
575.	*Morinda pubescens* J.E.Smith	Rubiaceae	Tree
576.	*Naringi crenulata* (Roxb.) Nicolson	Rutaceae	Tree
577.	*Neolamarckia cadamba* (Roxb.) Bosser	Rubiaceae	Tree
578.	*Nyctanthes arbor-tristis* L.	Nyctanthaceae	Tree
579.	*Ochna gamblei* King ex Brandis	Ochnaceae	Tree
580.	*Oroxylum indicum* (L.) Vent.	Bignoniaceae	Tree
581.	*Ougeinia oojeinensis* (Roxb.) Hochr.	Fabaceae	Tree
582.	*Peltophorum pterocarpum* (DC.) Baker ex Heyne	Caesalpiniaceae	Tree
583.	*Phoenix sylvestris* (L.) Roxb.	Arecaceae	Tree
584.	*Phyllanthus emblica* L.	Euphorbiaceae	Tree
585.	*Pithecellobium dulce* (Roxb.) Benth.	Mimosaceae	Tree
586.	*Polyalthia cerasoides* (Roxb.) Bedd.	Annonaceae	Tree
587.	*Pongamia pinnata* (L.) Pierre	Fabaceae	Tree
588.	*Prosopis juliflora* (Sw.) DC.	Mimosaceae	Tree
589.	*Pterocarpus marsupium* Roxb.	Fabaceae	Tree
590.	*Pterspermum xylocarpum* (Gaertn.) Sant. & Wagh	Sterculiaceae	Tree
591.	*Rhus* sp.	Anacardiaceae	Tree
592.	*Salix tetrasperma* Roxb	Salicaceae	Tree
593.	*Sapindus emarginatus* Vahl	Sapindaceae	Tree
594.	*Schleichera oleosa* (Lour.) Oken	Sapindaceae	Tree
595.	*Schrebera swietenioides* Roxb.	Oleaceae	Tree
596.	*Semecarpus anacardium* L.f.	Anacardiaceae	Tree
597.	*Senna siamea* (Lam.) Irwin & Barneby	Caesalpiniaceae	Tree
598.	*Shorea robusta* Gaertn.f.	Dipterocarpaceae	Tree
599.	*Soymida febrifuga* (Roxb.) A.Juss.	Meliaceae	Tree
600.	*Sterculia urens* Roxb.	Sterculiaceae	Tree
601.	*Stereospermum chelonoides* (L.f.) DC.	Bignoniaceae	Tree
602.	*Stereospermum tetragonum* DC.	Bignoniaceae	Tree
603.	*Streblus asper* Lour	Moraceae	Tree
604.	*Strychnos nux-vomica* L.	Loganiaceae	Tree
605.	*Strychnos potatorum* L.f.	Loganiaceae	Tree
606.	*Symplocos racemosa* Roxb.	Symplocaceae	Tree
607.	*Syzygium cumini* (L.) Skeels	Myrtaceae	Tree
608.	*Syzygium nervosum* A. Cunn. ex DC.	Myrtaceae	Tree
609.	*Syzygium* sp.	Myrtaceae	Tree
610.	*Tamarindus indica* L.	Caesalpiniaceae	Tree
611.	*Tamilnadia uliginosa* (Retz.) Tirvengadum & Sastre	Rubiaceae	Tree
612.	*Tecoma stans* (L.) Juss. ex Kunth	Bignoniaceae	Tree
613.	*Tectona grandis* L. f.	Verbenaceae	Tree
614.	*Terminalia arjuna* (Roxb. ex DC.) Wight & Arn.	Combretaceae	Tree

S.N.	Name of the Plant species	Family	Habit
615.	*Terminalia bellirica* (Gaertn.) Roxb.	Combretaceae	Tree
616.	*Terminalia chebula* Retz.	Combretaceae	Tree
617.	*Terminalia elliptica* Willd.	Combretaceae	Tree
618.	*Trema orientalis* (L.) Bl.	Ulmaceae	Tree
619.	*Wendlandia heynei* (Schult.) Santapau & Merchant	Rubiaceae	Tree
620.	*Wrightia tinctoria* (Roxb.) R.Br.	Apocynaceae	Tree
621.	*Xylia xylocarpa* (Roxb.) Taub.	Mimosaceae	Tree
622.	*Ziziphus mauritiana* Lam.	Rhamnaceae	Tree
623.	*Ziziphus xylopyrus* (Retz.) Willd.	Rhamnaceae	Tree
624.	*Acacia pennata* (L.) Willd.	Mimosaceae	Woody climber
625.	*Acacia torta* (Roxb.) Craib.	Mimosaceae	Woody climber
626.	*Acacia caesia* (L.) Willd.	Mimosaceae	Woody climber
627.	*Bauhinia vahlii* Wight & Arn.	Caesalpiniaceae	Woody climber
628.	*Butea superba* Roxb.	Fabaceae	Woody climber
629.	*Caesalpinia bonduc* (L.) Roxb.	Caesalpiniaceae	Woody climber
630.	*Caesalpinia cucullata* Roxb.	Caesalpiniaceae	Woody climber
631.	*Capparis zeylanica* L.	Capparidaceae	Woody climber
632.	*Combretum roxburghii* Roxb.	Combretaceae	Woody climber
633.	*Entada rheedii* Spreng.	Mimosaceae	Woody climber
634.	*Erycibe paniculata* Roxb.	Convolvulaceae	Woody climber
635.	*Milletia extensa* (Benth.) Baker	Fabaceae	Woody climber
636.	*Millettia racemosa* (Roxb.) Benth.	Fabaceae	Woody climber
637.	*Spatholobus parviflorus* (DC.) Kuntze	Fabaceae	Woody climber
638.	*Symphorema involucratum* Roxb.	Symphoremataceae	Woody climber
639.	*Ventilago maderaspatana* Gaertn.	Rhamnaceae	Woody climber
640.	*Ziziphus rugosa* Lam.	Rhamnaceae	Woody climber

Annexure 4.4

Medicinal Plants in Hasdeo-Arand Coalfield falls within Korba, Surguja and Surajpur districts of Chhattisgarh

S.N.	Name of the Plant species
1	*Abrus precatorius* L.
2	*Abutilon indicum* (L.) Sweet
3	*Acalypha indica* L.
4	*Achyranthes aspera* L.
5	*Aegle marmelos* (L.) Correa
6	*Aerva lanata* (L.) Juss. ex Schultes
7	*Alangium salvifolium* (L.f.) Wang
8	*Alstonia scholaris* (L.) R.Br.
9	*Andrographis paniculata* (Burm.f.) Wall. ex Nees
10	*Argemone mexicana* L.
11	*Aristolochia indica* L.
12	*Asparagus racemosus* Willd.
13	*Azadirachta indica* A. Juss.
14	*Bacopa monnieri* (L.) Wettst.
15	*Bacopa floribunda* (R.Br.) Wettst.
16	*Barleria prionites* L.
17	*Biophytum reinwardtii* (Zucc.) Klotzsch
18	*Biophytum sensitivum* (L.) DC.
19	*Boerhavia diffusa* L.
20	*Boswellia serrata* Roxb. ex Colebr.
21	*Bridelia retusa* (L.) Spreng.
22	*Caesalpinia bonduc* (L.) Roxb.
23	*Calotropis gigantea* (L.) R.Br.
24	*Calotropis procera* (Aiton) Dryand.
25	*Capparis zeylanica* L.
26	*Cardiospermum halicacabum* L.
27	*Cassia fistula* L.
28	*Cassine glauca* (Rottb.) Kuntze
29	*Celastrus paniculatus* Willd.
30	*Centella asiatica* (L.) Urban
31	*Cheilocostus speciosus* (J.Koenig) C.D.Specht
32	*Chlorophytum arundinaceum* Baker
33	*Chlorophytum tuberosum* (Roxb.) Baker
34	*Cissampelos pareira* L.
35	*Cissus quadrangularis* L.
36	*Cleome viscosa* L.
37	*Clerodendrum infortunatum* L.
38	*Clerodendrum serratum* (L.) Moon
39	*Curculigo orchioides* Gaertn.

S.N.	Name of the Plant species
40	*Cymbopogon martini* (Roxb.) W.Watson
41	*Cynodon dactylon* (L.) Pers.
42	*Cyperus rotundus* L.
43	*Datura metel* L.
44	*Desmodium gangeticum* (L.) DC.
45	*Desmodium triflorum* (L.) DC.
46	*Dioscorea bulbifera* L.
47	*Dioscorea hispida* Dennst.
48	*Diplocyclos palmatus* (L.) Jeffrey
49	*Dodonaea viscosa* (L.) Jacq.
50	*Eclipta prostrata* (L.) L.
51	*Elephantopus scaber* L.
52	*Embelia tsjeriam-cottam* (Roem. & Schult.) DC.
53	*Emilia sonchifolia* (L.) DC.
54	*Enicostema axillare* (Lam.) Raynal
55	*Entada rheedii* Spreng.
56	*Euphorbia hirta* L.
57	*Evolvulus alsinoides* (L.) L.
58	*Ficus benghalensis* L.
59	*Ficus racemosa* L.
60	*Ficus religiosa* L.
61	*Gardenia gummifera* L.f.
62	*Gloriosa superba* L.
63	*Gmelina arborea* Roxb.
64	*Helicteres isora* L.
65	*Hemidesmus indicus* (L.) R.Br.
66	*Holarrhena pubescens* (Buch.-Ham.) Wall. ex G. Don
67	*Holostemma ada-kodien* Schult.
68	*Homalium nepalense* Benth.
69	*Hybanthus enneaspermus* (L.) F.v.Muell.
70	*Iphigenia indica* (L.) A.Gray ex Kunth
71	*Ipomoea pes-tigridis* L.
72	*Jatropha curcas* L.
73	*Justicia adhatoda* L.
74	*Leucas aspera* (Willd.) Link
75	*Leucas cephalotes* (Roth) Spreng.
76	*Limonia acidissima* L.
77	*Madhuca longifolia*

S.N.	Name of the Plant species
	(Koen.)Macbr.var. *latifolia* (Roxb.) A.Cheval
78	*Manilkara hexandra* (Roxb.) Dubard
79	*Merremia tridentata* (L.) Hall.f.
80	*Micromeria biflora* (Buch.-Ham.ex D.Don) Benth
81	*Mucuna pruriens* (L.) DC.
82	*Mukia maderaspatana* (L.) Roem.
83	*Neolamarckia cadamba* (Roxb.) Bosser
84	*Nepeta hindostana* (B.Heyne ex Roth) Haines
85	*Nyctanthes arbor-tristis* L.
86	*Oldenlandia corymbosa* L.
87	*Operculina turpethum* (L.) Silva Manso
88	*Oroxylum indicum* (L.) Vent.
89	*Oxalis corniculata* L.
90	*Pavetta indica* L.
91	*Pergularia daemia* (Forssk.) Chiov.
92	*Peucedanum nagpurense* Prain
93	*Phyllanthus amarus* Schum. & Thonn.
94	*Phyllanthus emblica* L.
95	*Pongamia pinnata* (L.) Pierre
96	*Premna herbacea* Roxb.
97	*Pterocarpus marsupium* Roxb.
98	*Pueraria tuberosa* (Roxb. ex Willd.) DC.
99	*Rauvolfia serpentina* (L.) Benth ex Kurz
100	*Rubia cordifolia* L.

S.N.	Name of the Plant species
101	*Schleichera oleosa* (Lour.) Oken
102	*Scoparia dulcis* L.
103	*Semecarpus anacardium* L.f.
104	*Senna auriculata* (L.) Roxb.
105	*Senna occidentalis* (L.) Link
106	*Shorea robusta* Gaertn.f.
107	*Sida cordata* (Burm.f.) Borssum
108	*Sida cordifolia* L.
109	*Sida rhombifolia* L.
110	*Smilax zeylanica* L.
111	*Soymida febrifuga* (Roxb.) A.Juss.
112	*Spermacoce articularis* L. f.
113	*Sphaeranthes indicus* L.
114	*Stachytarpheta jamaicensis* (L.) Vahl.
115	*Stereospermum chelonoides* (L.f.) DC.
116	*Streblus asper* Lour
117	*Strychnos nux-vomica* L.
118	*Strychnos potatorum* L.f.
119	*Symplocos racemosa* Roxb.
120	*Syzygium cumini* (L.) Skeels
121	*Terminalia bellirica* (Gaertn.) Roxb.
122	*Terminalia chebula* Retz.
123	*Tinospora cordifolia* (Willd.) Miers ex Hook.f. & Thoms.
124	*Tribulus terrestris* L.
125	*Uraria picta* (Jacq.) DC.
126	*Vernonia cinerea* (L.) Less
127	*Vitex negundo* L.
128	*Waltheria indica* L

Annexure 4. 5

Timber yielding plant species in Hasdeo-Arand Coalfield falls within Korba, Surguja and Surajpur districts of Chhattisgarh

S. N.	Name of the Plant species
1	*Acacia nilotica* (L.) Willd. ex Delile
2	*Acacia auriculiformis* A. Cunn. ex Benth.
3	*Albizia lebbeck* (L.) Benth.
4	*Albizia odoratissima* (L.f.) Benth.
5	*Albizia procera* (Roxb.) Benth.
6	*Anogeissus latifolia* (Roxb. ex DC.) Wall. ex Guill.
7	*Arthocarpus heterophyllus* Lam.
8	*Azadirachta indica* A. Juss.
9	*Bauhinia semla* Wunderlin
10	*Bridelia retusa* (L.) Spreng.
11	*Cassia fistula* L.
12	*Chloroxylon swietenia* DC.
13	*Dalbergia latifolia* Roxb.
14	*Dalbergia sissoo* Roxb.
15	*Gmelina arborea* Roxb.
16	*Grewia tiliaefolia* Vahl
17	*Haldina cordifolia* (Roxb.) Ridsdale
18	*Holoptelea integrifolia* (Roxb.) Planch.
19	*Kydia calycina* Roxb.
20	*Lagerstroemia parviflora* Roxb.
21	*Lannea coromandelica* (Houtt.) Merr.
22	*Madhuca longifolia* (Koen.)Macbr.var. latifolia (Roxb.) A.Cheval
23	*Mangifera indica* L.
24	*Miliusa tomentosa* (Roxb.) Sinclair
25	*Mitragyna parvifolia* (Roxb.) Korth.
26	*Morinda pubescens* J.E.Smith
27	*Neolamarckia cadamba* (Roxb.) Bosser
28	*Ougeinia oojeinensis* (Roxb.) Hochr.
29	*Pterocarpus marsupium* Roxb.
30	*Schleichera oleosa* (Lour.) Oken
31	*Schrebera swietenioides* Roxb.
32	*Shorea robusta* Gaertn.f.
33	*Stereospermum chelonoides* (L.f.) DC.
34	*Stereospermum tetragonum* DC.
35	*Syzygium cumini* (L.) Skeels
36	*Tamarindus indica* L.
37	*Tectona grandis* L. f.
38	*Terminalia arjuna* (Roxb. ex DC.) Wight & Arn.
39	*Terminalia elliptica* Willd.
40	*Xylia xylocarpa* (Roxb.) Taub.

Annexure 4.6

Edible plant species in Hasdeo-Arand Coalfield falls within Korba, Surguja and Surajpur districts of Chhattisgarh

S.N.	Name of the Plant species
1	*Aegle marmelos* (L.) Correa
2	*Aerva lanata* (L.) Juss. ex Schultes
3	*Alangium salvifolium* (L.f.) Wang
4	*Alternanthera sessilis* (L.) R,Br. ex DC.
5	*Amaranthus spinosus* L.
6	*Amaranthus viridis* L.
7	*Annona reticulata* L.
8	*Annona squamosa* L.
9	*Antidesma acidum* Retz
10	*Ardisia solanacea* Roxb.
11	*Arthocarpus heterophyllus* Lam.
12	*Bambusa bambos* (L.) Voss
13	*Bambusa vulgaris* Schrad.
14	*Bauhinia vahlii* Wight & Arn.
15	*Bombax ceiba* L.
16	*Borassus flabellifer* L.
17	*Buchanania lanzan* Spreng.
18	*Canthium dicoccum* (Gaertn.) Teijsm.
19	*Canthium coromandelicum* (Burm.f.) Alston
20	*Carissa spinarum* L.
21	*Carissa carandas* L.
22	*Celosia argentea* L.
23	*Cissus quadrangularis* L.
24	*Colocasia esculenta* (L.) Schott
25	*Dendrocalamus strictus* (Roxb.) Nees
26	*Dioscorea belophylla* Voigt ex Haines
27	*Dioscorea bulbifera* L.
28	*Dioscorea hispida* Dennst.
29	*Dioscorea oppositifolia* L.
30	*Dioscorea pentaphylla* L.
31	*Dioscorea tomentosa* J.Koenig ex Spreng.
32	*Diospyros melanoxylon* Roxb.
33	*Ficus racemosa* L.
34	*Flacourtia indica* (Burm.f.) Merr.
35	*Gardenia gummifera* L.f.
36	*Gardenia latifolia* Ait.
37	*Garuga pinnata* Roxb.
38	*Grewia tiliaefolia* Vahl
39	*Indigofera cassioides* Rottl. ex DC.
40	*Ipomoea aquatica* Forssk.
41	*Limonia acidissima* L.
42	*Madhuca longifolia* (Koen.)Macbr.var. *latifolia* (Roxb.) A.Cheval
43	*Mangifera indica* L.
44	*Manilkara hexandra* (Roxb.) Dubard
45	*Neolamarckia cadamba* (Roxb.) Bosser
46	*Phoenix loureirii* Kunth
47	*Phoenix sylvestris* (L.) Roxb.
48	*Phyllanthus emblica* L.
49	*Pithecellobium dulce* (Roxb.) Benth.
50	*Portulaca oleracea* L.
51	*Pueraria tuberosa* (Roxb. ex Willd.) DC.
52	*Semecarpus anacardium* L.f.
53	*Sterculia urens* Roxb.
54	*Syzygium cumini* (L.) Skeels
55	*Syzygium nervosum* A. Cunn. ex DC.
56	*Syzygium salicifolium* (Wight) J. Graham
57	*Tamarindus indica* L.
58	*Xylia xylocarpa* (Roxb.) Taub.
59	*Ziziphus mauritiana* Lam.
60	*Ziziphus oenoplia* (L.) Mill.

Annexure 4.7

Fodder Plant species in Hasdeo-Arand Coalfield falls within Korba, Surguja and Surajpur districts of Chhattisgarh

S.N.	Name of the Plant species
1	*Alloteropsis cimicina* (L.) Stapf
2	*Andropogon pumilus* Roxb.
3	*Apluda mutica* L.
4	*Arthraxon hispidus* (Thunb.) Makino
5	*Arthraxon lancifolius* (Trin.) Hochst.
6	*Aruidinella pumila* (Hochst.ex A. Rich.) Steud.
7	*Arundinella setosa* Trin.
8	*Azadirachta indica* A. Juss.
9	*Bauhinia racemosa* Lam.
10	*Bauhinia variegata* L.
11	*Bothriochloa odorata* (Lisboa) A. Camus
12	*Bothriochloa pertusa* (L.) A.Camus
13	*Brachiaria ramosa* (L.) Stapf
14	*Brachiaria reptans* (L.) C.A.Gardner & C.E.Hubb.
15	*Celosia argentea* L.
16	*Chloris barbata* Sw.
17	*Chrysopogon fulvus* (Spring.) Chiov.
18	*Crotalaria juncea* L.
19	*Cynodon dactylon* (L.) Pers.
20	*Cyrtococcum patens* (L.) A.Camus
21	*Dactyloctenium aegyptium* (L.) Willd.
22	*Dichanthium annulatum* (Forssk.) Stapf
23	*Dichanthium caricosum* (L.) A.Camus
24	*Digeria muricata* (L.) Mart.
25	*Digitaria ciliaris* (Retz.) Koeler
26	*Digitaria longiflora* (Retz.) Pers.
27	*Digitaria stricta* Roth
28	*Dimeria ornithopoda* Trin.
29	*Eleusine indica* (L.) Gaertn.
30	*Enteropogon dolichostachyus* (Lag.) Keng
31	*Eragrostis unioloides* (Retz.) Nees ex Steud.
32	*Eragrostis japonica* (Thunb.) Trin.
33	*Eragrostis pilosa* (L.) P.Beauv.
34	*Erythrina suberosa* Roxb.
35	*Erythrina variegata* L.
36	*Eulaliopsis binata* (Retz.) Hubbard
37	*Ficus benghalensis* L.
38	*Ficus racemosa* L.
39	*Ficus religiosa* L.
40	*Hackelochloa granularis* (L.) Kuntze
41	*Heteropogon contortus* (L.) P.Beauv.
42	*Imperata cylindrica* (L.) Raeuschal
43	*Indigofera cassioides* Rottl. ex DC.
44	*Iseilema laxum* Hack.
45	*Oplismenus burmannii* (Retz.) P. Beauv.
46	*Oplismenus compositus* (L.) P. Beauv.
47	*Panicum maximum* Jacq.
48	*Paspalidium flavidum* (Retz.) A.Camus
49	*Paspalidium geminatum* (Forssk.) Stapf
50	*Paspalidium punctatum* (Burm.) A.Camus
51	*Paspalum scrobiculatum* L.
52	*Pennisetum pedicillatum* Trin.
53	*Pithecellobium dulce* (Roxb.) Benth.
54	*Saccharum spontaneum* L.
55	*Sacciolepis indica* (L.) Chase
56	*Setaria pumila* (Poir) Roem. & Schultes
57	*Setaria verticillata* (L.) P.Beauv.
58	*Sorghum halepense* (L.) Pers.
59	*Sporobolus indicus* (L.) R. Br.
60	*Sporobolus coromandelianus* (Retz.) Kunth
61	*Themeda quadrivalvis* (L.) Kuntze
62	*Themeda triandra* Forssk.
63	*Thysanolaena maxima* (Roxb.) Kuntze
64	*Tripogon jacquemontii* Stapf
65	*Urochloa panicoides* P.Beauv.

Annexure 4. 8

Fuel Plant species in Hasdeo-Arand Coalfield falls within Korba, Surguja and Surajpur districts of Chhattisgarh

S.N.	Name of the Plant species
1	*Acacia nilotica* (L.) Willd. ex Delile
2	*Acacia auriculiformis* A. Cunn. ex Benth.
3	*Alangium salvifolium* (L.f.) Wang
4	*Albizia lebbeck* (L.) Benth.
5	*Albizia odoratissima* (L.f.) Benth.
6	*Albizia procera* (Roxb.) Benth.
7	*Anogeissus latifolia* (Roxb. ex DC.) Wall. ex Guill.
8	*Azadirachta indica* A. Juss.
9	*Bambusa bambos* (L.) Voss
10	*Bambusa vulgaris* Schrad.
11	*Bauhinia racemosa* Lam.
12	*Bridelia retusa* (L.) Spreng.
13	*Cassia fistula* L.
14	*Cassine glauca* (Rottb.) Kuntze
15	*Chloroxylon swietenia* DC.
16	*Cordia obliqua* Willd.
17	*Dalbergia latifolia* Roxb.
18	*Dalbergia paniculata* Roxb.
19	*Dalbergia sissoo* Roxb.
20	*Dendrocalamus strictus* (Roxb.) Nees
21	*Diospyros melanoxylon* Roxb.
22	*Diospyros montana* Roxb.
23	*Diospyros sylvatica* Roxb
24	*Ehretia laevis* Roxb.
25	*Ficus benghalensis* L.
26	*Gardenia latifolia* Ait.
27	*Gardenia resinifera* Roth
28	*Garuga pinnata* Roxb.
29	*Glochidion zeylanicum* (Gaertn.) Juss.
30	*Gmelina arborea* Roxb.
31	*Gmelina asiatica* L.
32	*Grewia tiliaefolia* Vahl
33	*Haldina cordifolia* (Roxb.) Ridsdale
34	*Helicteres isora* L.
35	*Holarrhena pubescens* (Buch.-Ham.) Wall. ex G. Don
36	*Holoptelea integrifolia* (Roxb.) Planch.
37	*Hymenodictyon orixense* (Roxb.) Mabb.
38	*Homalium nepalense* Benth.
39	*Ixora pavetta* Andr.
40	*Kydia calycina* Roxb.
41	*Lagerstroemia parviflora* Roxb.
42	*Lannea coromandelica* (Houtt.) Merr.
43	*Madhuca longifolia* (Koen.)Macbr.var. *latifolia* (Roxb.) A.Cheval
44	*Mallotus philippensis* (L.) Muell.-Arg.
45	*Mangifera indica* L.
46	*Miliusa tomentosa* (Roxb.) Sinclair
47	*Milletia extensa* (Benth.) Baker
48	*Millettia racemosa* (Roxb.) Benth.
49	*Mitragyna parvifolia* (Roxb.) Korth.
50	*Morinda pubescens* J.E.Smith
51	*Ougeinia oojeinensis* (Roxb.) Hochr.
52	*Phyllanthus emblica* L.
53	*Pongamia pinnata* (L.) Pierre
54	*Pterocarpus marsupium* Roxb.
55	*Pterspermum xylocarpum* (Gaertn.) Sant. & Wagh
56	*Schleichera oleosa* (Lour.) Oken
57	*Schrebera swietenioides* Roxb.
58	*Shorea robusta* Gaertn.f.
59	*Soymida febrifuga* (Roxb.) A.Juss.
60	*Stereospermum chelonoides* (L.f.) DC.
61	*Stereospermum tetragonum* DC.
62	*Symplocos racemosa* Roxb.
63	*Syzygium cumini* (L.) Skeels
64	*Syzygium nervosum* A. Cunn. ex DC.
65	*Terminalia arjuna* (Roxb. ex DC.) Wight & Arn.
66	*Terminalia chebula* Retz.
67	*Terminalia elliptica* Willd.
68	*Trema orientalis* (L.) Bl.
69	*Vitex negundo* L.
70	*Woodfordia fruticosa* (L.) Kurz
71	*Wrightia tinctoria* (Roxb.) R.Br.
72	*Xylia xylocarpa* (Roxb.) Taub.
73	*Ziziphus mauritiana* Lam.
74	*Ziziphus rugosa* Lam.
75	*Ziziphus xylopyrus* (Retz.) Willd.
	Hymenodictyon orixense (Roxb.)

Annexure 4. 9

Commercially important plant species in Hasdeo-Arand Coalfield falls within Korba, Surguja and Surajpur districts of Chhattisgarh

S. N.	Name of the Plant species
1	*Acacia catechu* (L.f.) Willd.
2	*Aegle marmelos* (L.) Correa
3	*Andrographis paniculata* (Burm.f.) Wall. ex Nees
4	*Annona reticulata* L.
5	*Annona squamosa* L.
6	*Aristida setacea* Retz.
7	*Arthocarpus heterophyllus* Lam.
8	*Asparagus racemosus* Willd.
9	*Bacopa monnieri* (L.) Wettst.
10	*Bacopa floribunda* (R.Br.) Wettst.
11	*Bambusa bambos* (L.) Voss
12	*Bambusa vulgaris* Schrad.
13	*Bauhinia vahlii* Wight & Arn.
14	*Bixa orellana* Lam.
15	*Bombax ceiba* L.
16	*Boswellia serrata* Roxb. ex Colebr.
17	*Buchanania lanzan* Spreng.
18	*Butea monosperma* (Lam.) Taub.
19	*Butea superba* Roxb.
20	*Ceiba pentandra* (L.) Gaertn.
21	*Celastrus paniculatus* Willd.
22	*Centella asiatica* (L.) Urban
23	*Cheilocostus speciosus* (J.Koenig) C.D.Specht
24	*Chlorophytum arundinaceum* Baker
25	*Chlorophytum tuberosum* (Roxb.) Baker
26	*Curculigo orchioides* Gaertn.
27	*Cymbopogon martini* (Roxb.) W.Watson
28	*Dendrocalamus strictus* (Roxb.) Nees
29	*Diospyros melanoxylon* Roxb.
30	*Embelia tsjeriam-cottam* (Roem. & Schult.) DC.
31	*Eulaliopsis binata* (Retz.) Hubbard
32	*Gloriosa superba* L.
33	*Hemidesmus indicus* (L.) R.Br.
34	*Hyptis suaveolens* (L.) Poit.
35	*Imperata cylindrica* (L.) Raeuschal
36	*Iphigenia indica* (L.) A.Gray ex Kunth
37	*Jatropha curcas* L.
38	*Limonia acidissima* L.
39	*Madhuca longifolia* (Koen.)Macbr.var. *latifolia* (Roxb.) A.Cheval
40	*Mangifera indica* L.
41	*Phyllanthus emblica* L.
42	*Pithecellobium dulce* (Roxb.) Benth.
43	*Pongamia pinnata* (L.) Pierre
44	*Rauvolfia serpentina* (L.) Benth ex Kurz
45	*Sapindus emarginatus* Vahl
46	*Schleichera oleosa* (Lour.) Oken
47	*Semecarpus anacardium* L.f.
48	*Senna tora* (L.) Roxb.
49	*Sterculia urens* Roxb.
50	*Strychnos nux-vomica* L.
51	*Strychnos potatorum* L.f.
52	*Syzygium cumini* (L.) Skeels
53	*Tamarindus indica* L.
54	*Terminalia bellirica* (Gaertn.) Roxb.
55	*Terminalia chebula* Retz.
56	*Thysanolaena maxima* (Roxb.) Kuntze
57	*Tinospora cordifolia* (Willd.) Miers ex Hook.f. & Thoms.
58	*Vetiveria zizanioides* (L.) Nash
59	*Ziziphus mauritiana* Lam.

Annexure 4.10

RET plant species in Hasdeo-Arand Coalfield falls within Korba, Surguja and Surajpur districts of Chhattisgarh

S. N.	Name of the species	Threat Status	Locations (Core and buffer areas of Coal Blocks)
1	*Aegle marmelos* (L.) Correa	R***	Sparse in all blocks
2	*Andrographis paniculata* (Burm.f.) Wall. ex Nees	VU*	1, 7, 9,10,12,14,15, 16,17, 18 19,20
3	*Aristolochia indica* L.	NT*	13,15,19
4	*Asparagus racemosus* Willd.	T*	1, 6, 12,14,18, 19, 20
5	*Bacopa monnieri* (L.) Wettst.	R***	4, 12,18 and also in the moist areas of all blocks
6	*Boswellia serrata* Roxb. ex Colebr.	VU*	Sparse in all blocks
7	*Celastrus paniculatus* Willd.	T*	1,9,15,16,17,18, 20,21,22
8	*Cheilocostus speciosus* (J.Koenig) C.D.Specht	VU*	Sparse in all blocks
9	*Chlorophytum tuberosum* (Roxb.) Baker	VU*	4,12,14,16,17,19,22
10	*Clerodendrum serratum* (L.) Moon	EN*	Sparse in all blocks
11	*Dalbergia latifolia* Roxb.	R***	6,15,16,18,22
12	*Drosera indica* L.	R***	1,10,15,16,23 and also in moist areas of all blocks
13	*Drosera burmanni* Vahl	R***	1,15,19 and also in moist areas of all blocks
14	*Embelia tsjeriam-cottam* (Roem. & Schult.) DC.	NT*	1,22, 23
15	*Entada rheedii* Spreng.	R**	1,22, 23
16	*Gloriosa superba* L.	EN*	Very sparse in all blocks
17	*Habenaria diphylla* (Nimmo) Dalzell	R**	14,15,16,17,22
18	*Holostemma ada-kodien* Schult.	R**	Sparse in all blocks
19	*Homalium nepalense* Benth.	R**	9,10,12,14,15,16,20
20	*Iphigenia indica* (L.) A.Gray ex Kunth	T***	4,15,18
21	*Leea macrophylla* Roxb. ex. Hornem.	R***	1,4,7,9,17,18,20
22	*Mitrasacme pygmaea* R. Br.	R**	1,4,10,11,15,19
23	*Ophioglossum reticulatum* L.	R***	1,4,7,14,15,16,17,19,22
24	*Oroxylum indicum* (L.) Vent.	VU*	Sparse in all blocks
25	*Premna herbacea* Roxb.	R***	6, 11,13,15,19
26	*Pterocarpus marsupium* Roxb.	VU*	1,2,4,6,10,11,12,14,15,16,17,18,19,21,22
27	*Rauvolfia serpentina* (L.) Benth ex Kurz	CR*	Very rare in HAC region
28	*Schrebera swietenioides* Roxb.	VU*	Very rare in the core and buffer areas of all blocks

29	*Strychnos nux-vomica* L.	[illegible]	Very sparse in the core and buffer areas of all blocks
30	*Strychnos potatorum* L.f.	VU*	Very sparse in the core and buffer areas of all blocks
31	*Symphorema involucratum* Roxb.	R***	1,9,10,11,12,15,16,17,18,19,21,22,23,
32	*Symplocos racemosa* Roxb.	CR*	5,9,20,21,22
33	*Uraria picta* (Jacq.) DC.	VU*	Sparse in all blocks

*Ref:http://envis.frlht.org/documents/Chhattisgarh-Madhya Pradesh-Orissa-medicinal-plants-conservation.pdf
**bsienvis.nic.in/Database/EndemicandThreatenedtaxa_3942.aspx
***Additional list of species based on ICFRE studies
CR-Critically endangered, EN-Endangered, NT-Near Threatened, T-Threatened, R-Rare, VU-Vulnerable

Annexure 4.11

Phyto-sociological characteristics of Trees in core area of PEKB, Parsa, Kente Extension and Tara coal blocks in Hasdeo-Arand Coalfield falls within Surguja and Surajpur districts of Chhattisgarh

S.No	Name of the species	D	F	A	RD	RF	TBA	RBA	IVI
1.	*Shorea robusta*	116	67	1.7	27.39	24.35	192212.18	48.84	100.58
2.	*Diospyros melanoxylon*	107	48	2.2	25.16	17.51	49602.55	12.60	55.27
3.	*Madhuca longifolia* var. *latifolia*	52	36	1.5	12.19	12.88	40993.95	10.42	35.48
4.	*Terminalia elliptica*	21	19	1.1	4.98	7.04	22594.43	5.74	17.76
5.	*Anogeissus latifolia*	18	16	1.1	4.19	5.84	25283.04	6.42	16.45
6.	*Buchanania lanzan*	28	21	1.3	6.55	7.65	7986.86	2.03	16.23
7.	*Lagerostoemia parviflora*	19	14	1.4	4.46	5.03	5164.65	1.31	10.80
8.	*Boswellia serrata*	8.3	7.8	1.1	1.97	2.82	15983.04	4.06	8.84
9.	*Semecarpus anacardium*	6.7	6.7	1	1.57	2.41	4084.32	1.04	5.03
10.	*Ceriscoides turgida*	5.6	4.4	1.3	1.31	1.61	1020.80	0.26	3.18
11.	*Syzygium cumini*	3.9	3.3	1.2	0.92	1.21	3398.17	0.86	2.99
12.	*Woodfordia fruiticosa*	5.6	2.8	2	1.31	1.01	368.23	0.09	2.41
13.	*Flacourtia indica*	4.4	3.3	1.3	1.05	1.21	510.19	0.13	2.39
14.	*Casearia graveolens*	3.9	3.3	1.2	0.92	1.21	307.96	0.08	2.20
15.	*Cassia fistula*	3.3	3.3	1	0.79	1.21	651.27	0.17	2.16
16.	*Dalbergia latifolia*	1.1	1.1	1	0.26	0.40	5308.36	1.35	2.01
17.	*Dalbergia paniculata*	1.1	1.1	1	0.26	0.40	4525.48	1.15	1.81
18.	*Pterocarpus marsupium*	2.2	2.2	1	0.52	0.80	1450.08	0.37	1.70
19.	*Holarrhena pubescens*	3.3	2.2	1.5	0.79	0.80	276.04	0.07	1.66
20.	*Gardenia resinifera*	2.8	2.2	1.3	0.66	0.80	215.68	0.05	1.51
21.	*Phyllanthus emblica*	2.2	2.2	1	0.52	0.80	398.89	0.10	1.43
22.	*Ougeinia oojeinensis*	1.1	1.1	1	0.26	0.40	2372.61	0.60	1.27
23.	*Lannea coromandelica*	1.7	1.1	1.5	0.39	0.40	1162.10	0.30	1.09
24.	*Terminalia chebula*	1.1	1.1	1	0.26	0.40	1347.29	0.34	1.01
25.	*Haldina cordifolia*	0.6	0.6	1	0.13	0.20	2579.62	0.66	0.99
26.	*Schleichera oleosa*	0.6	0.6	1	0.13	0.20	1408.36	0.36	0.69
27.	*Syzygium nervosam*	0.6	0.6	1	0.13	0.20	1345.54	0.34	0.67
28.	*Careya arborea*	0.6	0.6	1	0.13	0.20	588.85	0.15	0.48
29.	*Bombax ceiba*	0.6	0.6	1	0.13	0.20	140.45	0.04	0.37
30.	*Symplocos racemosa*	0.6	0.6	1	0.13	0.20	114.97	0.03	0.36
31.	*Butea monosperma*	0.6	0.6	1	0.13	0.20	35.11	0.01	0.34
32.	*Croton persimilis*	0.6	0.6	1	0.13	0.20	23.01	0.01	0.34

Stand density: 424 ind/ha; Stand basal area = 21.87 m^2/ha

Simpson's index (λ) = 0.165; Shannon-Wiener index (H')= 2.282

Buza and Gibson's evenness index (E)= 0.66

D= Density (individuals/ha.); F=Frequency (%); A= Abundance; TBA= Total Basal Area (m^2/ ha); RD= Relative Density; RF= Relative Frequency; RBA = Relative Basal Area; IVI= Importance Value Index

Annexure 4.12

Phyto-sociological characteristics of Shrubs in core area of PEKB, Parsa, Kente Extension and Tara coal blocks in Hasdeo-Arand Coalfield falls within Surguja and Surajpur districts of Chhattisgarh

S.No.	Name of the species	D	F	A	RD	RF	IVI
1.	*Phoenix loureiroi*	51.65	32.97	1.57	54.02	53.10	107.12
2.	*Ichnocarpus frutescens*	8.79	6.04	1.45	9.20	9.73	18.93
3.	*Woodfordia fruticosa*	12.09	3.30	3.67	12.64	5.31	17.95
4.	*Hemidesmus indicus*	7.14	6.04	1.18	7.47	9.73	17.21
5.	*Urena lobata*	3.30	2.20	1.50	3.45	3.54	6.99
6.	*Ventilago maderaspatana*	3.30	2.20	1.50	3.45	3.54	6.99
7.	*Cissampelos pareira*	1.65	1.65	1.00	1.72	2.65	4.38
8.	*Dendrocalamus strictus*	1.65	1.65	1.00	1.72	2.65	4.38
9.	*Flemingia strobilifera*	1.65	1.65	1.00	1.72	2.65	4.38
10.	*Ziziphus oenoplia*	1.65	1.65	1.00	1.72	2.65	4.38
11.	*Ampelocissus latifolia*	0.55	0.55	1.00	0.57	0.88	1.46
12.	*Indigofera cassioides*	0.55	0.55	1.00	0.57	0.88	1.46
13.	*Jasminum coarctatum*	0.55	0.55	1.00	0.57	0.88	1.46
14.	*Jasminum multiflorum*	0.55	0.55	1.00	0.57	0.88	1.46
15.	*Smilax zeylanica*	0.55	0.55	1.00	0.57	0.88	1.46
Stand density: 95.6/100m2; Simpson's index (λ) = 0.326; Shannon-Wiener index (H')=1.667 Buza and Gibson's evenness index (E)=0.62							

Annexure 4.13

Phyto-sociological characteristics of Herbs in the core area of PEKB, Parsa, Kente Extension and Tara coal blocks in Hasdeo-Arand Coalfield falls within Surguja and Surajpur districts of Chhattisgarh

S.No	Name of the species	D	F	A	RD	RF	IVI
1.	*Elephantopus scaber*	78.57	30.22	2.60	22.45	29.10	51.55
2.	*Evolvulus nummularius*	113.74	12.64	9.00	32.50	12.17	44.67
3.	*Sida cordata*	41.76	16.48	2.53	11.93	15.87	27.80
4.	*Rungia pectinata*	37.91	7.14	5.31	10.83	6.88	17.71
5.	*Eragrostis ciliaris*	14.29	4.95	2.89	4.08	4.76	8.84
6.	*Vernonia cinerea*	8.79	5.49	1.60	2.51	5.29	7.80
7.	*Scleria lithosperma*	12.09	3.85	3.14	3.45	3.70	7.16
8.	*Bothriochloa pertusa*	9.34	2.20	4.25	2.67	2.12	4.79
9.	*Aristida adscensionis*	7.14	2.20	3.25	2.04	2.12	4.16
10.	*Cajanus scarabaeoides*	2.75	2.75	1.00	0.78	2.65	3.43
11.	*Sida cordifolia*	4.40	2.20	2.00	1.26	2.12	3.37
12.	*Evolvulu salsinoides*	3.30	2.20	1.50	0.94	2.12	3.06
13.	*Curculigo orchioides*	2.20	2.20	1.00	0.63	2.12	2.74
14.	*Hemigraphis latebrosa*	1.65	1.65	1.00	0.47	1.59	2.06
15.	*Spermacoce hispida*	1.65	1.65	1.00	0.47	1.59	2.06
16.	*Cyperus iria*	1.10	1.10	1.00	0.31	1.06	1.37
17.	*Lepidagathis fasciculata*	1.10	1.10	1.00	0.31	1.06	1.37
18.	*Alysicarpus monilifer*	2.20	0.55	4.00	0.63	0.53	1.16
19.	*Cyperus rotundus*	1.65	0.55	3.00	0.47	0.53	1.00
20.	*Achyranthes aspera*	1.10	0.55	2.00	0.31	0.53	0.84
21.	*Barleria cristata*	1.10	0.55	2.00	0.31	0.53	0.84
22.	*Crotalaria evolvuloides*	1.10	0.55	2.00	0.31	0.53	0.84
23.	*Andrographis paniculata*	0.55	0.55	1.00	0.16	0.53	0.69
24.	*Heteropogon contortus*	0.55	0.55	1.00	0.16	0.53	0.69
Stand density: 350/100 m^2; Simpson's index (λ) = 0.187; Shannon-Wiener index H')=2.1 Buza and Gibson's evenness index (E)= 0.66							

Annexure 4.14

Phyto-sociological characteristics of Trees in buffer area of PEKB, Parsa, Kente Extension and Tara coal blocks in Hasdeo-Arand Coalfield falls within Surguja and Surajpur districts of Chhattisgarh

S. No	Name of the species	D	F	A	RD	RF	TBA	RBA	IVI
1.	*Shorea robusta*	154.29	80.00	1.93	28.80	28.14	88239.50	63.12	120.06
2.	*Madhuca longifolia* var *latifolia*	148.57	54.29	2.74	27.73	19.10	16032.74	11.47	58.30
3.	*Diospyros melanoxylon*	95.71	50.00	1.91	17.87	17.59	7451.26	5.33	40.78
4.	*Buchanania lanzan*	44.29	30.00	1.48	8.27	10.55	3742.03	2.68	21.50
5.	*Lagerstroemia parviflora*	42.86	22.86	1.88	8.00	8.04	3273.89	2.34	18.38
6.	*Anogeissu slatifolia*	10.00	10.00	1.00	1.87	3.52	7858.25	5.62	11.01
7.	*Terminali aelliptica*	8.57	8.57	1.00	1.60	3.02	4190.03	3.00	7.61
8.	*Boswellia serrata*	5.71	5.71	1.00	1.07	2.01	4262.04	3.05	6.13
9.	*Terminalia chebula*	2.86	2.86	1.00	0.53	1.01	1701.99	1.22	2.76
10.	*Pterocarpus marsupium*	2.86	2.86	1.00	0.53	1.01	723.89	0.52	2.06
11.	*Semecarpus anacardium*	2.86	2.86	1.00	0.53	1.01	644.03	0.46	2.00
12.	*Syzygium cumini*	1.43	1.43	1.00	0.27	0.50	1127.47	0.81	1.58
13.	*Casearia graveolens*	2.86	2.86	1.00	0.53	1.01	38.38	0.03	1.57
14.	*Cassia fistula*	2.86	2.86	1.00	0.53	1.01	48.81	0.03	1.57
15.	*Holarrhena pubescens*	2.86	2.86	1.00	0.53	1.01	47.44	0.03	1.57
16.	*Albizia odorattisima*	4.29	1.43	3.00	0.80	0.50	245.39	0.18	1.48
17.	*Careya arborea*	1.43	1.43	1.00	0.27	0.50	133.84	0.10	0.86
18.	*Grewia optiva*	1.43	1.43	1.00	0.27	0.50	38.54	0.03	0.80
Stand density 535.71ind/ha; Stand basal area =13.98 m^2/ha Simpson's index (λ) = 0.206; Shannon-Wiener index (H')=1.872 Buza and Gibson's evenness index (E)=0.65									

Annexure 4.15

Phyto-sociological characteristics of shrubs in buffer area of PEKB, Parsa, Kente Extension and Tara coal blocks in Hasdeo-Arand Coalfield falls within Surguja and Surajpur districts of Chhattisgarh

S. No	Name of the species	D	F	A	RD	RF	IVI
1.	*Phoenix loureiroi*	5.44	28.00	1.68	44.76	16.09	60.85
2.	*Ichnocarpus frutescens*	1.74	11.00	1.36	14.29	6.32	20.61
3.	*Hemidesmus indicus*	1.50	7.00	1.86	12.38	4.02	16.40
4.	*Sida cordifolia*	0.81	5.00	1.40	6.66	2.87	9.54
5.	*Flemingia chapper*	0.93	2.00	4.00	7.62	1.15	8.77
6.	*Leea asiatica*	0.58	3.00	1.67	4.76	1.72	6.49
7.	*Ampelocissus latifolia*	0.35	2.00	1.50	2.86	1.15	4.01
8.	*Flemingia strobilifera*	0.23	2.00	1.00	1.90	1.15	3.05
9.	*Indigofera cassioides*	0.23	2.00	1.00	1.90	1.15	3.05
10.	*Asparagus racemosus*	0.12	1.00	1.00	0.95	0.57	1.53
11.	*Cryptolepis buchananii*	0.12	1.00	1.00	0.95	0.57	1.53
12.	*Desmodium gangeticum*	0.12	1.00	1.00	0.95	0.57	1.53
Stand density: 12.17 ind/100 m^2; Simpson's index (λ) = 0.25; Shannon-Wiener index (H')=1.8 Buza and Gibson's evenness index (E)=0.72							

Annexure 4.16

Phytosociological characteristics of herbs in buffer area of PEKB , Parsa, Kente Extension and Tara coal blocks in Hasdeo-Arand Coalfield falls within Surguja and Surajpur districts of Chhattisgarh

S.No	Name of the species	D	F	A	RD	RF	IVI
1.	*Desmodium triflorum*	377.00	28.00	13.46	12.34	5.545	17.9
2.	*Phyllanthus urenaria*	245.00	20.00	12.25	8.02	3.96	12.0
3.	*Elephantopus scaber*	100.00	33.00	3.03	3.273	6.535	9.81
4.	*Rungia pectinata*	180.00	18.00	10.00	5.892	3.564	9.46
5.	*Lindernia crustacea*	129.00	16.00	8.06	4.223	3.168	7.39
6.	*Lindernia ciliata*	113.00	11.00	10.27	3.699	2.178	5.88
7.	*Spermacoce pusilla*	109.00	10.00	10.90	3.568	1.98	5.55
8.	*Ageratum conyzoides*	113.00	9.00	12.56	3.699	1.782	5.48
9.	*Evolvulus nummularius*	63.00	16.00	3.94	2.062	3.168	5.23
10.	*Justicia glauca*	91.00	10.00	9.10	2.979	1.98	4.96
11.	*Curculigo orchioides*	34.00	18.00	1.89	1.113	3.564	4.68
12.	*Biophytum reinwardtii*	90.00	8.00	11.25	2.946	1.584	4.53
13.	*Sida cordata*	44.00	14.00	3.14	1.44	2.772	4.21
14.	*Oldenlandia corymbosa*	80.00	6.00	13.33	2.619	1.188	3.81
15.	*Cheilanthus farinosa*	65.00	8.00	8.13	2.128	1.584	3.71
16.	*Vernonia cinerea*	21.00	15.00	1.40	0.687	2.97	3.66
17.	*Kyllinga nemoralis*	47.00	9.00	5.22	1.538	1.782	3.32
18.	*Selaginella* sp.	62.00	5.00	12.40	2.029	0.99	3.02
19.	*Scleria lithosperma*	43.00	8.00	5.38	1.408	1.584	2.99
20.	*Cyanotis cristata*	34.00	8.00	4.25	1.113	1.584	2.7
21.	*Zornea gibbosa*	39.00	7.00	5.57	1.277	1.386	2.66
22.	*Crotalaria evolvuloides*	26.00	9.00	2.89	0.851	1.782	2.63
23.	*Ophioglosum reticulatum*	54.00	4.00	13.50	1.768	0.792	2.56
24.	*Spermacoce articularis*	34.00	7.00	4.86	1.113	1.386	2.5
25.	*Eragrostis ciliaris*	21.00	8.00	2.63	0.687	1.584	2.27
26.	*Murdannia nudiflora*	31.00	6.00	5.17	1.015	1.188	2.2
27.	*Cyperus iria*	39.00	4.00	9.75	1.277	0.792	2.07
28.	*Cyperus niveus*	19.00	7.00	2.71	0.622	1.386	2.01
29.	*Becopa floribunda*	50.00	1.00	50.00	1.637	0.198	1.83
30.	*Sporobolus indicus*	22.00	5.00	4.40	0.72	0.99	1.71
31.	*Mitracarpus hirtus*	26.00	4.00	6.50	0.851	0.792	1.64
32.	*Oplismenus burmannii*	32.00	2.00	16.00	1.047	0.396	1.44
33.	*Spermacoce ocymoides*	30.00	2.00	15.00	0.982	0.396	1.38
34.	*Themeda triandra*	35.00	1.00	35.00	1.146	0.198	1.34
35.	*Debia ovatifolia*	22.00	3.00	7.33	0.72	0.594	1.31
36.	*Adenosma indiana*	26.00	2.00	13.00	0.851	0.396	1.25
37.	*Digitaria ciliaris*	14.00	4.00	3.50	0.458	0.792	1.25
38.	*Triumfetta rhomboidea*	14.00	4.00	3.50	0.458	0.792	1.25
39.	*Launaea nudicaulis*	13.00	4.00	3.25	0.426	0.792	1.22
40.	*Adiantum philippense*	25.00	2.00	12.50	0.818	0.396	1.21
41.	*Dioscorea bulbifera*	6.00	5.00	1.20	0.196	0.99	1.19
42.	*Emilia sonchifolia*	6.00	5.00	1.20	0.196	0.99	1.19
43.	*Chloris dolichostachya*	23.00	2.00	11.50	0.753	0.396	1.15
44.	*Setaria pumila*	17.00	3.00	5.67	0.556	0.594	1.15
45.	*Commalina diffusa*	10.00	4.00	2.50	0.327	0.792	1.12
46.	*Murdannia spirata*	10.00	4.00	2.50	0.327	0.792	1.12
47.	*Scoparia dulcis*	9.00	4.00	2.25	0.295	0.792	1.09
48.	*Corchorus aestuans*	14.00	3.00	4.67	0.458	0.594	1.05
49.	*Evolvulus alsinoides*	7.00	4.00	1.75	0.229	0.792	1.02
50.	*Byttneria herbacea*	12.00	3.00	4.00	0.393	0.594	0.99
51.	*Fimbristylis* sp.	18.00	2.00	9.00	0.589	0.396	0.99

S.No	Name of the species	D	F	A	RD	RF	IVI
52.	*Kyllinga bulbosa*	5.00	4.00	1.25	0.164	0.792	0.96
53.	*Mitrasacme pygmaea*	16.00	2.00	8.00	0.524	0.396	0.92
54.	*Spermacoce hispida*	4.00	4.00	1.00	0.131	0.792	0.92
55.	*Hyptis suaviolens*	21.00	1.00	21.00	0.687	0.198	0.89
56.	*Eragrostis unioloides*	8.00	3.00	2.67	0.262	0.594	0.86
57.	*Senna tora*	8.00	3.00	2.67	0.262	0.594	0.86
58.	*Blumea flava*	14.00	2.00	7.00	0.458	0.396	0.85
59.	*Biophytumum braculum*	12.00	2.00	6.00	0.393	0.396	0.79
60.	*Canscora diffusa*	11.00	2.00	5.50	0.36	0.396	0.76
61.	*Phyllanthus rheedei*	5.00	3.00	1.67	0.164	0.594	0.76
62.	*Phyllanthus virgatus*	5.00	3.00	1.67	0.164	0.594	0.76
63.	*Pityrogramma calomelanos*	9.00	2.00	4.50	0.295	0.396	0.69
64.	*Stylidium tenellum*	14.00	1.00	14.00	0.458	0.198	0.66
65.	*Andrographis paniculata*	7.00	2.00	3.50	0.229	0.396	0.63
66.	*Vicoa indica*	13.00	1.00	13.00	0.426	0.198	0.62
67.	*Acrocephalus hispidus*	6.00	2.00	3.00	0.196	0.396	0.59
68.	*Imperata cylindrica*	6.00	2.00	3.00	0.196	0.396	0.59
69.	*Alysicarpus monilifer*	4.00	2.00	2.00	0.131	0.396	0.53
70.	*Chrysopogon fulvus*	10.00	1.00	10.00	0.327	0.198	0.53
71.	*Cyperus compressus*	4.00	2.00	2.00	0.131	0.396	0.53
72.	*Dioscorea oppositifolia*	4.00	2.00	2.00	0.131	0.396	0.53
73.	*Eragrostis pilosa*	10.00	1.00	10.00	0.327	0.198	0.53
74.	*Premna herbacea*	4.00	2.00	2.00	0.131	0.396	0.53
75.	*Sacciolepis indica*	4.00	2.00	2.00	0.131	0.396	0.53
76.	*Canscora pauciflora*	3.00	2.00	1.50	0.098	0.396	0.49
77.	*Crotalaria linifolia*	3.00	2.00	1.50	0.098	0.396	0.49
78.	*Desmodium velutinum*	3.00	2.00	1.50	0.098	0.396	0.49
79.	*Blumea oxyodonta*	2.00	2.00	1.00	0.065	0.396	0.46
80.	*Cajanus scarabaeoides*	2.00	2.00	1.00	0.065	0.396	0.46
81.	*Chlorophytum arundinaceum*	2.00	2.00	1.00	0.065	0.396	0.46
82.	*Cissampelo spareira*	2.00	2.00	1.00	0.065	0.396	0.46
83.	*Digitaria stricta*	2.00	2.00	1.00	0.065	0.396	0.46
84.	*Eragrostiella bifaria*	8.00	1.00	8.00	0.262	0.198	0.46
85.	*Sida rhombifolia*	2.00	2.00	1.00	0.065	0.396	0.46
86.	*Urena sinuata*	2.00	2.00	1.00	0.065	0.396	0.46
87.	*Phyllanthus amarus*	6.00	1.00	6.00	0.196	0.198	0.39
88.	*Alloteropsis cimicina*	5.00	1.00	5.00	0.164	0.198	0.36
89.	*Mitrasacme indica*	5.00	1.00	5.00	0.164	0.198	0.36
90.	*Oldenlandia herbacea*	5.00	1.00	5.00	0.164	0.198	0.36
91.	*Barleria cristata*	4.00	1.00	4.00	0.131	0.198	0.33
92.	*Hackelochloa granularis*	4.00	1.00	4.00	0.131	0.198	0.33
93.	*Aristida adscensionis*	3.00	1.00	3.00	0.098	0.198	0.3
94.	*Digitaria abludens*	3.00	1.00	3.00	0.098	0.198	0.3
95.	*Heteropogon contortus*	3.00	1.00	3.00	0.098	0.198	0.3
96.	*Ipomoea pes-trigridis*	3.00	1.00	3.00	0.098	0.198	0.3
97.	*Alysicarpus vaginalis*	2.00	1.00	2.00	0.065	0.198	0.26
98.	*Arthraxon lancifolius*	2.00	1.00	2.00	0.065	0.198	0.26
99.	*Bulbophyllum* sp.	2.00	1.00	2.00	0.065	0.198	0.26
100.	*Dimeria ornithopoda*	2.00	1.00	2.00	0.065	0.198	0.26
101.	*Equisetum diffusum*	2.00	1.00	2.00	0.065	0.198	0.26
102.	*Rhynchospora wightiana*	2.00	1.00	2.00	0.065	0.198	0.26
103.	*Tripogon jacquemontii*	2.00	1.00	2.00	0.065	0.198	0.26
104.	*Anisomeles indica*	1.00	1.00	1.00	0.033	0.198	0.23
105.	*Aristida setacea*	1.00	1.00	1.00	0.033	0.198	0.23
106.	*Arthraxon hispidus*	1.00	1.00	1.00	0.033	0.198	0.23
107.	*Brachiaria ramosa*	1.00	1.00	1.00	0.033	0.198	0.23
108.	*Chamaecrista mimosoides*	1.00	1.00	1.00	0.033	0.198	0.23

S.No	Name of the species	D	F	A	RD	RF	IVI
109.	*Crotalaria juncea*	1.00	1.00	1.00	0.033	0.198	0.23
110.	*Cyperus cyprenus*	1.00	1.00	1.00	0.033	0.198	0.23
111.	*Cyperus rotundus*	1.00	1.00	1.00	0.033	0.198	0.23
112.	*Digitaria longiflora*	1.00	1.00	1.00	0.033	0.198	0.23
113.	*Dioscorea belophylla*	1.00	1.00	1.00	0.033	0.198	0.23
114.	*Drimia indica*	1.00	1.00	1.00	0.033	0.198	0.23
115.	*Drosera burmannii*	1.00	1.00	1.00	0.033	0.198	0.23
116.	*Drosera indica*	1.00	1.00	1.00	0.033	0.198	0.23
117.	*Eriocaulon* sp.	1.00	1.00	1.00	0.033	0.198	0.23
118.	*Hybanthus enneaspermus*	1.00	1.00	1.00	0.033	0.198	0.23
119.	*Indoneesiella echioides*	1.00	1.00	1.00	0.033	0.198	0.23
120.	*Iphiginia indica*	1.00	1.00	1.00	0.033	0.198	0.23
121.	*Murdannia edulis*	1.00	1.00	1.00	0.033	0.198	0.23
122.	*Paspalidium flavidum*	1.00	1.00	1.00	0.033	0.198	0.23
123.	*Utricularia* sp.	1.00	1.00	1.00	0.033	0.198	0.23
124.	*Vigna trilobata*	1.00	1.00	1.00	0.033	0.198	0.23
Stand density: 3055 ind/100m^2; ; Simpson's index (λ) =0.039; Shannon-Wiener index (H')=3.83 Buza and Gibson's evenness index (E)=0.79							

Annexure 4.17

Phyto-sociological characteristics of Trees and woody climbers in core areas of all coal blocks in Hasdeo-Arand Coalfield falls within Korba, Surguja and Surajpur districts of Chhattisgarh

S.N	Name of the species	D	F	A	RD	RF	TBA	RBA	IVI
1.	*Shorea robusta*	196.19	78.75	2.49	32.73	23.65	349389.75	47.80	104.18
2.	*Diospyros melanoxylon*	98.09	46.32	2.12	16.36	13.91	81744.19	11.18	41.46
3.	*Madhuca longifolia var. latifolia*	86.38	44.69	1.93	14.41	13.42	78135.59	10.69	38.52
4.	*Buchanania lanzan*	40.05	29.70	1.35	6.68	8.92	22070.14	3.02	18.62
5.	*Terminalia elliptica*	27.52	17.71	1.55	4.59	5.32	32304.54	4.42	14.33
6.	*Anogeissus latifolia*	18.53	15.80	1.17	3.09	4.75	35520.62	4.86	12.70
7.	*Lagerstroemia parviflora*	19.89	12.81	1.55	3.32	3.85	8875.48	1.21	8.38
8.	*Boswellia serrata*	8.45	7.36	1.15	1.41	2.21	29132.17	3.99	7.60
9.	*Semecarpus anacardium*	9.54	8.45	1.13	1.59	2.54	13177.95	1.80	5.93
10.	*Terminalia chebula*	7.08	6.27	1.13	1.18	1.88	8666.56	1.19	4.25
11.	*Casearia graveolens*	9.26	7.08	1.31	1.55	2.13	1453.82	0.20	3.87
12.	*Croton persimilis*	9.26	6.27	1.48	1.55	1.88	1439.65	0.20	3.62
13.	*Pterocarpus marsupium*	4.63	4.09	1.13	0.77	1.23	7652.95	1.05	3.05
14.	*Woodfordia fruticosa*	8.72	3.81	2.29	1.45	1.15	950.08	0.13	2.73
15.	*Dalbergia paniculata*	2.45	1.91	1.29	0.41	0.57	10482.72	1.43	2.42
16.	*Syzygium nervosam*	3.27	2.72	1.20	0.55	0.82	5176.59	0.71	2.07
17.	*Holarrhena pubescens*	4.63	3.81	1.21	0.77	1.15	1055.25	0.14	2.06
18.	*Symplocos racemosa*	5.45	3.27	1.67	0.91	0.98	1096.74	0.15	2.04
19.	*Lannea coromandelica*	3.27	2.72	1.20	0.55	0.82	3559.16	0.49	1.85
20.	*Cassia fistula*	3.81	3.00	1.27	0.64	0.90	1997.69	0.27	1.81
21.	*Syzygium cumini*	3.81	3.54	1.08	0.64	1.06	390.13	0.05	1.75
22.	*Phyllanthus emblica*	3.00	2.72	1.10	0.50	0.82	1796.50	0.25	1.56
23.	*Ceriscoides turgida*	3.00	2.45	1.22	0.50	0.74	1074.62	0.15	1.38
24.	*Haldina cordifolia*	1.63	1.09	1.50	0.27	0.33	5583.76	0.76	1.36
25.	*Syzygium* sp.	0.54	0.54	1.00	0.09	0.16	7697.85	1.05	1.31
26.	*Gardenia resinifera*	3.27	2.18	1.50	0.55	0.65	444.35	0.06	1.26
27.	*Flacourtia indica*	2.45	1.91	1.29	0.41	0.57	664.33	0.09	1.07
28.	*Schleichera oleosa*	2.18	1.09	2.00	0.36	0.33	2499.04	0.34	1.03
29.	*Dalbergia latifolia*	0.54	0.54	1.00	0.09	0.16	5308.36	0.73	0.98
30.	*Careya arborea*	1.63	1.63	1.00	0.27	0.49	1256.29	0.17	0.94
31.	*Miliusa tomentosa*	1.36	1.36	1.00	0.23	0.41	2150.72	0.29	0.93
32.	*Ougeinia oojeinensis*	0.82	0.82	1.00	0.14	0.25	2649.76	0.36	0.74

S.N	Name of the species	D	F	A	RD	RF	TBA	RBA	IVI
33.	*Terminalia bellirica*	0.54	0.54	1.00	0.09	0.16	2727.39	0.37	0.63
34.	*Butea monosperma*	1.36	1.09	1.25	0.23	0.33	468.07	0.06	0.62
35.	*Chloroxylon swietenia*	1.09	0.82	1.33	0.18	0.25	825.96	0.11	0.54
36.	*Gardenia gummifera*	1.09	0.82	1.33	0.18	0.25	177.15	0.02	0.45
37.	*Rhus* sp.	1.09	0.54	2.00	0.18	0.16	104.62	0.01	0.36
38.	*Gardenia latifolia*	0.54	0.54	1.00	0.09	0.16	46.02	0.01	0.26
39.	*Diospyros montana*	0.82	0.27	3.00	0.14	0.08	59.32	0.01	0.23
40.	*Albizia procera*	0.27	0.27	1.00	0.05	0.08	630.65	0.09	0.21
41.	*Acacia caesia*	0.54	0.27	2.00	0.09	0.08	49.76	0.01	0.18
42.	*Bombax ceiba*	0.27	0.27	1.00	0.05	0.08	140.45	0.02	0.15
43.	*Cassine glauca*	0.27	0.27	1.00	0.05	0.08	183.44	0.03	0.15
44.	*Glochidion zeylanica*	0.27	0.27	1.00	0.05	0.08	62.42	0.01	0.14
45.	*Ziziphus oenoplea*	0.27	0.27	1.00	0.05	0.08	76.51	0.01	0.14
46.	*Bridelia retusa*	0.27	0.27	1.00	0.05	0.08	20.38	0.00	0.13
Stand density: 599.46 ind/ha; Stand basal area= 19.92 m^2/ha Simpson's index (λ) = 0.1650; Shannon-Wiener index (H')= 2.403 Buza and Gibson's evenness index (E)=0.63									

Annexure 4.18

Phyto-sociological Characteristics of shrubs and climbing shrubs in core areas of all blocks in Hasdeo-Arand Coalfield falls within Korba, Surguja and Surajpur districts of Chhattisgarh

S. No	Name of the species	D	F	A	RD	RF	IVI
1.	*Phoenix loureiroi*	18.89	116.00	1.47	15.65	19.93	35.59
2.	*Hemidesmus indicus*	13.56	90.00	1.36	11.23	15.46	26.70
3.	*Dioscorea bulbifera*	16.00	70.00	2.06	13.26	12.03	25.29
4.	*Ichnocarpus frutescens*	7.78	52.00	1.35	6.45	8.93	15.38
5.	*Holostemma ada-kodien*	14.00	12.00	10.50	11.60	2.06	13.66
6.	*Flemingia strobilifera*	6.89	38.00	1.63	5.71	6.53	12.24
7.	*Ampelocissus latifolia*	4.44	22.00	1.82	3.68	3.78	7.46
8.	*Cissampelos pareira*	4.00	22.00	1.64	3.31	3.78	7.09
9.	*Barleria cristata*	3.33	20.00	1.50	2.76	3.44	6.20
10.	*Desmodium pulchellum*	6.44	4.00	14.50	5.34	0.69	6.03
11.	*Desmodium gangeticum*	2.89	14.00	1.86	2.39	2.41	4.80
12.	*Cissus repanda*	2.22	10.00	2.00	1.84	1.72	3.56
13.	*Senna tora*	2.44	6.00	3.67	2.03	1.03	3.06
14.	*Waltheria indica*	1.56	8.00	1.75	1.29	1.37	2.66
15.	*Smilax perfoliata*	1.11	8.00	1.25	0.92	1.37	2.30
16.	*Smilax zeylanica*	1.11	8.00	1.25	0.92	1.37	2.30
17.	*Corchorus capsularis*	2.22	2.00	10.00	1.84	0.34	2.19
18.	*Leea asiatica*	0.89	8.00	1.00	0.74	1.37	2.11
19.	*Flamingia chapper*	0.89	6.00	1.33	0.74	1.03	1.77
20.	*Jasminum coarctatum*	1.11	4.00	2.50	0.92	0.69	1.61
21.	*Jasminum multiflorum*	0.67	6.00	1.00	0.55	1.03	1.58
22.	*Dioscorea belophylla*	0.67	4.00	1.50	0.55	0.69	1.24
23.	*Eranthemum roseum*	0.67	4.00	1.50	0.55	0.69	1.24
24.	*Indigofera cassioides*	0.67	4.00	1.50	0.55	0.69	1.24
25.	*Jatropha gossypifolia*	0.89	2.00	4.00	0.74	0.34	1.08
26.	*Asparagus racemosus*	0.44	4.00	1.00	0.37	0.69	1.06
27.	*Marsdenia tenacissima*	0.44	4.00	1.00	0.37	0.69	1.06
28.	*Pueraria tuberosa*	0.44	4.00	1.00	0.37	0.69	1.06
29.	*Thespesia lampas*	0.44	4.00	1.00	0.37	0.69	1.06
30.	*Dioscorea hispida*	0.44	2.00	2.00	0.37	0.34	0.71
31.	*Flemingia semialata*	0.44	2.00	2.00	0.37	0.34	0.71
32.	*Grewia hirsuta*	0.44	2.00	2.00	0.37	0.34	0.71
33.	*Ampelocissus tomentosus*	0.22	2.00	1.00	0.18	0.34	0.53
34.	*Aristolochia indica*	0.22	2.00	1.00	0.18	0.34	0.53

S. No	Name of the species	D	F	A	RD	RF	IVI
35.	*Cassytha filiformis*	0.22	2.00	1.00	0.18	0.34	0.53
36.	*Cayratia pedata*	0.22	2.00	1.00	0.18	0.34	0.53
37.	*Dioscorea oppositifolia*	0.22	2.00	1.00	0.18	0.34	0.53
38.	*Dioscorea tomentosa*	0.22	2.00	1.00	0.18	0.34	0.53
39.	*Embelia tsjeriam-cottam*	0.22	2.00	1.00	0.18	0.34	0.53
40.	*Gmelina asiatica*	0.22	2.00	1.00	0.18	0.34	0.53
41.	*Grewia rothii*	0.22	2.00	1.00	0.18	0.34	0.53
42.	*Helicteres isora*	0.22	2.00	1.00	0.18	0.34	0.53
Stand density: 120.67 ind/100m^2; Simpson's index (λ) = 0.084; Shannon-Wiener index (H')= 2.868; Buza and Gibson's evenness index (E)=0.63							

Annexure 4.19

Phyto-sociological Characteristics of Herbs in core areas of all blocks in Hasdeo-Arand Coalfield falls within Korba, Surguja and Surajpur districts of Chhattisgarh

S. No	Name of the species	D	F	A	RD	RF	IVI
1.	*Elephantopus scaber*	112.72	30.70	3.67	4.32	7.93	12.25
2.	*Desmodium triflorum*	216.23	12.72	17.00	8.28	3.29	11.57
3.	*Rungia pectinata*	180.26	15.35	11.74	6.91	3.97	10.87
4.	*Evolvulus nummularius*	110.75	16.89	6.56	4.24	4.36	8.61
5.	*Phyllanthus urinaria*	110.31	12.50	8.82	4.23	3.23	7.46
6.	*Justicia quinqueangularis*	120.39	6.80	17.71	4.61	1.76	6.37
7.	*Lindernia ciliata*	92.76	10.75	8.63	3.55	2.78	6.33
8.	*Sida cordata*	47.37	15.35	3.09	1.81	3.97	5.78
9.	*Curculigo orchioides*	51.97	14.47	3.59	1.99	3.74	5.73
10.	*Biophytum reinwardtii*	85.96	8.99	9.56	3.29	2.32	5.62
11.	*Lindernia crustacea*	75.88	8.33	9.11	2.91	2.15	5.06
12.	*Ageratum conyzoides*	71.05	7.46	9.53	2.72	1.93	4.65
13.	*Cyanotis cristata*	58.33	9.21	6.33	2.23	2.38	4.61
14.	*Oplismenus burmannii*	68.86	4.39	15.70	2.64	1.13	3.77
15.	*Spermacoce pusilla*	52.63	5.48	9.60	2.02	1.42	3.43
16.	*Selaginella* sp.	61.40	3.95	15.56	2.35	1.02	3.37
17.	*Adenosma indiana*	70.18	1.75	40.00	2.69	0.45	3.14
18.	*Murdannia spirata*	27.85	7.02	3.97	1.07	1.81	2.88
19.	*Zornia gibbosa*	35.31	5.70	6.19	1.35	1.47	2.83
20.	*Evolvulus alsinoides*	20.61	6.58	3.13	0.79	1.70	2.49
21.	*Cheilanthus farinosa*	41.01	3.07	13.36	1.57	0.79	2.36
22.	*Spermacoce ocymoides*	33.77	3.95	8.56	1.29	1.02	2.31
23.	*Kyllinga nemoralis*	33.55	3.51	9.56	1.29	0.91	2.19
24.	*Mitracarpu shirtus*	34.87	3.29	10.60	1.34	0.85	2.19
25.	*Setaria pumila*	25.88	4.17	6.21	0.99	1.08	2.07
26.	*Phyllanthus rheedii*	26.75	3.95	6.78	1.02	1.02	2.04
27.	*Vernonia cinerea*	10.96	6.14	1.79	0.42	1.59	2.01
28.	*Torenia indica*	29.82	3.07	9.71	1.14	0.79	1.94
29.	*Bothriochloa pertusa*	35.53	2.19	16.20	1.36	0.57	1.93
30.	*Justicia glauca*	38.60	1.75	22.00	1.48	0.45	1.93
31.	*Murdannia nudiflora*	20.61	4.39	4.70	0.79	1.13	1.92
32.	*Acrocephalus indicus*	19.74	3.95	5.00	0.76	1.02	1.78
33.	*Ophioglossum reticulatum*	27.19	2.63	10.33	1.04	0.68	1.72
34.	*Mitrasacme pygmaea*	30.70	1.97	15.56	1.18	0.51	1.69
35.	*Eragrostis ciliaris*	13.60	4.39	3.10	0.52	1.13	1.65
36.	*Debia ovatifolia*	19.08	3.51	5.44	0.73	0.91	1.64
37.	*Cajanus scarabaeoides*	6.36	4.82	1.32	0.24	1.25	1.49
38.	*Spermacoce articularis*	14.91	3.51	4.25	0.57	0.91	1.48
39.	*Eragrostiella bifaria*	24.78	1.97	12.56	0.95	0.51	1.46
40.	*Hackelochloa granularis*	15.57	2.63	5.92	0.60	0.68	1.28

S. No	Name of the species	D	F	A	RD	RF	IVI
41.	*Salomonia cantoniensis*	21.71	1.75	12.38	0.83	0.45	1.28
42.	*Orthosiphon pallidus*	21.93	1.54	14.29	0.84	0.40	1.24
43.	*Sporobolus indicus*	14.25	2.63	5.42	0.55	0.68	1.23
44.	*Aristida adscensionis*	9.43	3.29	2.87	0.36	0.85	1.21
45.	*Blumea flava*	18.20	1.97	9.22	0.70	0.51	1.21
46.	*Emilia sonchifolia*	12.28	2.85	4.31	0.47	0.74	1.21
47.	*Biophytum umbraculam*	12.06	2.85	4.23	0.46	0.74	1.20
48.	*Corchorus aestuans*	10.75	3.07	3.50	0.41	0.79	1.20
49.	*Cyperus niveus*	8.55	2.85	3.00	0.33	0.74	1.06
50.	*Crotalaria evolvuloides*	9.43	2.63	3.58	0.36	0.68	1.04
51.	*Cyperus iria*	9.87	2.41	4.09	0.38	0.62	1.00
52.	*Cyperus rotundus*	11.18	2.19	5.10	0.43	0.57	1.00
53.	*Spermacoce hispida*	5.48	2.85	1.92	0.21	0.74	0.95
54.	*Triumfetta rhomboidea*	6.80	2.63	2.58	0.26	0.68	0.94
55.	*Byttneria herbacea*	7.68	2.41	3.18	0.29	0.62	0.92
56.	*Cheilanthus* sp.	5.92	2.63	2.25	0.23	0.68	0.91
57.	*Andrographis paniculata*	5.04	2.63	1.92	0.19	0.68	0.87
58.	*Premna herbacea*	14.91	1.10	13.60	0.57	0.28	0.85
59.	*Commelina diffusa*	6.58	2.19	3.00	0.25	0.57	0.82
60.	*Imperata cylindrica*	7.68	1.97	3.89	0.29	0.51	0.80
61.	*Crotalaria alata*	4.17	2.41	1.73	0.16	0.62	0.78
62.	*Scleria lithosperma*	5.04	2.19	2.30	0.19	0.57	0.76
63.	*Sida cordifolia*	4.39	2.19	2.00	0.17	0.57	0.73
64.	*Eriocaulon* sp.	11.62	1.10	10.60	0.45	0.28	0.73
65.	*Arthraxon lancifolius*	8.33	1.54	5.43	0.32	0.40	0.72
66.	*Brachiaria ramosa*	6.58	1.75	3.75	0.25	0.45	0.71
67.	*Kyllinga bulbosa*	6.80	1.75	3.88	0.26	0.45	0.71
68.	*Oldenlandia herbacea*	9.21	1.32	7.00	0.35	0.34	0.69
69.	*Fimbristylis dichotoma*	3.73	1.75	2.13	0.14	0.45	0.60
70.	*Enteropogon dolichostachyus*	8.11	1.10	7.40	0.31	0.28	0.59
71.	*Spilanthes calva*	5.04	1.54	3.29	0.19	0.40	0.59
72.	*Scleria parvula*	4.82	1.54	3.14	0.18	0.40	0.58
73.	*Eragrostis unioloides*	6.14	1.32	4.67	0.24	0.34	0.58
74.	*Phyllanthus virgatus*	3.29	1.75	1.88	0.13	0.45	0.58
75.	*Digitarias tricta*	4.17	1.54	2.71	0.16	0.40	0.56
76.	*Oldenlandia corymbosa*	4.82	1.32	3.67	0.18	0.34	0.52
77.	*Launaea nudicaulis*	4.17	1.32	3.17	0.16	0.34	0.50
78.	*Sacciolepis indica*	2.85	1.32	2.17	0.11	0.34	0.45
79.	*Scoparia dulcis*	4.39	1.10	4.00	0.17	0.28	0.45
80.	*Heteropogon contortus*	1.97	1.32	1.50	0.08	0.34	0.42
81.	*Indoneesiella echioides*	3.51	1.10	3.20	0.13	0.28	0.42
82.	*Cyperus cyprenus*	2.19	1.32	1.67	0.08	0.34	0.42
83.	*Digitaria abludens*	3.51	1.10	3.20	0.13	0.28	0.42
84.	*Spermacoce latifolia*	7.89	0.44	18.00	0.30	0.11	0.42
85.	*Sida rhombifolia*	1.54	1.32	1.17	0.06	0.34	0.40
86.	*Dimeria ornithopoda*	7.68	0.22	35.00	0.29	0.06	0.35
87.	*Canscora diffusa*	2.19	0.88	2.50	0.08	0.23	0.31
88.	*Chamaecrista pumila*	2.19	0.88	2.50	0.08	0.23	0.31
89.	*Digitaria ciliaris*	3.73	0.66	5.67	0.14	0.17	0.31
90.	*Crotalaria juncea*	1.97	0.88	2.25	0.08	0.23	0.30
91.	*Chrysopogon fulvus*	4.61	0.44	10.50	0.18	0.11	0.29
92.	*Hemigraphis latebrosa*	1.54	0.88	1.75	0.06	0.23	0.29
93.	*Cyperus compressus*	2.85	0.66	4.33	0.11	0.17	0.28
94.	*Eragrostis tenella*	2.63	0.66	4.00	0.10	0.17	0.27
95.	*Crotalaria linifolia*	1.97	0.66	3.00	0.08	0.17	0.25
96.	*Mecardonia procumbens*	1.54	0.66	2.33	0.06	0.17	0.23
97.	*Alternanthera ficoidea*	1.10	0.66	1.67	0.04	0.17	0.21

⌒. No	Name of the species	D	F	A	RD	RF	IVI
98.	*Vigna vexillata*	1.10	0.66	1.67	0.04	0.17	0.21
99.	*Canscora decussata*	0.66	0.66	1.00	0.03	0.17	0.20
100.	*Fimbristylis ferruginea*	2.19	0.44	5.00	0.08	0.11	0.20
101.	*Flemingia nana*	0.88	0.66	1.33	0.03	0.17	0.20
102.	*Iphiginia indica*	0.66	0.66	1.00	0.03	0.17	0.20
103.	*Mitrasacme indica*	2.19	0.44	5.00	0.08	0.11	0.20
104.	*Stylidium tenellum*	3.73	0.22	17.00	0.14	0.06	0.20
105.	*Brachiaria reptans*	1.97	0.44	4.50	0.08	0.11	0.19
106.	*Bacopa floribunda*	1.54	0.44	3.50	0.06	0.11	0.17
107.	*Eragrostis pilosa*	1.54	0.44	3.50	0.06	0.11	0.17
108.	*Alysicarpu smonilifer*	1.32	0.44	3.00	0.05	0.11	0.16
109.	*Euphorbia hirta*	1.10	0.44	2.50	0.04	0.11	0.16
110.	*Habenaria diphylla*	1.10	0.44	2.50	0.04	0.11	0.16
111.	*Hyptis suaveolens*	1.10	0.44	2.50	0.04	0.11	0.16
112.	*Paspalidium punctatum*	1.32	0.44	3.00	0.05	0.11	0.16
113.	*Phaspalidum flavidum*	1.32	0.44	3.00	0.05	0.11	0.16
114.	*Drimia indica*	1.10	0.44	2.50	0.04	0.11	0.16
115.	*Vigna trilobata*	1.10	0.44	2.50	0.04	0.11	0.16
116.	*Bacilicum polystachyon*	2.19	0.22	10.00	0.08	0.06	0.14
117.	*Eragrostis nutans*	2.19	0.22	10.00	0.08	0.06	0.14
118.	*Murdannia edulis*	0.66	0.44	1.50	0.03	0.11	0.14
119.	*Paspalidium geminatum*	0.66	0.44	1.50	0.03	0.11	0.14
120.	*Microstachys chamaelea*	0.66	0.44	1.50	0.03	0.11	0.14
121.	*Urena sinuata*	0.66	0.44	1.50	0.03	0.11	0.14
122.	*Lepidagathis incurva*	0.44	0.44	1.00	0.02	0.11	0.13
123.	*Nepeta hindostana*	1.97	0.22	9.00	0.08	0.06	0.13
124.	*Alloteropsis cimicina*	0.44	0.44	1.00	0.02	0.11	0.13
125.	*Chlorophytum laxum*	0.44	0.44	1.00	0.02	0.11	0.13
126.	*Urochloa panicoides*	1.75	0.22	8.00	0.07	0.06	0.12
127.	*Habenaria plantaginea*	1.32	0.22	6.00	0.05	0.06	0.11
128.	*Lygodium flexuosum*	0.88	0.22	4.00	0.03	0.06	0.09
129.	*Cynodon dactylon*	0.66	0.22	3.00	0.03	0.06	0.08
130.	*Arundinella pumila*	0.66	0.22	3.00	0.03	0.06	0.08
131.	*Canscora pauciflora*	0.66	0.22	3.00	0.03	0.06	0.08
132.	*Fimbristylis umbellaris*	0.66	0.22	3.00	0.03	0.06	0.08
133.	*Rhynchosia rufescens*	0.66	0.22	3.00	0.03	0.06	0.08
134.	*Richardia scabra*	0.66	0.22	3.00	0.03	0.06	0.08
135.	*Achyranthes aspera*	0.44	0.22	2.00	0.02	0.06	0.07
136.	*Aristida setacea*	0.22	0.22	1.00	0.01	0.06	0.07
137.	*Crotalaria prostata*	0.44	0.22	2.00	0.02	0.06	0.07
138.	*Adiantum philippense*	0.22	0.22	1.00	0.01	0.06	0.07
139.	*Aerva lanata*	0.22	0.22	1.00	0.01	0.06	0.07
140.	*Arisaema* sp.	0.22	0.22	1.00	0.01	0.06	0.07
141.	*Blumea oxyodonta*	0.44	0.22	2.00	0.02	0.06	0.07
142.	*Chlorophytum arundinaceum*	0.44	0.22	2.00	0.02	0.06	0.07
143.	*Chlorophy tumtuberosum*	0.22	0.22	1.00	0.01	0.06	0.07
144.	*Commelina bengalensis*	0.44	0.22	2.00	0.02	0.06	0.07
145.	*Molineria trichocarpa*	0.22	0.22	1.00	0.01	0.06	0.07
146.	*Desmodium heterocarpon*	0.44	0.22	2.00	0.02	0.06	0.07
147.	*Drosera burmannii*	0.44	0.22	2.00	0.02	0.06	0.07
148.	*Eulophia epidendraea*	0.22	0.22	1.00	0.01	0.06	0.07
149.	*Euphorbia prostrata*	0.44	0.22	2.00	0.02	0.06	0.07
150.	*Fimbristylis quinquangularis*	0.22	0.22	1.00	0.01	0.06	0.07
151.	*Habenaria commelinifolia*	0.44	0.22	2.00	0.02	0.06	0.07
152.	*Hibiscus lobatus*	0.22	0.22	1.00	0.01	0.06	0.07
153.	*Indigofera nummularifolia*	0.44	0.22	2.00	0.02	0.06	0.07
154.	*Justicia diffusa*	0.44	0.22	2.00	0.02	0.06	0.07

S. No	Name of the species	D	F	A	RD	RF	IVI
155.	*Lindernia caespitosa*	0.22	0.22	1.00	0.01	0.06	0.07
156.	*Polygala chinensis*	0.22	0.22	1.00	0.01	0.06	0.07
157.	*Polygala erioptera*	0.22	0.22	1.00	0.01	0.06	0.07
158.	*Rhynchosia minima*	0.44	0.22	2.00	0.02	0.06	0.07
159.	*Rhynchospora wightiana*	0.44	0.22	2.00	0.02	0.06	0.07
160.	*Sida acuta*	0.44	0.22	2.00	0.02	0.06	0.07
161.	*Striga angustifolia*	0.22	0.22	1.00	0.01	0.06	0.07
162.	*Striga asiatica*	0.44	0.22	2.00	0.02	0.06	0.07
163.	*Tacca leontopetaloides*	0.22	0.22	1.00	0.01	0.06	0.07
164.	*Urania picta*	0.44	0.22	2.00	0.02	0.06	0.07
Stand density 2610.31ind/100m^2; Simpson's index (λ) = 0.0298; Shannon-Wiener index (H')=3.991 Buza and Gibson's evenness index (E)=0.78							

Annexure 4.20

Phyto-sociological characteristics of trees and woody climbers in buffer areas of all Coal Blocks in Hasdeo-Arand Coalfield falls within Korba, Surguja and Surajpur districts of Chhattisgarh

S.No	Name of the species	D	F	A	RD	RF	TBA	RBA	IVI
1.	*Shorea robusta*	249.25	81.4	3.06	27.39	17.92	244154.02	42.50	87.80
2.	*Diospyros melanoxylon*	121.11	58.8	2.06	13.31	12.94	52852.07	9.20	35.45
3.	*Madhuca longifolia* var. *latifolia*	95.48	45.2	2.11	10.49	9.96	50396.66	8.77	29.22
4.	*Buchanania lanzan*	84.42	44.7	1.89	9.28	9.85	16341.00	2.84	21.97
5.	*Lagerstroemia parviflora*	67.84	25.6	2.65	7.45	5.64	9093.47	1.58	14.68
6.	*Terminalia elliptica*	37.69	25.1	1.50	4.14	5.53	25910.27	4.51	14.18
7.	*Anogeissus latifolia*	26.63	20.1	1.33	2.93	4.42	33247.21	5.79	13.14
8.	*Boswellia serrata*	19.10	13.6	1.41	2.10	2.99	36841.88	6.41	11.50
9.	*Semecarpus anacardium*	33.67	21.1	1.60	3.70	4.65	13091.32	2.28	10.62
10.	*Casearia graveolens*	25.63	11.1	2.32	2.82	2.43	1608.20	0.28	5.53
11.	*Syzygium cumini*	11.06	6.03	1.83	1.21	1.33	13881.37	2.42	4.96
12.	*Terminalia chebula*	8.04	7.54	1.07	0.88	1.66	11138.06	1.94	4.48
13.	*Lannea coromandelica*	8.54	8.04	1.06	0.94	1.77	8351.91	1.45	4.16
14.	*Syzygium nervosum*	5.03	3.02	1.67	0.55	0.66	10483.20	1.82	3.04
15.	*Symplocos racemosa*	9.55	7.54	1.27	1.05	1.66	1557.72	0.27	2.98
16.	*Pterocarpus marsupium*	5.03	5.03	1.00	0.55	1.11	5301.91	0.92	2.58
17.	*Haldina cordifolia*	6.03	3.52	1.71	0.66	0.77	6561.23	1.14	2.58
18.	*Croton persimilis*	8.54	6.03	1.42	0.94	1.33	1360.11	0.24	2.50
19.	*Dalbergia latifolia*	4.02	3.52	1.14	0.44	0.77	6710.99	1.17	2.38
20.	*Cleistanthus collinus*	9.05	2.01	4.50	0.99	0.44	4616.64	0.80	2.24
21.	*Woodfordia fruticosa*	10.05	4.52	2.22	1.10	1.00	629.22	0.11	2.21
22.	*Holarrhena pubescens*	5.53	4.52	1.22	0.61	1.00	467.12	0.08	1.68
23.	*Butea monosperma*	4.52	4.02	1.13	0.50	0.88	1553.66	0.27	1.65
24.	*Cassia fistula*	5.03	4.52	1.11	0.55	1.00	348.49	0.06	1.61
25.	*Syzygium* sp.	4.52	3.02	1.50	0.50	0.66	1296.74	0.23	1.39
26.	*Careya arborea*	3.02	3.02	1.00	0.33	0.66	1710.19	0.30	1.29
27.	*Casearia tomentosa*	4.52	3.02	1.50	0.50	0.66	699.52	0.12	1.28
28.	*Schleichera oleosa*	2.01	2.01	1.00	0.22	0.44	2107.72	0.37	1.03
29.	*Cassine glauca*	2.51	2.51	1.00	0.28	0.55	242.28	0.04	0.87
30.	*Diospyros montana*	2.01	2.01	1.00	0.22	0.44	838.46	0.15	0.81
31.	*Gardenia gummifera*	3.02	2.01	1.50	0.33	0.44	131.93	0.02	0.80
32.	*Ficus religiosa*	0.50	0.5	1.00	0.06	0.11	3612.18	0.63	0.79
33.	*Ougeinia oojeinensis*	1.51	1.51	1.00	0.17	0.33	1162.18	0.20	0.70
34.	*Spatholobus parviflorus*	1.51	1.01	1.50	0.17	0.22	1759.00	0.31	0.69
35.	*Miliusa tomentosa*	2.01	1.51	1.33	0.22	0.33	313.85	0.05	0.61
36.	*Phyllanthus emblica*	2.01	1.51	1.33	0.22	0.33	144.19	0.03	0.58
37.	*Flacourtia indica*	1.51	1.51	1.00	0.17	0.33	148.49	0.03	0.52

S.No	Name of the species	D	F	A	RD	RF	TBA	RBA	IVI
38.	*Chloroxylon swietenia*	2.01	1.01	2.00	0.22	0.22	408.12	0.07	0.51
39.	*Celastrus paniculatus*	1.01	1.01	1.00	0.11	0.22	226.51	0.04	0.37
40.	*Gardenia latifolia*	1.01	1.01	1.00	0.11	0.22	96.89	0.02	0.35
41.	*Smilax perfoliata*	2.01	0.5	4.00	0.22	0.11	46.02	0.01	0.34
42.	*Stereospermum tetragonum*	1.01	0.5	2.00	0.11	0.11	558.36	0.10	0.32
43.	*Albiziaodorattisima*	1.51	0.5	3.00	0.17	0.11	245.54	0.04	0.32
44.	*Bridelia retusa*	0.50	0.5	1.00	0.06	0.11	812.18	0.14	0.31
45.	*Gardenia resinifera*	1.01	0.5	2.00	0.11	0.11	233.92	0.04	0.26
46.	*Bombax ceiba*	0.50	0.5	1.00	0.06	0.11	459.87	0.08	0.25
47.	*Acacia catechu*	1.01	0.5	2.00	0.11	0.11	80.97	0.01	0.24
48.	*Bauhinia racemosa*	1.01	0.5	2.00	0.11	0.11	43.39	0.01	0.23
49.	*Pterospermum xylocarpum*	1.01	0.5	2.00	0.11	0.11	46.66	0.01	0.23
50.	*Terminalia bellirica*	0.50	0.5	1.00	0.06	0.11	121.10	0.02	0.19
51.	*Antidesma ghaesembilla*	0.50	0.5	1.00	0.06	0.11	66.96	0.01	0.18
52.	*Grewia optiva*	0.50	0.5	1.00	0.06	0.11	81.53	0.01	0.18
53.	*Mitragyna parvifolia*	0.50	0.5	1.00	0.06	0.11	81.53	0.01	0.18
54.	*Albizia procera*	0.50	0.5	1.00	0.06	0.11	17.91	0.00	0.17
55.	*Dalbergia paniculata*	0.50	0.5	1.00	0.06	0.11	38.54	0.01	0.17
56.	*Ehretia leavis*	0.50	0.5	1.00	0.06	0.11	49.76	0.01	0.17
57.	*Nyctanthes arbor tristis*	0.50	0.5	1.00	0.06	0.11	11.46	0.00	0.17
58.	*Oroxylum indicum*	0.50	0.5	1.00	0.06	0.11	45.86	0.01	0.17
Stand density 910.55 ind/ ha; Stand basal area = 28.87 m^2/ha; Simpson's index (λ) = 0.124; Shannon-Wiener index (H')= 2.68; Buza and Gibson's evenness index (E)=0.66									

Annexure 4.21

Phyto-sociological characteristics of Shrubs and climbing shrubs in buffer areas of all Coal Blocks in Hasdeo-Arand Coalfield falls within Korba, Surguja and Surajpur districts of Chhattisgarh

S.No	Name of the species	D	F	A	RD	RF	IVI
1.	*Phoenix loureiroi*	4.88	23.77	1.85	24.87	23.45	48.32
2.	*Hemidesmus indicus*	2.84	17.04	1.50	14.47	16.81	31.28
3.	*Ichinocarpus frutescens*	2.84	13.90	1.84	14.47	13.72	28.18
4.	*Flemingia strobilifera*	1.30	4.93	2.36	6.60	4.87	11.47
5.	*Triumfetta rhomboidea*	1.30	4.48	2.60	6.60	4.42	11.02
6.	*Cissampelos pareira*	0.75	5.83	1.15	3.81	5.75	9.56
7.	*Dioscorea bulbifera*	1.00	3.59	2.50	5.08	3.54	8.62
8.	*Flamingia chapper*	0.65	3.59	1.63	3.30	3.54	6.84
9.	*Sida cordifolia*	0.40	2.69	1.33	2.03	2.65	4.69
10.	*Woodfordia fruticosa*	0.40	2.69	1.33	2.03	2.65	4.69
11.	*Carissa spinarum*	0.45	1.79	2.25	2.28	1.77	4.05
12.	*Desmodium pulchellum*	0.50	0.90	5.00	2.54	0.88	3.42
13.	*Barleria cristata*	0.20	1.35	1.33	1.02	1.33	2.34
14.	*Cryptolepis buchananii*	0.20	1.35	1.33	1.02	1.33	2.34
15.	*Desmodium heterocarpon*	0.20	1.35	1.33	1.02	1.33	2.34
16.	*Ampelocissus latifolia*	0.15	0.90	1.50	0.76	0.88	1.65
17.	*Leea asiatica*	0.15	0.90	1.50	0.76	0.88	1.65
18.	*Embeliatsjeriam-cottam*	0.20	0.45	4.00	1.02	0.44	1.46
19.	*Asparagus racemosus*	0.10	0.90	1.00	0.51	0.88	1.39
20.	*Desmodium gangeticum*	0.10	0.90	1.00	0.51	0.88	1.39
21.	*Grewia optiva*	0.10	0.90	1.00	0.51	0.88	1.39
22.	*Holostemmaada-kodien*	0.10	0.90	1.00	0.51	0.88	1.39
23.	*Indigo feracassioides*	0.10	0.90	1.00	0.51	0.88	1.39
24.	*Smilax perfoliata*	0.10	0.90	1.00	0.51	0.88	1.39
25.	*Canthium coromandelicum*	0.10	0.45	2.00	0.51	0.44	0.95
26.	*Desmodium velutinum*	0.10	0.45	2.00	0.51	0.44	0.95

S.No	Name of the species	D	F	A	RD	RF	IVI
27.	*Pogostemon benghalensis*	0.10	0.45	2.00	0.51	0.44	0.95
28.	*Cissus repanda*	0.05	0.45	1.00	0.25	0.44	0.70
29.	*Dioscorea belophylla*	0.05	0.45	1.00	0.25	0.44	0.70
30.	*Dioscorea tomentosa*	0.05	0.45	1.00	0.25	0.44	0.70
31.	*Helicteres isora*	0.05	0.45	1.00	0.25	0.44	0.70
32.	*Marsdenia tenacissima*	0.05	0.45	1.00	0.25	0.44	0.70
33.	*Smilax zeylanica*	0.05	0.45	1.00	0.25	0.44	0.70
34.	*Thespesia lampas*	0.05	0.45	1.00	0.25	0.44	0.70
Stand density 19.66 ind/100m^2; Simpson's index (λ) = 0.12; Shannon-Wiener index (H')=2.56; Buza and Gibson's evenness index (E)=0.68							

Annexure 4.22

Phyto-sociological characteristics of Herbs in buffer areas of all coal blocks in Hasdeo-Arand Coalfield falls within Korba, Surguja and Surajpur districts of Chhattisgarh

S.No	Name of the species	D	F	A	RD	RF	IVI
1.	*Desmodium triflorum*	286.80	21.60	13.28	10.22	4.46	14.68
2.	*Rungia pectinata*	238.40	29.20	8.16	8.50	6.03	14.52
3.	*Elephantopus scaber*	104.80	34.00	3.08	3.73	7.02	10.75
4.	*Phyllanthus urenaria*	158.00	15.20	10.39	5.63	3.14	8.77
5.	*Sida cordata*	68.80	23.20	2.97	2.45	4.79	7.24
6.	*Evolvulus nummularius*	72.80	20.00	3.64	2.59	4.13	6.72
7.	*Ageratum conyzoides*	100.00	13.20	7.58	3.56	2.73	6.29
8.	*Curculigo orchioides*	38.80	12.80	3.03	1.38	2.64	4.03
9.	*Lindernia ciliata*	77.20	5.60	13.79	2.75	1.16	3.91
10.	*Justicia glauca*	73.20	6.00	12.20	2.61	1.24	3.85
11.	*Justicia quinqueangularis*	72.40	5.20	13.92	2.58	1.07	3.65
12.	*Vernonia cinerea*	24.00	12.40	1.94	0.86	2.56	3.42
13.	*Torenia violacea*	66.40	4.80	13.83	2.37	0.99	3.36
14.	*Biophytum reinwardtii*	45.60	7.60	6.00	1.63	1.57	3.19
15.	*Lindernia crustacea*	57.20	5.20	11.00	2.04	1.07	3.11
16.	*Kyllinga nemoralis*	34.80	7.20	4.83	1.24	1.49	2.73
17.	*Cyperusrotundus*	25.20	8.80	2.86	0.90	1.82	2.71
18.	*Imperata cylindrica*	42.00	4.40	9.55	1.50	0.91	2.41
19.	*Oplismenus burmmannii*	44.80	3.60	12.44	1.60	0.74	2.34
20.	*Cyanotis cristata*	31.20	5.60	5.57	1.11	1.16	2.27
21.	*Spermacoce pusilla*	35.60	4.40	8.09	1.27	0.91	2.18
22.	*Selaginella* sp.	44.40	2.80	15.86	1.58	0.58	2.16
23.	*Zornia gibbosa*	27.60	5.60	4.93	0.98	1.16	2.14
24.	*Spilanthes calva*	39.60	2.80	14.14	1.41	0.58	1.99
25.	*Evolvulus alsinoides*	18.00	6.00	3.00	0.64	1.24	1.88
26.	*Salomonia cantoniensis*	38.40	2.40	16.00	1.37	0.50	1.86
27.	*Hemigraphis latebrosa*	21.60	5.20	4.15	0.77	1.07	1.84
28.	*Cyperus niveus*	16.00	5.60	2.86	0.57	1.16	1.73
29.	*Cheilanthus* sp.	29.60	3.20	9.25	1.05	0.66	1.72
30.	*Oldenlandia herbacea*	34.40	2.40	14.33	1.23	0.50	1.72
31.	*Mitrasacme indica*	29.60	2.80	10.57	1.05	0.58	1.63
32.	*Cyperus iria*	29.20	2.80	10.43	1.04	0.58	1.62
33.	*Oldenlandia corymbosa*	22.40	4.00	5.60	0.80	0.83	1.62
34.	*Digitaria ciliaris*	24.80	3.20	7.75	0.88	0.66	1.54
35.	*Murdannia nudiflora*	16.40	4.40	3.73	0.58	0.91	1.49
36.	*Setaria pumila*	20.80	3.20	6.50	0.74	0.66	1.40
37.	*Blumea flava*	14.80	4.00	3.70	0.53	0.83	1.35
38.	*Eragrostis ciliaris*	14.80	4.00	3.70	0.53	0.83	1.35
39.	*Spermacoce hispida*	10.40	4.40	2.36	0.37	0.91	1.28
40.	*Byttneria herbacea*	12.00	4.00	3.00	0.43	0.83	1.25

Sl No	Name of the species	D	F	A	RD	RF	IVI
41.	*Ipomoea pes-trigridis*	16.40	3.20	5.13	0.58	0.66	1.25
42.	*Sporobolus indicus*	16.40	3.20	5.13	0.58	0.66	1.25
43.	*Cajanus scarabaeoides*	6.80	4.80	1.42	0.24	0.99	1.23
44.	*Launaea nudicaulis*	13.60	3.60	3.78	0.48	0.74	1.23
45.	*Scoparia dulcis*	12.40	3.60	3.44	0.44	0.74	1.19
46.	*Enteropogon dolichostachyus*	19.20	2.40	8.00	0.68	0.50	1.18
47.	*Hyptis suaveolens*	20.80	2.00	10.40	0.74	0.41	1.15
48.	*Spermacoce articularis*	13.60	3.20	4.25	0.48	0.66	1.15
49.	*Brachiaria ramosa*	24.80	1.20	20.67	0.88	0.25	1.13
50.	*Crotalaria calycina*	7.60	4.00	1.90	0.27	0.83	1.10
51.	*Crotalaria juncea*	6.80	4.00	1.70	0.24	0.83	1.07
52.	*Molineria trichocarpa*	8.80	3.60	2.44	0.31	0.74	1.06
53.	*Cheilanthes farinosa*	13.20	2.80	4.71	0.47	0.58	1.05
54.	*Murdannia spirata*	12.00	2.80	4.29	0.43	0.58	1.01
55.	*Emilia sonchifolia*	6.00	3.60	1.67	0.21	0.74	0.96
56.	*Arthraxon lancifolius*	14.00	2.00	7.00	0.50	0.41	0.91
57.	*Bothriochloa pertusa*	18.00	1.20	15.00	0.64	0.25	0.89
58.	*Andrographis paniculata*	7.60	2.80	2.71	0.27	0.58	0.85
59.	*Mitrasacme pygmaea*	14.40	1.60	9.00	0.51	0.33	0.84
60.	*Canscora decussata*	6.80	2.80	2.43	0.24	0.58	0.82
61.	*Crotalaria linifolia*	6.40	2.80	2.29	0.23	0.58	0.81
62.	*Becopa floribunda*	20.00	0.40	50.00	0.71	0.08	0.80
63.	*Premna herbacea*	5.60	2.80	2.00	0.20	0.58	0.78
64.	*Ophioglossum reticulatum*	12.00	1.60	7.50	0.43	0.33	0.76
65.	*Plectranthus mollis*	14.00	1.20	11.67	0.50	0.25	0.75
66.	*Debia ovatifolia*	6.80	2.40	2.83	0.24	0.50	0.74
67.	*Eragrostis pilosa*	9.20	2.00	4.60	0.33	0.41	0.74
68.	*Sporobolus coromandelianus*	11.20	1.60	7.00	0.40	0.33	0.73
69.	*Mitracarpus hirtus*	10.00	1.60	6.25	0.36	0.33	0.69
70.	*Phyllanthus rheedei*	3.20	2.80	1.14	0.11	0.58	0.69
71.	*Kyllinga bulbosa*	4.40	2.40	1.83	0.16	0.50	0.65
72.	*Senna tora*	4.40	2.40	1.83	0.16	0.50	0.65
73.	*Corchorus aestuans*	6.40	2.00	3.20	0.23	0.41	0.64
74.	*Stylidium tenellum*	13.20	0.80	16.50	0.47	0.17	0.64
75.	*Adiantum philippense*	10.80	1.20	9.00	0.38	0.25	0.63
76.	*Hackelochloa granularis*	5.60	2.00	2.80	0.20	0.41	0.61
77.	*Spermacoce ocymoides*	7.20	1.60	4.50	0.26	0.33	0.59
78.	*Aristida adscensionis*	4.80	2.00	2.40	0.17	0.41	0.58
79.	*Themeda triandra*	14.00	0.40	35.00	0.50	0.08	0.58
80.	*Digitaria abludens*	4.40	2.00	2.20	0.16	0.41	0.57
81.	*Crotalaria evolvuloides*	6.40	1.60	4.00	0.23	0.33	0.56
82.	*Adenosma indiana*	10.40	0.80	13.00	0.37	0.17	0.54
83.	*Alternanthera ficoidea*	3.60	2.00	1.80	0.13	0.41	0.54
84.	*Flemingia nana*	3.60	2.00	1.80	0.13	0.41	0.54
85.	*Blumea lacinata*	2.40	2.00	1.20	0.09	0.41	0.50
86.	*Scleria lithosperma*	6.40	1.20	5.33	0.23	0.25	0.48
87.	*Spermacoce latifolia*	8.40	0.80	10.50	0.30	0.17	0.46
88.	*Acrocephalus indicus*	2.80	1.60	1.75	0.10	0.33	0.43
89.	*Canscora diffusa*	5.20	1.20	4.33	0.19	0.25	0.43
90.	*Dicranopteris linearis*	5.20	1.20	4.33	0.19	0.25	0.43
91.	*Eragrostis unioloides*	5.20	1.20	4.33	0.19	0.25	0.43
92.	*Phyllanthus amarus*	6.80	0.80	8.50	0.24	0.17	0.41
93.	*Torena asiatica*	6.80	0.80	8.50	0.24	0.17	0.41
94.	*Urena sinuata*	2.00	1.60	1.25	0.07	0.33	0.40
95.	*Chlorophytum arundinaceum*	1.60	1.60	1.00	0.06	0.33	0.39
96.	*Rotala* sp.	8.40	0.40	21.00	0.30	0.08	0.38
97.	*Utricularia* sp.	6.00	0.80	7.50	0.21	0.17	0.38

S.No	Name of the species	D	F	A	RD	RF	IVI
98.	*Biophytum umbraculam*	2.80	1.20	2.33	0.10	0.25	0.35
99.	*Cyperus cyprenus*	2.80	1.20	2.33	0.10	0.25	0.35
100.	*Eragrostella bifaria*	5.20	0.80	6.50	0.19	0.17	0.35
101.	*Commelina benghalensis*	2.40	1.20	2.00	0.09	0.25	0.33
102.	*Phyllanthus virgatus*	2.00	1.20	1.67	0.07	0.25	0.32
103.	*Crotalaria prostrata*	1.60	1.20	1.33	0.06	0.25	0.30
104.	*Euphorbia hirta*	1.60	1.20	1.33	0.06	0.25	0.30
105.	*Fimbristylis dichotoma*	6.00	0.40	15.00	0.21	0.08	0.30
106.	*Vicoa indica*	5.20	0.40	13.00	0.19	0.08	0.27
107.	*Dichanthium annulatum*	2.80	0.80	3.50	0.10	0.17	0.26
108.	*Aristida setacea*	2.40	0.80	3.00	0.09	0.17	0.25
109.	*Eragrostiella nardoides*	4.40	0.40	11.00	0.16	0.08	0.24
110.	*Chrysopogon fulvus*	4.00	0.40	10.00	0.14	0.08	0.23
111.	*Alysicarpus monilifer*	1.60	0.80	2.00	0.06	0.17	0.22
112.	*Commelina diffusa*	1.60	0.80	2.00	0.06	0.17	0.22
113.	*Cyperus compressus*	1.60	0.80	2.00	0.06	0.17	0.22
114.	*Hybanthus enneaspermus*	1.60	0.80	2.00	0.06	0.17	0.22
115.	*Leucas aspera*	1.60	0.80	2.00	0.06	0.17	0.22
116.	*Paspalidium punctatum*	1.60	0.80	2.00	0.06	0.17	0.22
117.	*Canscora pauciflora*	1.20	0.80	1.50	0.04	0.17	0.21
118.	*Rhynchospora wightiana*	1.20	0.80	1.50	0.04	0.17	0.21
119.	*Vigna vexillata*	1.20	0.80	1.50	0.04	0.17	0.21
120.	*Cynodon dactylon*	3.20	0.40	8.00	0.11	0.08	0.20
121.	*Rubia cordiforia*	3.20	0.40	8.00	0.11	0.08	0.20
122.	*Blepharis maderaspatensis*	0.80	0.80	1.00	0.03	0.17	0.19
123.	*Blumea oxyodonta*	0.80	0.80	1.00	0.03	0.17	0.19
124.	*Digitaria stricta*	0.80	0.80	1.00	0.03	0.17	0.19
125.	*Sida rhombifolia*	0.80	0.80	1.00	0.03	0.17	0.19
126.	*Vigna trifoliata*	0.80	0.80	1.00	0.03	0.17	0.19
127.	*Alloteropsis cimicina*	2.00	0.40	5.00	0.07	0.08	0.15
128.	*Apluda mutica*	2.00	0.40	5.00	0.07	0.08	0.15
129.	*Achyranthes aspera*	1.60	0.40	4.00	0.06	0.08	0.14
130.	*Lindernia caespitosa*	1.60	0.40	4.00	0.06	0.08	0.14
131.	*Arisaema* sp.	1.20	0.40	3.00	0.04	0.08	0.13
132.	*Corchorus capsularis*	1.20	0.40	3.00	0.04	0.08	0.13
133.	*Fimbristylis ferruginea*	1.20	0.40	3.00	0.04	0.08	0.13
134.	*Heteropogon contortus*	1.20	0.40	3.00	0.04	0.08	0.13
135.	*Lobelia alsinoides*	1.20	0.40	3.00	0.04	0.08	0.13
136.	*Oldenlantia corymbosa*	1.20	0.40	3.00	0.04	0.08	0.13
137.	*Sida acuta*	1.20	0.40	3.00	0.04	0.08	0.13
138.	*Bulbo phyllum* sp.	0.80	0.40	2.00	0.03	0.08	0.11
139.	*Chlorophytum laxum*	0.80	0.40	2.00	0.03	0.08	0.11
140.	*Cyrtococcum patens*	0.80	0.40	2.00	0.03	0.08	0.11
141.	*Dimeria ornithopoda*	0.80	0.40	2.00	0.03	0.08	0.11
142.	*Equisetum ramosissimum*	0.80	0.40	2.00	0.03	0.08	0.11
143.	*Justicia diffusa*	0.80	0.40	2.00	0.03	0.08	0.11
144.	*Paspalum scrobiculatum*	0.80	0.40	2.00	0.03	0.08	0.11
145.	*Sacciolepis indica*	0.80	0.40	2.00	0.03	0.08	0.11
146.	*Tripogon jacquemontii*	0.80	0.40	2.00	0.03	0.08	0.11
147.	*Waltheria indica*	0.80	0.40	2.00	0.03	0.08	0.11
148.	*Acilepis squarrosa*	0.40	0.40	1.00	0.01	0.08	0.10
149.	*Indoneesiella echioides*	0.40	0.40	1.00	0.01	0.08	0.10
150.	*Anisomeles indica*	0.40	0.40	1.00	0.01	0.08	0.10
151.	*Arthraxon hispidus*	0.40	0.40	1.00	0.01	0.08	0.10
152.	*Chamaecrista mimosoides*	0.40	0.40	1.00	0.01	0.08	0.10
153.	*Chlorophytum tuberosum*	0.40	0.40	1.00	0.01	0.08	0.10
154.	*Crotalaria alata*	0.40	0.40	1.00	0.01	0.08	0.10

No	Name of the species	D	F	A	RD	RF	IVI
155.	*Digitaria longiflora*	0.40	0.40	1.00	0.01	0.08	0.10
156.	*Drimia indica*	0.40	0.40	1.00	0.01	0.08	0.10
157.	*Drosera burmannii*	0.40	0.40	1.00	0.01	0.08	0.10
158.	*Drosera indica*	0.40	0.40	1.00	0.01	0.08	0.10
159.	*Eragrostis tenella*	0.40	0.40	1.00	0.01	0.08	0.10
160.	*Eriocaulon* sp.	0.40	0.40	1.00	0.01	0.08	0.10
161.	*Iphiginia indica*	0.40	0.40	1.00	0.01	0.08	0.10
162.	*Ipomoea eriocarpa*	0.40	0.40	1.00	0.01	0.08	0.10
163.	*Lepidagathis trinervis*	0.40	0.40	1.00	0.01	0.08	0.10
164.	*Leucas biflora*	0.40	0.40	1.00	0.01	0.08	0.10
165.	*Murdannia edulis*	0.40	0.40	1.00	0.01	0.08	0.10
166.	*Orthosiphon pallidus*	0.40	0.40	1.00	0.01	0.08	0.10
167.	*Parthenium hysterophorus*	0.40	0.40	1.00	0.01	0.08	0.10
168.	*Paspalidium geminatum*	0.40	0.40	1.00	0.01	0.08	0.10
169.	*Dicliptera paniculata*	0.40	0.40	1.00	0.01	0.08	0.10
170.	*Thysanolaena maxima*	0.40	0.40	1.00	0.01	0.08	0.10
171.	*Triumfetta annua*	0.40	0.40	1.00	0.01	0.08	0.10

Stand density 2806 ind/100m^2;
Simpson's index (λ) =0.032; Shannon-Wiener index (H')=4.10
Buza and Gibson's evenness index (E)=0.79

Annexure 4.23

Detail list of forest compartment wise extent of forest cover in 23 coal blocks within Hasdeo-Arand Coalfield that falls within Korba, Surguja and Surajpur districts of Chhattisgarh

Name of Coal Block	Forest Division	Forest Range	Compartment No / Village Name	Full or Part	Water	Non-Forest	Scrub	Open Forest	Moderately Dense Forest	Very Dense Forest	Total Area (Ha.)
					Area in Ha						
Nakiya I, II & III	Korba	Lemru	P880	Part	0.00	13.23	4.35	7.67	22.67	0.00	47.91
			P873	Part	0.00	16.45	0.77	20.89	0.10	0.00	38.20
			OA 1198	Part	0.00	1.13	0.00	2.48	18.21	0.00	21.82
			P901	Part	0.00	0.25	0.00	24.01	424.39	0.00	448.65
			OA 1196	Part	0.00	41.92	5.21	25.77	74.65	0.00	147.56
			OA 1195	Part	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			P904	Part	0.00	1.39	0.00	7.82	90.60	0.00	99.82
			OA 1200	Part	0.00	12.76	0.00	21.02	87.62	0.00	121.40
			P910	Part	0.00	0.00	0.00	0.23	42.52	0.00	42.75
			P903	Part	0.00	7.21	0.38	49.58	189.55	0.00	246.72
			P902	Part	0.00	15.46	1.27	60.59	512.90	0.00	590.22
			P879	Full	0.00	8.02	0.00	205.88	208.22	0.00	422.12
			P912	Part	0.00	0.00	0.00	0.37	9.10	0.00	9.47
			P913	Part	0.00	6.38	0.00	30.11	90.83	0.00	127.32
			P876	Part	0.00	109.82	0.00	87.83	83.81	0.00	281.46
			P877	Part	0.00	24.16	0.00	24.40	37.52	0.00	86.08
			OA 1199	Part	0.00	61.13	5.77	174.35	101.84	0.00	343.09
			P878	Part	0.00	29.84	0.00	72.04	38.90	0.00	140.78
	Surguja	Udaipur	P2152	Part	0.00	1.12	0.00	10.71	5.36	0.00	17.19
			P2153	Part	0.00	0.00	0.00	0.56	1.04	0.00	1.60
	Korba	Lemru	Nakiya	Part	0.00	35.00	1.49	36.57	75.69	0.00	148.75
			Bimalta	Part	0.00	4.15	0.00	4.06	14.37	0.00	22.58
			Pendradih	Part	0.00	0.35	0.00	4.66	18.50	0.00	23.51

Name of Coal Block	Forest Division	Forest Range	Compartment No / Village Name	Full or Part	Water	Non-Forest	Scrub	Open Forest	Moderately Dense Forest	Very Dense Forest	Total Area (Ha.)
					Area in Ha						
Chotia 2A	Katghora	Pasan	OA628	Part	0.00	151.42	6.55	114.58	161.29	0.00	433.84
			P212	Part	0.00	0.00	0.00	0.00	1.60	0.00	1.60
			P210	Part	0.00	0.00	0.00	1.15	4.29	3.32	8.76
		Kendai	OA629	Part	0.00	2.91	0.00	0.77	0.96	0.37	5.01
			OA703	Part	0.00	0.00	0.00	0.00	7.33	0.00	7.33
			P348	Part	0.00	10.60	13.10	88.00	133.80	37.03	282.53
			P349	Part	0.00	0.00	0.00	15.09	31.83	27.21	74.13
			OA713	Part	0.00	104.36	0.40	176.53	177.68	0.00	458.97
			P350	Part	0.00	31.89	0.00	39.19	82.66	0.00	153.74
			OA712	Part	0.00	37.30	0.00	1.45	0.00	0.00	38.75
			OA705	Part	0.00	0.00	0.00	2.07	0.75	0.00	2.82
			Rode	Part	0.00	30.50	0.98	7.82	4.56	0.00	43.86
			Chotiya	Part	2.63	364.07	1.29	113.84	52.07	0.40	534.30
		Kendai & Pasan	Baniya	Part	0.00	348.46	3.70	164.90	169.08	1.73	687.86
Chotia 2B	Katghora	Kendai	P331	Part	0.00	44.92	2.00	6.61	38.07	0.00	91.60
			P330	Part	0.00	52.04	6.05	50.76	105.51	0.00	214.36
			P329	Part	0.00	14.77	1.31	1.14	10.02	0.00	27.24
			Sakhoda	Part	0.00	26.40	0.89	6.72	30.35	0.00	64.35
Morga I	Katghora	Kendai	OA701		0.00	1.33	0.76	2.04	7.93	0.00	12.06
			OA702	Part	0.00	3.29	9.37	0.10	0.82	212.20	225.78
			P370	Part	0.00	28.99	3.75	11.09	60.11	0.00	103.94
			P371	Part	0.00	13.64	19.73	9.63	63.38	0.00	106.38
			P372	Part	0.00	3.58	9.91	0.00	47.87	119.44	180.80
			P373	Part	0.00	25.21	10.37	16.06	370.12	0.96	422.72
			P374	Part	0.00	6.39	2.45	6.93	53.91	0.00	69.68
			P375	Part	0.00	0.01	0.00	0.00	1.85	0.00	1.86

Name of Coal Block	Forest Division	Forest Range	Compartment No / Village Name	Full or Part	Water	Non-Forest	Scrub	Open Forest	Moderately Dense Forest	Very Dense Forest	Total Area (Ha.)
					Area in Ha						
			P379	Part	0.00	1.39	0.01	4.99	74.30	72.24	152.93
			P380	Part	0.00	0.00	0.00	0.00	0.00	0.60	0.60
			P385	Part	0.00	0.53	0.00	0.00	1.85	9.27	11.65
			P390	Part	0.00	0.00	0.00	0.00	0.00	7.03	7.03
			P391	Part	0.00	0.00	0.00	0.04	0.69	19.39	20.12
			P394	Part	0.00	0.58	0.00	6.08	1.88	0.00	8.54
			P401	Part	0.00	6.84	0.83	1.72	8.40	29.74	47.53
			P402	Full	0.00	18.34	11.44	5.44	34.34	56.43	125.99
			P403	Full	0.00	6.92	0.00	25.34	69.23	148.40	249.89
			P404	Part	0.00	20.31	7.35	22.67	20.49	127.22	198.04
			P405	Part	0.00	1.65	0.68	1.72	1.22	0.00	5.27
			Kendai	Part	0.00	4.12	0.41	8.16	13.59	41.29	67.56
			Morga	Part	0.00	52.53	1.85	22.45	52.53	14.20	143.57
Morga II	Katghora	Kendai	OA702	Part	0.00	0.00	0.00	0.00	0.00	2.41	2.41
			OA726	Part	0.00	0.00	0.00	0.00	0.02	0.00	0.02
			P373	Part	0.00	0.98	0.00	1.75	24.04	0.00	26.77
			P374	Part	0.00	0.01	0.00	0.00	0.71	0.00	0.72
			P375	Part	4.23	54.20	1.06	8.85	56.37	0.00	124.71
			P376	Part	1.01	2.07	0.00	0.00	0.99	0.00	4.07
			P377	Part	1.30	11.49	0.71	23.07	195.56	0.00	232.13
			P378	Full	2.41	66.48	15.46	14.49	168.03	4.86	271.73
			P379	Part	0.00	19.69	0.00	24.15	195.41	33.71	272.96
			P380	Full	0.00	13.08	14.27	23.05	305.20	92.43	448.03
			P381	Part	24.80	32.52	0.00	18.09	253.25	0.00	328.66
			P382	Part	0.33	1.27	0.00	4.83	235.93	7.28	249.64
			P383	Part	0.00	6.01	7.81	6.87	181.56	175.49	377.74
			P390	Part	0.00	0.00	0.00	0.00	0.00	10.40	10.40

Name of Coal Block	Forest Division	Forest Range	Compartment No / Village Name	Full or Part	Area in Ha						Total Area (Ha.)
					Water	Non-Forest	Scrub	Open Forest	Moderately Dense Forest	Very Dense Forest	
			P391	Part	0.00	0.81	1.60	1.81	49.00	49.05	102.27
			P394	Part	0.00	3.97	0.00	1.47	14.20	0.00	19.64
			Kendai	Part	0.00	63.40	1.21	22.09	71.63	5.83	164.16
Morga III	Katghora	Kendai	P355	Part	8.29	57.32	0.00	37.64	76.34	0.00	179.59
			P356	Part	0.00	15.44	0.00	5.47	25.54	0.00	46.45
			P374	Part	0.00	10.22	0.00	14.43	52.84	0.00	77.49
			P375	Part	8.47	25.06	4.29	9.62	51.52	0.00	98.96
Morga IV	Katghora	Kendai	P356	Part	0.00	15.15	30.31	73.34	81.23	0.00	200.03
			P357	Part	0.00	4.60	22.01	20.70	98.78	0.00	146.09
			P374	Part	0.00	1.72	0.00	11.46	118.06	0.00	131.24
Morga South	Katghora	Kendai	OA698	Part	0.00	12.33	4.33	11.41	98.56	105.36	231.99
			OA699	Part	0.00	4.25	0.99	1.94	19.94	23.38	50.50
			OA700	Part	0.00	0.00	0.00	0.47	2.23	40.78	43.48
			OA727	Part	0.00	0.00	0.00	0.00	0.32	0.00	0.32
			P365	Part	0.00	29.51	3.85	8.66	15.83	200.18	258.03
			P366	Part	0.00	6.87	2.12	7.87	18.43	136.61	171.90
			P385	Part	0.00	23.78	19.04	0.00	15.05	45.26	103.13
			P404	Part	0.00	0.33	0.58	2.28	4.93	48.10	56.22
			P405	Part	0.00	1.60	0.86	0.00	2.17	0.00	4.63
			P410	Part	0.00	0.19	0.48	0.00	1.33	0.00	2.00
			P421	Part	0.00	0.00	0.00	0.00	0.36	0.00	0.36
			P422	Part	0.00	0.00	0.00	0.00	0.59	0.00	0.59
			P423	Full	0.00	4.53	5.70	9.92	85.66	3.13	108.94
			P424	Part	0.00	0.00	0.00	0.00	1.30	0.00	1.30
			P426	Full	0.00	6.91	15.96	5.51	327.21	0.00	355.59
			P427	Part	0.00	3.85	2.31	2.22	92.41	127.28	228.07
			P428	Part	0.00	0.85	0.00	0.49	25.39	233.51	260.24

Name of Coal Block	Forest Division	Forest Range	Compartment No / Village Name	Full or Part	Water	Non-Forest	Scrub	Open Forest	Moderately Dense Forest	Very Dense Forest	Total Area (Ha.)
					Area in Ha						
			P429	Part	0.00	0.20	0.00	0.00	5.06	45.22	50.48
			P436	Part	0.00	5.97	0.09	2.68	140.81	0.00	149.55
			P437	Part	0.00	1.50	2.43	4.66	214.64	0.00	223.23
			P438	Part	0.00	0.72	1.10	11.01	262.22	0.00	275.05
			P439	Part	0.00	9.53	0.00	16.63	57.57	0.00	83.73
			P440	Part	0.00	0.00	0.00	0.13	35.77	0.00	35.90
			P442	Part	0.00	0.00	0.00	0.02	1.73	0.00	1.75
			Morga	Part	0.00	35.43	0.56	0.37	4.02	0.68	41.06
			Uchlenga		0.00	288.32	6.03	3.05	65.91	115.27	478.58
			Arisiya		0.00	66.99	1.36	31.40	70.95	4.96	175.67
			Gidmuri		0.00	0.00	0.00	1.03	10.61	0.00	11.64
Gidmuri	Surguja	Udaipur	P1999	Part	0.00	0.00	0.00	0.00	13.16	0.00	13.16
			P2000	Part	0.00	0.00	0.00	0.00	2.95	0.00	2.95
	Katghora	Kendai	P427	Part	0.00	1.07	1.37	0.42	8.68	0.00	11.54
			P433	Part	0.00	7.98	2.27	5.24	54.26	0.00	69.75
			P434	Part	0.00	32.64	9.27	3.94	125.86	0.00	171.71
			P435	Part	0.00	17.26	1.64	16.05	45.42	0.00	80.37
			P436	Part	0.00	5.84	5.25	13.62	153.31	0.00	178.02
			P439	Part	0.00	17.49	4.83	2.47	12.21	0.00	37.00
			Gidmuri	Part	0.00	62.61	3.66	37.09	94.81	0.00	198.17
Paturia	Katghora	Kendai	OA698	Part	0.00	9.85	0.00	7.43	27.85	154.24	199.37
			P364	Part	0.00	2.64	1.83	1.63	35.77	129.17	171.04
			P365	Part	0.00	0.00	0.00	0.67	0.04	51.71	52.42
			P366	Part	0.00	1.20	0.00	1.12	25.47	72.31	100.10
			P367	Part	0.00	0.00	0.00	0.00	18.04	0.05	18.09
			P386	Part	0.00	5.74	8.89	2.90	83.59	56.99	158.11
			P387	Part	0.00	2.65	0.00	3.14	43.72	0.00	49.51

Name of Coal Block	Forest Division	Forest Range	Compartment No / Village Name	Full or Part	Water	Non-Forest	Scrub	Open Forest	Moderately Dense Forest	Very Dense Forest	Total Area (Ha.)
					Area in Ha						
			P427	Part	0.00	13.96	0.12	9.96	79.73	15.28	119.05
			P428	Part	0.00	0.02	0.00	0.00	8.25	17.15	25.42
			P429	Part	0.00	4.48	5.02	0.84	45.17	210.03	265.54
			P430	Part	0.00	86.54	9.69	56.92	191.26	0.00	344.41
			P431	Part	0.00	6.00	2.95	13.39	94.32	0.00	116.66
			P436	Part	0.00	4.94	0.07	2.69	8.98	0.00	16.68
			Uchlenga	Part	0.00	0.00	0.00	0.62	1.17	54.67	56.47
			Madanpur	Part	0.00	17.72	3.56	13.89	29.98	5.45	70.61
			Paturiyadand	Part	0.00	238.48	2.92	18.91	69.24	0.53	330.09
Madanpur North	Katghora	Kendai	P358	Part	0.00	9.60	0.00	4.83	41.92	0.00	56.35
			P359	Part	0.00	29.59	0.00	25.03	43.94	0.00	98.56
			P362	Part	0.00	6.56	0.00	4.94	38.07	0.00	49.57
			P363	Part	0.00	73.86	3.34	55.61	234.35	0.00	367.16
			P364	Part	0.00	0.40	0.97	0.25	4.39	2.18	8.19
			P366	Part	0.00	0.02	1.97	0.00	15.74	28.94	46.67
			P367	Part	0.00	36.02	3.21	58.38	359.07	4.89	461.57
			P368	Part	0.00	16.28	5.08	13.38	34.94	0.00	69.68
			P369	Part	0.00	132.46	8.53	70.69	198.35	0.00	410.03
			P370	Part	0.00	5.28	0.00	5.56	7.18	0.00	18.02
			P371	Part	0.00	27.86	8.70	17.66	191.23	0.00	245.45
			P372	Part	0.00	2.39	1.27	0.16	3.12	0.00	6.94
			P385	Part	0.00	1.35	1.24	1.39	0.51	0.00	4.49
			P386	Part	0.00	3.72	2.11	0.69	3.45	0.00	9.97
			P388	Part	0.00	3.72	2.11	0.69	3.45	0.00	9.97
			Madanpur	Part	0.00	5.32	2.35	5.48	4.13	0.00	17.29
Madanpur South	Katghora	Kendai	OA701	Part	0.00	0.26	0.01	2.50	9.75	0.00	12.52
			P366	Part	0.00	1.37	0.00	0.00	5.66	5.17	12.20

Name of Coal Block	Forest Division	Forest Range	Compartment No / Village Name	Full or Part	Water	Non-Forest	Scrub	Open Forest	Moderately Dense Forest	Very Dense Forest	Total Area (Ha.)
					Area in Ha						
			P367	Part	0.00	0.00	0.00	2.84	8.47	0.00	11.31
			P368	Part	0.00	25.42	12.05	37.16	182.70	0.00	257.33
			P372	Part	0.00	7.99	5.14	0.12	31.81	0.10	45.16
			P385	Part	0.00	16.55	4.60	2.06	76.41	29.22	128.84
			P389	Full	0.00	1.33	0.00	0.00	26.37	0.00	27.70
			Morga		0.00	116.94	4.07	36.16	90.01	1.16	248.34
Kente Extension	Surguja	Udaipur	2109	Part	0.00	23.48	9.29	27.36	16.84	0.00	76.97
			2110	Part	0.00	2.51	1.61	7.20	2.01	0.00	13.33
			P2069	Part	0.00	3.64	0.00	0.00	6.29	1.21	11.14
			P2099	Part	0.00	0.98	0.00	8.51	50.77	12.01	72.27
			P2104	Part	0.00	10.17	0.00	10.61	59.96	207.47	288.21
			P2105	Part	0.00	5.81	5.73	9.30	155.84	24.75	201.43
			P2106	Part	0.00	0.00	1.18	5.93	63.98	0.77	71.86
			P2107	Part	0.00	4.28	17.37	47.50	102.48	0.00	171.63
			P2108	Part	0.00	19.71	8.59	18.98	44.29	0.00	91.57
			P2111	Part	0.00	0.00	0.00	0.00	0.09	0.00	0.09
			P2124	Part	0.00	2.55	4.72	6.28	46.30	0.00	59.85
			P2125	Part	0.00	1.15	0.00	3.62	128.82	0.00	133.59
			P2126	Full	0.00	2.47	1.72	18.15	305.18	13.99	341.51
			P2127	Part	0.00	17.88	11.87	25.26	174.90	0.00	229.91
			P2128	Part	0.00	1.49	0.73	4.98	7.09	0.00	14.29
			P2130	Part	0.00	1.41	7.49	14.50	21.92	0.00	45.32
			Basen	Part	0.00	8.54	0.00	1.43	4.93	2.21	17.11
Parsa	Surajpur	Ramanuj Nagar	1982	Part	0.00	8.19	4.71	6.27	47.09	19.37	85.63
			P1986	Part	0.00	8.37	2.64	0.00	12.75	0.00	23.76
			P1997	Part	0.00	1.37	0.00	3.31	2.02	10.90	17.60
	Surguja	Udaipur	P1998	Part	0.00	23.51	4.03	10.41	20.97	0.00	58.92

Name of Coal Block	Forest Division	Forest Range	Compartment No / Village Name	Full or Part	Water	Non-Forest	Scrub	Open Forest	Moderately Dense Forest	Very Dense Forest	Total Area (Ha.)
					Area in Ha						
			P2005	Part	0.00	18.45	0.10	6.75	67.53	0.00	92.83
			P2006	Part	0.00	49.23	12.23	12.32	219.28	0.00	293.06
			P2007	Part	0.00	0.00	0.00	1.26	0.00	0.00	1.26
			Fattepur	Part	0.00	213.74	0.66	10.35	32.43	0.00	257.18
			Salhi	Part	0.00	366.72	4.13	24.45	75.34	3.28	473.92
	Surajpur	Ramanuj Nagar	Kantaroli	Part	0.00	2.40	0.81	0.00	3.97	0.00	7.18
PEKB	**Surguja**	Udaipur	2109	Part	0.00	15.14	10.01	57.07	26.91	0.00	109.13
			2110	Part	0.00	26.80	21.04	65.90	32.42	1.06	147.22
			P1998	Part	0.00	2.17	0.55	6.00	3.11	0.00	11.83
			P2002	Part	0.00	12.70	4.17	18.21	83.74	15.73	134.55
			P2003	Full	0.00	17.84	3.64	12.78	92.35	98.11	224.72
			P2004	Full	0.00	44.66	17.86	9.62	183.01	85.85	341.00
			P2005	Part	0.00	59.49	6.66	16.90	199.96	0.00	283.01
			P2007	Part	0.00	59.43	0.94	15.78	54.28	0.00	130.43
			P2008	Part	0.00	18.12	0.00	7.61	36.04	10.59	72.36
			P2069	Part	0.00	2.82	0.42	0.00	0.00	0.00	3.24
			P2103	Part	0.00	0.00	0.00	0.40	1.53	3.21	5.14
			P2104	Part	0.00	3.08	0.04	0.00	0.00	6.07	9.19
			P2105	Part	0.00	3.65	0.00	0.00	0.08	19.56	23.29
			P2106	Part	0.00	0.10	1.39	21.23	109.44	2.82	134.98
			P2111	Part	0.00	2.79	0.68	12.66	49.43	8.04	73.60
			P2114	Part	0.00	0.00	0.00	3.98	0.70	0.00	4.68
			Ghatbarra	Part	0.00	393.15	1.23	55.43	5.44	0.35	455.61
			Basen	Part	0.00	0.38	0.56	0.66	0.00	3.16	4.77
			Salhi	Part	0.00	177.98	0.70	58.11	14.70	0.00	251.49
			Parsa	Part	0.00	418.68	0.89	15.59	17.97	1.44	454.57

Name of Coal Block	Forest Division	Forest Range	Compartment No / Village Name	Full or Part	Water	Non-Forest	Scrub	Open Forest	Moderately Dense Forest	Very Dense Forest	Total Area (Ha.)
					Area in Ha						
Tara Central	Surajpur	Ramanuj Nagar	1932	Part	0.00	7.84	0.00	0.00	40.21	140.82	188.87
			1933	Part	0.00	0.00	0.00	0.00	4.49	0.00	4.49
			1975	Part	0.00	0.00	0.00	2.03	9.52	0.00	11.55
			1977	Part	0.00	0.56	0.00	0.00	25.19	89.96	115.71
			1978	Part	0.00	0.00	0.00	0.00	19.36	51.97	71.33
			1979	Part	0.00	10.68	8.20	0.04	28.80	231.02	278.74
			1980	Part	0.00	1.50	3.13	1.83	22.62	64.87	93.95
			1981	Part	0.00	0.00	0.00	1.27	13.07	20.58	34.92
			1982	Part	0.00	1.76	0.16	0.38	10.70	290.06	303.06
			1983	Full	0.00	15.14	1.91	2.12	15.14	220.08	254.39
			1984	Full	0.00	4.44	1.62	2.22	5.53	208.96	222.77
			1985	Full	0.00	14.01	16.45	0.81	8.32	51.95	91.54
			P1986	Part	0.00	22.92	7.52	6.72	49.25	0.14	86.55
			P1992	Part	0.00	8.54	0.58	0.00	30.76	28.03	67.91
			P1993	Part	0.00	1.31	0.00	1.67	4.81	28.14	35.93
			P1997	Part	0.00	6.67	0.00	1.19	11.82	57.59	77.27
	Katghora	Kendai	OA724	Part	0.00	0.00	0.00	0.00	6.76	0.00	6.76
	Surajpur	Ramanuj Nagar	Tara	Part	0.00	113.63	1.67	5.43	48.08	77.77	246.57
			Janardanpur	Part	0.00	25.76	0.97	12.11	2.95	42.14	83.94
			Kantaroli	Part	0.00	195.43	7.32	16.11	49.83	79.33	348.02
			Salhi	Part	0.00	0.00	0.00	1.67	0.17	4.84	6.68
			Fattepur	Part	0.00	13.55	2.44	0.90	22.06	0.01	38.95
Puta-Parogia	Surajpur	Ramanuj Nagar	1980	Part	0.00	0.00	0.00	13.01	94.01	141.16	248.18
			1981	Part	0.00	15.88	4.03	25.32	272.15	16.49	333.87
	Surguja	Udaipur	2116	Part	0.00	0.00	0.00	0.00	0.03	2.35	2.38
			P1998	Part	0.00	15.81	19.16	16.16	80.87	0.00	132.00
			P1999	Part	0.00	11.04	7.82	7.80	219.45	0.00	246.11

Name of Coal Block	Forest Division	Forest Range	Compartment No / Village Name	Full or Part	Water	Non-Forest	Scrub	Open Forest	Moderately Dense Forest	Very Dense Forest	Total Area (Ha.)
					Area in Ha						
			P2000	Part	0.00	6.86	16.67	19.25	223.31	0.00	266.09
			P2001	Part	0.00	15.21	1.18	15.69	213.80	48.14	294.02
			P2002	Part	0.00	17.89	11.01	30.17	74.11	0.00	133.18
			P2070	Part	0.00	2.64	0.00	10.81	61.90	5.97	81.32
			P2113	Part	0.00	0.00	0.00	0.00	0.01	0.00	0.01
			P2114	Part	0.00	3.03	2.25	5.63	149.29	23.98	184.18
			P2115	Part	0.00	2.11	0.00	21.56	173.99	121.00	318.66
	Katghora	Kendai	OA724	Part	0.00	50.90	14.43	63.14	141.75	3.08	273.30
			OA725	Part	0.00	0.19	0.00	1.48	9.10	0.00	10.77
			P425	Part	0.00	2.31	1.89	0.19	10.73	0.00	15.12
			P430	Part	0.00	8.99	1.14	11.23	63.91	0.00	85.27
			P431	Part	0.00	21.93	7.76	15.54	229.88	0.00	275.11
			P432	Part	0.00	0.89	2.61	15.69	253.95	0.00	273.14
			P433	Part	0.00	17.99	10.12	39.04	262.39	0.00	329.54
			P434	Part	0.00	0.12	0.41	0.00	30.29	0.00	30.82
			P435	Part	0.00	10.18	0.00	5.88	121.42	0.00	137.48
			P438	Part	0.00	0.00	0.00	0.23	36.14	0.00	36.37
			P439	Part	0.00	0.00	0.00	0.06	32.47	0.00	32.53
			P440	Part	0.00	0.00	1.02	34.90	162.72	0.00	198.64
			P441	Part	0.00	0.00	0.00	2.23	10.10	0.00	12.33
			P442	Part	0.00	0.00	0.00	4.54	72.29	0.00	76.83
			Puta	Part	0.00	98.88	11.33	20.01	58.33	0.00	188.55
			Gidmuri	Part	0.00	47.42	0.00	15.63	87.44	0.00	150.50
	Surguja	Udaipur	Ghatbarra	Part	0.00	164.57	7.07	77.76	156.91	0.00	406.31
	Surajpur	Ramanuj Nagar	Kantaroli	Part	0.00	0.01	0.00	0.10	25.77	5.58	31.46
Parogia	Surguja	Udaipur	2116	Part	0.00	0.46	0.00	3.61	144.20	82.23	230.50

Name of Coal Block	Forest Division	Forest Range	Compartment No / Village Name	For or Part	Water	Non-Forest	Scrub	Open Forest	Moderately Dense Forest	Very Dense Forest	Total Area (Ha.)
					Area in Ha						
			P2002	Part	0.00	0.00	0.00	0.45	0.07	0.00	0.52
			P2070	Part	0.00	1.62	6.33	0.31	0.95	55.31	64.52
			P2111	Part	0.00	6.93	2.22	11.24	12.10	0.00	32.49
			P2112	Part	0.00	28.23	0.00	18.58	48.24	0.00	95.05
			P2113	Full	0.00	3.45	0.00	3.81	125.84	71.97	205.07
			P2114	Part	0.00	0.00	0.00	1.07	14.73	71.53	87.33
Saidu	Surguja	Udaipur	2116	Part	0.00	3.52	1.11	14.72	59.88	14.37	93.60
			P2070	Part	0.00	6.49	2.07	3.22	28.86	65.03	105.67
			P2117	Full	0.00	5.46	3.00	20.99	83.37	79.02	191.84
			P2118	Part	0.00	2.45	1.37	33.36	92.75	5.46	135.39
	Katghora	Kendai	P441	Part	0.00	11.62	11.98	5.16	25.65	0.68	55.09
			P444	Part	0.00	1.31	4.01	5.14	29.09	0.00	39.55
			P445	Part	0.00	9.97	5.84	17.79	77.06	0.00	110.66
			P446	Part	0.00	7.06	2.79	5.46	33.45	0.00	48.76
	Surguja	Udaipur	Saidu	Part	0.00	0.82	0.13	2.62	18.38	10.28	32.23
Pindraki	Surguja	Udaipur	P2073	Part	0.00	4.73	0.07	2.71	42.58	0.00	50.09
			P2074	Part	0.00	71.07	4.19	48.79	275.66	0.00	399.71
			P2075	Part	0.00	33.71	3.66	7.71	111.85	0.00	156.93
			P2077	Part	0.00	0.00	0.00	0.00	7.49	0.00	7.49
			P2121	Part	0.00	0.04	1.12	0.00	0.00	0.00	1.16
			P2122	Part	0.00	3.54	8.78	3.13	13.19	0.00	28.64
			P2123	Part	0.00	4.01	2.09	44.03	31.89	0.00	82.02
			P2124	Part	0.00	0.96	0.51	5.65	51.42	0.00	58.54
			P2125	Part	0.00	0.00	0.00	16.88	118.81	0.00	135.69
			P2127	Part	0.00	1.41	0.00	3.11	43.91	0.00	48.43
			P2129	Part	0.00	0.01	1.74	0.00	3.85	0.00	5.60
			P2130	Part	0.00	2.29	1.98	17.45	31.95	0.00	53.67

Name of Coal Block	Forest Division	Forest Range	Compartment No / Village Name	Full or Part	Water	Non-Forest	Scrub	Open Forest	Moderately Dense Forest	Very Dense Forest	Total Area (Ha.)
					Area in Ha						
			P2131	Part	0.00	5.87	9.06	0.04	45.69	0.00	60.66
			P2132	Part	0.00	1.68	0.89	5.81	66.27	0.00	74.65
			P2133	Part	0.00	12.43	10.40	12.62	228.95	0.00	264.40
			P2134	Full	0.00	52.43	15.56	42.96	168.60	0.00	279.55
			P2135	Full	0.00	25.31	18.07	70.87	205.73	0.00	319.98
			P2136	Part	0.00	2.77	14.16	5.61	31.56	0.00	54.10
			P2137	Part	0.00	1.16	6.45	3.47	179.30	0.00	190.38
			Pendarkhi		0.00	109.68	0.00	1.91	10.73	0.00	122.32
Sarma	Surguja	Udaipur	P2055	Part	0.00	3.41	0.70	2.53	0.20	0.00	6.84
			P2056	Part	0.00	16.89	0.76	32.71	74.27	0.00	124.63
			P2057	Part	0.00	2.94	0.00	1.03	1.04	0.00	5.01
			P2059	Part	0.00	12.85	0.45	6.25	0.99	0.00	20.54
			P2060	Part	0.00	81.98	3.40	64.60	203.49	0.00	353.47
			P2061	Full	0.00	66.04	0.00	18.11	178.64	0.00	262.79
			P2062	Part	0.00	43.98	1.00	69.26	96.31	0.00	210.55
			P2065	Part	0.00	39.70	0.00	30.55	87.66	0.00	157.91
			P2066	Part	0.00	2.98	0.00	5.48	10.26	0.00	18.72
			P2067	Full	0.00	17.30	1.31	5.71	31.20	0.00	55.52
			P2068	Part	0.00	0.10	0.00	4.35	0.00	0.00	4.45
			Puta	Part	0.00	239.84	0.09	29.84	15.24	0.00	285.01
			Tendutikra	Part	0.00	107.33	0.00	7.29	13.81	0.00	128.43
			Chakeri	Part	0.00	121.52	1.32	50.10	0.16	0.00	173.10
			Ramnagar	Part	0	3.31	0.00	5.64	1.83	0.00	10.78
Laxmangarh	Surguja	Udaipur	P2031	Part	0.00	1.44	0.75	1.51	37.10	4.28	45.08
			P2033	Part	0.00	3.91	0.00	6.85	8.91	0.00	19.67
			P2035	Part	0.00	5.02	1.90	20.28	31.76	0.00	58.96
			P2036	Part	0.00	0.44	0.00	0.00	27.99	0.00	28.43

Name of Coal Block	Forest Division	Forest Range	Compartment No / Village Name	Full or Part	Water	Non-Forest	Scrub	Open Forest	Moderately Dense Forest	Very Dense Forest	Total Area (Ha.)
					Area in Ha						
			P2046	Part	0.00	38.43	3.77	0.00	53.47	0.00	95.67
			P2047	Part	0.00	31.42	0.17	40.35	7.67	0.00	79.61
			P2048	Part	0.00	37.28	2.12	49.76	40.40	0.00	129.56
			P2062	Part	0.00	8.56	0.00	14.40	5.59	0.00	28.55
			P2063	Full	0.00	169.91	94.86	51.25	0.15	0.00	316.17
			P2064	Part	0.00	17.55	26.96	46.78	30.17	0.00	121.46
			P2065	Part	0.00	40.58	0.51	40.89	65.11	0.00	147.09
			Laxmangarh	Part	0.00	154.21	17.86	28.09	1.98	0.00	202.14
			Mahespur	Full	0.00	412.92	9.02	3.26	16.02	0.00	441.22
			Mohanpur	Part	3.32	124.48	0.80	18.56	7.65	0.00	154.81
			Jhirmiti	Part	0.00	187.84	0.46	9.94	2.99	0.00	201.23
			Ramnagar	Part	0.00	146.75	0.00	2.62	0.59	0.00	149.97
			Phungi	Part	0.00	112.81	17.20	13.62	0.79	0.00	144.43
Bakurma	**Surguja**	Udaipur	2170	Part	0.00	59.10	0.00	1.43	0.00	0.00	60.53
			P2140	Part	0.00	0.00	0.00	0.00	0.14	0.00	0.14
			P2141	Part	0.00	0.00	0.00	0.00	10.12	0.00	10.12
			P2143	Part	0.00	1.02	0.00	0.00	5.33	0.00	6.35
			P2144	Full	0.00	48.61	11.77	13.64	157.86	0.00	231.88
			P2145	Part	0.00	6.81	0.00	7.59	143.75	0.00	158.15
			P2146	Part	0.00	2.99	0.00	5.42	46.67	0.00	55.08
			P2149	Part	0.00	10.57	0.00	1.53	17.51	0.00	29.61
			P2160	Part	0.00	0.00	0.00	0.00	9.56	0.00	9.56
			P2161	Part	0.00	0.00	0.00	0.00	24.81	0.00	24.81
			P2164	Part	0.00	25.91	0.00	3.18	62.99	0.00	92.08
			P2165	Full	0.90	43.95	5.55	5.10	6.21	103.08	164.79
			P2166	Part	0.00	84.13	2.29	6.25	66.75	0.52	159.94
			P2167	Part	0.00	9.27	0.00	7.34	99.83	0.00	116.44

Name of Coal Block	Forest Division	Forest Range	Compartment No / Village Name	Full or Part	Water	Non-Forest	Scrub	Open Forest	Moderately Dense Forest	Very Dense Forest	Total Area (Ha.)
					Area in Ha						
			P2169	Part	0.00	46.44	1.95	5.01	0.87	0.00	54.27
			P2171	Part	1.47	88.56	4.12	0.00	16.79	42.60	153.54
			P2186	Part	0.00	7.64	0.00	9.95	148.32	0.00	165.91
			P2187	Full	0.00	66.97	0.16	38.27	166.42	0.00	271.82
			P2188	Part	0.00	97.76	2.17	27.35	208.97	0.00	336.25
			P2189	Full	1.42	36.98	0.95	21.68	109.50	83.97	254.50
			P2190	Part	0.00	25.67	0.00	0.29	218.05	0.00	244.01
			P2226	Part	0.00	0.00	0.00	0.00	0.00	0.03	0.03
Kedma	Surguja	Udaipur	P2163	Part	0.00	0.00	0.00	0.00	18.43	0.00	18.43
			P2164	Part	0.20	4.78	0.00	8.81	228.15	0.00	241.94
			P2171	Part	0.43	1.18	0.00	0.00	0.92	0.41	2.94
			P2172	Part	0.00	0.19	0.00	4.19	122.23	0.00	126.61
			P2173	Full	0.00	5.09	0.00	9.91	104.07	91.58	210.65
			P2174	Part	0.00	7.75	0.00	1.63	40.52	91.15	141.05
			P2175	Part	0.00	0.00	0.00	0.00	17.30	32.15	49.45
			P2221	Part	0.00	22.04	0.00	0.33	35.14	21.21	78.72
			P2222	Full	0.00	15.87	0.00	4.42	103.76	108.29	232.34
			P2223	Full	0.00	1.28	0.00	4.65	176.75	0.00	182.68
			P2224	Part	0.00	5.40	0.00	13.43	139.59	3.52	161.94
			P2225	Part	0.00	31.74	0.00	3.11	84.99	2.48	122.32
			P2226	Part	2.45	5.08	0.00	0.34	12.97	1.29	22.13
			P2233	Part	0.00	0.00	0.00	0.00	13.29	0.00	13.29
			P2234	Part	0.57	55.30	0.00	19.92	54.75	0.00	130.54
			Kedma		0.00	37.96	0.00	0.00	28.13	0.00	66.08
			Badegaon		0.00	54.85	0.00	6.61	5.37	0.61	67.44
			Keshma		0.00	15.65	0.00	2.89	8.34	0.00	26.88

Annexure 5.1

Checklist of Avifauna in Hasdeo-Arand Coalfield falls within Korba, Surguja and Surajpur districts of Chhattisgarh

S.N.	Family/ Common Name	Scientific Name	Migration Status	Wildlife (Protection) Act Schedule	Endemic status	Relative abundance status
	Accipitridae					
1	White-eyed Buzzard*	*Butastur teesa*	R	I	Widespread	Common
2	Crested Serpent Eagle*	*Spilornis cheela*	R	I	Widespread	Common
3	Shikra*	*Accipiter badius*	R	I	Widespread	Common
4	Black-Winged Kite	*Elanus caeruleus*	R	I	Widespread	Uncommon
5	Black Eagle	*Ictinaetus malaiensis*	R	I	Widespread	
6	Black Kite	*Milvus migrans*	R	I	Widespread	
	Aegithinidae					
7	Common Iora	*Aegithina tiphia*	R	IV	Widespread	
	Alcedinidae					
8	White-throated Kingfisher	*Halcyon smyrnensis*	R	IV	Widespread	Common
	Apodidae					
9	Crested Treeswift	*Hemiprocne coronata*	R	-	Widespread	Fairly common
	Ardeidae					
10	Asian Pond Heron*	*Ardeola grayii*	R	IV	Widespread	Common
11	Cattle Egret	*Bubulcus ibis*	R	IV	Widespread	Uncommon
12	Little Egret	*Egretta garzetta*	R	IV	Widespread	Fairly common
13	Intermediate Egret	*Ardea intermedia*	WM	IV	Widespread	
14	Great Egret	*Ardea alba*	R	IV	Widespread	
	Campephagidae					
15	Small Minivet*	*Pericrocotus cinnamomeus*	R	IV	Widespread	Very common
16	Large Cuckooshrike	*Coracinajavensis*	R	-	Widespread	Fairly common
17	Black-headed cuckooshrike	*Lalage melanoptera*	SM	-	Widespread	Fairly common
18	Black-winged CuckooShrike	*Lalage melaschistos*	WM	-	Widespread	Uncommon
	Caprimulgidae					
19	Indian Nightjar	*Caprimulgus asiaticus*	R	IV	Widespread	Fairly common
20	Savanna Nightjar	*Caprimulgus affinis*	R	IV	Widespread	Uncommon

	Family/ Common Name	Scientific Name	Migration Status	Wildlife (Protection) Act Schedule	Endemic status	Relative abundance status
	Charadriidae					
21	Red-wattled Lapwing	*Vanellus indicus*	R	-	Widespread	Fairly common
	Ciconiidae					
22	Asian Openbill	*Anastomusoscitans*	R	IV	Widespread	Common
	Cisticolidae					
23	Grey-breasted Prinia	*Prinia hodgsonii*	R	-	Widespread	Fairly common
24	Common Tailorbird*	*Orthotomus sutorius*	R	-	Widespread	Fairly common
25	Plain Prinia	*Prinia inornata*	R	-	Widespread	Uncommon
	Columbidae					
26	Spotted Dove	*Streptopelia chinensis*	R	IV	Widespread	Common
27	Rock Pigeon	*Columba livia*	R	-	Widespread	Fairly common
28	Yellow-legged Green Pigeon	*Treron phoenicopterus*	R	IV	Widespread	
	Coraciidae					
29	Indian Roller*	*Coracias benghalensis*	R	IV	Widespread	Very common
	Corvidae					
30	Rufous Treepie*	*Dendrocitta vagabunda*	R	IV	Widespread	Common
31	Large-billed Crow	*Corvus macrorhynchos*	R	-	Widespread	
32	House Crow	*Corvus splendens*	R	V	Widespread	
	Cuculidae					
33	Common Hawk Cuckoo*	*Hierococcyx varius*	R	IV	Indian subcontinent	Very common
34	Greater Coucal*	*Centropus sinensis*	R	-	Widespread	Common
35	Asian Koel	*Eudynamys scolopaceus*	R	IV	Widespread	Fairly common
36	Indian Cuckoo	*Cuculus micropterus*	SM	IV	Widespread	Fairly common
37	Sirkeer Malkoha	*Taccocua leschenaultii*	R	-	Indian Subcontinent	Fairly common
	Dicaeidae					
38	Pale-billed Flowerpecker	*Dicaeum erythrorhynchos*	R	IV	Indian Subcontinent	Common
39	Thick-billed Flowerpecker	*Sirkeer cuckoo*	R	IV	Widespread	Fairly common
	Dicruridae					
40	Black Drongo*	*Dicrurus macrocercus*	R	IV	Widespread	Very common
41	White-bellied Drongo*	*Dicrurus caerulescens*	R	IV	Indian Subcontinent	Fairly common
42	Greater Racquet-tailed Drongo	*Dicrurus paradiseus*	R	IV	Widespread	Uncommon

	Family/ Common Name	Scientific Name	Migration Status	Wildlife (Protection) Act Schedule	Endemic status	Relative abundance status
43	Lesser Racquet-tailed Drongo	*Dicrurus remifer*	R	IV	Widespread	
44	Hair-crested Drongo	*Dicrurus hottentottus*	R	IV	Widespread	
	Leiothrichidae					
45	Jungle Babbler*	*Turdoides striata*	R	IV	Indian Subcontinent	Very common
	Meropidae					
46	Green Bee-eater*	*Merops orientalis*	R	-	Widespread	Very common
	Monarchidae					
47	Indian paradise-flycatcher	*Terpsiphone paradisi*	SM	-	Widespread	Uncommon
48	Black-naped Monarch	*Hypothymis azurea*	R	-	Widespread	Uncommon
	Motacillidae					
49	Tree Pipit	*Anthus trivialis*	WM	IV	Widespread	Common
50	Grey Wagtail	*Motacilla cinerea*	WM	-	Widespread	Uncommon
	Muscicapidae					
51	Oriental Magpie Robin*	*Copsychus saularis*	R	IV	Widespread	Common
52	Red-breasted Flycatcher	*Ficedula parva*	WM	IV	Widespread	Common
53	Tickell's Blue Flycatcher*	*Cyornis tickelliae*	R	IV	Indian Subcontinent	Fairly common
54	Blue Rock Thrush	*Monticola solitarius*	WM	IV	Widespread	Uncommon
55	Blue-capped rock Thrush	*Monticola cinclorhynchus*	WM	IV	Indian Subcontinent	Uncommon
	Nectariniidae					
56	Purple Sunbird	*Cinnyris asiaticus*	R	IV	Widespread	Common
57	Purple-rumped Sunbird	*Leptocoma zeylonica*	R	IV	Indian Subcontinent	Uncommon
	Oriolidae					
58	Black-hooded Oriole*	*Oriolus xanthornus*	R	IV	Widespread	Very common
59	Indian Golden oriole	*Oriolus kundoo*	R	IV	Widespread	Fairly common
	Paridae					
60	Cinereous Tit*	*Parus cinereus*	R	IV	Widespread	Common
	Passeridae					
61	Yellow-throated sparrow	*Gymnoris xanthocollis*	R	-	Widespread	Very common
62	House Sparrow	*Passer domesticus*	R	-	Widespread	Very common
	Phalacrocoracidae					
63	Indian Cormorant	*Phalacrocorax fuscicollis*	WM	IV	Widespread	Uncommon

	Family/ Common Name	Scientific Name	Migration Status	Wildlife (Protection) Act Schedule	Endemic status	Relative abundance status
	Phasianidae					
64	Common Quail	*Coturnix coturnix*	WM	IV	Widespread	Common
65	Red JungleFowl*	*Gallus gallus*	R	IV	Widespread	Fairly common
	Phylloscopidae					
66	Greenish leaf Warbler	*Seicercus trochiloides*	WM	-	Widespread	Very common
67	Hume's leaf- Warbler	*Phylloscopus humei*	WM	-	Widespread	Common
68	Common Chiffchaff	*Phylloscopus collybita*	WM	-	Widespread	
	Picidae					
69	White-naped Woodpecker *	*Chrysocolaptes festus*	R	IV	Indian Subcontinent	Very common
70	Yellow-fronted Pied Woodpecker*	*Dendrocopos mahrattensis*	R	IV	Widespread	Very common
71	Brown-capped Pygmy Woodpecker	*Dendrocopos moluccensis*	R	IV	Widespread	Fairly common
72	Lesser Golden-backed Woodpecker	*Dinopium benghalense*	R	IV	Indian Subcontinent	Uncommon
	Pittidae					
73	Indian Pitta	*Pitta brachyura*	SM	IV	Indian Subcontinent	Uncommon
	Podicipedidae					
74	Great Crested Grebe	*Podiceps cristatus*	WM	IV	Widespread	
	Psittaculidae					
75	Plum-headed Parakeet*	*Psittacula cyanocephala*	R	IV	Indian Subcontinent	Very common
76	Rose-ringed Parakeet	*Psittacula krameri*	R	IV	Widespread	Fairly common
	Pycnonotidae					
77	Red-vented Bulbul*	*Pycnonotus cafer*	R	IV	Indian Subcontinent	Fairly common
	Rallidae					
78	White-breasted Waterhen*	*Amaurornis phoenicurus*	R	-	Widespread	Very common
	Ramphastidae					
79	Brown-headed Barbet*	*Psilopogonzeylanicus*	R	IV	Indian Subcontinent	Very common
	Rhipiduridae					
80	White- browed Fantail	*Rhipidura aureola*	R	-	Widespread	Fairly common
81	White-throated Fantail	*Rhipidura albicollis*	R	-	Widespread	Uncommon

	Family/ Common Name	Scientific Name	Migration Status	Wildlife (Protection) Act Schedule	Endemic status	Relative abundance status
	Sittidae					
82	Indian Nuthatch*	*Sitta castanea*	R	-	Indian Subcontinent	Very common
	Strigidae					
83	Spotted Owlet*	*Athene brama*	R	IV	Widespread	Common
84	Jungle Owlet*	*Glaucidium radiatum*	R	IV	Indian Subcontinent	Common
	Sturnidae					
85	Common Myna*	*Acridotheres tristis*	R	IV	Widespread	Very common
86	Chestnut-tailed Starling	*Sturnia malabarica*	R	IV	Widespread	Fairly common
	Threskiornithidae					
87	Indian Black Ibis*	*Pseudibis papillosa*	R	IV	Indian Subcontinent	Common
	Turdidae					
88	Tickell's Thrush	*Turdus unicolor*	WM	IV	Indian Subcontinent	Uncommon
89	Indian Blackbird	*Turdus simillimus*	R	IV	Indian Subcontinent	
	Upupidae					
90	Common Hoopoe	*Upupa epops*	R	-	Widespread	Fairly common
	Vangidae					
91	Common Woodshrike	*Tephrodornis pondicerianus*	R	-	Widespread	Very common
	Zosteropidae					
92	Oriental White-eye	*Zosterops palpebrosus*	R	IV	Widespread	Uncommon

R – Resident; WM- Wintering Migrants; SM-Summer Migrant

Annexure 5.2

Forest department correspondence authenticating tiger occurrence in Korba Forest Division in the areas adjoining Hasdeo-Arand Coalfield

कार्यालय वन परिक्षेत्राधिकारी बाल्को परिक्षेत्र बाल्को, (छ.ग.)

क्रमांक/ 1101 दिनांक/ 7-8-14

प्रति,

वनमंडलाधिकारी
कोरबा वनमंडल कोरबा

विषय :- परिक्षेत्र अन्तर्गत वन्य प्राणी बाघ के पंजे का निशान मिलने की सूचना बाबत्।

उपरोक्त विषय में निवेदन है कि बाल्को परिक्षेत्र के अंतर्गत प.स.वृत्त बाल्को के दोतार परिसर के कक्ष क्रमांक पुराना 2155 नया 944 में आज दिनांक 07.08.2014 को सुबह वन्य प्राणी बाघ के पंजे का निशान मिलने की सूचना प्राप्त हुई मौका निरीक्षण मेरे द्वारा किया गया एवं पंजे का निशान को प्लास्टर ऑफ पेरिस से लिया गया। जिसका पंजे की साईज लगभग 14 से.मी. लम्बाई एवं 15 से.मी. चौडाई तथा आगे पंजे से पीछे पंजे की दूरी लगभग 114 से मी. पाया गया है ।

अतः प्रतिवेदन आपके अवलोकनार्थ एवं आवश्यक कार्यवाही हेतु सादर सम्प्रेषित है।

वन परिक्षेत्राधिकारी
बाल्को परिक्षेत्र बाल्को

कार्यालय वनपरिक्षेत्राधिकारी बालको परिक्षेत्र बालको, (छ.ग.)

क्रमांक/ 1419 दिनांक/ 09/09/2015

प्रति,

वनमंडलाधिकारी

कोरबा वनमंडल कोरबा

विषय – परिक्षेत्र अन्तर्गत तना प्राणी वास के पंजे का निशान मिलने की सूचना बाबत।

सविनय निवेदन है कि बालको परिक्षेत्र के अंतर्गत ए क वृत्त अजगरबहार परिसर का कक्ष क्रमांक पी 972 में आज सुबह दिनांक 07.09.2015 एवं दोपहर में अजगरबहार परिसर के कक्ष क्रमांक आर एफ 1236 कर्वधा में वन्य प्राणी बाघ के पंजे का निशान मिलने की सूचना प्राप्त हुई थी। परिक्षेत्र स्टाफ द्वारा मिला गया एवं पंजे का निशान को प्लास्टर ऑफ पेरिस से लिया गया। जिसका पंजे का नाप लगभग 14 से.मी. लम्बाई एवं 14 से.मी. चौड़ाई पाया गया है। जिसका विवरण एवं जी.पी.एस. स्थिति नीचे वर्णानुसार है।

क्र.	दिनांक	परिसर का नाम	कक्ष क्रमांक	जी.पी.एस. स्थिति	पंजे की साईज
1.	07.09.2015	दोनों	पी 972	N - 22°26'11.28" E - 82°46'27.51"	लगभग 14 से.मी. लम्बाई
2.	07.09.2015	अजगरबहार	आर.एफ. 1236 ग्राम कर्वधा	N - 22°29'582" E - 82°41'442"	लगभग 14 से.मी. चौड़ाई

आप प्रतिवेदन आपत्ति अग्रसारणार्थ एवं आवश्यक कार्यवाही हेतु भवदीय प्रस्तुत है।

संलग्न – उपरोक्तानुसार प्लास्टर ऑफ पेरिस से लिया गया पंजे का निशान।

वन परिक्षेत्राधिकारी
बालको परिक्षेत्र बालको

Details of spatio-temporal samplings of aquatic macrobenthic fauna from the streams in core/buffer areas of proposed/active coal blocks in the whole Hasdeo-Arand Coalfield in Surguja, Surajpur and Korba, Chhattisgarh

Sl. No.	Location Sl. No.	Sampling Period	Coal Block No. (Core/Buffer)	Compartment/ Village	Forest Range	Forest Division	Lat. (N)	Long. (E)	Alt. (m)
	1	Jun, 2019	12, 20, 21 Buffer	P2103	Udaipur	Surguja	22°50'50.33''	82°51'23.89''	519
	18	Sept, 2019	12, 20, 21 Buffer	P2103	Udaipur	Surguja	22°50'46.48''	82°51'26.11''	523
1	**49**	Feb, 2020	12, 20, 21 Buffer	P2103	Udaipur	Surguja	22°50'48.48''	82°51'23.39''	518
	2	Jun, 2019	20, 21 Buffer	P2059	Udaipur	Surguja	22°52'17.11''	82°54'47.28''	552
	16	Sept, 2019	20, 21 Buffer	P2059	Udaipur	Surguja	22°52'17.72''	82°54'48.45''	560
2	**48**	Feb, 2020	20, 21 Buffer	P2059	Udaipur	Surguja	22°52'17.14''	82°54'48.69''	550
3	**3**	Jun, 2019	13, 14, 15, 20, 21 Buffer	P2014	Udaipur	Surguja	22°52'33.10''	82°47'48.92''	493
4	**17**	Sept, 2019	20 Buffer	P2100	Udaipur	Surguja	22°50'34.22''	82°53'01.35''	539
5	**19**	Sept, 2019	21 Core	P2062	Udaipur	Surguja	22°51'37.57''	82°57'09.99''	572
	4	Jun, 2019	13, 14, 15, 20, 21 Buffer	Shivnagar	Ramanuj Nagar	Surajpur	22°52'35.52''	82°47'44.39''	488
	21	Sept, 2019	13, 14, 15, 20, 21 Buffer	Shivnagar	Ramanuj Nagar	Surajpur	22°52'37.12''	82°47'47.11''	493
6	**42**	Feb, 2020	13, 14, 15, 20, 21 Buffer	Shivnagar	Ramanuj Nagar	Surajpur	22°52'36.79''	82°47'47.19''	489

Sl. No.	Location Sl. No.	Sampling Period	Coal Block No. (Core/Buffer)	Compartment/ Village	Forest Range	Forest Division	Lat. (N)	Long. (E)	Alt. (m)
	15	Jun, 2019	15 Buffer	P1993	Ramanuj Nagar	Surajpur	22°53'34.72''	82°44'48.32''	504
7	22	Sept, 2019	15 Buffer	P1993	Ramanuj Nagar	Surajpur	22°53'33.95''	82°44'42.03''	504
	39	Sept, 2019	13, 14, 15 Buffer	Salhi Village	Udaipur	Surguja	22°51'41.09''	82°47'01.65''	503
8	43	Feb, 2020	13, 14, 15 Buffer	Salhi Village	Udaipur	Surguja	22°51'42.26''	82°47'00.81''	504
9	46	Feb, 2020	13 Core & 14, 15 Buffer	Salhi Village	Udaipur	Surguja	22°51'11.36''	82°46'58.86''	504
10	47	Feb, 2020	14 Core	Ghatbara village	Ramanuj Nagar	Surajpur	22°49'21.69''	82°47'44.66''	531
	7	Jun, 2019	9 Core & Buffer 7, 8, 16	P366	Kendai	Katghora	22°45'44.07''	82°40'08.80''	456
11	26	Sept, 2019	9 Core & Buffer 7, 8, 16	P366	Kendai	Katghora	22°45'44.34''	82°40'10.71''	451
	9	Jun, 2019	11 Core & 3, 7, 8, 9, 16 Buffer	P372	Kendai	Katghora	22°46'41.33''	82°37'51.55''	412
	25	Sept, 2019	11 Core & 3, 7, 8, 9, 16 Buffer	P371	Kendai	Katghora	22°46'41.38''	82°37'59.39''	413
12	58	Feb, 2020	11 Core & 3, 7, 8, 9, 16 Buffer	P371	Kendai	Katghora	22°46'42.23''	82°37'59.67''	406
13	59	Feb, 2020	3, 4, 7 Buffer	Kendai OA726	Kendai	Katghora	22°43'48.48''	82°36'32.29''	421
	23	Sept, 2019	11 Core & 9, 10, 15, 16 Buffer	P363	Kendai	Katghora	22°48'02.56''	82°40'16.84''	437
14	24	Sept, 2019	9 Core & 15, 16 Buffer	P387	Kendai	Katghora	22°47'41.14''	82°41'51.72''	459
15	45	Feb, 2020	9 Core & 15, 16 Buffer	P387	Kendai	Katghora	22°47'41.20''	82°41'52.01''	454

Sl. No.	Location Sl. No.	Sampling Period	Coal Block No. (Core/Buffer)	Compartment/ Village	Forest Range	Forest Division	Lat. (N)	Long. (E)	Alt. (m)
16	**44**	Feb, 2020	16 Core & 15, 10 Buffer	OA724	Kendai	Katghora	22°48'47.14''	82°42'38.89''	483
	5	Jun, 2019	19 Core & Buffer 12, 20, 21	P2125	Udaipur	Surguja	22°46'36.93''	82°52'27.46''	433
	40	Sept, 2019	19 Core & Buffer 12, 20, 21	P2125	Udaipur	Surguja	22°46'37.56''	82°52'26.22''	430
17	**52**	Feb, 2020	19 Core & Buffer 12, 20, 21	P2125	Udaipur	Surguja	22°46'37.95''	82°52'28.91''	416
	6	Jun, 2019	12, 14, 17, 19 Buffer	Parogya	Udaipur	Surguja	22°46'16.22''	82°50'09.38''	441
	34	Sept, 2019	12, 14, 17, 19 Buffer	Parogya	Udaipur	Surguja	22°46'22.87''	82°50'11.39''	437
18	**63**	Feb, 2020	12, 14, 17, 19 Buffer	Parogya	Udaipur	Surguja	22°46'16.72''	82°50'09.20''	430
	8	Jun, 2019	16 Core & 8, 13, 14, 15 Buffer	P434	Kendai	Katghora	22°46'10.63''	82°45'48.63''	469
19	**30**	Sept, 2019	16 Core & 8, 13, 14, 15 Buffer	P434	Kendai	Katghora	22°46'09.50''	82°45'52.36''	461
	11	Jun, 2019	19 Core	P2135	Udaipur	Surguja	22°46'00.11''	82°53'35.67''	458
	41	Sept, 2019	19 Core	P2135	Udaipur	Surguja	22°46'04.71''	82°53'36.93''	453
20	**53**	Feb, 2020	19 Core	P2135	Udaipur	Surguja	22°46'03.53''	82°53'36.70''	454
	29	Sept, 2019	7 Buffer	Arisiya OA727	Kendai	Katghora	22°43'53.78''	82°43'52.42''	420
21	**60**	Feb, 2020	7 Buffer	Arisiya OA727	Kendai	Katghora	22°43'53.88''	82°43'52.36''	421
22	**31**	Sept, 2019	16, 17, 14 Buffer	P440	Kendai	Katghora	22°45'36.39''	82°46'40.72''	440

Sl. No.	Location Sl. No.	Sampling Period	Coal Block No. (Core/Buffer)	Compartment/ Village	Forest Range	Forest Division	Lat. (N)	Long. (E)	Alt. (m)
	61	Feb, 2020	16, 17, 14 Buffer	P440	Kendai	Katghora	22°45'36.07''	82°46'41.52''	430
23	**62**	Feb, 2020	12, 14, 17, 19 Buffer	Parogya Village	Udaipur	Surguja	22°46'49.46''	82°50'19.68''	437
	12	Jun, 2019	1 Core Nakiya	P873	Lemru	Korba	22°39'08.07''	82°53'55.04''	471
	36	Sept, 2019	1 Core Nakiya	OA1199	Lemru	Korba	22°39'08.06''	82°53'56.68''	469
24	**55**	Feb, 2020	1 Core Nakiya	OA1199	Lemru	Korba	22°39'07.45''	82°53'56.52''	468
	13	Jun, 2019	1 Core Nakiya	Rapta Village	Lemru	Korba	22°38'55.61''	82°55'39.62''	469
	37	Sept, 2019	1 Core Nakiya	Rapta Village	Lemru	Korba	22°38'55.96''	82°55'38.21''	465
25	**56**	Feb, 2020	1 Core Nakiya	Rapta Village	Lemru	Korba	22°38'56.10''	82°55'39.37''	464
26	**14**	Jun, 2019	1 Core Nakiya	P901	Lemru	Korba	22°38'52.91''	82°56'32.38''	511
	35	Sept, 2019	1 Buffer	OA1186	Lemru	Korba	22°41'05.65''	82°50'57.53''	391
27	**54**	Feb, 2020	1 Buffer	OA1186	Lemru	Korba	22°41'05.54''	82°50'48.70''	372
	38	Sept, 2019	1 Core Nakiya	OA1196	Lemru	Korba	22°38'58.22''	82°57'58.29''	573
28	**57**	Feb, 2020	1 Core Nakiya	OA1196	Lemru	Korba	22°38'58.90''	82°57'57.77''	562
	10	Jun, 2019	2 Buffer	PondiKhurd	Kendai	Katghora	22°49'30.03''	82°28'08.31''	391
29	**27**	Sept, 2019	2 Buffer	PondiKhurd	Kendai	Katghora	22°49'33.37''	82°28'08.16''	380

Sl. No.	Location Sl. No.	Sampling Period	Coal Block No. (Core/Buffer)	Compartment/ Village	Forest Range	Forest Division	Lat. (N)	Long. (E)	Alt. (m)
	64	Feb, 2020	2 Buffer	PondiKhurd	Kendai	Katghora	22°49'33.01''	82°28'06.18''	389
	28	Sept, 2019	2 Buffer	Parla Village	Kendai	Katghora	22°46'44.85''	82°29'53.13''	424
30	**65**	Feb, 2020	2 Buffer	Parla Village	Kendai	Katghora	22°46'44.10''	82°29'52.50''	419
	20	Sept, 2019	21, 22, 23 Buffer	Narkola Village	Udaipur	Surguja	22°54'09.85''	82°59'57.80''	578
31	**51**	Feb, 2020	21, 22, 23 Buffer	Narkola Village	Udaipur	Surguja	22°54'09.55''	82°59'57.66''	570
	32	Sept, 2019	22 Core	P2188	Udaipur	Surguja	22°42'43.85''	82°57'54.97''	665
32	**50**	Feb, 2020	22 Core	P2188	Udaipur	Surguja	22°42'39.35"	82°57'53.74"	650
33	**33**	Sept, 2019	23 Core	P2175	Udaipur	Surguja	22°43'34.61"	83°03'12.74"	659

Annexure 6.2

A comparative account of the tolerance values of macroinvertebrate taxa for calculating biotic indices used in different geographic regions together with the values used at present for use of water quality assessment

S.N.	Order/Taxa	Family/Taxa	Tolerance Values Referred						Tolerance Values used for Present Study
			1	2	3	4	5	6	
1	Turbellaria	Dugesiidae*	5	2		4	3		4
2	Arhynchobdellida	Erpobdellidae	3	1	3		1		3
3	Rhynchobdellida	Glossiphoniidae	3	1	3	4	2		3
4	Oligochaeta	Oligochaeta*	1		1	2	2		1
5	Coleoptera	Dytiscidae	5	2	5		5	6	2
6	Coleoptera	Elmidae		7		8		5	5
7	Coleoptera	Gyrinidae	5	4	5	7		5	4
8	Coleoptera	Hydraenidae		3	5	8	8	5	3
9	Coleoptera	Hydrophilidae	5	2	5		6	6	2
10	Coleoptera	Lampyridae						6	6
11	Coleoptera	Psephenidae	5	6	5	8		5	6
12	Diptera	Athericidae		8		9	10	5	5
13	Diptera	Ceratopogonidae		4		2	3	6	4
14	Diptera	Chironomidae	2	3	2	1	2	1	2
15	Diptera	Culicidae		1			1		1
16	Diptera	Simuliidae	5	5	5	7	4	5	4
17	Diptera	Stratiomyidae		2	3			5	3
18	Diptera	Tabanidae		3		7		5	5
19	Diptera	Tipulidae	5	5	5	8	3	6	5
20	Ephemeroptera	Baetidae	4	5	4		7	6	4
21	Ephemeroptera	Caenidae	7	4	7	7	7	4	4
22	Ephemeroptera	Ephemerellidae*	10	9	10	7		5	10
23	Ephemeroptera	Ephemeridae	10		10			6	10
24	Ephemeroptera	Heptageniidae	10		10	10	9	6	10
25	Ephemeroptera	Leptophlebidae	10	8	10	7	10	6	10
26	Plecoptera	Perlidae	10		10	8	9	6	10
27	Trichoptera	Hydropsychidae	5	6	5	9	7	5	6
28	Trichoptera	Leptoceridae	10	6	10		7	6	6
29	Trichoptera	Limnephilidae		8					8
30	Trichoptera	Odontoceridae	10	7	10	7	10	8	7
31	Trichoptera	Philopotamidae	8	8	8	7	8	6	8
32	Trichoptera	Rhyacophilidae	7			8			7
33	Lepidoptera	Pyralidae		3		7		5	5
34	Megaloptera	Corydalidae	4	7	4	7		7	7
35	Hemiptera	Belostomatidae		1	5				5
36	Hemiptera	Corixidae	5	2	5		10	6	2
37	Hemiptera	Gerridae	5	4	5		5	5	4
38	Hemiptera	Naucoridae	5	2	5	7	7	6	5
39	Hemiptera	Nepidae	5	3	5	6			3
40	Hemiptera	Notonectidae	5	1	5	3	8	5	3
41	Hemiptera	Pleidae	5	2	5	4		5	4
42	Odonata	Aeshnidae	6	4	6	7	9	8	6

S.N.	Order/Taxa	Family/Taxa	Tolerance Values Referred						Tolerance Values used for Present Study
			1	2	3	4	5	6	
43	Odonata	Calopterygidae	6		6	8	8	7	**6**
44	Odonata	Coenagrionidae	6	2	4	5	3	5	**4**
45	Odonata	Cordulidae	6	5	4	5	5	6	**5**
46	Odonata	Gomphidae	6	5	6		8	5	**5**
47	Odonata	Lestidae		1	6	7			**6**
48	Odonata	Libellulidae	6	4	4	6	4	5	**4**
49	Odonata	Macromiidae	6	8	6	7			**8**
50	Decapoda	Atyidae	8	3	3	6	6		**6**
51	Decapoda	Gecarcinucidae*	3	3	3	6	9		**3**
52	Decapoda	Palaemonidae	8	4	3	6	7		**4**
53	Basommatophora	Lymnaeidae	3	1	3	4	1	1	**1**
54	Basommatophora	Planorbidae	3	2	3	6	2		**2**
55	Mesogastropoda	Thiariade	3	4	3	4	1		**3**
56	Mesogastropoda	Viviparidae	6	4	4	6			**4**
57	Basommatophora	Ancylidae	6	4			1		**6**
58	Unionoida	Unionidae	6		4	6			**4**
59	Venerioda	Pisidiidae*	3	5	3	7			**3**
		Total Taxa	**47**	**51**	**48**	**44**	**39**	**39**	**59**

*used different taxa names as per the latest classifications

1. **Thailand:** BMWP-Thai (Mustow, 2002); 2. **Australia:** Signal2 (Chessman, 2003); 3. **Vietnam:** BMWP-Viet (Nguyen *et al.*, 2004); 4. **Lower Gangetic Plains**-HKH Bios: (Ofenbock*et al.*, 2010); 5. **Singapore:** Sign-Score (Blakely *et al.*, 2014); 6. **Malaysia:** BMWP-My (Zakaria& Mohamed, 2019)

Annexure 6.3

Taxonomic classification of the macroinvertebrates collected from the streams in the core/buffer areas of the proposed/active coal blocks in the whole HAC

S.N.	Phylum	Class	Order/Taxa	Family/Taxa	Species/ Taxa	Total Abundance
1	Platyhelminthes	Rhabditophora	Tricladida	Dugesiidae		154
2	Annelida	Clitellata	Arhynchobdellida	Erpobdellidae		42
3	Annelida	Clitellata	Rhynchobdellida	Glossiphoniidae		24
4	Annelida	Clitellata	Lumbriculida	Lumbriculidae		28
5	Annelida	Clitellata	Haplotaxida	Naididae		18
6	Annelida	Clitellata	Haplotaxida	Tubificidae		2
7	Annelida	Clitellata	Oligochaeta	Oligochaeta		50
8	Arthropoda	Insecta	Diptera	Athericidae		86
9	Arthropoda	Insecta	Diptera	Ceratopogonidae		6
10	Arthropoda	Insecta	Diptera	Chironomidae		447
11	Arthropoda	Insecta	Diptera	Culicidae		15
12	Arthropoda	Insecta	Diptera	Simuliidae		2333
13	Arthropoda	Insecta	Diptera	Stratiomyidae		4
14	Arthropoda	Insecta	Diptera	Tabanidae		78
15	Arthropoda	Insecta	Diptera	Tipulidae	*Hexatoma* sp.	22
16	Arthropoda	Insecta	Diptera	Tipulidae		26
17	Arthropoda	Insecta	Coleoptera	Dytiscidae	*Cybister* sp.	26
18	Arthropoda	Insecta	Coleoptera	Dytiscidae		27
19	Arthropoda	Insecta	Coleoptera	Dytiscidae	*Hydaticus* sp.	2
20	Arthropoda	Insecta	Coleoptera	Elmidae		38
21	Arthropoda	Insecta	Coleoptera	Gyrinidae		10
22	Arthropoda	Insecta	Coleoptera	Hydraenidae		12
23	Arthropoda	Insecta	Coleoptera	Hydrophilidae		100
24	Arthropoda	Insecta	Coleoptera	Lampyridae		1
25	Arthropoda	Insecta	Coleoptera	Psephenidae		34
26	Arthropoda	Insecta	Ephemeroptera	Baetidae		786
27	Arthropoda	Insecta	Ephemeroptera	Caenidae		296
28	Arthropoda	Insecta	Ephemeroptera	Ephemerellidae		169
29	Arthropoda	Insecta	Ephemeroptera	Ephemeridae		14
30	Arthropoda	Insecta	Ephemeroptera	Heptageniidae		15
31	Arthropoda	Insecta	Ephemeroptera	Leptophlebidae		330
32	Arthropoda	Insecta	Plecoptera	Perlidae		5
33	Arthropoda	Insecta	Trichoptera	Hydropsychidae		1848
34	Arthropoda	Insecta	Trichoptera	Leptoceridae		659
35	Arthropoda	Insecta	Trichoptera	Limnephilidae		2
36	Arthropoda	Insecta	Trichoptera	Odontoceridae		53
37	Arthropoda	Insecta	Trichoptera	Philopotamidae		158
38	Arthropoda	Insecta	Trichoptera	Rhyacophilidae		11
39	Arthropoda	Insecta	Lepidoptera	Pyralidae		18
40	Arthropoda	Insecta	Megaloptera	Corydalidae		6
41	Arthropoda	Insecta	Hemiptera	Belostomatidae	*Lithoceru sindicus*	3

S.N.	Phylum	Class	Order/Taxa	Family/Taxa	Species/ Taxa	Total Abundance
42	Arthropoda	Insecta	Hemiptera	Belostomatidae		1
43	Arthropoda	Insecta	Hemiptera	Corixidae		8
44	Arthropoda	Insecta	Hemiptera	Gerridae		14
45	Arthropoda	Insecta	Hemiptera	Naucoridae		7
46	Arthropoda	Insecta	Hemiptera	Nepidae	*Laccotrphes* sp.	57
47	Arthropoda	Insecta	Hemiptera	Nepidae	*Ranatra* sp.	4
48	Arthropoda	Insecta	Hemiptera	Notonectidae	*Enithares* sp.	8
49	Arthropoda	Insecta	Hemiptera	Notonectidae		1
50	Arthropoda	Insecta	Hemiptera	Pleidae		1
51	Arthropoda	Insecta	Odonata	Aeshnidae		2
52	Arthropoda	Insecta	Odonata	Calopterygidae		5
53	Arthropoda	Insecta	Odonata	Coenagrionidae		216
54	Arthropoda	Insecta	Odonata	Cordulidae		7
55	Arthropoda	Insecta	Odonata	Gomphidae		183
56	Arthropoda	Insecta	Odonata	Lestidae		62
57	Arthropoda	Insecta	Odonata	Libellulidae		392
58	Arthropoda	Insecta	Odonata	Macromiidae		8
59	Arthropoda	Malacostraca	Decapoda	Atyidae		1
60	Arthropoda	Malacostraca	Decapoda	Gecarcinucidae		25
61	Arthropoda	Malacostraca	Decapoda	Palaemonidae	*Macrobrachium* sp.	51
62	Mollusca	Gastropoda	Basommatophora	Ancylidae	*Ferrissia* sp.	42
63	Mollusca	Gastropoda	Basommatophora	Lymnaeidae		320
64	Mollusca	Gastropoda	Basommatophora	Planorbidae		338
65	Mollusca	Gastropoda	Mesogastropoda	Thiariade	*Melanoidestuberculata*	102
66	Mollusca	Gastropoda	Mesogastropoda	Thiariade	*Thiarascabra*	1
67	Mollusca	Gastropoda	Mesogastropoda	Viviparidae	*Bellamya* sp.	14
68	Mollusca	Bivalvia	Unionoida	Unionidae		5
69	Mollusca	Bivalvia	Venerioda	Pisidiidae		91
Abundance						**9924**
Richness						**69**

Annexure 7.1

List of census villages in study area of Hasdeo-Arand Coalfield falls within Korba, Surguja and Surajpur districts of Chhattisgarh

District	Tehsil	Name of Villages		
Korba	Poundi Uproda	Fulsar	Dhajak	Lad
		Hardeva	Ketma	Ghunchapur
		Korbi	Morga	Jajgi
		Rode	Uchalenga	Sakhoda
		Sarma	Kendai	Bhujung Kachhar
		Baniya	Arisiya	Gidmudi
		Pondi Khurd	Puta	Thrriama
		Chotiya	Khirati	Khotkhurri
		Parla	Madanpur	Lamna
		Lalpur	Paturiyadand	Kulhariya
		Kapana Wapara		
	Korba	Amaldiha	Bahera	Mauhar
		Nakiya	Kerijheriya	Kerwa
		Bimalta	Kadam Jheriya	Samarkana
		Kudrichingar	Gahaniya	Aretara
		Pendradih	Balsengha	Rapta
		Lemroo	Patrapali	Keubahar
		Ranpa		
Surajpur	Premnagar	Rameshwar Nagar	Mendra	Janardanpur
		Baldevnagar	Laxmanpur	Kantaroli
		Vindhyachal	Raghunathpur	Salka
		Hariharpur	Chandannagar	Tara
		Maheshpur	Abhaypur	Shivnagar
Surguja	Udiapur	Mudgaon	Ghatbarra	
		Gumga	Kete	Manpur
		Salba	Bule	Sanibarra
		Bangru	Khondhala	Jhirmiti
		Puta	Jajga	Jarhadih
		Manoharpur	Matringa	Daulatpur
		Dawa	Pangoti	Basen
		Vishunpur	Badegaon	Chakeri
		Pandripani	Bhakurma	Sarma
		Palka	Bakoi	Tendu Tikra
		Khodri	Khujhi	Pendarkhi
		Rajbandh	Parogia	Pahadkorja
		Kawalgiri	Saidu	Laxmangarh
		Sontarai	Salhi	Phungi
		Keshma	Hariharpur	Ramnagar
		Lalpur	Fattepur	Udaipur
		Kundeli	Parsa	Dumardih
		Mareya	Sukhari Bhander	Kedma
		Sitkalo	Sayar	Mohanpur
		Suskam	Kumdewa	Maheshpur

Γ trict	Tehsil	Name of Villages		
		Dandgaon		
	Lakhanpur	Amgasi	Kenapara	Dhodha Kesra
		Biniya	Kunni	Patkura
		Jiwiliya	Karai	Lipangi
		Narkalo	Tirkela	Pondi
		Manja	Jama	Tunga
		Chodeya	Argoti	
Source- Based on Census of India, 2011 data				

Annexure 7.2

Table 1: List of respodents interviewed from villages in study area Hasdeo-Arand Coalfield falls within Korba, Surguja and Surajpur districts of Chhattisgarh

S.No.	Name of Respondent	Village	CD Block	District
1	Ghasi Ram	Laxmangarh	Udaipur	Surguja
2	Bhulehi	Khoji	Udaipur	Surguja
3	Ranjan Singh Binswar	Arsiya	Poudi Uproda	Korba
4	Jaisingh Binjhwar	Arsiya	Poudi Uproda	Korba
5	Indrapal Binjhwar	Arsiya	Poudi Uproda	Korba
6	Shiv SinghBinjhwar	Arsiya	Poudi Uproda	Korba
7	Ram Singh Bijhwar	Arsiya	Poudi Uproda	Korba
8	Budhram Kanwar	Arsiya	Poudi Uproda	Korba
9	Shriram Ahir	Arsiya	Poudi Uproda	Korba
10	Surajram Yadav	Arsiya	Poudi Uproda	Korba
11	Ramvichar Yadav	Arsiya	Poudi Uproda	Korba
12	Tampeshwar kumar Ahir	Arsiya	Poudi Uproda	Korba
13	Injorsai Binjhwar	Uchlenga	Poudi Uproda	Korba
14	Raisingh Binjhwar	Uchlenga	Poudi Uproda	Korba
15	Brijlal Binjhwar	Uchlenga	Poudi Uproda	Korba
16	NanhiRam Binjhwar	Uchlenga	Poudi Uproda	Korba
17	Gopal Binjhwar	Uchlenga	Poudi Uproda	Korba
18	Moliram Binjhwar	Uchlenga	Poudi Uproda	Korba
19	Akaluram Binjhwar	Uchlenga	Poudi Uproda	Korba
20.	Rajamohan Raghvanshi	Bhakurma,	Udaipur	Surguja
21.	Amritlal Ekka	Bhakurma,	Udaipur	Surguja
22	Ramko	Bhakurma,	Udaipur	Surguja
23.	Mohar Sai	Bhakurma,	Udaipur	Surguja
24.	Salabah	Bhakurma,	Udaipur	Surguja
25.	Majnu	Bhakurma,	Udaipur	Surguja
26.	Sahat Ram	Bhakurma,	Udaipur	Surguja
27.	Kunjal Mani	Bhakurma,	Udaipur	Surguja
28.	Laxman Bada	Bhakurma,	Udaipur	Surguja
29.	Ajay Bhagat	Bhakurma	Udaipur	Surguja
30.	Munshi	Beldandh	Poudi Uproda	Korba
31.	Sanath	Beldandh	Poudi Uproda	Korba
32.	Philip Lakra	Dhanudangh	Poudi Uproda	Korba
33.	Jual Lakra	Dhanudangh	Poudi Uproda	Korba
34.	Bhangud	Dhanudangh	Poudi Uproda	Korba
35.	Pascal Tigga	Dhanudangh	Poudi Uproda	Korba

S.No.	Name of Respondent	Village	CD Block	District
36.	Pawan Tigga	Dhanudangh	Poudi Uproda	Korba
37.	Suresh Ekka	Kudarbaswar	Poudi Uproda	Korba
38.	Tejram Minz	Kudarbaswar	Poudi Uproda	Korba
39.	Suklal Kujur	Kudarbaswar	Poudi Uproda	Korba
40	Akhilesh Kumar	Kudarbaswar	Poudi Uproda	Korba
41	Naymal Khais	Jujdandh	Poudi Uproda	Korba
42	Rajiv	Jujdandh	Poudi Uproda	Korba
43.	Yakub Ekka	Khudarbaswar	Poudi Uproda	Korba
44.	Akhilesh Kumar Uikey	Parogiya	Udaipur	Surguja
45	Premnath Yadav	Parogiya	Udaipur	Surguja
46	Sannu Ram	Parogiya	Udaipur	Surguja
47	Alam Sai	Parogiya	Udaipur	Surguja
48	Gauharam	Parogiya	Udaipur	Surguja
49	Takeshwar Yadav	Parogiya	Udaipur	Surguja
50	Sinha Ram	Parogiya	Udaipur	Surguja
51	Devnal	Parogiya	Udaipur	Surguja
52	Bhola Ram	Parogiya	Udaipur	Surguja
53	Seva Ram	Parogiya	Udaipur	Surguja
54	Nehar Sai	Parogiya	Udaipur	Surguja
55	Kailash Singh	Chakeri,	Udaipur	Surguja
56	Om Prakash	Chakeri,	Udaipur	Surguja
57	Munna Singh	Chakeri,	Udaipur	Surguja
58	Surendra	Chakeri,	Udaipur	Surguja
59	Bir Singh	Chakeri,	Udaipur	Surguja
60	Vijay Kumar	Chakeri,	Udaipur	Surguja
61	Monu Ram	Sarma	Udaipur	Surguja
62	Sunandan	Sarma	Udaipur	Surguja
63	Masat Ram Paikra	Sarma	Udaipur	Surguja
64	Govind	Sarma	Udaipur	Surguja
65	Dev Shankar	Sarma	Udaipur	Surguja
66	Munna Ram	Sarma	Udaipur	Surguja
67	Bhagwan Singh	Bhujang Kachar	Poudi Uproda	Korba
68	Prabhu Singh	Bhujang Kachar	Poudi Uproda	Korba
69	Mulki Bai	Bhujang Kachar	Poudi Uproda	Korba
70	Krishna Kumar	Bhujang Kachar	Poudi Uproda	Korba
71	Shiv Mangal Singh	Bhujang Kachar	Poudi Uproda	Korba
72	Sita Ram	Bhujang Kachar	Poudi Uproda	Korba
73	Ram Chandra	Bhujang Kachar	Poudi Uproda	Korba
74	Chitrapal Singh	Guchapur	Poudi Uproda	Korba
75	Brijlal	Guchapur	Poudi Uproda	Korba
76	Naihar Lal	Guchapur	Poudi Uproda	Korba
77	Jay Lal	Guchapur	Poudi Uproda	Korba
78	Prayag Lal Yadav	Guchapur	Poudi Uproda	Korba
79	Dev Prasad	Guchapur	Poudi Uproda	Korba
80	Shukarvar Singh	Chotia	Poudi Uproda	Korba
81	Jai Ram	Chotia	Poudi Uproda	Korba
82	Nawal Singh	Chotia	Poudi Uproda	Korba
83	Kripal Singh	Chotia	Poudi Uproda	Korba
84	Shiv Kumar	Chotia	Poudi Uproda	Korba
85	Krishna Kumar	Chotia	Poudi Uproda	Korba
86	Bandhan Das	Chotia	Poudi Uproda	Korba
87	Nohar Lal	Imli Para	Premnagar	Surajpur

No.	Name of Respondent	Village	CD Block	District
88	Brij Lal	Mendra,	Premnagar	Surajpur
89	Shankar Prasad	Laxmangarh,	Udaipur	Surguja
90	Harihar Prasad	Laxmangarh,	Udaipur	Surguja
91	Ghasi Ram Patel	Laxmangarh,	Udaipur	Surguja
92	Laxman	Tendu Tikra,	Udaipur	Surguja
93	Paras Ram	Tendu Tikra,	Udaipur	Surguja
94	Amar Sai	Pandrekhi,	Udaipur	Surguja
95	Sabal Singh	Saidu	Poudi Uproda	Korba
96	Aladesh	Saidu	Poudi Uproda	Korba
97	Gulaab Singh	Kedma	Udaipur	Surguja
98	Ramdhan Rathiya	Nakiya	Korba	Korba
99	Sh. Ganesh Ram	Khoji	Udaipur	Surguja
100	Sh. Sudeshwar Singh	Khoji	Udaipur	Surguja
101	Sh. Kariban Singh	Khoji	Udaipur	Surguja
102	Shrimati	Khoji	Udaipur	Surguja
103	Asha Painkra	Khoji	Udaipur	Surguja
104	Ramjit	Sarma	Udaipur	Surguja
105	Birbal Singh	Sarma	Udaipur	Surguja
106	Madwari Ram	Sarma	Udaipur	Surguja
107	Sobhnath	Laxmangarh	Udaipur	Surguja
108	Laxman Ram	Laxmangarh	Udaipur	Surguja
109	Sukhan Ram	Laxmangarh	Udaipur	Surguja
110	Harihar Prasad	Laxmangarh	Udaipur	Surguja
111	Prem Sai	Laxmangarh	Udaipur	Surguja
112	Hari Bilas	Laxmangarh	Udaipur	Surguja
113	Dhaneshwar	Laxmangarh	Udaipur	Surguja
114	Baridas	Laxmangarh	Udaipur	Surguja
115	Vinod Kumar	Laxmangarh	Udaipur	Surguja
116	Ramadhar Rathia	Nakiya	Korba	Korba
117	Sattar singh	Nakiya	Korba	Korba
118	Pawan Kumar	Nakiya	Korba	Korba
119	Chait Ram	Nakiya	Korba	Korba
120	Dhanesh	Nakiya	Korba	Korba
121	Sanjhav Ram	Nakiya	Korba	Korba
122	Sukh Singh	Bimlata	Korba	Korba
123	Nauha Sai	Bimlata	Korba	Korba
124	Shamshad	Bimlata	Korba	Korba
125	Odia Ram	Bimlata	Korba	Korba
126	Chanesh Ram	Bimlata	Korba	Korba
127	Barath Ram	Bimlata	Korba	Korba
128	Sher Singh	Bimlata	Korba	Korba
129	Ram Sai	Bimlata	Korba	Korba
130	Bhawan Singh	Bimlata	Korba	Korba
131	Deo Singh	Bimlata	Korba	Korba
132	Shesh Kumar	Rapta	Korba	Korba
133	Mangt Ram	Rapta	Korba	Korba
134	Aghan Sai	Rapta	Korba	Korba
135	Maya Ram	Rapta	Korba	Korba
136	Sant Ram	Rapta	Korba	Korba
137	Rati Ram Minz	Lalpar	Poudi Uproda	Korba
138	Shiv Kumar	Lalpur	Poudi Uproda	Korba
139	Biran	Guchapur	Poudi Uproda	Korba

S.No.	Name of Respondent	Village	CD Block	District
140	Bandhan Singh	Kolargadra	Poudi Uproda	Korba
141	Arjun Singh	Kolargadra	Poudi Uproda	Korba
142	Puniram Binjwar	Kolargadra	Poudi Uproda	Korba
143	Mahipal Singh	Bhujang Kachar	Poudi Uproda	Korba
144	Ram Singh Bijhwar	Navopara	Poudi Uproda	Korba
145	Bhanu Pratap	Navopara	Poudi Uproda	Korba
146	Dilip Paikra	Navopara	Poudi Uproda	Korba
147	Dilaram	Navopara	Poudi Uproda	Korba
148	Guharam Binjhwar	Saliha Pahri	Poudi Uproda	Korba
149	Chaituraam	Saliha Pahri	Poudi Uproda	Korba
150	Mahesh	Saliha Pahri	Poudi Uproda	Korba
151	Budhwa Singh	Saliha Pahri	Poudi Uproda	Korba
152	Dharm Singh	Rapta	Poudi Uproda	Korba

Table 2: List of key resource persons consulted and interviewed with the Forest Department, mining companies in study area Hasdeo-Arand Coalfield falls within Korba, Surguja and Surajpur districts of Chhattisgarh

	Name and designation	Contact No.
Udaipur Forest Range Surguja Forest Division	Mrs. Sapna Mukherjee, FRO	7987934053
	Ganga Ram Sharma, Forets Range Clerk	9424262564
	Ashok Singh, Forest Beat Officer, Dadgaon	7223044384
	Dinesh Tiwari, Forest Beat Officer, Laxmangarh	7000513944
	Rishi K Ravi, Forest Beat Officer, Sarma	9340197987
	Jarishakar Yikey, Forest Beat Officer, Bhakurma	9399197785
	Rajesh Rajware, Forest Beat Officer, Pindrakhi	9131073526
	Girish Bahadur, Forest Sepoy, Udaipur	7987530614
	Basant, Forest Beat Officer, Basen	8319879187
	SR Verma, Forest Beat Officer, Khoji	9926194546
	Bharat Singh, Forest Beat Officer, Parogia	8319279809
	Chonthe Ram, Forest Beat Officer, Badegaon	9644503479
	Bindeshwar, Forest Beat Officer, Kedma A	9340274002
	Raju, Forest Beat Officer, Kedma B	8461850369
	Satish Kapoor Sarthi, Forest Beat Officer, Khudarwasar	7748870317
	Amarnath Rajware, Forest Beat Officer, Siar	799939286
	Arun K Singh, Forest Beat Officer, Salhi	8120790640
	Dhaneshwar Singh, Forest Beat Officer, Manpur	8319667260
	Girish Mohan Singh, Forest Beat Officer, Udaipur	7987590614
	Sashi Kant, Forest Beat Officer, Sontaria	8319702045
	Egnes Beck, Forest Beat Officer, Maria	7999766290
	Kaushal K Pekra, Forest Beat Officer, Matringa	6264434084
Kendai Forest Range Kathgora Forest Division	AK Chhobey, Forest Range Officer, Kendai Forest Range	9425512760
	AK Mainnerwar, Dy. FRO	8889160076
	Vinay Kanwar, Forest Beat Officer, Botopal	9669009993
	Lalji Patel, Forest Beat Officer, Arsiya, Uchlenga, Gidmuri	9827550864
	Vinod K Rai, Forest Beat Officer, Saliapharai	9644048405
	Sanju Markam, Forest Beat Officer, Khutkhori	8463876881
	RK Banerjee, Forest Beat Officer, Dhajag	8719892013
	Sanjay Uraon, Forest Beat Officer, Ketma	7879527447

	Sundar K Kanwar, Forest Beat Officer, Morga & Khirti	8719819607
	AK Srivasa, Forest Beat Officer, Lalpur	9691603022
	Nagangar Jaiswal, Forest Beat Officer, Sakhoda	7771933664
	Bindeshwar Singh, Forest Beat Officer, Kedma	9340274002
	Chandrabhan Singh, Forest Beat Officer, Saidu	7697589552
	Sidar, Forest Beat Officer, Parla	8717879083
	Pawan Manjwar, Forest Beat Officer, Madanpur	7771952390
Lemru Forest Range Korba forest Division	Jainath Singh Gaur, FRO	8959724371
	Gayaki, Bindeshwar Singh, Forest Beat Officer, Nakiya	7587039431
	Vikas K Banerjee, Forest Beat Officer, Bimlata	9713482466
	Dr. Vijender Rathi, PHC Korbi	-
	Sh Rajeev Ranjan, CSR Head, PEKB Coal Mine	9109976354
	Er Manik CHand Bala, RRVNL, Ambikapur	9413349565

Definitions

- **Village:** The basic unit in rural area as revenue village, which has definite surveyed boundaries. The revenue village may comprise of one or more hamlets but the entire village is treated as one unit. In un-surveyed areas, like villages within forest areas, each habitation area with locally recognized boundaries is treated as one village.
- **Household:** A 'household' is usually a group of persons who normally live together and take their meals from a common kitchen unless the exigencies of work prevent any of them from doing so. Persons in a household may be related or unrelated or a mix of both. However, if a group of unrelated persons live in a census house but do not take their meals from the common kitchen, then they are not constituent of a common household. Each such person was to be treated as a separate household. The important link in finding out whether it was a household or not was a common kitchen/common cooking. There may be one member households, two member households or multimember households.
- **Educational Amenities:**-The type of different of Government and private educational facilities / institutions available in the village. If there are composite schools like Middle schools with Primary classes, or Secondary schools with middle classes, these are included in the number of Primary and Middle schools respectively. For example, if in a village there are two Primary schools and one Middle school with primary classes, the number of Primary schools in the village are given as three and that of Middle school as one even though there may be only three educational institutions. So also in case of Secondary schools. For better understanding, the distinctiveness of different types of schools is depicted hereunder:
- **Literate:** A person aged 7 years and above who can both read and write with understanding in any language is taken as literate. A person who can only read but cannot write is not literate. It is not necessary that to be considered as literate, a person should have received any formal education or passed any minimum educational standard. Literacy could have been achieved through

adult literacy classes or through any non-formal educational system. People who are blind and can read in Braille are treated as literates.

- **Literacy rate** of the population is defined as the percentage of literates in the age-group seven years and above.
- **Educational level is the** highest level of education a person has completed.
- **Population density is** the number of persons inhabited per square kilometer of the area.
- **Age:** Age is measured in terms of the completed number of years.
- **Sex/Gender Ratio is the n**umber of females per 1,000 males in a population.
- **Work participation rate is the p**ercentage of Workers (Main + Marginal) to total population.
- **Work** is defined as participation in any economically productive activity with or without compensation, wages or profit. Such participation may be physical and/or mental in nature. Work involves not only actual work but also includes effective supervision and direction of work. It even includes part time help or unpaid work on farm, family enterprise or in any other economic activity. All persons engaged in 'work' as defined above are workers. The main point to note is that the activity should be economically productive. Reference period for determining a person as worker and non-worker is one year preceding the date of enumeration.
- **Main worker is a** person who has worked for major part of the reference period (i.e. six months or more during the last one year preceding the date of enumeration) in any economically productive activity is termed as 'Main worker'.
- **Marginal worker is a** person who worked for 3 months or less but less than six months of the reference period (i.e. in the last one year preceding the date of enumeration) in any economic activity is termed as 'Marginal worker'.
- **Non-worker is a** person who has not worked at all in any economically productive activity during the reference period (i.e. last one year preceding the date of enumeration) is termed as 'Non worker'.
- **Cultivator is** a person if he or she is engaged in cultivation of land owned or from government or from private persons or institutions for payment in money, kind or share. Cultivation also includes effective supervision or direction in cultivation. Cultivation involves ploughing, sowing, harvesting and productionof cereals and millet crops such as wheat, paddy, jowar, bajra, ragi, etc., and other crops such as sugarcane, tobacco, ground-nuts, tapioca, etc., and pulses, raw jute and kindred fiber crop, cotton, cinchona and other medicinal plants, fruit growing, vegetable growing or keeping orchards or groves, etc. Cultivation does not include the plantation crops like– tea, coffee, rubber, coconut and betel nuts (areca). The workers engaged in Plantation crops are recorded under "other workers".
- **Agricultural labourer is a** person who works on another person's land for wages in cash or kind or share is regarded as an agricultural labourer. She/he has no risk in the cultivation. but merely works on another person's land for

wages. An agricultural labourer has no right of lease or contract on land on which she/he works.

- **Household industry worker:** Household industry is defined as an industry conducted by one or more members of the household at home or within the village in rural areas and only within the precincts of the house where the household lives in urban areas. The larger proportion of workers in household industry should consist of members of the household. The industry should not be run on the scale of a registered factory which would qualify or has to be registered under the Indian Factories Act and should be engaged in manufacturing, processing, servicing and repairs of goods. The activity relate to production, processing, servicing, repairing or making and selling of goods. It does not include professions such as a pleader, Doctor, Musician, Dancer, Waterman, Astrologer, Dhobi, Barber, etc. or merely trade or business, even if such professions, trade or services are run at home by members of the household.
- **Other worker** is a person, who has been engaged in some economic activity during the last year of reference period but not as a cultivator or agricultural labourer or worker in Household Industry. The type of workers that come under this category include all government servants, municipal employees, teachers, factory workers, plantation workers, those engaged in trade, commerce, business, transport, banking, mining, construction, political or social work, priests, entertainment artists, etc. In fact, all those workers other than cultivators or agricultural labourers or household industry workers are 'Other Workers'.
- **Affected area** are such areas that are notified by the appropriate government for purpose of land acquisition.
- **Family** includes a person, his or her spouse, minor children, minor brothers or sisters dependent on him. Every major son/ daughter of a displaced family who has become major on the date of notification, will be considered a separate family. Also an unmarried daughter above the age of 18 years and a deserted women/widow will also be considered to be a separate household.
- **Project affected families** are the persons who are affected by i) acquisition causes loss of land or other immovable properties; ii) family who does not own any land but member of the family may be agricultural labours, tenants, share-croppers, artisans and is working in the area for more than 3 years and their primary livelihood is affected; iii) scheduled Tribes/other traditional forest dwellers who have lost their forest right under FRA 2006 due to land acquisition; iv) any family who would be losing primary livelihood due to acquisition of water- bodies, forests such as gatherers of forest produce, hunters, fishermen, boatmen, etc and who have been dependent on the livelihood source in the same area for more than 3 years; and member of the family who have been assigned land under any government schemes, both state and central government.

- **Project displaced family is** any family, who on account of acquisition of land has to be relocated and resettled from the affected area to the resettlement area. Holding of land means the total land held by a person as an owner, occupant or tenant or otherwise.
- **Land Oustees are the** households who are losing only their land for the project and living in villages not affected by the project.
- **Land &Home Oustees are t**he households who are losing their house as well as land for the project. The livelihoods of these households are also lost. Therefore they are categorized as Project Displaced Households.
- **Home Outees** are the households who are losing their house for the project.
- **Land-owners** includes any person whose name is recorded as the owner of the land or building or part thereof, in the records of the concerned authority or any person who is granted forest right under the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights Act 2006) or who is entitled to be granted patta rights on the land under any law of the state or any person who has been declared as such by an order of the court or authority.
- **Marginal Farmers** means a cultivator with an un-irrigated land-holding upto 1 hectare or irrigated land upto 0.5 hectare.
- **Small Farmers** means a cultivator with an un-irrigated land-holding upto 2 hectare or irrigated land upto 1 hectare but more than holding of marginal farmers.
- **Market Value** means the value of land determined by the Collector as per market value specified in the India Stamps Act, 1899 for registration of sales deed where the land is situated or average price of land in the neighbouring villages or consented amou .. as agreed upon for private companies or Public - Private partnership.
- **Weekly Haat** are those clusters of shops with or without fixed premises which are open once a week.
- **Forests** includes all lands classed as forest under any legal enactment dealing with forests or administered as forests, whether state-owned or private, and whether wooded or maintained as potential forest land. The area of crops raised in the forest and grazing lands or areas open for grazing within the forests remain included under the forest area.
- **Area under non-agricultural use** includes all lands occupied by buildings, roads and railways or under water, e.g. rivers and canals and other lands put to uses other than agriculture.
- **Barren and un-culturable land** includes all barren and unculturable land like mountains, deserts, etc. land which cannot be brought under cultivation except at an exorbitant cost should be classed as unculturable whether such land is in isolated blocks or within cultivated holdings.
- **Permanent pastures and other grazing lands** includes all grazing lands whether they are permanent pastures and meadows or not. Village common grazing land is included under this head.

- **Land under miscellaneous tree crops, etc.** includes all cultivable land which is not included in 'Net area sown' but is put to some agricultural uses. Lands under trees, thatching grasses, bamboo bushes and other groves for fuel, etc. which are not included under 'Orchards' are classed under this category.
- **Culturable waste land** includes lands available for cultivation, whether not taken up for cultivation or taken up for cultivation once but not cultivated during the current year and the last five years or more in succession for one reason or other.
- **Fallow lands other than current fallows** includes all lands which were taken up for cultivation but are temporarily out of cultivation for a period of not less than one year and not more than five years.
- **Current fallows** represents cropped area, which is kept fallow during the current year.
- **Net area sown** represents the total area sown with crops and orchards. Area sown more than once in the same year is counted only once.
- **Total irrigated land area** includes all land which is cultivable and irrigated by any source of irrigation.
- **Total un-irrigated land area** includes all land which is cultivable but not irrigated by any source of irrigation.
- **Scheduled Area** is an area with a preponderance of tribal population, economic backwardness as compared to the neighbouring areas and subject to a special governance mechanism wherein the central government plays a direct role in safeguarding cultural and economic interests of scheduled tribes in the area

Annexuture 7.3

QUESTIONNAIRE FOR VILLAGE SURVEY

S. No. .....

1	Name of the Village	
2	Name of the Panchayat	
3	Name of Block	
4	Name of Tehsil	
5	Name of Forest Division	
6	Name of District	
7	Name of State	
8	Infrastructure facilities (Pl Tick √)	
	Primary School	
	Sec. School	
	Primary health Centre	
	College	
	Panchayat House	
	Post Office	
	Bank	
	Hospital	
	Market	
	Seed Centre	
9	Existing institutional Mechanism (Pl Tick √)	
	JFMC	
	Van Panchayat	
	Gram Panchayat	
	Water Shed Committee	
	Soil Management Committee	
	Social justice Committee	
	Infrastructure development committee	
	Health Committee	
	Education Committee	
	Self Help Groups (SHGs)	
	Aganwadi	
10	Road connectivity (Pl Tick √)	
	Kaccha	
	Semi Paccka	
	Paccka	
11	Land use Pattern (ha)	
	Reserve forest	
	Protected forest	
	Wasteland	
	Van Panchayat	
	Grazing land	
	Civil Soyam	
	Agriculture land	
	Irrigated	

	Unirrigated	
12	Household type (Nos.)	
	Kuchcha	
	Semi-Paccka	
	Paccka	
13	Household economic status (Nos.)	
	Affluent	
	Less Affluent	
	Others	
14	Drinking water (Pl Tick √)	
	Tap water	
	Hand pump	
	River	
	Canal	
	Well	
	Others	
15	Is the drinking water sufficiently available?	(Pl Tick √) Yes/ No
16	Village population	
	Male	
	Female	
	Total	
17	Occupational Status (Pl Tick √)	
	Agriculture	
	Cattle rearing	
	Govt. Service	
	Private service	
	Business	
	Labour	
18	Land availability of farmers (Pl Tick √)	
	Landless farmer	
	Land between less than 1 ha	
	Land between 1 to 2.5 ha	
	Land greater than 2.5 ha	
19	Caste Category (No.)	
	Scheduled Caste (SC)	
	Scheduled Tribal (ST)	
	Other Backward Class (OBC)	
	General	
20	Literacy (No.)	
	Male	
	Female	
	Total	
21	Sources of energy used (Pl Tick √)	
	LPG	
	Kerosene Oil	
	Fuelwood	
	Electricity	

	Biogas	
	Solar energy	
	Agricultural Waste	
	Cow dung	
	Coal	
	Others	
22	Sources of Fuel wood (√)	
	Forest	
	Agriculture	
	Wasteland	
	Others	
23	Fuel wood Species	
24	Sources of Fodder (√)	
	Forest land	
	Agriculture land	
	Wasteland	
	Others	
25	Fodder species	
26	Agricultural production	
	Crop Species	
	Area (ha)	
	Production (kg)	
27	Irrigation Facility (√)	
	Rain	
	Others	

	Any other information .....
	Dated- Name of the investigator

QUESTIONNAIRE FOR HOUSEHOLD SURVEY

Sr. No-------

1	Name of Village								
2	Name of District								
3	Name of Respondent								
4	Contact No.								
5	Name of head of household								Relation with respondent .....
6	Ownership of house (√)	(i) Own							
		(ii) Rented							
7	Type of house (√)	(i) Kachcha							
		(ii) Semi Paccka							
		(iii) Paccka							
8	Type of Family (√)	(i) Nuclear							
		(ii) Joint							
9	No. of family members.....								
10	Religion								
11	Caste (√)	(i) SC							
		(ii) ST							
		(iii) OBC							
		(iv) General							
12	Distance of the nearest forest from the house (Km.)								
13	Do you have BPL Card ? (√)	Yes / No							
14	Average Monthly Income of family (Rs.)								
15	Agricultural land (ha)	(i) Total land							
		(ii) Scattered							
		(iii) Consolidated							
		(iv) Wasteland							
		(v) Irrigated land							
		(vi) Unirrigated land							
16	Land area under crop cultivation (ha) ..... Other use								
17	**Agriculture details**								
	Are under Paddy crop (ha)								
	Production (q/ha)								
	Prevailing market rates (Rs./Q)								
18	**Livestock details**								
		Cows	Buffalos	Bulls	Goats	Sheep	Mules	Pigs	Others
	No.								
	Grazing								
	Stall feeding								
19	**Source of grazing**								
	Forest								
	Van panchayat								
	Community land								
	Source of fodder for								

	stall feeding (%)							
20	**Source of fuelwood**							
	Forest							
	Van Panchayat							
	Community land							
	Own land							
	Purchase							
21	**Biomass extraction from forest**							
	Timber for Agricultureal Implements							
	Timber for house items							
	Grass							
	Honey							
	Resin							
	Others							

Any other information

Dated

Name of the investigator

ANNEXURE - 9.1

List of plant species naturally growing in different transplanted sites in PEKB Coal Block

Sl. No.	Species Name	Presence in plantation locations															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	*Acacia catechu*															√	
2	*Achyranthes aspera*		√	√			√	√				√		√			
3	*Ageratum conyzoides*	√	√	√			√	√			√	√	√	√	√	√	√
4	*Ailanthus excelsa*									√							
5	*Alternanthera ficoidea*		√	√			√	√	√	√		√		√	√		
6	*Alternanthera sessilis*	√															
7	*Andrographis paniculata*											√					
8	*Anogeissus latifolia*		√	√										√		√	√
9	*Apluda mutica*																√
10	*Aristida hystrix*												√				
11	*Aristida setacea*														√		
12	*Azadirachta indica*		√	√												√	
13	*Bombax ceiba*		√	√													√
14	*Bridelia retusa*			√												√	√
15	*Buchanania lanzan*		√											√			
16	*Butea monosperma*	√	√	√							√			√		√	√
17	*Calotropis gigantea*		√	√			√		√		√		√	√	√		√
18	*Casseria tomentosa*	√															
19	*Cassia fistula*		√	√													
20	*Cassia tora*	√						√	√						√	√	√
21	*Cassine glauca*		√	√												√	
22	*Catunaregam spinosa*	√		√						√							
23	*Cenchrus ciliaris*		√	√				√						√	√		
24	*Corchorus* sp.	√															
25	*Crotalaria juncea*		√	√			√	√	√	√			√	√	√	√	
26	*Curculigo orchioides*		√	√						√			√				
27	*Cymbopogon* sp.													√			
28	*Cynodon dactylon*	√					√				√			√	√	√	√
29	*Cyperus compressus*							√	√	√			√				
30	*Desmodium gangeticum*		√	√													
31	*Desmodium triflorum*	√	√	√			√	√		√	√	√	√		√	√	√
32	*Dicanthium* sp.	√	√	√			√	√			√		√	√	√	√	√
33	*Diospyros melanoxylon*	√	√	√			√			√		√	√		√	√	√
34	*Elephantopus scaber*												√				
35	*Euphorbia hirta*		√	√			√	√	√		√	√		√			
36	*Evolvulus alsinoides*	√					√										
37	*Ficus benghalensis*		√	√													
38	*Ficus racemosa*													√	√		
39	*Ficus religiosa*														√		
40	*Gmelina arborea*		√	√													
41	*Hemidesmus indicus*															√	
42	*Heteropogon contortus*		√	√												√	√

43	*Holarrhena pubescens*		√	√			√	√		√				√			√
44	*Hyptis suaveolens*		√	√										√		√	√
45	*Ichnocarpus frutescens*						√										
46	*Imperata cylindrica*		√	√												√	√
47	*Justicia glauca*	√									√			√			
48	*Lagerstoremia parviflora*		√	√								√					
49	*Launaea nudicaulis*	√		√													
50	*Leucaena leucocephala*	√													√		
51	*Madhuca longifolia*						√										
52	*Oroxylum indicum*													√			
53	*Paspalidium flavidum*	√						√	√			√		√			
54	*Pennisetum pedicellatum*		√													√	√
55	*Phoenix loureirii*		√	√				√		√				√			√
56	*Phyllanthus amarus*	√	√				√	√	√			√	√	√	√		
57	*Pongamia pinnata*	√										√					
58	*Pterocarpus marsupium*							√									
59	*Pueraria tuberosa*						√										
60	*Rungia pectinata*	√	√				√	√									
61	*Saccharum spontenium*													√			
62	*Semicarpus anacardium*		√	√			√										
63	*Setaria glauca*	√	√				√	√	√		√		√	√		√	
64	*Shorea robusta*	√	√	√			√			√		√		√		√	
65	*Sida acuta*	√		√				√	√								
66	*Sida cordata*	√	√	√			√	√			√	√	√		√		√
67	*Sida cordifolia*	√	√	√				√	√	√		√	√		√		
68	*Sida rhombifolia*													√			√
69	*Spilanthus calva*	√						√		√			√		√	√	
70	*Sporobolus* sp.	√					√	√	√	√			√	√	√	√	√
71	*Stylosanthes hamata*		√	√			√			√			√		√	√	√
72	*Syzygium cumini*		√	√									√				
73	*Terminalia arjuna*		√	√													
74	*Terminalia bellirica*		√	√													
75	*Terminalia elliptica*		√	√										√		√	
76	*Tridax procumbens*		√	√			√	√	√	√	√		√	√		√	√
77	*Triumfetta rhomboidea*	√						√	√			√	√		√	√	√
78	*Urena lobata*	√					√	√	√			√		√	√	√	√
79	*Ventilago maderaspatensis*		√	√					√							√	
80	*Vernonia cinerea*	√	√	√			√	√	√		√		√	√	√		
81	*Xanthium strumarium*	√	√	√			√	√	√			√	√			√	
82	*Ziziphus mauritiana*	√	√	√											√	√	√
Total Number		**31**	**45**	**44**	**0**	**0**	**27**	**27**	**18**	**16**	**12**	**17**	**22**	**30**	**24**	**30**	**26**

1) Check post Safety Zone; 2) Front of Mahua Dev Dump; 3) New View Point; 4) New Nursery Road (Nil); 5) New Nursery Dump (Nil); 6) CHP Dump Area; 7) CHP Main Washery; 8) Dispatch Road; 9) Dispatch Road Area Dump; 10) KJS Filling Point; 11) Parsa Village - Busti Para; 12) View Point; 13) Check Post; 14) Baigapara Pond; 15) Baigapara Dump & 16) Baigapara Road

Annexure 10.1

Details of the forest Compartment falling within the Biodiversity Conservation Area of Hasdeo-Arand Coalfield, Chhattisgarh

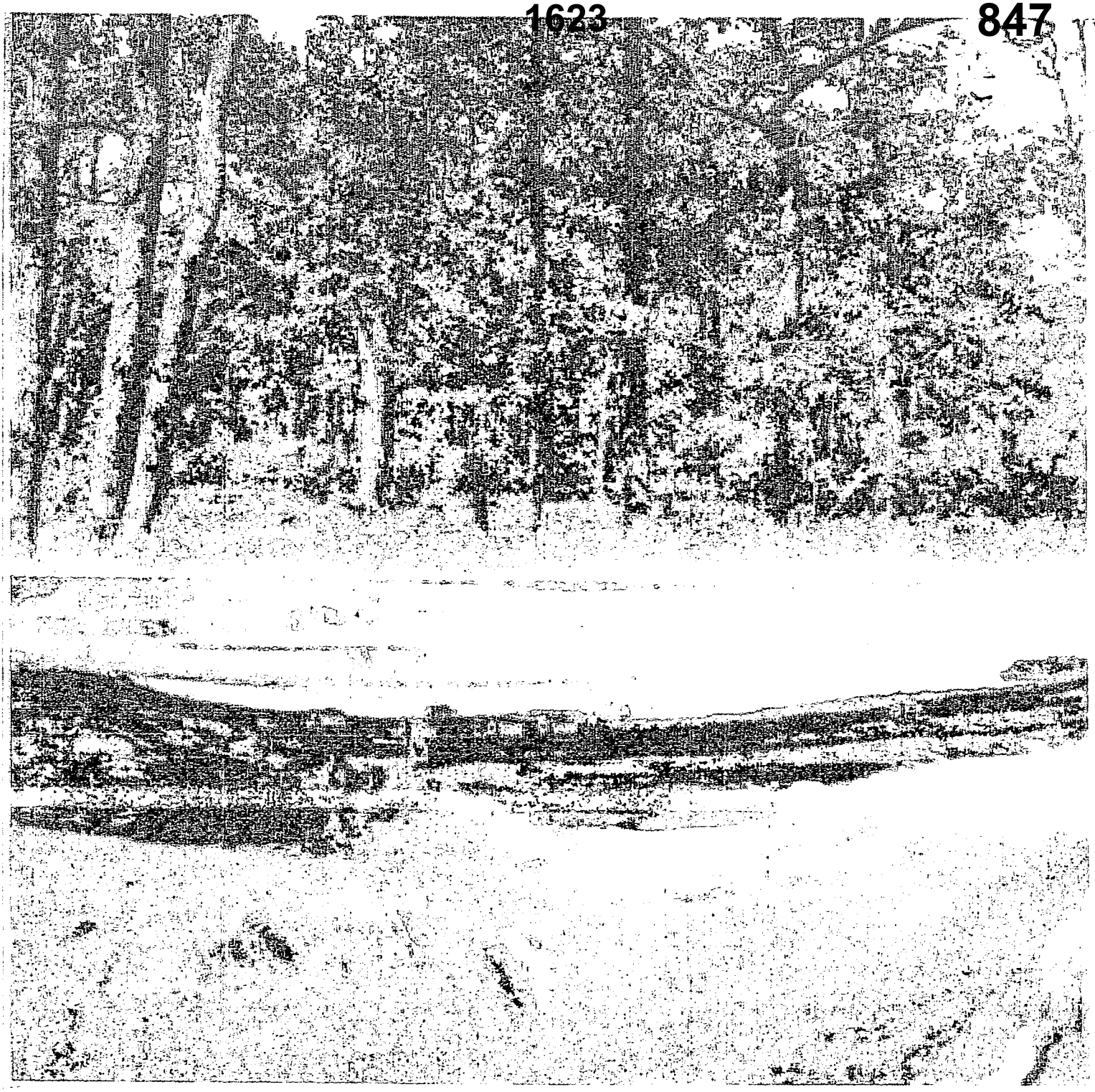
Forest Division	Forest Range	Sl. No.	Compartment No.	Area in Hectare	Sl. No.	Compartment No.	Area in Hectare
KATGHORA	ATMANAGAR	1.	P521	311.699	243.	P512	245.28
		2.	P522	274.602	244.	P511	167.863
		3.	P523	329.565	245.	OA750	55.7
		4.	P461	342.09	246.	OA752	17.833
		5.	P520	276.543	247.	OA751	57.602
		6.	P517	209.338	248.	P518	31.098
		7.	P509	254.032	249.	OA757	13.349
		8.	P510	289.909	250.	OA754	32.305
		9.	P508	156.104	251.	P459	240.074
		10.	P507	223.569	252.	P456	181.333
		11.	OA748	6.06	253.	P457	215.595
		12.	P519	376.973	254.	OA746	10.329
		13.	OA747	16.996	255.	P481	99.916
		14.	P516	255.584	256.	P455	418.873
		15.	P513	313.281	257.	P458	465.176
		16.	OA753	111.08	258.	P515	246.381
		17.	P464	171.706	259.	P454	143.933
		18.	P463	161.545	260.	P466	376.843
		19.	P462	237.2	261.	P469	202.974
		20.	P460	171.893	262.	P467	288.16
		21.	P465	278.594	263.	P470	46.013
		22.	OA749	32.657	264.	P468	270.486
		23.	P514	404.01	265.	P453	310.131
		24.	OA756	51.443	266.	P500	56.666
	KENDAI	25.	P443	155.546	267.	P386	162.613
		26.	P448	139.656	268.	P388	29.442
		27.	P449	220.789	269.	OA724	335.441
		28.	P447	233.028	270.	P361	264.32
		29.	P444	189.683	271.	P360	295.4
		30.	P445	193.702	272.	P362	371.85
		31.	P446	220.92	273.	P425	119.825
		32.	P410	222.744	274.	P387	137.396
		33.	P409	109.428	275.	P385	251.93
		34.	P408	303.502	276.	P436	344.25
		35.	P411	174.455	277.	P402	125.992
		36.	P412	147.752	278.	P404	303.895
		37.	P413	343.157	279.	P403	249.881
		38.	P414	302.225	280.	OA700	44.48
		39.	P422	260.531	281.	OA699	50.506
		40.	P416	156.071	282.	OA725	10.774
		41.	P415	271.154	283.	P426	355.601
		42.	P420	276.438	284.	P359	404.283
		43.	P421	291.417	285.	P384	252.56
		44.	P417	215.984	286.	P397	237.822
		45.	P418	159.102	287.	P396	261.007
		46.	OA727	29.092	288.	P381	437.208
		47.	P405	282.641	289.	P382	311.068
		48.	P406	108.782	290.	P355	414.169
		49.	P407	376.413	291.	P356	461.219
		50.	P401	303.672	292.	P374	427.149
		51.	P400	180.847	293.	P375	362.348

		52.	P399	463.634	294.	P377	356.25
		53.	OA698	463.269	295.	P379	425.893
		54.	P451	208.536	296.	P378	271.734
		55.	P419	253.533	297.	P373	449.489
		56.	P437	404.036	298.	P376	395.725
		57.	P452	254.185	299.	P394	28.229
		58.	P424	28.817	300.	P398	216.773
		59.	P450	128.738	301.	OA726	40.988
		60.	P441	198.24	302.	P383	401.781
		61.	P442	321.456	303.	P391	122.382
		62.	P434	202.531	304.	P395	12.932
		63.	P439	153.5	305.	P393	11.498
		64.	P440	234.598	306.	P392	6.89
		65.	P438	315.312	307.	P357	398.872
		66.	P435	217.838	308.	P352	548.823
		67.	P430	429.693	309.	P353	395.672
		68.	P431	473.261	310.	P337	414.795
		69.	P432	273.136	311.	P354	469.213
		70.	P433	399.293	312.	OA708	501.626
		71.	OA702	228.199	313.	OA707	337.12
		72.	OA701	24.571	314.	OA709	83.815
		73.	P389	27.701	315.	P336	409.924
		74.	P368	327.003	316.	P339	321.743
		75.	P367	490.976	317.	P340	236.187
		76.	P369	413.901	318.	P342	256.992
		77.	P358	271.963	319.	P334	280.261
		78.	P363	397.817	320.	P332	374.906
		79.	P370	191.366	321.	P341	313.295
		80.	P371	351.818	322.	P335	401.405
		81.	P372	232.886	323.	P343	195.219
		82.	P423	108.934	324.	P338	238.946
		83.	P366	330.865	325.	P333	286.755
		84.	P365	310.146	326.	OA706	115.132
		85.	P427	358.668	327.	P390	17.435
		86.	P364	179.228	328.	P380	448.632
		87.	P429	316.017	329.	P428	285.674
korba	Korba	88.	P1040	82.539	330.	OA 1322	14.709
		89.	OA 1323	11.886	331.	OA 1325	32.112
	Kudmura	90.	P1072	365.86	332.	P1095	333.782
		91.	P1092	679.74	333.	P1100	608.629
		92.	P1091	519.987	334.	P1096	200.791
		93.	P1101	449.657	335.	P1098	332.076
		94.	P1093	452.522	336.	P1099	285.151
		95.	P1053	381.526	337.	P1070	374.457
		96.	P1094	374.399	338.	P1054	488.043
	Lemru	97.	P2155	260.767	339.	P845	447.921
		98.	P908	579.265	340.	P849	274.877
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		100.	P911	406.371	342.	OA 1207	299.433
		101.	P912	524.309	343.	P883	370.093
		102.	P913	586.149	344.	P884	490.479
		103.	P909	580.453	345.	P901	677.722
		104.	P893	379.384	346.	OA 1196	181.461
		105.	P894	296.551	347.	OA 1200	279.909
		106.	P892	455.468	348.	P903	330.097
		107.	P889	486.762	349.	P902	666.266
		108.	P891	416.858	350.	P879	422.116
		109.	P905	513.706	351.	P876	576.83

		110.	P904	450.427	352.	P877	282.041
		111.	P900	526.455	353.	OA 1199	408.971
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		113.	P890	514.894	355.	OA 1197	10.428
		114.	P895	430.333	356.	OA 1198	25.193
		115.	P896	266.322	357.	OA 1195	146.889
		116.	P907	515.292	358.	OA 1189	152.802
		117.	P869	564.061	359.	P865	310.338
		118.	P868	343.983	360.	P866	289.4
		119.	P875	438.804	361.	OA 1192	39.272
		120.	P863	425.396	362.	OA 1193	115.775
		121.	P870	297.629	363.	OA 1191	27.568
		122.	OA 1186	153.044	364.	OA 1194	90.983
		123.	OA 1201	239.608	365.	P867	357.309
		124.	P880	506.781	366.	OA 1190	37.023
		125.	P881	490.135	367.	P811	219.152
		126.	P882	392.735	368.	P859	228.367
		127.	P897	515.827	369.	OA 1181	236.718
		128.	P873	423.563	370.	P813	219.109
		129.	P872	302.244	371.	OA 1184	109.716
		130.	P871	417.37	372.	P858	349.589
		131.	P874	339.658	373.	OA 1185	118.166
		132.	P888	390.649	374.	P860	241.991
		133.	P838	401.507	375.	OA 1183	147.024
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		135.	P843	218.289	377.	P862	401.798
		136.	P841	342.041	378.	P817	161.947
		137.	P835	352.265	379.	OA 1209	19.875
		138.	P836	345.369	380.	P815	250.145
		139.	P842	318.248	381.	P822	137.245
		140.	P839	461.359	382.	OA 1208	8.613
		141.	P837	346.44	383.	P816	105.759
		142.	P885	401.242	384.	P821	224.848
		143.	P887	577.175	385.	OA 1212	64.554
		144.	P906	346.924	386.	P819	367.935
		145.	P826	238.037	387.	P818	179.558
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		147.	P851	297.846	389.	OA 1180	43.537
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		151.	OA 1210	0.001	393.	P864	355.13
		152.	P853	270.441	394.	OA 1204	38.817
		153.	P852	180.06	395.	OA 1205	55.329
		154.	OA 1206	146.435	396.	P803	231.937
		155.	P824	183.087	397.	P804	248.125
		156.	P823	179.249	398.	P802	194.254
		157.	P825	200.93	399.	P809	184.189
		158.	P830	269.544	400.	P810	190.997
		159.	P828	347.124	401.	P806	243.943
		160.	OA 1203	242.587	402.	P807	234.249
		161.	P855	391.625	403.	P808	286.674
		162.	P831	274.971	404.	P820	265.26
		163.	P829	537.938	405.	P805	364.624
		164.	P827	272.244	406.	OA 1178	89.912
		165.	P844	347.289	407.	P801	279.134
		166.	P840	352.751	408.	OA 1187	31.823
		167.	P846	336.955	409.	OA 1188	103.566

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		173.	P1062	304.15	415.	P1047	375.83
		174.	P1027	328.351	416.	P1045	337.981
		175.	P1067	115.266	417.	P1046	87.464
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		177.	P1026	145.889	419.	P1043	489.598
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		179.	P1056	439.844	421.	P1018	356.638
		180.	P1055	553.308	422.	P1057	481.026
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		183.	P1017	318.592	425.	P1025	191.835
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		185.	P1058	440.318	427.	P1024	469.61
		186.	P1021	325.949	428.	P1061	437.229
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		188.	P939	245.872	430.	P955	658.054
		189.	P938	234.183	431.	P945	296.611
		190.	P937	517.683	432.	P944	736.455
		191.	P959	408.254	433.	P936	655.362
		192.	P958	454.678	434.	P934	358.132
		193.	P957	415.595	435.	P935	274.539
		194.	P942	320.751	436.	P953	287.155
		195.	P943	312.14	437.	P952	269.732
		196.	P956	345.726	438.	P918	0.202
		197.	P941	381.143	439.	OA 1219	14.519
		198.	P960	440.217	440.	P914	56.532
		199.	P961	453.629	441.	P969	558.169
		200.	P965	534.29	442.	P967	184.568
		201.	P966	203.343	443.	P970	503.966
		202.	OA 1238	9.35	444.	OA 1218	5.2
		203.	P964	168.825	445.	OA 1217	35.023
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		205.	P950	127.742	447.	P834	358.416
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		207.	P962	197.971	449.	P915	2.553
Surajpur	Ramanuj nagar	208.	1981	368.799	450.	1980	342.124
Surguja	Udaipur	209.	P2153	165.785	451.	P2119	229.123
		210.	P2158	272.116	452.	P2070	315.513
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		212.	P2122	224.865	454.	P2113	205.105
		213.	P2071	372.803	455.	P2114	276.187
		214.	P2147	247.084	456.	P2001	294.026
		215.	P2120	284.716	457.	P2000	269.043
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		218.	P2138	259.939	460.	P1999	259.285
		219.	P2140	408.516	461.	P2089	254.495
		220.	P2072	355.243	462.	P2092	185.519
		221.	P2139	325.628	463.	P2077	200.009
		222.	P2148	287.359	464.	P2094	211.452
		223.	P2151	161.828	465.	P2091	296.246
		224.	P2152	276.688	466.	P2096	274.349

		225.	P2123	325.348	467.	P2095	265.49
		226.	P2137	274.045	468.	P2088	245.276
		227.	P2135	320.509	469.	2097	205.583
		228.	P2134	279.544	470.	P2093	222.796
		229.	P2131	146.532	471.	P2085	182.882
		230.	P2133	268.146	472.	P2086	272.54
		231.	P2129	388.585	473.	2080	272.52
		232.	P2079	243.805	474.	P2084	241.815
		233.	P2168	323.433	475.	P2090	237.979
		234.	P2141	237.071	476.	P2083	131.801
		235.	P2073	278.699	477.	P2082	223.374
		236.	P2074	472.059	478.	P2081	359.997
		237.	P2075	329.699	479.	P2041	382.564
		238.	P2132	120.386	480.	P2042	381.821
		239.	P2142	267.922	481.	P2087	237.751
		240.	P2112	194.305	482.	P2043	278.842
		241.	2116	366.849	483.	P2076	386.269
		242.	P2118	288.189			



Environment Management Division
Directorate of Extension
Indian Council of Forestry Research and Education
An Autonomous body under the Ministry of Environment Forests & Climate Change
Government of India
New Forest P.O, Uttarakhand

IN THE HON'BLE NATIONAL GREEN TRIBUNAL

PRINCIPAL BENCH

AT NEW DELHI

ORIGINAL APPLICATION NO. 59 OF 2024

IN THE MATTER OF: -

HASDEO ARRAND BACHAO SANGHRSH SAMITI ... INTERVENOR

Versus

In the Suo motu matter of-

NEWS ITEM TITLED "DEFORESTATION FOR MINING RESUMES IN HASDEO LOCALS ACTIVISTS ALLEGE DETETION''APPEARING IN THE HINDU DATED 22.12.2023

Next Date 03.07.2024

VOLUME -2

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2.	**ANNEXURE A-4** Order dated 02.05.2024 Passed by the Hon'ble High Court of ChhattisgarhBilaspur in Writ Petition (c) No. 1346 of 2016	990-1013
3.	Vakalatnama/Authorization to represent	1014-1015

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Date : 12.06.2024

Place:Delhi

 Annexure - III

REPORT OF FAC SUB-COMMITTEE

PARSA EAST KATE BASAN (PEKB) COAL BLOCK, CHHATTISGARH

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1.0 Introduction

1.1 Ministry of Environment, Forests and Climate Change. Government of India, New Delhi constituted a Sub-Committee in pursuance of recommendation of the FAC in their meeting held on 28 October, 2021 vide OM No. 8-31/2010 – FC dated 9 November, 2021 (Copy is enclosed as **Annexure- 1**).

1.2 The mandate of the Sub-committee is as under:

a) To visit the proposed area;
b) To assess the status of reclamation measures already implemented/ being implemented in the lease area by the User Agency in terms of its efficacy and provision provided in the mining plan, and
c) Status of compliance of various conditions stipulated in the approval dated 15/03/2012. (copy of the Minutes of FAC held on 28.10.2021 enclosed as **Annexure 2)**

1.3 A virtual meeting of the Sub-Committee was convened by the Ministry on 12 November, 2021 along with Dr. Sudhir Kumar, Dy DGF, ICFRE, Dehradun and Nodal Officer of the State of Chhattisgarh After deliberations members of the Sub-Committee requested the Ministry to nominate an official to assist the Sub-Committee for co-ordination of the visit and sought following documents before proceeding to visit the area:

a. Copy of the Final Approval dated 15/03/2012.
b. Compliances submitted by State, if any,
c. Copy of Mining Reclamation/ Closure Plan,
d. Copy of Bio-diversity Assessment Report, formulated by ICFRF Dehradun,
e. Copy of approved Integrated Wildlife Management Plan,
f. Copy of Notification with Map of Lemru Elephant Reserve.
g. List of activities carried out for reclamation of Mined area,
h. List of activities being reclaimed by the User Agency and
i. Comments from the User agency as well as State Forest Department of Chhattisgarh on the mandate of the Sub-committee
j. Judicial pronouncement in the present issue if any

Shri Rakesh Kumar, Technical Officer FC Division, was accordingly nominated by the MoEF&CC to accompany Sub-Committee during site visit

1.4 The Members of the Sub-Committee visited the site **from 26 November 2021 to 29 November. 2021.** Third Member of the Sub-Committee Mr Rakesh Jagenia, DIG (WL) could not accompany the Sub-Committee because of his pre-occupied official commitments (as informed by him). The officials of the State Forest Department and representatives of User Agencies were present during site inspection The list of participants is enclosed as **Annexure-3**

1.5 Background of the Project: The present proposal is for non-forestry use of 1898.328 ha of forest and (1654.109 ha of revenue forest land and 244.219 ha forest land) in favour of Rajasthan Rajya Vidyut Utpadan Nigam Limited, in Villages Parsa and Kete Telsil Udaipur, District Surguja Chhattisgarh.

order is enclosed at Annexure-4) *inter-alia* stipulating that forest land will be utilized for mining in phase wise manner wherein during phase-I mining was allowed over an area of 762 ha for 15 years while during phase-II mining over the balance forest area of 1136 ha will be allowed by the State.
Condition stipulated in the approval dated 15.03.2012 is reproduced as under:

"8. The mining shall be done in two phases (Copy of Map is enclosed at Annexure-5):
a. During phases-I, covering 15 years, the mining shall be restricted to 762.00ha of forest land.
b. During phase-II the mining permission over remaining 1136 00ha will be linked to the reforestation and biodiversity management in phase-I.
c The project proponent will submit the application for permission for mining in phase-II along with compliance report of phase-I."

Government of Chhattisgarh, vide their letter dated 22.02.2021 requested the Central Government to allow mining of phase-II as the entire forest area of 762 ha of Phase-I has been exhausted The State Government had also informed about the status of reclamation and biodiversity assessment in the area which has not been submitted as yet. Status of reclamation measures undertaken by the User Agency have not been verified by the needs to be verified by the IRO of the Ministry.

The matter was examined in the Ministry and it was *inter-alia* observed that biodiversity assessment study of the area was under consideration with the State Government and also various issues emanating from mining in the PEKB Coal Block are sub-judice in the Hon'ble Supreme Court Therefore, considering the past developments of the matter, it was decided in the Ministry to await the submission of Biodiversity Assessment Study by the State. Ministry vide its letter dated 25.05.2021 requested the State Government to submit its considered opinion in the matter in light of various orders of Hon ble Supreme Court to the Ministry for further necessary action in the matter, which is awaited from the State Government

The Biodiversity Assessment report ascertained that permission be granted for mining in the already allotted coal blocks falling Gej-Jhink watershed, viz. PEKB, Parsa, and Tara while subject to strict compliance of environmental safeguards, recommended that mining in Kete Extensions could be allowed.

In addition to these 4 blocks, mining in another 4 blocks located in Rehar watershed, viz., Sarma (20), Laxmangarh (21), Bhakurma-Mardinga (22) and Kedma (23) were also recommended to be allowed after ensuring their demarcation and detailed assessment of catchment and drainage network Overall 14 projects, falling within both the Chornai (8) and Ton-Teri (9) watershed have not been recommended for mining keeping in view of conserving the relatively dense moist-dry deciduous sal dominated forest tracts that provide home range for elephant.

In view of the above, it was proposed that proposal of the State to allow Phase-II mining over an area of 1136 ha, along with Draft Biodiversity Assessment Report submitted by the State may be placed before the FAC for its further examination.

2.0 Documents Received by the Sub-Committee:
2.1 From MoEF&CC: Documents pertaining to point numbers (i), (iv) and (x) – NGT Order dated 24 March, 2014 in Appeal No 73/2012 and Hon'ble Supreme Court orders in Civil Appeal No. 4395/2014) in addition to minutes of meeting of FAC dated 28 October, 2021.

his Nodal Officer has submitted the Compliance Report of Final order dated 15-03-2021 (Copy is enclosed at **Annexure- 6**), Mining Reclamation Plan and Mining Closure Plan (**Annexure- 7**) and copy of Notification and Map of Lemru Elephant Reserve (**Annexure-8**). In addition, Wildlife Census Report 2012 and Incidence of man-wild animal conflict occurred during the last 10 years (**Annexure- 9**) were also seen.

2.3 From User Agency:
A copy of PPT on reclamation plan, compliance report, Surface Water Management initiatives, Biodiversity management initiatives, wildlife management initiatives and reclamation undertaken was given during deliberation.

2.4 Documents, such as (a) communicative request by User Agency to the State of Chhattisgarh to handover Phase II land (1136.328ha) on 24/09/2019 and (b) copy of the recommendations by the State to Central Govt. dated 22/01/2021.

2.5 Against copy of the Report of MoEF&CC, State Government had resubmitted Legal opinion of Standing Counsel of Chhattisgarh Government to Hon'ble High Court, New Delhi by its letter dated 22/06/2021 which concluded that pending case in Supreme Court (Civil Appeal No 4395/2014) did not come in way of exercising any administrative action in accordance with law. This document was provided.

3.0 Proceedings of Site visit:
3.1 'Briefing': A detailed discussion on the Project was held by the Sub-Committee with senior officials of the User Agency wherein, a detailed presentation on status of project operation, reclamation measures undertaken with respect to approved mining plan and compliance of conditions of Forest Clearance was made before the Sub-Committee which covered following aspects:

- Background of the proposal& requirement of the phase-II land
- Salient Features of the proposed expansion project
- Status of ongoing reclamation (Biological & Physical) with respect to mined out areas along with plantation details (Copy of order is enclosed at **Annexure-10**)
- Status of compliance of various conditions stipulated in the approval dated 15.03.2012

3.2 Visit of Sub-Committee to Project Area: The Sub-Committee visited the site to make assessment in line with the TOR provided by the FAC. Location specific observations of the Sub-Committee are provided in the following pages.

a **OB Dump locations including external dumps, restoration areas, greenbelt, nursery:** Observation of the committee is as below-

- **External Overburden Dump-** Two external dumps (East & West) are there in place and reclamation measures undertaken were observed. Slope stability, angle of slope, drainage arrangements around dumps, erosion control measures including biological reclamation measures undertaken, etc. were observed on Over Burden dumps. As per information provided by User Agency, 105.16 ha of external dump out of 112.66 ha has been reclaimed biologically with plantations. At some places committee instructed project officials to further improve drainage, rain cuts as well as gap plantations and through introduction of fruit species in the blanks.
- **Internal dumping and backfilled area as well as plantation area:** Sub-Committee visited reclaimed area as well as undertaken live survey of the reclaimed area undertaken through drone. As per information provided by

through plantation of about 4.8 Lakh saplings of different native species including Sal species. Committee also visited in-house nursery. Sal is being propagated in nursery was also observed. Sal species is pre-dominant species in the area and regeneration of the same is important for overall reclamation of the mined-out land.

b. **Avenue plantation, safety zone plantation, area:** The Sub-Committee also visited locations with avenue plantation, safety zone plantation, locations with transplanted trees. (Copy of photos are enclosed at **Annexure-11**)

c. **Sites showing CSR initiatives:** The Sub-Committee visited Parsa village wherein CSR activity centers were located. Under CSR, a number of initiatives in the form of self-employment generation, agriculture, dairy, vermin-composting, women empowerment, etc. for uplifting socio-economic conditions of the people around PEKB Block were undertaken. The works done by local women of all the adjoining villages were lauded by the Sub-Committee. The Sub-Committee was also apprised of other CSR initiatives launched by RRVUNL. Committee members such as 10+2 CBSE School and Kaushal Vikas Kendra which are being operated for education and skill development of surrounding area, etc. (Copy of photos are enclosed at **Annexure-12**).

3.3 'De-briefing' at PEKB Mining Area: De briefing/ Concluding discussions with project officials of User Agency was held after the site visits were concluded. The detailed discussions in the Meeting included sharing of observations of the Sub-Committee with the officials of User Agency and suggestive measures to be undertaken for improvement in environment of areas under operations in the Mining areas.

4 Important facts of the Project:

4.1 A proposal for diversion of 1898.328 ha of forest land at Parsa East and Kante-Basan captive coal blocks (shortly referred to as PEKB Coal blocks) situated at Hasdeo-Arand Forests of South Sarguja Forest Division, District Sarguja, Chhatishgarh in favour of M/s Rajasthan Rajya Vidyut Utpadan Nigam Limited (shortly referred to as RRVUNL), was forwarded by State of Chhatishgarh on 20 April 2010 for approval under section 2 of the Forest Conservation Act, 1980.

4.2 The proposed site is located approx 5 km from near NH 130 and nearest Rail Head Bilaspur on Bijur Ambikapur station of the South East Central Railway. Rail line is extended upto coal mining site.

4.3 Hasdeo-Arand Coal Field is one of the major coal-fields in the Central India located in the upper reaches of Mahanadi Valley of Gondwana Basin. Total geographical reserves estimated for stands at 256.40 MT while mineable reserves estimated by opencast mining stands 200 MT.

4.4 The Coal Block of the User Agency is located in Northern outer fringe area of Hasdeo-Arand Coal Field and proposed for open cast coal mining at about 290 km. from Raipur and about 150 km from Bilaspur. There are 18 coal blocks in Hasdeo-Arand Coal Field.

4.5 Map and profiles showing the Coal Blocks in the entire Hasdeo-Arand Coalfield area that falls within Surguja, Surajpur and Korba Districts is enclosed for reference as **Annexure-14 Annexure-15**.

22°45'34.39N" and longitude 82°57'55.95"E to 82°57'58.66"E.

4.7 The User Agency on its own submitted a revised proposal before the Ministry regarding sequential mining of coal in two phases on 02nd March 2011 and this revised proposal were deliberated before FAC held on 10 March 2011.

4.8 The area in question of PEKB Coal Blocks was going to virtually shaved off its forest cover for the purpose of mining in two phases of 15 year duration each and the reclamation towards regeneration of forest cover and restoration of bio-diversity. Undoubtedly nature has a potential to regenerate so long as this potential is not destroyed or irreversibly damaged

4.9 The mining is planned in two phases with the aim of sequential mining, scientific void management, planned felling of trees and afforestation, top soil management and reclamation etc. In phase I (15 Years), total requirement of forest area was 762 ha (40 % of the total), where 125547 trees were felled. In phase II (16th year onwards), total requirement of forest area is 1138.328 ha, where 242670 trees will be affected

4.10 Reclamation work has began after 3rd year of mining and findings of the earlier report of the sub-committee states that reclamation and plantation works taken up by the User Agency is also supported by report on vegetation mapping and land reclamation.

a) According to a Report, on the top-soil study at Parsa East and Kanta Basan open cast mining of February 2018, submitted by the Dept of Civil and Environmental Engineering, Birla Institute of Technology MESRA- Ranchi, the Soil Organic Carbon varies from 0.5 to 1.0 per cent at three locations and less than 0.5 per cent at 10 other locations. However soil organic carbon at three locations was carried out on 25.11.2021 which varied between 0.34 to 0.49 per cent

b) Groundwater level monitoring report of PVKB during dry months of April and May in various years at one place near mango garden is as under:

Year	April (mbgl)	May (mbgl)
2014		18.10
2015		-
2016	10.80	12.20
2017	10.45	11.60
2018	11.70	12.05
2019	12.94	13.57
2020	15.97	16.60
2021	14.30	15.44

c) The acceptable limit of water quality of samples collected on August 18, 2021 which was carried out at villages Salhi, Parsa Basan, Shivnagar, Gidmuri, Pargaia, Salba, and Piezometer number * and the results were within the acceptable limits of the test report of Vardan Envirolab Gurugram submitted by the User Agency

d) According an assessment of annual mine closure activities, as per the approved mine closure plan of PEKB open cast mine Sarguja conducted by CSIR-NEERI, Nagpur, the following observations are listed:

specified in the mining plan.

- Slopes of the dumps were found to be maintained at a natural angle of repose, range varied from 0 degree to 90 degrees.
- Propose mitigative measures are taken to minimize soil erosion and choking of streams by putting geo-textiles on the slope of dumps and planting soil stabilizing grasses and plants.
- Out of total external dump area of 138.90 ha. a total of 98.18 ha of area has been afforested, while out of total back-filled overburdened dump area, out of 404.77 ha, an area of 135.62 ha has undergone afforestation with plantation of 1.74,603 plants.
- Garland drains of constructed to collect eroded over-burdened material and prevention of water-bodies and siltation.
- Top-soil was used for spreading over-reclamation and embankments for plantation and development of greenbelts as per the approved management plan.
- The total estimated quantity of top-soil that was to be generated as per plan, i.e., 76,58,955 cubic metres, a total of 19,47,331 Cubic metre of top-soil is extracted since the inception of mine and approximately 1,00,800 cubic metres of top soil is presently available and has been stacked for future use
- Under the important protection and landscaping measures, the periphery of mine is secured and fenced to prevent any untoward incidences, geo-matting for slope stabilisation and soil erosion control in vulnerable areas, plantations along safety zones for stabilisation and pollution prevention and garland drains construction around the mine to prevent ingress of catchment water in to the mine
- Regular environmental monitoring has been conducted through M/s Vardan Envirolabs Gurugram (a NABL and MOEF accredited laboratory).
- Under bio-reclamation, plantation work has been extensively carried out in and around the mine void on the over-burdened dumps
- A total number of 2,81,402 saplings have been planted during the years 2018 and 2021. In addition tree transplantation is exclusively used to move trees that are obstructing mining activities to the newly identified locations.
- The mine has scientifically developed self sustainable and impressive in house nursery for meeting its plantation demands.
- The avenue plantations were also carried out along the roadsides, plantations on dump-slopes, landscaping in office premises and tree plantations around the mine periphery and nearby villages to avoid dust pollution and air pollution risk improving the aesthetics and ensuring the ecosystem benefits.
- As bio-reclamation of the mined out area is an on-going process the progressive development of greenbelt and self-sustained ecosystem is a regular process.

4.11 After careful consideration of the proposal Ministry of Environment Forests and Climate Change, Government of India, New Delhi Issued in- principle approval under FC Act 1980 vide letter no. 8-31/ 2010- FC dated 06/07/2011. After receipt of the compliances from the State Government, Ministry issued Final approval of over number letter dated 15 March 2012.

4.12 Status of compliance of various conditions stipulated in the approval is provided in **Annexure- 6**. The report confirms that all conditions have been complied

Hasdeo-Arand Coalfield (1879.6 sqkm) comprising of 23 Coal Blocks that included Parsa East and Kanta Basan (PEKB) Coal Blocks and identified the potential impacts of mining on flora and fauna and prepared a Biodiversity Conservation and Management Plan Report has suggested the mitigation measures for management of impacts arising out of mining on forest land.

4.14 The proposal does not form the part of any PAs or notified eco-sensitive zone.

4.15 Details of year-wise biologically reclaimed areas in 762ha during Phase-I are provided below:

Year	Plantation/ Biological reclamation (in ha)				Total Saplings planted
	Other area	External dump area	Internal dump area	Total area	
2012-13	01.50	000.00	000.00	001.50	003732
2013-14	02.30	000.00	002.30	002.30	005852
2014-15	05.10	000.00	000.80	005.90	014799
2015-16	04.60	000.00	003.10	007.70	019296
2016-17	09.35	021.65	008.20	039.20	097903
2017-18	03.61	014.49	010.20	028.30	070705
2018-19	01.59	026.59	027.90	056.08	140180
2019-20	00.00	009.63	056.10	065.73	141213
2020-21	00.00	025.82	029.35	055.17	155105
2021-22	00.00	006.98	057.11	064.09	162348
Total	28.05	105.15	192.76	325.97	811142

However external over-dump area of approx 85ha is yet to be stabilized (biologically reclaimed), as per Mining Plan.

4.16 The User Agency claimed that the current mining operations have zero effluent discharge, no road transport of the mined coals (all are being transported by rail), coal extraction by surface miners only and not by blasters, biological reclamation is very close to target and success percentage of transplantations of Sal trees is approximately 80 per cent. This was verified and confirmed in the field

4.17 A representation dated October 11, 2021 from villagers of Tara Gram panchayat, Janamanpur Gram panchayat, Shivnagar Gram panchayat, Yasen Gram panchayat belonging to Udaypur Tehsil of Sarguja District was submitted to the Collector Sarguja, thereby alleging two NGOs, viz Chhattisgarh Bachao Andolan and Hasdeo-Arand Sangharsh Samitee who were supposedly halting the regional development and employment generation by the mining companies of the region.

4.18 **Print media coverage:** A news item appeared in the Indian Express (daily newspaper) dated 27.11.2021 said, "Chhattisgarh pushes Adani-run coal block despite Wildlife Institute of India's (WII) 'Red flag' where the State Forest Department denied the allegations based on the facts Copy of report sent by the State Forest Department is enclosed at **Annexure- 15**)

4.19 The Top-soil dump was located by the side of approach road from Basan East of the Eastern external dump It was completely utilized by spreading on the technically reclaimed NE part of external Over-burden dump and also on the East internal backfilled dump The Sub-Committee also noticed two top soil stacks with

reclaimed East and West internal Over-burden dump tops for future use.

4.20 Hon'ble Chief Minister of Rajasthan vide his letters to Hon'ble Chief Minister of Chhattisgarh, Hon'ble Minister of Coal and Mining, Hon'ble Minister of Power and Energy, Hon'ble Environment, Forests, and Climate Change, Govt. of India, New Delhi has requested to facilitate earliest necessary sanction for coal mining at Persa Coal Block. (Copy of letters is enclosed at **Annexure- 16**).

5.0 Observations during Site Visit:

5.1 Based on the outcome of Biodiversity Assessment Study of ICFRE, an integrated Wildlife Management Plan was put in place and the measures suggested in the plan are being implemented locally

5.2 No operational mining was sighted during the site inspection in Phase-II area and no reclamation work has therefore been done.

5.3 A live survey with the help of drone of the Blocks placed at Sl. No. 14 was carried out at the Site Office of the User Agency. The mining operation areas, top-soil dumping sites, garland drains, washery and locations of settling ponds which covered entire mining area were shown to the Sub-Committee. Members of Sub-Committee observed that the vegetation mapping charts submitted by the User Agency were almost similar to those which were observed during live drone mapping/ survey

5.4 Salient features of coal mine as informed by the User Agency is as under:

a) The category-wise utilisation of forest area under first phase of mining in 762 ha, 175.212 ha is being used for the purpose of infrastructure, dump, and washers, etc. and 586.788 ha area is mining area

b) **Mine pit parameters:** Present parameters of mine pit are as under:

No	Parameters	Dimension
1	Length of quarry	6 km (approx.)
2	Width of quarry	800 m (approx.)
3	Depth of quarry	45m(approx.)
4	Area of quarry	621 ha (approx.)
5	Coal seams exposed	Two (No. IV &V)

c) Total three seams i.e., Seam-IV to Seam-VI are considered for open cast mining. In general, the coal bearing formation exhibits a more or less NW-SE strike with southerly dip. The minimum and maximum dip amount ranges from 2 to 5 Degrees. The beds are almost flat/sub-horizontal near Seam IV in crop in the West and East

d) **In-pit Conveying System:** As proposed in the mining plan in-pit conveying system for transportation of coal from mine head to 10 MTP coal handling plant (CHP) and 5 MTP CHP is in operation. This arrangement has reduced the lead distance of approximately 7 km. Further, it is proposed to extend this conveyor next year by 400 to 500 meters

5.5 The fruit plants were significantly absent in the plantation programme carried out by User Agency. However, the species diversity within the biological reclaimed areas was satisfactory. The growth of plants and undercover growth was significantly visible. No water (in excess) was observed flowing outside the mining zone.

5.6 De-silting of ponds is done annually. The exit of Garland drains and sillation ponds meet at Silha Nalla which ultimately pours its water in Atem Nadi (River) that leads to Hasdeo River. This was the original water flow design of the Gej-Jhink watershed of the landscape. The flow of the confluence was inspected by the Sub-Committee.

5.7 To reduce the impacts from the mine erosion, the Project proponent has made retaining walls, Silt-settling tanks/ Garland/ Catch water drains and other bio-engineering measures in the degraded areas. These structures are to be properly and periodically maintained for effective management of environmental safeguards

5.8 Two-third of the PEKB Coal Block falls under Gej-Jhink watershed and one-third of the area falls under Chornai watershed. As such, there is no significant visible impact noticed on either sides of the watershed

5.9 The status of **Mining Closure Plan** is as under:

No.	Recommendation	Status after Inspection
1	Mined area will be backfilled by internal dumping.	Area is already reclaimed hence cannot make any comments.
2	The top soil kept separately will be spread over to the dumps and fast growing plants species and grass will be planted to restore the biological and ecological system at the earliest.	According to the CSIR-NEERI report, out of total estimated quantity of top-soil to be generated as per plan, i.e., 76,58,955 cubic metres, a total of 19,47,331 cubic metres of top-soil is extracted since the inception of mine and approximately 1,00,800 cubic metres of top-soil is presently available and has been stacked for future use The local fast growing species have been planted in biologically reclaimed area. The undergrowth with dense herbs were also seen during site inspection
3	New drainages will be designed to avoid erosion.	New drainage points/ garland drains are in place and as such there is no soil erosion in the mined out area
4	The land profile will be kept closed to the profile of nearby areas as shown in reclamation plan.	As per the CSIR-NEERI observations, reclamation work done by the User Agency is almost similar to the local landscape of un-mined area, however after a detailed inspection, it has been proposed to create undulating landscapes within the reclaimed areas in future to match surrounding landscapes.

No.	Recommendation	Status after inspection
5	The worked out slopes will be stabilized by planting appropriate shrub/grass species on the slopes.	Afforestation has been done and the growth of the plants is satisfactory. Herbs and shrubs are seen on the slopes, which is a good soil binder. It seems that Slopes are almost stabilized because no erosion was noticed after rains.
6	Plantation around the quarry and CHP will put up a green belt for mitigating air pollution.	Complied
7	Greenbelt development should be taken up all along the haul roads and overburden dumps.	Complied
8	The land reclamation will be taken progressively after exhaustion of coal and completion of internal back dumping and flushing with external dumps.	Being complied.
9	The top soil is to be used with minimum time-lag for spreading over the external & internal dumps	The growth of plants and under-cover indicates that the top soil has been spread with a minimum time-lag except at few places
10	The fly ash generated from proposed Reject Based Power Project shall be disposed-off by backfilling of Parsa East and Kanta Basen (PEKB) Coal Mines An admixture of Ash and Overburden in proposed mix ratio based on the stability analysis results and factor of safety shall be used to backfill the mines.	The observations through drone confirmed that the fly ash/ mine rejects have been dumped behind the green curtain along the approach road to mines.
11	Tailing pond will be made of adequate capacity All waste water from mine, washery, workshop colony will be first allow to settle down in this pond before discharging it to nearby water stream.	Complied.

5.9 Compliances of Recommendation of Biodiversity Assessment Report

No.	Recommendation	Compliance
1.	Opening of long mine face shall be minimized by undertaking intensive mining i.e mining in smaller strike length up to the bottom of the ore body with simultaneous backfilling It was suggested to operate the mine on the western and eastern end intensively up to bottom of coal seam without opening lengthy mine face with simultaneous concurrent backfilling and	The opencast mine is being worked on the 3-shift/ day and seven days/week round the year (330 working days) for coal extraction and overburden removal Based on these factors, User Agency has worked out a Mining system for achievement of rated capacity in shorter period, i.e , low gestation period as well as reduction of Inter-mixing of Coal with stone bands and

NO.	Recommendation	Compliance
	advancing mining operation at the middle of the mine pit to minimize land degradation at any point of mining operation. Similar Mining operation may be adopted during the phase II of the mining; accordingly, mine planning needs to be envisaged and implemented	started internal dumping as sufficient 'De-coaled' area is created The Over-burden benches above coal seams are being extracted by User Agency by horizontal slicing method.
2.	Seepage water was seen accumulated on lower coal seam (IV) floor at surface miner operational area Such seepage water may be properly channelized to mine sump for keeping coal seam floor clean	No such water accumulation was noticed during the inspection. However, the prior works for channelizing the over-flow of seepage water could be undertaken as precautionary measure.
3.	The PEKB mine authorities have translocated /transplanted mainly Sal saplings/ trees falling under the girth class 20-60 cm from forest blocks and few other common species at various sites within mine lease in consultation with the State Forest Department (SFD). A total number of 8177 trees belong to 18 different species have been transplanted during the period i e 2012 2020 The efficacy assessment made by ICFRE team is confined to survival and health status of the translocated trees in 16 different translocated sites in PEKB coal mine lease area The survival rate at few places are significant, however overall, it is poor due to lack of monitoring in terms of follow-up activities after planting like pest/disease surveillance, recording of growth measurements and replacement of dead trees, etc	Efficacy assessment made by ICFRE on health status of translocated Sal trees at lease area was not very promising though survival rate of the same has been over 80 per cent
4.	Long-term site-specific scientific study for suitability assessment of indigenous species of HAC (Hansdeo-Arand Coalfield) shall be undertaken by the SFD in association with the coal block in operation to assess the success rate and to develop species specific SoP	It has been complied and an SoP has to be drafted
5.	The whole of HAC landscape comprise of 647 forest compartments spread over 12 forest ranges in 4 forest divisions Elephant occurrence is not limited to any particular part of the landscape, however	With a view to provide natural habitat for wild elephants, mitigate Human-Elephant Conflict (HEC) with the objective of better management practices, the

No.	Recommendation	Compliance
	it spread across in HAC landscape and surrounding. The forests where the elephants currently occur are highly fragmented and degraded due to incompatible land use. Therefore, the elephant herds are generally interlinked to home ranges resulting in continuous dispersal of elephant herds from the neighboring States of Jharkhand, Madhya Pradesh and Odisha. The large home range results in human-wildlife conflict in the form of crop, property and livestock losses is also a major concern.	Government of Chhattisgarh has declared "Lemru Elephant Reserve" with in an area of 1995.48 sq.km covering 11 forest ranges under 4 forest divisions. **(Annexure-8)**
6.	PEKB 14 & Tara (15) and other two contiguous blocks i.e., Sarma (20) and Laxmangarh (21) are on the **Gej-Jhink watershed** with Atem Nadi and its headwater feeder streams flowing towards north The cumulative impact of land use land cover changes due to these coal blocks will have influence of magnitude on the forest ecosystem and the Hydrology considering the quite larger area under peril.	Two-third of the PEKB Coal Block falls under Gej-Jhink watershed and one-third of the area falls under Chornai watershed As such, there is no significant visible impact noticed on either sides of the watershed.
7.	It is pertinent that the Chhattisgarh State Forest Department may identify areas for declaration as Conservation Reserves with due consultation and involvement of local communities and all other relevant stakeholders Under the ambit of a conservation reserve, habitat improvement activities such as restoration of grasslands and degraded forests, improving surface water availability for wildlife in relatively drier tracts during summer regulating forest fires and improving overall protection can benefit wildlife The **ICFRE suggests Biodiversity Conservation Area** comprising of 337 forest compartments (938sq.km) in Chornai watershed . and 140 forest compartments (330.51sq.km) in Jon-Teti watershed. where 14 proposed coal blocks are located, for a sustainable development and conservation	The State Forest Department may consider notifying the proposed area (mentioned in Biodiversity Assessment Report) as 'Conservation Reserve'.

Condition 1(A) Out of expected total area of 3797 ha degraded forests identified for compensatory afforestation, 4320.256 ha area within 142 sites have been afforested.

Condition number 2(b) which mentions fencing of safety zone (approx. 9.8 km) has been completed. As per site inspection report done on October 30, 2021 by State Forest Officials, the damaged fencing needs repair and maintenance and accordingly User agency was directed to do so. The local species have been planted in the safety zone.

Condition number 2(iii): User Agency has constructed check-dams and retention wall for preventing soil erosion through terracing/ benching.

All the remaining conditions of Final Approval date March 15, 2012 have been complied with by the User Agency, as informed by officials of State Forest Department, Chhattisgarh vide a report submitted on November 17, 2021

6.0 Findings of the Sub-Committee:

6.1 Majority of important conditions suggested under Mining Closure Plan have been complied with by the User Agency

6.2 Complete compliances of Recommendations of Biodiversity Assessment Report are under process. This is due to the fact that the report has been received by the Ministry of Environment Forests and Climate Change only about six weeks prior to site visit by Sub-Committee (on October 08, 2021), and hence not been reviewed by concerned Section within the Ministry.

6.3 Innovative measures have been attempted by the User Agency with respect to translocation the Sal Trees. The Sub-Committee while appreciating the said efforts, suggested that health of transplanted trees needed a few more monitoring approaches for better management of biologically reclaimed areas. Photo of the Sal translocation is enclosed at **Annexure- 17**

6.4 According to the Report submitted by DFO, Sarguja on Man-Elephant Conflict for over a decade, it was observed that number of cases of such instances had increased during the period 2011-12 up to 2017-18. Subsequently a decreasing trend was reportedly observed since 2018-19, on Human-Elephant conflict aspect. It was further corroborated by the APO of Integrated Wildlife Management Plan, that the Plan was proactively being implemented in the lease area since 2018-19. Copy of the compliances of various activities of Integrated Wildlife Management Plan is enclosed at **Annexure- 18**

The metadata also highlighted details of the compliances of recommendations of Integrated Wildlife Management Plan

6.5 Compliances of conditions stipulated in Final approval dated 15/03/2012 was found to be satisfactory by the Sub-Committee.

6.6 The Sub Committee observed that monitoring of reclamation work being done by SFD as well as User Agency could be done by IRO, Raipur on every fifth year till the duration of completion of the reclamation works as well as mine closure

- Based on Sub-Committee's site inspection, discussion meetings held, followed by critical interaction with the members of User Agency, site verification of Mining Closure Plan, compliance of the Final Approval of the Compliance Plan, recommendations of the Integrated Wildlife Management Plan and recommendations of the Biodiversity Assessment Report, outcome as per the Terms of Reference (TOR) to the Sub-Committee are as under:

1. TOR 01: The status of reclamation measures already implemented/ being implemented in the area of inspection is satisfactory and ecologically sustainable.
2. TOR 02: The conditions stipulated in the final approval by Ministry of Environment, Forests and Climate Change, Govt. of India, dated March 15, 2012 have been complied with, by the User Agency.

In view of the above, the Sub-Committee is of the opinion that the FAC may consider recommending the said Proposal for non-forestry use of 1898.328ha of Forest and (1654 109ha of Revenue Forest land and 244 219ha Forest land) in favour of Rajasthan Rajya Vidyut Utpadan Nigam Limited, in Villages Parsa and Kete, Telsil Udaipur, District Surguja Chhattisgarh.

01/12/2021

BIVASH RANJAN, IFS
Dy DGF (Central)
Integrated Regional Office, Lucknow

SANJAY DESHMUKH

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Government of India
Ministry of Environment, Forest and Climate Change
(Forest Conservation Division)

Indira Paryavaran Bhawan
Jor Bagh Road, Aliganj
New Delhi-110003
Dated: 9th November, 2021

Office Memorandum

Sub: Visit of FAC sub-committee to Parsa East Kate Basen (PEKB) coal block, Chhattisgarh.

In pursuance to the recommendation of the FAC in their meeting held on 28.10.2021, the following sub-committee of FAC is hereby constituted to visit the PEKB site:

1. Dr. Sanjay Deshmukh, FAC Member
2. Sh Bibhash Ranjan, Regional Officer, IRO, Lucknow
3. Sh Rakesh Jagenia, DIGF(WL), MoEF&CC

The Sub-Committee may co-opt expert members, as may deem appropriate, who will accompany the Sub-committee in their field visit. The Sub-committee shall undertake visit to the PEKB in Surguja District of Chhattisgarh to assess the following:

i. To assess that status of reclamation measures already implemented/being implemented in the lease area by the user agency in terms of its efficacy and provisions provided in the Mining Plan.
ii Status of compliance of various conditions stipulated in the approval dated 15.03.2012

Government of Chhattisgarh may depute an officer from the State Forest Department to make available the requisite documents, as may be desired by the Committee and also to make necessary arrangement of logistics and transport for the Sub-Committee. Contact details of the officer deputed for the purpose may be shared with the members/undersigned.

Sd/-
(Suneet Bhardwaj)
Assistant Inspector General of Forests

To

1. All members of the Sub-Committee as constituted above.
2. Addl Chief Secretary (Forest), Government of Chhattisgarh, Atal Nagar , Nawa Raipur: with a request to extend all assistance including transpost and accommodation, as required, for smooth conduct of the above field visit.

Copy to;

i Regional Officer, IRO Raipur with a request to depute an officer from the IRO to accompany the Committee
ii. Nodal Officer (FCA), Government of Chhattisgarh, Aranya Bhawan, Nawa Raipur Chhattisgarh
iii. User Agency.

Minutes of the Meeting of the Forest Advisory Committee (FAC) held on 28.10.2021

Agenda Item No. 1

F. No. 8-93/2013-FC (Pt.)

Sub: Proposal for non-forestry use of 255.3 ha of forest land under Forest (Conservation) Act, 1980 in favour of Dy Director Achanakmar Tiger reserve for relocation of villages in Mungeli Forest Division from the core area of Achanakmar Tiger Reserve (ATR) in Bilaspur District (Chhattisgarh)

The above stated agenda item was considered by FAC in its meeting on 28.10.2021. The details of the proposal may be seen at www.parivesh.nic.in. During the meeting, all the facts and background of the proposal, alongwith examination of the proposal in the DSS were presented by Member Secretary before the FAC for their examination and analysis. FAC after through deliberation and discussion observed that:

1. The State Government of Chhattisgarh vide their letter No. F 5-13/2020/10-2 dated 14.10.2020, submitted the above proposal seeking prior approval of the Central Government under the Forest (Conservation) Act, 1980.
2. The Proposal envisages relocation and rehabilitation of 3 villages namely Tilalibara, Birarpani and Chhirhatta (133 families) from the core area of Achanakmar Tiger reserve to Compartment No. 96, 557 and 558 of Lorami Forest Range of Mungeli Forest Division.
3. The Proposal involves relocation of total 133 families for which an area of 255.3 ha of forest land been proposed for rehabilitation of three villages. It is further reported that 963.775 ha area will be vacated from ATR.
4. Vegetation density of the forest area proposed for rehabilitation of the villages is 0.4 with 9,862 project affected trees.

5. Provision of the compensatory afforestation are not applicable in the instant case in view of the fact that area proposed to be vacated will be used for further enhancement of ecosystem goods and services by undertaking management prescription appropriate to the said area.
6. It was also observed that similar proposal was received from Government of Chattishgarh earlier. The same was considered by the FAC held on 29th January, 2014 and the FAC, after detailed discussion, recommended the proposal for diversion of 706.10 ha of forest land out of 839.50 ha after excluding 133.40 ha (75.90 and 57.50) of good Sal forest areas of Tawadbara in PF 1254& PF 1255. The FAC also recommended that the Stage-I approval to the proposal will be considered only after obtaining compliance of FRA. Recommendation of the FAC was conveyed to the State Government and complete reply from the State has not been received so far.
7. Pending reply, as per the observations of the FAC, the State Government has now submitted a new proposal involving three villages namely Tilalibara, Birarpani and Chhirhatta out of five proposed in the old proposal.
8. The present proposal along with additional information and site inspection report was placed before FAC in its meeting held on 25.06.2021. FAC observed that the proposed rehabilitation area involves an ESZ area and decided to defer the proposal seeking following information to take a comprehensive view on the proposal.
    i. A confirmation letter from the Government of Chhattisgarh that the restrictions related to ESZ within which the villages are to be relocated, have been discussed with the villagers.
    ii. Comments of CWLW on the issues related to human–animal conflict in the area selected for proposed relocation.

    On receipt of the above information, a view may be taken also considering the details of regulated, prohibited and permitted activities in the ESZ.
9. Ministry vide its letter dated 23.07.2021 requested the State Government to submit above information. The State government has provided following reply

S. No.	Observation made by the MoEF&CC	Reply from the State Government
1	A confirmation letter	Three villages that are proposed to be relocated are

	from the Government of Chhattisgarh that the restrictions related to ESZ within which the villages are to be relocated, have been discussed with the villagers.	Tilaidabra, Birarpani and Chirhatta falling within core area of Achanakmar Tiger Reserve. The administration of Achanakmar Tiger Reserve conducted a meeting with the villages of Tilaidabra on 03/07/21 and that with the villagers of Birarpani and Chirhatta on 04/07/21. During this meeting the villagers were informed that the area that they are being relocated into falls within the ESZ demarcated around the tiger reserve. They were informed of the provisions of the ESZ and were read out and explained about the different activities that falls under the categories of prohibited, regulated and permitted. The villagers then agreed to adhere to the conditions applicable in the ESZ and did not have any objection to be relocated into the existing proposed area. The copy of 'Panchnama' for all the three villages stating that the villagers have been explained the provisions of ESZ and that they have no objection in moving to the proposed area duly signed by them are submitted.
2	Comments of CWLW on the issues related to human- animal conflict in the area selected for proposed relocation.	In this regard, the State Government informed that there has been not a single case of human Wildlife Conflict recorded in last five years in the proposed site of relocation.

Decision of the FAC:

After thorough deliberation with Nodal officer Chattishgarh and representative of Chief Wild life Warden, Chattisgarh, **FAC recommended the proposal** with general, standard and following specific conditions.

i. State Government shall take effective steps to ensure that the villagers who are being relocated from the core area, do not return to the area.

ii. State Government shall submit the certificate of compliance under FRA, in both the areas i.e the area being vacated and the area where the people will be relocated.

iii. The area to be vacated shall be mutated in the name of State Forest Department and notified as RF/PF.

iv. State Government shall ensure that the area under the three villages that are proposed to be shifted outside the Achanakmar Tiger Reserve (ATR) will become inviolate after the shifting and no families are left with in these villages for further relocation.

Agenda Item No. 2

F. No. 8-31/1999-FC

Sub: Proposal involving non-forestry use of 192.250 ha of forest land in favour of M/s Jayaswal Neco Industries Limited for mining of iron ore located in village Chhote Donger, District Narayanpur (Chhattisgarh) - reg.

The above stated agenda item was considered by FAC in its meeting on 28.10.2021. The details of the proposal may be seen at www.parivesh.nic.in. During the meeting, all the facts and background of the proposal, alongwith examination of the proposal in the DSS were presented by Member Secretary before the FAC for their examination and analysis. FAC after through deliberation and discussion observed that:

1. The proposal was recommended for approval for partial area (91.0 ha) in 2004 by the then FAC in its meeting on 21.4 2004. In the meeting, it was considered as a special policy issue to allow mining in the Bastar area.
2. Stage I was granted only for 91 ha out of 192.250 ha as requested by the State government. Further Out of 91 ha, stage II was granted only for 35.74 ha to be worked in phase I.
3 While granting Stage II approval for only 35.74 ha of forest land, it was observed by the ministry that final approval with respect to 55.26 ha of forest land would be issued on receipt of further compliance report. Meanwhile, the

user agency was asked to protect and maintain the whole area at the project cost and under the supervision of the State forest department.

4. At this stage with regard to approval granted under the FC Act, the following were noted:

   i. Out of total lease area of 192.50 ha, Stage I approval was granted for 91.0 ha.

   ii. Out of 91.0 ha having Stage-I approval, Stage-II approval was granted for 35.74 ha only while remaining 55.26 ha of forest land is covered under Stage-I approval since 2006

   iii. 101.25 ha of forest land out of total lease area is yet to be granted Stage-I approval under the FC Act

   iv. Approval under FC Act was considered n phase wise manner by the Ministry based on the phase wise plan of mining submitted by the State

   v. State government has now submitted the compliance of Stage I approval of balanced area of 55.260 ha (out of 91 ha) and requested for Stage-II approval in respect of 55.26 ha and Stage-I approval for balance area of 101.25 ha.

   vi. The user agency has paid the NPV for the entire forest area involved in the mining lease of the user agency.

   vii. Due to acute problem of Naxalism in the area, the user agency could not do any work till recently. However, with the intervention of State Govt/Paramilitary forces, the user agency has resumed mining operations recently.

   viii. Analysis using DSS tool revealed the area falling in to High Conservation Value Zone

Decision of FAC:

After thorough deliberation and discussion with the Nodal officer Chhattisgarh and in view of the fact that after following due process of approval given under the Act, the MoEF&CC has already granted Stage-I approval over part of the total forests in the lease area and also justification submitted by the State Government for not able to do work on the diverted forest area of the State Government was considered plausible. Accordingly, FAC **recommend the proposal for the**

Stage II approval for 55.260 ha (for which Stage I approval has been obtained 21.4.2004) with General and Standard conditions. The balance area of 101.25 ha will be considered on merit later on.

Agenda item No. 3

Sub: Proposal for renewal of approval granted under the Forest (Conservation) Act, 1980 for non-forestry use of 16839.40 ha of Reserve Forest land in favour of Indian Army for Asan Field Firing Range (Sector 1, 3 and 5 as safety zone in District Dehradun (Uttarakhand) under Dehradun District of Uttarakhand

The above stated agenda item was considered by FAC in its meeting on 28.10.2021. The details of the proposal may be seen at www.parivesh.nic.in. During the meeting, all the facts and background of the proposal, alongwith examination of the proposal in the DSS were presented by Member Secretary before the FAC for their examination and analysis. Nodal Officer (FCA), Uttarakhand and Regional Officer, IRO, Dehradun were also present in the meeting. FAC after through deliberation and discussion noted the following:

1. Asan Field Firing Range (AFFR) of Indian Army was notified in August, 1995. Total area of the AFFR is 42,725.04 ha spread over two States viz. Uttarakhand (Dehradun District) and Uttar Pradesh (Saharanpur District). Forest area of the AFFR falling in Uttar Pradesh and Uttarakhand is 25,885.64 ha and 16,839.40 ha, respectively. Approval for part of forest area of 25,885.64 ha of AFFR falling in Uttar Pradesh was granted approval by the Central Government vide letter no. 8-20/2016-FC dated 10.04.2018 read with letter dated 15.10.2019 for a period of 30 years.
2. Part of forest area of AFFR, falling in the Dehradun District of Uttarakhand has been earmarked as Sector 1, 3 and 5 Safety Zone). In the past, approval under the FC Act, 1980 for the part of forest area falling in safety zone in Uttarakhand was granted vide Ministry's letter dated 8.01.2007 read with letter dated 1.10.2007
3. State Government has now submitted the proposal for renewal of approval granted under the Forest (Conservation) Act, 1980. Proposal for renewal was submitted after a gap of almost of 4 years.

4. The Ministry, after scrutiny of the proposal sought additional detail from the State viz. justification of delay in submission of the renewal proposal, status of compliance of approval of earlier approval, status of violation of Act, if any, done by the user agency, detail of CA undertaken in lieu of approval granted in the past, rationale for proposing the term of renewal as 10 years while the same has been proposed for 30 years for the AFFR in the State of Uttar Pradesh, etc.
5. IRO, Dehradun has also conducted an inspection of the area and has recommended the proposal for approval under the FC Act, 1980. IRO in its inspection report has also suggested to examine the possibility to exclude the safety zone area from the FC area and the user agency may be permitted, through an administrative order, for demarcating the safety zone area. Control and management of safety zone area may remain under the control of concerned DFO and DFO may consider grant of temporary permission as and when needed by the user Agency.
6. State Government vide their letter dated 14.09.2021 furnished the reply to the observation of the Ministry and after examination of the reply of the State and SIR of the IRO following is observed:
   (i) With regards to the non-forestry use of AFFR, the State reported that the same was used with permission of DM for temporary use to avoid any delay in training of cadets/troops who, in turn granted permission after taking necessary clearance from the concerned DFO.
   (ii) Use of AFFR, during the intervening period from 1.10.2017 onwards without the prior approval of the Central Government under the Forest (Conservation) Act, 1980 amounts to violation of Forest (Conservation) Act, and accordingly, appropriate action as per law should be initiated by the State and IRO of the Ministry.
   (iii) Partial detail of compensatory afforestation undertaken by the State against approval granted in the past has been made available by the State. Complete detail of the CA land supported with KML/Shape file needs to be submitted to enable the future monitoring of the area by the Ministry and its IRO.
   (iv) The justification for delay in submission of the renewal proposal stated to be occurred relatively little understanding of procedures is not tenable and

State Government in future needs to ensure the timely processing of such renewal in a consolidated manner.

(v) The State Government has also requested to make the term of renewal of approval for the period of 30 years instead of 10 years as proposed initially by the State.

(vi) The suggestion by the IRO to allow non-forestry use merely on the basis of an administrative order also seems to be not appropriate as the area is required for firing of various warheads which have conspicuous impacts on the surrounding area i.e. safety zone considerably. Restoration of damage, if any occurs due to firing of heavy warheads/artillery, may not be done on the strength of an administrative order. Moreover, administrative order cannot be equated to the statutory approval of FC Act compliance of which is binding on User agency.

Decision of FAC:

After thorough deliberation and discussion, the FAC **recommended the proposal** for for renewal of approval granted under the Forest (Conservation) Act, 1980 for non-forestry use of 16839.40 ha of Reserve Forest land in favour of Indian Army for Asan Field Firing Range (Sector 1, 3 and 5 as safety zone in District Dehradun, Uttarakhand) under Dehradun District of Uttarakhand **for a period of 30 years** with General, Standard and following specific conditions:

(i) Use of AFFR, during the intervening period from 1.10.2017 onwards without the prior approval of the Central Government under the Forest (Conservation) Act, 1980 amounts to violation of Forest (Conservation) Act, and accordingly, appropriate action as per law should be initiated by the IRO of the Ministry and State Government;

(ii) The State Government/User Agency shall ensure that in future, renewal proposal will be processed in time and a consolidated manner;

(iii) The State/UA shall submit the comprehensive proposal for both States for next renewal of this proposal;

(iv) The terrain of the area proposed for non-forestry use is hilly requiring special measure for the conservation of soil. Therefore, appropriate soil and moisture conservation measures, at project cost, will be undertaken by

user agency in the area being diverted in consultation with the State Forest Department;

(v) The Eco-Task force shall take appropriate compensatory afforestation measures at own cost after consultation of the State Forest Department without using of the resources of SFD. A scheme of afforestation, along with financial provisions, shall be submitted along with the compliance of Stage-I approval; and

(vi) Complete detail of compensatory afforestation undertaken against the approval granted in the past such as KML/Shape files shall be submitted along with the compliance of Stage-I approval. KML/Shape file of the afforestation undertaken in the CA land shall also be uploaded on the e-Green Watch Portal to enable the future monitoring of the area by the Ministry and its IRO and compliance of the same shall be submitted before Stage-II approval.

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Agenda No. 4

File No. 8-31/2019-FC

Sub: Proposal for non-forestry use of 1898.328 ha of forest and (1654.109 ha of revenue forest land and 244.219 ha forest land) in favour of Rajasthan Rajya Vidyut Utpadan Nigam Limited, for mining in Parsa East & Kete Basan (PEKB) coal block, District Surguja, Chhattisgarh-reg.

The above stated agenda item was considered by FAC in its meeting on 28.10.2021. The details of the proposal may be seen at www.parivesh.nic.in. During the meeting, all the facts and background of the proposal including chronology of related events, alongwith examination of the proposal in the DSS were presented by Member Secretary before the FAC for their examination and analysis. FAC after through deliberation and discussion observed that:

1. The proposal has been granted Stage-II approval vide Ministry's letter dated 15.03.2012 inter-alia stipulating the following condition:

"8. the mining shall be done in two phases:

(i) *During phases-I, covering 15 years, the mining shall be restricted to 762.00 ha of forest land.*

(ii) During phase –II the mining permission over remaining 1136.00 ha will be linked to the reforestation and biodiversity management in phase-I.

(iii) *The project proponent will submit the application for permission for mining in phase – II along with compliance report of phase-I."*

2. The condition regarding carrying out mining in two phases was stipulated by the competent authority in speaking order dt 23.06.2011 wherein recommendation of FAC for rejecting the proposal were overruled by competent authority and proceeded to grant stage-I approval to the proposal.
3. Now the State Government has submitted a proposal mentioning that User Agency vide their letter no 1708 dated 24.04.2019 has requested for permission to carry out mining in balance 1136.0 ha of forest land prior to completion of 15 years as stipulated. It is informed that due to enhanced production capacity the mining activities of Phase-I would be over in 2021. Accordingly, permission for Phase-II has been sought before the expiry of Phase-I.
4. It is informed that the Compensatory afforestation has been completed in the year 2012-13, 2013-14 and 2014-15 as per APOs approved by the administration over 3797.656 ha of degraded forest land.
5. Detail of maintenance of Safety Zone: Safety zone comprising 7.5 meter wide strip over a length of 9.80 km has been fenced and planted with local species.
6. Reclamation has been undertaken in the PEKB Coal Mining Project. Overburden has been used for backfilling and levelling the mined out areas. The user agency has planted 4,93,689 seedlings in the reclaimed areas.
7. The user agency has deposited Rs. 22 crores into the CAMPA account for the implementation of the Wildlife Management Plan. Implementation of works approved under the Wildlife Management Plan is under progress.
8. A total of 8,145 local trees have been transplanted by the user agency till 31.03.2020. Regeneration of sal trees is being undertaken by the user agency.
9. State Government has reported that felling of trees over an area of 753.804 ha has been carried out by the User Agency.
10. It has also been mentioned by the State Government that as per demand raised by the user agency so far i.e. upto 30.04.2020 an area of 612.290 ha of forest land out of 762 ha has been handed over to the user agency.

11. Differential GPS map of the forest area used for mining and other infrastructural facilities by the User agency has been made available by the user agency.

12. The State Government has also mentioned that following two cases pertaining to the approval granted for PEKB Coal Block are pending in the various Courts of law:

i) Civil Appeal No. 4395/2014 in the matter of Rajyasthan Rajya Vidyut Utpadan Nigam Limited vs Sudiep Srivastava is pending in the Hon'ble Supreme Court.

ii) W.P. (C) No 1346/2016 in the matter of Forest Right Committee, Ghatbarra vs Union of India and others is pending in the Hon'ble High Court of Chhattisgarh at Bilaspur.

13. Pursuant to Stage-II approval dated 15.03.2012, Government of Chhattisgarh vide their letter dated 28.03.2012 issued the final order of diversion of forest land.

14. Order of the State Government was challenged in NGT in Appeal No. 73/2012 in the matter of Shri Sudiep Srivastava and Other. Hon'ble NGT vide its order dated 24.03.2014 disposed of the said appeal inter-alia directing that:

"the case is remanded to the MoEF&CC with directions to seek fresh advice of the FAC within reasonable time on all aspects of the proposal discussed herein above with emphasis on seeking answers to the following questions: (i) What type of flora and fauna in terms of biodiversity and forest cover existed as on the date of the proposal in PEKB Coal Blocks in question. (ii) is/ was the PEKB Coal Blocks habitat to endemic or endangered species of flora and fauna. (iii) Whether the migratory route/corridor of any wild animal particularly, elephant passes through the area in question and, if yes, its need. (iv) Whether the area of PEKB Block has that significant conservation/ protection value so much so that the area cannot be compromised for coal mining with appropriate conservation/management strategies. (v) What is their opinion about opening the PEKB Coal Blocks for mining as per the sequential mining and reclamation method proposed as well as the efficacy of the translocation of the tree vis-a-vis the gestation period for regeneration of the flora? (vi.) What is their opinion about the Wildlife Management Plan finally prescribed? (vii.) What conditions and restriction do they propose on the mining in question, if they favour such mining?

Liberty is granted to the FAC to seek advice/opinion/specialised knowledge from any authoritative sources such as Indian Council of Forestry Research and Education Dehradun or Wildlife Institute of India including the sources indicated in the present case by the parties. All work commenced by the respondents no. 3 project proponent and Respondent no. 4 pursuant to the order dated 28th March, 2012 passed by Respondent No. 1 State of Chhattisgarh under Section 2 of the FC act, 1980, except the work of conservation of existing flora and fauna, shall stand suspended till such further orders are passed by the MoEF in accordance with law".

15. In compliance of the order of the Hon'ble National Green Tribunal, the matter was taken up in the meeting of FAC held on 29.04.2014. During the meeting, it was learned that the user agency i.e. Rajasthan Rajya Vidyut Nigam Ltd. has filed a Civil Appeal in the Hon'ble Supreme Court and an interim order of stay on the direction of the NGT order dated 24.03.2014 was passed by the Hon'ble Supreme Court. The FAC, which reviewed the whole matter and after examination of the issue, recommended that since the matter is sub-judice, decision on the matter may be deferred.

16. In the meantime, order of Hon'ble NGT was challenged by the User Agency by way of Civil Appeal No. 4395 of 2014 in the matter of Rajasthan Rajya Vidyut Nigam Ltd. Vs. Sudiep Srivastava. Hon'ble Court vide its order dated 28.04.2014 (Pg 1939/c) passed the following order:

> *".....we stay the direction in the impugned order that all works commenced by the appellant pursuant to the order dated 28th March, 2012 passed by the State of Chhattisgarh under Section 2 of the Forest Conservation Act, 1980 shall stand suspended till further orders are passed by the Ministry of Environment and Forests".*

Pursuant to the above Order of Hon'ble Supreme Court, Ministry vide its letter dated 27.05.2014 requested the Standing Counsel of Government of India in Supreme Court to furnish his considered legal opinion in the matter regarding further course of action, if any, to be taken by the Ministry. That the Standing Counsel, furnished his opinion through email dated 24.07.2014, which is reproduced as under:

'I have perused the documents mailed to me. In my opinion, the Supreme order is unambiguous. The order of NGT has been stayed in toto. Therefore, no action need to be taken by the MoEF till the disposal of Civil Appeal by the Supreme Court.'

17. The Ministry in light of above opinion took no further action in the matter.

18. Subsequently, the State Government vide their letter dated 03.05.2017, forwarded a proposal for change in land use of 29.09 ha of forest land out of already diverted forest land of 1898.328 ha in favour of Rajasthan Rajya Vidyut Nigam Limited, in villages Parsa and Kete, Tehsil Udaipur, District Surguja, Chhattisgarh. Simultaneously, the User Agency had also moved an application to MoEF&CC for grant of Environment Clearance to the expansion project of ***"Parsa East and Kete Basan (PEKB)"*** Opencast Coal Mine from 10 MTPA to 15 MTPA along with the expansion of Pit Head Coal Washery from 10 MTPA to 15 MTPA. The MoEF&CC on the said proposal of EC observed that since the Supreme Court has stayed the part (4) of the order of the Hon'ble National Green Tribunal whereby the ongoing operation of mining was suspended, the matter should be placed before the FAC in compliance of the order dated 23rd March, 2014 of the Hon'ble National Green Tribunal wherein the Hon'ble Tribunal directed to seek advice of the FAC on the whole issue.

19. That the FAC in its meeting held on 25.01.2018 considered the whole issue and analysed the existing condition of the mining lease area using the shape file on the Decision Support System (DSS" for short) of the Ministry and satellite images. FAC observed that the mining in the area is under process and forest has been cut as per the mining plan after the stay order granted by the Hon'ble Supreme Court vide order dated 28.04.2014. The mining cannot be stopped now due to the stay order on suspension of mining operation. Since the matter has become a *"fait accompli"* situation, the Petitioner has to comply with the mitigation measures as recommended in the Stage – II granted by the Ministry. Relevant recommendations of the FAC are reproduced hereunder:

i. *The mining shall be restricted to the area proposed in Phase I area i.e. 762 ha only without any change in mining plan till the final order of the Supreme Court in Civil Appeal No. 4395 of 2014.*

ii. *A biodiversity assessment study based on the criteria fixed by NGT in its order in Appeal no 72/2012 in the matter of Sudiep Srivastava versus state of Chhattisgarh, shall be undertaken by State Government through ICFRE Dehradun in consultation with Wildlife institute of India Dehradun for the whole Hasdeo- Arand coalfields comprising of Tara, Parsa, Parsa East, Kante. The study is to be awarded by State Government by associating the Indian Council of Forestry Research and Education (ICFRE), Dehradun and Wildlife Institute of India (WII) Dehradun and integrated wildlife management plan (IWMP) will be prepared and conservation area will be identified and mitigation measures will be recommended by the expert committee. The cost of study and cost of implementation of recommendations shall be borne by M/s Rajasthan Rajya Vidyut Utpadan Nigam Ltd (RRVUNL). The report will be submitted within two years.*

20. In the meantime, an IA No. 53863 of 2019 was filed Shri Sudiep Srivastava in Civil Appeal no. 4395 of 2014 alleging that Ministry has considered the approvals under the FC Act and EP Act in contrary to order of NGT and also to the conditions stipulated in the earlier approvals granted by the Ministry on 15.03.2012. The said IA came up for hearing in the Hon'ble Supreme Court on 28.01.2019 wherein Hon'ble Supreme issued following directions:

> *"Ms. Madhvi Divan, learned Additional Solicitor General, is requested to seek instructions and to file affidavit on the compliance effected by the Ministry of Environment & Forest and Climate Change in regard to the directions contained in Clause 2 of the operative part of the order of the National Green Tribunal dated 23th March, 2014. The Ministry of Environment & Forest and Climate Change shall file its response within four weeks from Today".*

21. The MoEF&CC, in pursuant to the above directions filed a detailed affidavit in the Hon'ble Supreme Court in April, 2019. In the said affidavit details regarding action taken by the MoEF&CC so far for the conservation and protection of biodiversity were also highlighted. The matter was last listed for hearing on 30.04.2019 wherein taking cognizance of the fact that applicant has

sought time to file rejoinder, the matter was listed for 15.07.2019. However, thereafter no effective hearing in the matter took place.

22. The instant request of the State government for permission for phase II was analysed in the FC division and the State government was asked for comments of the State on various Supreme Court orders wherein State Government forwarded an opinion of State Government's Advocate on record opining that proposal of PEKB may be considered as per law as the issues related to Biodiversity are being addressed in the Biodiversity Assessment Report.

23. In view of the above legal opinion furnished by the State, view point upheld by the Ministry in the past and pending the disposal of the case in the Supreme Court specifically with regards to biodiversity issues. Ministry of Law & Justice was requested to furnish its legal opinion as per law on the following:

> *Pending the final disposal of Civil Appeal No. 4395 of 2014 by the Hon'ble Supreme Court and after receipt of approved Biodiversity Assessment Study report from the State and its acceptance by the Ministry, whether request of the State Government to allow further mining over an area of 1136 ha which as per approval granted under the FC Act, 1980 was to be commenced after 15 years can be considered by the Ministry?*
>
> Legal opinion as sought above, is yet to be received from the MoL&J.

24. In the mean time due to ongoing coal crises, the issue related to approval, to different coal blocks were discussed in the meeting of Secretary (Coal) with Secretary (EF&CC). The proposal of PEKB Coal Block was also discussed and it was decided that since the State Government has submitted the BAR (Biodiversity Assessment Report), MoEF&CC may place the project proposal before FAC, pending opinion of MoLJ, for further decision on phase II.

25. During the meeting, it was also noted that the State government has submitted only draft Biodiversity Assessment Report (BAR) of the Hasdeo Arand Coalfield (HAC). However, it was confirmed by the Nodal officer (FCA), Chattisgarh and the representative of ICFRE, who had attended the meeting, that the report is final and State Government recommend the same.

26. During the meeting, ICFRE also made a detailed presentation on the Biodiversity Assessment study report, wherein, *inter alia*, it was clarified that

HAC has 1879 sq km of area and have 23 different coal blocks that includes Tara, Parsa, Parsa East & Kete Basan (PEKB) and Kente Extension (as on the Study period 2019-2020). These coal blocks in HAC are in 647 forest compartments.

The ICFRE study recommends that in the allotted four contiguous coal blocks falling within the Gej-Jhink watershed viz, Tara, Parsa, PEKB and Kete extension that are either already opened or in advance Stage of getting Statutory clearances/TOR approved, can be considered for mining with strict environmental safeguards including appropriate conservation measures for management of surface water and biodiversity. Further the BAR also suggests that mining in Kete Extension may be decided appropriately with strict environmental safeguards pertaining to the surface water management and biodiversity conservation measures considering the presence of relatively more very dense, moderately dense forest cover and wild life occurrence, particularly elephant movements. The officials of ICFRE also clarified that in remaining 19 coal blocks in the HAC, it is proposed that a cumulative impact assessment of all the coal blocks mining on environment or carrying capacity study involving physical, biological, social environment w.r.t. developmental intervention of the entire HAC shall be carried out for decision making and to achieve sustainable development.

BAR submitted by ICFRE also suggests for making of Biodiversity Conservation Area (BCA) by including a total of 337 forest compartments covering an area of 938 sq km in Chorni watershed and 140 forest compartments covering an area of 330.51 sq km in Ton-Teti watershed. The Nodal Officer (FCA), Chattisgarh stated that in order to strengthen the conservation efforts, the State has already constituted Lemru Elephant Reserve.

In view of the ecological considerations made in the ICFRE report, the Committee was of the view that mining activities should be done responsibly with proper safeguards, which need regular monitoring.

Decision of the FAC

Taking all facts related to the case into consideration FAC after thorough deliberation and discussion with the Nodal officer Chhattisgarh and officials of

ICFRE **deferred the proposal** and recommended that a subcommittee of following members shall be formed to visit the PEKB site.

i) Dr. Sanjay Deshmukh, FAC Member
ii) Sh Bibhash Ranjan, Regional Officer, IRO, Lucknow
iii) Rakesh Jagenia, DIG of Forests (WL), MoEF&CC

The Committee shall undertake visit to the Parsa East and Kante Basan coal block in Surguja District of Chhattisgarh to assess the following:

(i) To assess that status of reclamation measures already implemented/being implemented in the lease area by the user agency in terms of its efficacy and provisions provided in the Mining Plan.
(ii) Status of compliance of various conditions stipulated in the approval dated 15.03.2012

The Committee may co-opt expert member(s) as they may deem appropriate, to accompany the Committee during their visit to the site.

*****

Agenda No. 5

Policy issue 1

Sub:- Concerns of the People of Goa, whose lands have been identified as Private Forests-Reg

1. Dr. Pramod Sawant, Hon'ble Chief Minister of Goa has sent a D.O. letter no. 1-1-2021/CM/158 dt 16.04.2021 to the Hon'ble Minister EF&CC for informing that 46 sq. km. has been identified as private forests in the state of Goa. Further, for approximately 32 sq.km area process for identification and demarcation of remaining Private Forest is underway as per directions of the National Green Tribunal.
2. It was further stated that since Private Forest attracts provisions of the Forest (Conservation) Act, 1980, the owners of Private Forest are facing hardships, both financial and physical, as well as spend precious time in approaching Central Government for diversion of even a very small part of their private forest area for genuine needs. Similar to other Project Proponents, they are also required to pay applicable cost of Net Present Value, land and cost for Compensatory Afforestation.
3. In view of above, it was requested that appropriate policy interventions and relaxation in the relevant Acts/rules may be considered by the Ministry to provide appropriate relief and financial incentives to people of Goa, whose land have been identified as private forests.
4. The issue is being considered similar to the private forest areas of Mussoorie, Uttarakhand. A Special guideline referred in para 11.9 in comprehensive guideline handbook has been issued by MoEF&CC to deal with specific cases pertaining to private forest area of Mussoorie (Uttarakhand). This guideline permits usage of upto 250 sq m area for residential purpose by homestead owner for bonafide use and not for any commercial ventures.
6. Permission for residential purpose on forest land is generally not entertained under the provisions of FCA 1980. However, In Uttarakhand the homestead owners have been allowed to obtain permission for construction of residential house over 250 sq. m. The applicant has to move his application under the

provisions of FCA 1980 and guideline para 11.9. The same is reproduced as under:

> ***Residential Projects:*** *The Central Government will not entertain any proposal for diversion of forestland for construction of residential or dwelling houses. However, the Central Government has accorded permission for construction of residential houses in their private forests land for construction of residential or dwelling houses in the MDDA areas of Uttarakhand subject to fulfilment of following conditions:*
>
> a) *Construction activity for residential purpose in private forest shall be allowed only for domestic purpose and shall not be extended to any institutional buildings or commercial development*
> b) *The construction activates shall be restricted to a maximum of 250 square meter of built up area in each case.*
> c) *The construction of residential building in private forest is permitted in MDDA areas and other parts of Uttarakhand State only in order to alleviate hardship of homestead owners for constructing/completing their bonafide residential buildings.*

Above stipulation is strictly restricted to construction of residential or dwelling houses in private forest land in MDDA areas of Uttarakhand, where non forest land is not available.

Decision of FAC:

FAC after thorough deliberation and discussion on the issue, recommended that, one time permission for construction of homestead/ residential houses upto 250 sq m by the owners of the private area (deemed forest) in Goa may be given on similar conditions as specified in the guidelines dated 27.09.2018 issued for Mussoorie Dehradun Development Authority (MDDA).

Policy issue 2

Sub: Coal Mining leases involving forest and non-forest land; Commencement of mining operations in non-forest land before obtaining prior approval under the Forest (Conservation) Act, 1980 for the forest area within the lease — reg.

1. The above stated policy issue was also deliberated in the FAC on 25.11.20 and 25.6.2021.
2. Coal India Limited, vide their letter dated 14.07.2020 and M/o Coal vide their letter dated 14.08.2020 have, *inter-alia*, requested the MoEF&CC to allow commencement of mining operations where Stage-I approval and environment clearance has been obtained and to relax the quorum of Gram Sabha prescribed for ensuring compliance of Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006. Subsequently, a refcrence was also received from the Secretary (Coal) wherein issued highlighted by the Ministry of Coal was re-iterated.
3. Issue related to commencement of mining operations in the non-forest land after obtaining Stage-I approval for mining in the forest lands in the lease area and deposition of compensatory levies into the account of CAMPA was examined in the FC Division and followings were revealed:
   (i) As per Forest (Conservation) Rules, 2003, prior approval of the Central Government in obtained in two stages i.e. Stage-I and Stage-II. Stage-I approval is 'in-principle' approval of the Central Government, wherein certain conditions are stipulated, to be complied with by the State/User Agency. After having satisfied with the compliance of conditions stipulated in the Stage-I approval, Stage-II approval is granted by the Central Government under the FC Act, 1980.
   (ii) Further, with a view to avoid situations where investment made for commencing mining operations become infructuous in case approval under FC Act is finally denied, the MoEF&CC vide its guidelines, as incorporated at para 1.14 of the Handbook, has provided that work on non-forest land should not be started till the final approval (Stage-II

approval) of the Central Government under the FC Act 1980s obtained for forest land.

(iii) Hon'ble Supreme Court in Lafarge Judgment (06.07.2011) has directed not to create *fait accompli* situations. Hon'ble Court in Common Cause Judgement dated 2.09.2017, citing report dated 26.04.2010 highlighted the following:

> *"(b) Even otherwise the Rule 24-A(6), MCR, 1960 does not authorize the lessee to operate a mine without the statutory clearances/approvals. Therefore, in respect of a mine covered under the 'deemed extension' clause, the mining operations should be permitted to be undertaken in the non-forest area of the mining lease only if (i) it has the requisite environmental clearance; it has the consent to operate from the State Pollution Control Board under the Air and Water Acts; (iii) Mining Plan is duly approved by the competent authority; and (iv) the NPV for the entire forest falling within the mining lease is deposited in the Compensatory Afforestation Fund.*
>
> *The mining in the forest land included in the mining lease should be permissible only if, in addition to the above, the approval under the FC Act/TWP has been obtained:"*

(iv) MoEF&CC vide its guidelines dated 10.11.2015, incorporated at para 7.3 (v) of the Handbook of FC Act with a view to allow commencement of mining operations in the mining leases involving forest as well as non-forest land. It has made provisions that: the State Government, if so desires, may execute a separate mining lease for the whole or part of non-forest land falling in such mining lease, once stage-I approval under the Forest (Conservation) Act, 1980 for the entire forest land falling in such mining lease is obtained. The Government, in such cases, shall take all measures to ensure that no violations of the Forest (Conservation) Act, 1980 occurs on the forest land.

4. The proposal of M/o Coal and Coal India Limited was earlier considered by the FAC in its meeting held on 25.11.2020, wherein, after detailed deliberations it had observed that agreeing to the request as such may create *fait accompli*

situations and cannot be agreed as a general principle. For specific cases in which the forest land/non forest land is already broken within an area having approved mining plan, permission for commencement of mining operation in non-forest area may be considered by the State government after obtaining Stage I approval, subject to compliance of the following conditions:

i) All the compensatory levies stipulated in Stage I approval have been deposited.

ii) Environment clearances for the total area have been obtained.

iii) Such permission in the non-forest area shall not create any obligation of *fait accompli* with regard to Stage II clearance for the proposed forest area

5. The competent authority in the Ministry, after examination of the recommendation of the FAC, desired to seek legal opinion in the matter from the Ministry of Law & Justice. The opinion received from MoL&J is as follows:

"From the above, it is very much clear that what may constitute a fait accompli situation is a question of fact and not the question of law and therefore, the administrative Ministry is advised to look into all aspects of a project and while granting clearances of Stage I or Stage-II take all necessary measures that requires to be taken to avoid a fait accompli situation."

6. From the opinion of the M/o L&J, it may be ascertained that decision on the commencement of mining operation in non-forest land (in respect of existing mining leases) after obtaining Stage-I approval, environment clearance and deposition of compensatory levies into CAMPA account, is an administrative decision to be taken by adequately addressing the factor which may create *fait accompli* situations. Cases where such dispensation is proposed, Stage-I clearance and environment clearance already stand obtained by the concerned State/User Agency, i.e. well informed decision/inclination of the Central Government already made. implies that factor attributing to *fait accompli* situations, if any, have been taken care off/addressed.

7. In view of the above, the file was submitted seeking the approval of the competent authority to accept the recommendation of the FAC and to amend the para 1.14 of the Handbook of the Forest (Conservation) Act, 1980 to

consider commencement of mining operations in non-forest land in specific cases having forest land/non forest land already broken up within an area having approved mining plan and in which Stage-I approval has been obtained. The amended para was submitted for approval as under:

> *"1.14. Projects involving both forest and non-forest lands: Some projects involve use of forest land as well as non-forest land. State Governments/project authorities sometimes start work on non-forest lands in anticipation of the approval of the Central Government for release of the forest lands required for the project. Though the provisions of the FC Act may not have technically been violated by starting of work on non-forest lands, expenditure incurred on works on non-forest lands may prove to be infructuous if diversion of forest lands involved is not approved. Therefore, if a project involves forest as well as non-forest land, work should not be started on non-forest land till approval of the Central Government for use of forest land under the Act has been obtained unless and to the extent permitted by the FC Rules or guidelines issued there under.*
>
> *However, for specific cases in which the forest land/non forest land is already broken within an area having approved mining plan, permission for commencement of mining operation only in non-forest area may be considered by the State government after Stage 1 approval, subject to compliance of the following conditions:*
>
> *(i) All the compensatory levies stipulated in Stage I approval have been deposited.*
>
> *(ii) Environment clearances for the total area have been obtained.*
>
> *(iii) Such permission in the non-forest area shall not create any obligation of fait accompli with regard to Stage II clearance for the proposed forest area*

8. Secretary, EF&CC, after examination of the matter, observed that:

> *"I don't agree with recommendation of FAC. Even though lease area may include forest area, we are under no obligation to grant forest clearance. There can be no fait-accompli. If PP undertakes mining operation in non-forest area, it is none of our business to stop it and*

certainly casts no obligation on us to grant FC. If some expenditure of PP becomes infructuous, so be it. He is taking that risk. We have absolutely no jurisdiction over non-forest land and shall not indulge in over-reach. We shall restrict ourselves to just what SC order says, nothing beyond it. We shall permit any operations in non-forest area as long as it does not involve use of forest area. Please reconsider it in FAC again".

9. Based on the above observation of Secretary, EF&CC, the issue was again reconsidered by FAC on 26.6.2021 and FAC after thorough deliberation and discussion with the Nodal Officer Madhya Pradesh, Regional officer IRO Bhopal, IRO Nagpur observed that for reaching a conclusive stand on keeping non-forest area out of consideration of FC proposals it is essential that holistic information is available before FAC so that it could make appropriate recommendation and that the approval doesn't create a *fait-accompli* situation underlined by Hon'ble Supreme Court. Therefore, the FAC decided that IRO, Bhopal to prepare a comprehensive briefing paper on all-India basis on the matter. Accordingly, the DDG, IRO, Bhopal was requested.

10. DDG, Integrated Regional Office, Bhopal submitted their reply in response to Ministry's letter dated 23.07.2021, made an analysis of the issue and submitted the following recommendations:

i. In case of violation they should forego a bank guarantee which may be prescribed, for such cases.
ii. Relevant State Forest Act/Revenue Forest Act/IFA, 1927 whatever prescription is available for such violation may be made applicable. Penal NPV for violation of guidelines may be prescribed.
iii. In this case only an undertaking that he will not claim fait accompli plea in case of rejection of forest area for diversion may be obtained from UA.

Decision of FAC:

FAC after thorough deliberation and discussion with DDGs who attended the meeting, observed that in cases where the mining area involve both forest and

non forest area, the user agency can start the work over non forest area, subject to following conditions:

(i) The mining plan for working in the non-forest area within a coal block/lease (which also has forest area within it), shall not involve any forest area in the coal block/lease concerned.

(ii) No component/activity of the mining in the non-forest forest of such block/lease shall have any dependency in the forest area of the same block/lease.

(iii) Such permission in the non-forest area shall not create any obligation or *fait accompli* with regard to approval (Stage-I or Stage-II) under the Forest (Conservation) Act, 1980 by the Central Government.

(iv) Stand-alone proposal shall be made, if mining is intended in the forest area of the coal block/lease, under the provisions in the FC Act, 1980. No reference of mining already taken up in non-forest area shall be made in such proposal.

(v) In case of any violation over forest area is reported, matter shall be dealt as per the provisions in the FC Act, 1980 and Rules made thereunder.

*****

Confirmed through E-mail
Dr. Sanjay Deshmukh
(FAC Member)

Confirmed through E-mail
Shri Anmol Kumar
(FAC Member)

Confirmed through E-mail
Shri S. D. Vora
(FAC Member)

Confirmed through E-mail
Shri O. P. Sharma
(FAC Member)

Absent
Shri Soumitra Dasgupta
ADGF-FC

Shri Anjan Kumar Mohanty
Member Secretary (FAC)

Approved the final draft
Subhash Chandra
(Chairman and DGF)

Annexure-3 891

List of the participants during the site visit on 27/11/2021

Sl. No.	Name	Designation	Contact No.
1.	Shri Bivash Ranjan	IRO, Lucknow	9300791415
2.	Prof. Sanjay Deshmukh	FAC, Member	9300791415
3.	Dr Sudhir Kumar	DDG, ICFRE	9075603097
4	Dr. Bharadwaj Adiraju	c/o IRO, Raipur	8817284182
5.	Shri. Rakesh Kumar	TO, MoEF	9780960209
6.	Dr N. Ramarao	Expert, ICFRE	7987474345
7	Shri Sunil Mishra	Addl. PCCF land management &Nodal officer	
8.	Shri Anurag Shrivastava	CCF, Surguja	9424258701
9.	Shri Pankaj Kamal	DFO, Surguja	7827815730
10.	Shri V.S Bhagat	DFO, Surajpur	7000301023
11	Shri Vijendra Singh Thakur	S D.O. Udaipur	9584025909
12	Smt. Sapna Mukherjee	F.R.O. Udaipur	7987934053
13.	Shri. Gajendra Dohre	F.R.O, Production, Udaipur	9479182095
14.	Shri Radhe Shyam Yadav	D.M. Surguja Division	9425256352
15.	Shri Jugej Sahu	R.A. Basen	9399728132
16.	Shri Parmeshwar Singh	Beat Guard ,Ghatbarra	9131073128
17.	Shri Basant Ram	Beat Guard, Basen	9131273562
18	Shri Chandrabhan Singh	Beat Guard, Saldu	9406130513
19.	Shri Bharat Singh	Beat Guard, Parogiya	8319279809
20.	Shri R.K. Sorai	Director (Projects), RVNL	8370014848
21.	Shri Sanjay Kumar Singh	Cluster Head- Surguja & Bishrampur	7303091069

22.	Shri. Prateek Pandey	GM-Corporate Affairs	9009993678
23.	Shri. Amit Roy Chowdhury	AGM-Corporate Affairs	9099993690
24.	Shri. Rajeev Raman	Mines Manager. PEKB	9109988154
25.	Shri. Raj Kumar Pandey	Sr. Manager, Horticulture	8370012812

Annexure-4

F. No. 8-31/2010-FC
Government of India
Ministry of Environment & Forests
(FC Division)

Paryavaran Bhawan, C.G.O Complex,
Lodhi Road, New Delhi - 110510.
Dated: 15th March, 2012

To

The Principal Secretary (Forests),
Government of Chhattisgarh,
Raipur.

Sub: **Diversion of 1898.328. ha in two phases of forest land for Parsa East and Kete Basan captive coal block open cast mining project in favour of M/s Rajasthan Rajya Vidut Utpadan Nigam Limited in South Surguja Forest Division in Surguja District of Chhattisgarh – reg.**

Sir,

I am directed to refer to the State Government's letter no. FS-4/2010/10-2 dated 28.04.2010 on the subject cited above seeking prior approval of the Central Government under the Forest (Conservation) Act, 1980. After careful consideration of the proposal by the Forest Advisory Committee constituted under section-3 of the said Act, in-principle approval was granted vide this Ministry's letter of even number dated 06.07.2011 subject to fulfilment of certain conditions prescribed therein. The State Government has furnished compliance report in respect of the conditions stipulated in the in-principle approval and has requested the Central Government to grant final approval.

In this connection, I am directed to say that on the basis of the compliance report furnished by the State Government vide letter no. vide its letter no. 331-53/2455 dated 31.12.2011, approval of the Central Government is hereby granted under section-2 of the Forest (Conservation) Act, 1980 for diversion of 1898.328. ha in two phases of forest land for Parsa East and Kete Basan captive coal block open cast mining project in favour of M/s Rajasthan Rajya Vidut Utpadan Nigam Limited in South Surguja Forest Division in Surguja District of Chhattisgarh subject to fulfilment of the following conditions:

1. Legal status of forest land shall remain unchanged.

   a. Compensatory afforestation shall be raised and maintained by the State Forest Department over degraded orange forest land double in extent to the forest land proposed to be diverted at the project cost.

   b Fencing, protection and regeneration of the safety zone area shall be done at the project cost. Besides this, afforestation on degraded forest land, to be selected elsewhere, measuring one and a half times the area under safety zone, shall also be done at the project cost.

   c. Wherever possible and technically feasible, the User Agency shall undertake afforestation measures in the blanks within the lease area, as well as along the roads outside the lease area diverted under this approval, in consultation with the State Forest Department at the project cost.

2. Following activities undertaken by the project proponent under the supervision of the State Forest Department at the project cost:

   (i) Proper mitigative measures to minimize soil erosion and choking of streams shall be prepared and implemented.

   (ii) Planting of adequate drought hardy plant species and sowing of seeds to arrest soil erosion.

   (iii) Construction of check dams, retention / toe walls to arrest sliding down of the excavated material along the contour.

   (iv) The areas shall be reclaimed keeping in view the international practice of stabilizing the dumps by grading / benching so that angles of repose (normally less than 28 at any given place) are maintained.

   (v) No damage shall be caused to the top-soil and the user agency will follow the top soil management plan.

3. The approval under the Forest (Conservation) Act, 1980 is subject to the clearance under the Environment (Protection) Act, 1986 and any other Acts/Regulation/Rules.

4. The period of diversion of the said forest land under this approval shall be for a period co-terminus with the period of the mining lease proposed to be granted under the Mines and Minerals (Development & Regulating) Act, 1957, or Rules framed there under, subject to a maximum period of 30 years.

5. The User Agency shall furnish an undertaking to pay the additional NPV, if so determined, as per the final decision of Hon'ble Supreme Court of India.

6. Demarcation of mining lease area will be done on the ground at project cost using four feet high reinforced cement concrete pillars with serial numbers, forward and back bearings and distance from pillar to pillar.

7. Mining/reclamation schedule shall be implemented by the user agency at their cost as per Environmental Management Plan / phased reclamation programme. The annual report about the progress of reclamation should be submitted to the CCF (Central), Regional Office, Bhopal.

8. The mining shall be done in two phases:

   i. During phases-I, covering 15 years, the mining shall be restricted to 762.00 ha of forest land.

   ii. During phase –II the mining permission over remaining 1136.00 ha will be linked to the reforestation and biodiversity management in phase-I.

   iii. The project proponent will submit the application for permission for mining in phase II along with compliance report of phase-I.

9. The user agency will ensure the dumping of OB and phase wise rehabilitation and afforestation of the used / mined out pits / voids as per the approved plan under the supervision of the State Forest Department

10. The user agency will make arrangement for free supply of alternate fuels to labourers and staff working on the project site so as to avoid any pressure on the adjacent forest areas.

11. The forest land shall not be used for any purpose other than that specified in the proposal.

12. Any tree felling shall be done only when it is unavoidable and under strict supervision of the State Forest Department.

13. No damage to the flora and fauna of the area shall be caused.

14. No labour camps shall be set up inside the forest area.

15. The forest land proposed to be diverted shall under no circumstances shall be transferred to any other agency, department or person without prior approval of the Central Government.

16. The user agency will implement the Resettlement and Rehabilitation Plan as per the R&R Policy of State Government

17. The user agency will undertake transplantation of important tree species under 60 cm girth under the supervision of State Forest Department.

18. The State Government will not come up for opening up of the main Hasdeo-Arand area.

19. The user agency will ensure proper implementation of Wildlife Management Plan prepared by the State Government.

20. The user agency will assist the State Government in conservation and preservation of the flora and fauna of the area.

21. The State Government will suitably incorporate the comments, as suggested by of the WII, Dehradun, into the Wildlife Management Plan prepared for the area. The project proponent has deposited an amount of Rs. 22 crores (Rs. Twenty two crores) towards cost of implementation of the Wildlife Management Plan. Increased costs, if any, due to incorporation of the suggestions of WII, Dehradun will be borne by the user agency. Final copy of the Wildlife Management Plan will be submitted to this Ministry and the Regional Office, Bhopal within a period of three months for the purpose of monitoring. A soft copy in PDF format will also be submitted to the Ministry.

22 The user agency will make provision for appropriate financial outlay for the establishment of Rescue and Rehabilitation team to mitigate human-wildlife conflicts.

23. The Wildlife Management Plan will be implemented by the State Government and independent institutions like the Nature Conservation Foundation, Wildlife Trust of India and the Center for Ecological Studies at the Indian Institute of Science apart from the Wildlife Institute of India may be involved in implementation of the Plan. In order to ensure proper implementation of the Wildlife Management Plan, the State Government shall make necessary provisions for carrying out the monitoring and evaluation of the plan. It would be appropriate to include

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Chief Wildlife Warden of the State in monitoring the implementation of the Plan.

24. The user agency will undertake and implement suitable mitigative measures as prescribed in the Wildlife Management Plan for reducing the dependency of cattle and people on the surrounding forest area.

25. Any other condition that the Chief Conservator of Forests (Central), Regional Office, Bhopal may impose from time to in the interest of conservation, protection or development of forests.

26. The user agency shall submit the annual compliance report in respect of the above conditions to the State Government and to the Regional Office, Bhopal regularly.

Yours faithfully,

(Shiv Pal Singh)
Sr. Assistant Inspector General of Forests

Copy to:-

1. The Principal Chief Conservator of Forests Government of Chhattisgarh, Raipur.
2. The Nodal Officer, Office of the PCCF, Government of Chhattisgarh, Raipur.
3. The Chief Conservator of Forest, Regional Office, Bhopal.
4. User Agency
5. Monitoring Cell, FC Division.
6. Guard file.

(Shiv Pal Singh)
Sr. Assistant Inspector General of Forests

Untitled Map
Legend
N
Google Earth

Annexure-6

कार्यालय मुख्य वन संरक्षक, सरगुजा वनवृत्त, अम्बिकापुर (छ0ग0)

Ph.No. :- (O) 07774-240544, (R) 240019, (F) 240682 E_Mail :- cfsurguja@rediffmail.com

क्र0/मा.चि./न.क्र.–08/ 2021/ 2270 अम्बिकापुर, दिनांक 18/11/2021

प्रति,

आपर प्रधान मुख्य वन संरक्षक
(भू–प्रबंध)
अटल नगर नवा रायपुर (छ0ग0)

विषय :– **Visit of FCA Sub-committee to Parsa East Kate Basen (PEKB) Coal Block, Chhattisgarh.**

संदर्भ :– 1. अपर प्रधान मुख्य वन संरक्षक, (भू–प्रबंध) छ0ग0 रायपुर का पत्र क्रमांक/भू–प्रबंध/ खनिज/331-45/2800 दिनांक 16.11.2021
2. वनमण्डलाधिकारी, सरगुजा वनमण्डल का पत्र क्रमांक/तक.अधि./1748 दिनांक 17.11.2021

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विषयांतर्गत संदर्भित पत्र–01 के तारतम्य में चाही गई दो बिन्दुओं की जानकारी, जो वनमण्डलाधिकारी सरगुजा वनमण्डल के संदर्भित पत्र–02 द्वारा इस कार्यालय को प्रेषित है, की प्रति अनुशंसा सहित संलग्न कर अवलोकनार्थ एवं आवश्यक कार्यवाही हेतु सम्प्रेषित है।

संलग्न :– संदर्भित पत्र–02 मय दो बिन्दुओं की जानकारी।

मुख्य वन संरक्षक
सरगुजा वनवृत्त, अम्बिकापुर

पृ0क्र0/मा.चि./न.क्र.–08/ 2021/ 2271 अम्बिकापुर, दिनांक 18/11/2021

प्रतिलिपि :– वनमण्डलाधिकारी, सरगुजा वनमण्डल की ओर सूचनार्थ प्रेषित।

मुख्य वन संरक्षक
सरगुजा वनवृत्त, अम्बिकापुर

कार्यालय वनमण्डलाधिकारी, सरगुजा वनमण्डल, अम्बिकापुर (छ.ग.)
(प्रतापपुर रोड, फारेस्ट कैम्पस, अम्बिकापुर, जिला-सरगुजा)
☎ (07774-240238 (O), 240236 (R), 240238 (F) E-Mail :- dfosouthsurguja_200@rediffmail.com

क्रमांक/तक.अधि./1748 अम्बिकापुर, दिनांक/ 17/11/2021

प्रति,

मुख्य वन संरक्षक,
सरगुजा वनवृत्त अम्बिकापुर

विषय :— Visit of FCA sub-committee to Parsa East Kete Basen (PEKB) coal block, Chhattisgarh.

संदर्भ :— अपर प्रधान मुख्य वन संरक्षक (भू-प्रबंध) छ.ग. नवा रायपुर, अटल नगर का पत्र क्रमांक/भू-प्रबंध/खनिज/331-45/2800 दिनांक 16.11.2021

—00—

विषयान्तर्गत संदर्भित पत्र के तारतम्य में चाही गई दो बिन्दुओं की जानकारी निम्नानुसार है :—

i. To assess that status of reclamation measures already implemented being unimplemented in the lease area by the user agency in terms of its efficacy and provision provided in the mining plan.

परसा ईस्ट एवं केंते बासेन कोल माईन्स परियोजना के माईनिंग प्लान एवं माईन क्लोजर प्लान (15 MTPA Mining Plan) अन्तर्गत रिक्लेमेशन हेतु प्रावधान का संक्षिप्त विवरण एवं किये गये कार्यों की जानकारी संलग्न है।

ii. Status of compliance of various conditions stipulated in the approval dated 18-03-2012.

परसा ईस्ट एवं केंते बासेन कोल माईन्स परियोजना अन्तर्गत भारत सरकार वन एवं पर्यावरण मंत्रालय नई दिल्ली के पत्र क्रमांक/एफ-8-31/2010-एफ.सी. दिनांक 15.03.2012 के द्वारा स्वीकृति किया गया। प्रकरण में अधिरोपित शर्तों का आवेदक संस्थान राजस्थान राज्य विद्युत उत्पादन निगम लिमिटेड, जयपुर द्वारा पालन प्रतिवेदन प्रस्तुत किया गया।

परसा ईस्ट एवं केंते बासेन कोल माईन्स परियोजना का स्थल निरीक्षण दिनांक 30.10.2021 को उप वनमण्डलाधिकारी, उदयपुर, वन परिक्षेत्राधिकारी, उदयपुर एवं आवेदक संस्थान के अधिकारियों एवं कर्मचारियों के साथ किया गया। आवेदक संस्थान द्वारा प्रस्तुत पालन प्रतिवेदन में स्थल निरीक्षण उपरांत टीप सहित अधिरोपित शर्तों का पालन प्रतिवेदन संलग्न है।

उपरोक्तानुसार जानकारी अवलोकनार्थ एवं आवश्यक कार्यवाही हेतु सम्प्रेषित है।

संलग्न :— उपरोक्तानुसार।

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पृ.क्रमांक/तक.अधि./1749 अम्बिकापुर, दिनांक/ 17/11/2021

प्रतिलिपि :— अपर प्रधान मुख्य वन संरक्षक (भू-प्रबंध) छ.ग. अरण्य भवन, अटल नगर, नवा रायपुर को सूचनार्थ एवं आवश्यक कार्यवाही हेतु सम्प्रेषित।

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i. To assess that status of reclamation measures already implemented being unimplemented in the lease area by the user agency in terms of its effiency and provision provided in the mining plan.

परसा ईस्ट एवं कैते बासेन कोल माईन्स परियोजना के माईनिंग प्लान एवं माईन क्लोजर प्लान (15 MTPA Mining Plan) अन्तर्गत Action Plan for Technical and biological reclamation का विवरण वर्षवार परिशिष्ट में संलग्न है।

माईनिंग प्लान के अन्तर्गत प्रावधान (Provisions) एवं किये गये कार्यों का विवरण निम्नानुसार है :-

क्र.	प्रावधान (Provisions)	कार्य का विवरण
1	CLOSURE PLAN MINED OUT PLAN The lease is being freshly allotted. The area has never been mined. The mined out land will be reclaimed through plantation on dumping material. The mined out area will be backfilled by internal dumping. The top soil kept separately will be spreaded over to the dumps and fast growing plants species and grass will be planted to restore the biological and ecological system at the earliest.	माईनिंग प्लान के अनुसार कुल 586.870 है. क्षेत्र को बैक फिलिंग किया जाना है। संस्थान द्वारा उपलब्ध कराई गई जानकारी अनुसार 516.343 है. क्षेत्र में बैक फिलिंग कार्य किया गया है. जिसमें भौतिक रिक्लेमेशन कार्य 262.630 है. क्षेत्र में किया गया है। रिक्लेमेशन उपरांत वृक्षारोपण कार्य किया गया है एवं वर्तमान में रिक्लेमेशन कार्य प्रगति पर है। आवेदक संस्थान को रिक्लेमेशन कार्य लक्ष्य के अनुरूप पूर्ण करने एवं रिक्लेमेशन उपरांत वृक्षारोपण कार्य पूर्ण करने हेतु निर्देशित किया गया है।
2	TOPSOIL MANAGEMENT Top soil is excavating and segregate separately.Top soil is scrapped by dozer before the ground preparation for drilling and blasting.Scrapped top soil is being transported to the top soil storage area. During initial period of mining the top soil is being directly utilized for plantation of saplings along the proposed roads and bacern land. As and when the external waste dump gets stabilized the stored top soil will be spread over the area of dump to facilitate plantation.	प्रयोक्ता संस्थान द्वारा क्षेत्र की उपरी सतह की मृदा (Top soil) को खनन कार्य प्रारंभ करने से पूर्व क्षेत्र से सुरक्षित हटवाकर पृथक से संग्रहित कराया गया है। सत्यापन के दौरान मौके पर कार्य होना पाया गया।
3	TAILING DUMP MANAGEMENT Tailing pond will be made of adequate capacity. All waste water from mine,washery,workshop, colony will be first allow to settle down in the pond before discharging it to nearby water stream.	आवेदक संस्थान द्वारा परियोजना के वेस्ट वाटर (waste water) को Recycling करने हेतु कुल 11 नग सेटलिंग पॉण्ड (Settling Ponds) का निर्माण कराया गया है।
4	Plantation Work	आवेदक संस्थान द्वारा डम्प एरिया एवं अन्य क्षेत्र में रिक्लेमेशन कार्य उपरांत कुल 326.970 है. क्षेत्र में विभिन्न प्रजातियों के कुल 809134 नग पौधों का रोपण कार्य किया गया है। रोपित पौधों के उचित रख–रखाव हेतु संस्थान को निर्देशित किया गया है।

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MINING CLOSURE PLAN OF PARSA EAST & KANTA BASEN COAL BLOCK - IS MTY (SECOND REVISION)

Action Plan for Technical and biological reclamation presented in table below :-

Year Wise	Cummulative Area "Ha"							Cummulative Plantation "Ha"				Agriculture Land	Total
	Excavation	Back Filling	Void	Temporary Soil	External Dump	Others	Total	Back Filling	External Dump	Green Area	Infrastructure/Others		
PRESENT	206.27	68.64	137.63	5.000	112.66	176.95	500.877						
UP TO YEAR - 01	368.48	129.63	238.85	5.000	112.66	176.95	663.093				37.120		37.120
UP TO YEAR - 05	602.40	735.14	267.27	5.000	112.66	176.95	897.014				53.411		53.411
UP TO YEAR - 05	825.64	586.97	238.77	5.000	112.66	176.95	1120.248		112.655		54.674		167.329
UP TO YEAR - 10	1226.34	957.77	268.560	5.000	112.66	176.95	1520.945		112.655		54.674		167.329
UP TO YEAR - 20	1949.06	1565.35	383.72	5.000	112.66	176.95	2243.673		112.655		54.674		167.329
UP TO FINAL YEAR	2388.25	2157.560	230.69	5.000	112.66	176.95	2682.856	2127.555	112.655		54.674		2294.884
END OF MINE CLOSURE	2388.25	2157.560	230.69	5.000	112.66	176.95	2682.856	2127.555	112.655		54.674		2294.884

Source - PEKB Coal Block - 15 MTY Mining Plan - Mine Closure Plan - Page No. 45

MINING PLAN OF PARSA EAST & KANTA BASEN COAL BLOCK - 15 MTY (SECOND REVISION)

Table 10.24 Yearwise Land Use and Reclamation Area

Parsa East Kete Basen Coal Block Udaipur

Sl.N.	Particulars	Present	Up to Year - 01	Up to Year - 03	Up to Year - 05	Up to Year - 10	Up to Year - 20	Up to Final Year
A	Mining							
	Excavation Area & Barrier	206.268	368.480	602.405	835.639	1226.336	1949.064	2388.247
B	Infrastructure & OB Dump Area							
1	External Dump	112.655	112.655	112.655	112.655	112.655	112.655	112.655
2	Infrastructure	36.224	36.224	36.224	36.224	36.224	36.224	36.224
3	Coal Evacuation Route	30.260	30.260	30.260	30.260	30.260	30.260	30.260
4	CHP & Washery	28.381	28.381	28.381	28.381	28.381	28.381	28.381
5	Reject Based Thermal Power Project	42.570	42.570	42.570	42.570	42.570	42.570	42.570
6	Colonoy & Plantation Area	3.986	3.986	3.986	3.986	3.986	3.986	3.986
7	Rationalization Area	40.533	40.533	40.533	40.533	40.533	40.533	40.533
	Total (B)	294.609	294.609	294.609	294.609	294.609	294.609	294.609
	Grand Total (A+B)	500.877	663.093	897.014	1120.248	1520.945	2243.673	2682.856
a	Inter Dump Area (Reclamation/Back Filled Area)	68.640	123.632	335.136	586.870	957.774	1565.346	2157.560
b	Void Area (Non Reclamation/Back Filled Area)	137.628	244.851	267.268	238.768	268.562	383.718	230.687
c	Balance Area for Quarry	2182.257	2020.042	1786.121	1562.887	1162.189	439.462	

Source - PEKB Coal Block - 15 MTY Mining Plan - Environmental Management Plan - Page No. 10-71

प्रपत्र

1.	वनमण्डल का नाम		सरगुजा वनमण्डल अम्बिकापुर
2.	प्रस्ताव का नाम	-	परसा ईस्ट एवं केते बासेन कोल परियोजना
3	आवेदक संस्थान का नाम		राजस्थान राज्य विद्युत उत्पादन निगम लिमिटेड, जयपुर
4.	लोकेशन	—	परिक्षेत्र उदयपुर, परिक्षेत्र सहायक वृत्त — बासेन, बीट — बासेन एवं घाटवर्रा
5.	स्थल निरीक्षण की तिथि	—	30.10.2021
6.	व्यपवर्तन हेतु प्रस्तावित वनभूमि एव वन भूमि का एक्टीगीटीवाईज ब्रेकअप का विवरण	-	कोयला उत्खनन कार्य — 1898.328 हे. (प्रथम चरण हेतु - 762.000 हे.) आरक्षित वनभूमि — 0.000 हे., संरक्षित वनभूमि — 1654.109 हे. राजस्व वनभूमि — 244.219 हे.
7.	द्वितीय चरण स्वीकृति का दिनांक	—	भारत सरकार, पर्यावरण एवं वन मंत्रालय के पत्र क्रमांक/एफ—8—31/2010—एफसी दिनांक 15.03.2012
8.	मू—प्रबंध कार्यालय का नस्थी क्रमांक	—	331—45

स.क्र.	द्वितीय चरण स्वीकृति की शर्त का विवरण क्रमांक सहित	आवेदक संस्थान से प्राप्त पालन (01 जुलाई 2021 की स्थिति में)	निरीक्षण प्रतिवेदन के आधार पर वनमण्डलाधिकारी की टीप	रिमार्क
1	2	3	4	5
I	Legal Status of Forest Land Shall remain unchanged			
	(A) Compensatory afforestation shall be raised and maintained by the State Forest Department over degraded orange forest land double in extent to the forest land proposed to be diverted at the project cost.	An amount of Rs. 58.41 crore has been deposited in CAMPA for Compensatory Afforestation over total area of 3797 ha of degraded forest (Protected Forest).	वैकल्पिक वृक्षारोपण कुल क्षेत्रफल 3797 हे. विगडे वनक्षेत्र के लिए छ.ए. कैम्पा खाता में राशि रूपये 58.41 करोड दिनांक 03.10.2011 को आर.टी.जी.एस. के माध्यम से आवेदक संस्थान द्वारा जमा केया गया। परियोजना अन्तर्गत क्षतिपूर्ति वृक्षारोपण वर्ष	

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स.क्र	द्वितीय चरण स्वीकृति की शर्त का विवरण क्रमांक सहित	आवेदक संस्थान से प्राप्त पालन (01 जुलाई 2021 की स्थिति में)	निरीक्षण प्रतिवेदन के आधार पर वनमण्डलाधिकारी की टीप	रिमार्क
1	2	3	4	5
			2011–12 से वर्ष 2014–15 तक कुल 4320.256 है. वनक्षेत्र में किया गया। क्र. वनमण्डल कुल स्थल संख्या रकबा (है.में) 1 सरगुजा 74 2047.000 2 रामानुजगंज 33 835.000 3 कोरिया 11 370.000 4 सूरजपुर 24 1068.256 योग :– 142 4320.256 जानकारी वनमण्डलवार, स्थलवार संलग्न है।	
	(B) Fencing, protection and regeneration of the safety zone area shall be done at the project cost. Besides this, afforestation on degraded forest land, to be selected elsewhere, measuring one and a half times the area under safety zone, shall also be done the project cost.	Fencing of safety Zone approx 9.8 k.m. has been completed protection and regeneration work of safety zone for first phase of the project has been completed. Approx. 15017 nos. natives species sapling plants including transplantation of important species like sal (majority) and other trees has been planted in approx. 7.66 ha. land in safety zone area. An amount of Rs. 29,00,435/- has been deposited in CAMPA accountof Forest Department for compensatory afforestation over 1.5 times of safety zone area over degraded forest land on 03.10.2011 & 24.03.2014.	सेण्टीजोन क्षेत्र के डेढ़ गुना क्षेत्र के बराबर विगडे वनों के सुधार हेतु राशि रूपये 29,00,435.00 कैम्पा खाता में दिनांक 03.10.2011 को आर.टी.जी.एस. के माध्यम से जमा किया गया। सेन्टी जोन क्षेत्र का स्थल निरीक्षण दिनांक 30.10.2021 को उप वनमण्डलाधिकारी, उदयपुर एवं वन परिक्षेत्राधिकारी, उदयपुर के साथ संयुक्त रूप से किया गया। सेन्टी जोन क्षेत्र में प्रस्तावित फेंसिंग कार्य को सुगमता हेतु निर्देशित किया गया। पौधों के उचित रखरखाव हेतु निर्देशित किया गया। सेन्टी जोन क्षेत्र में स्थानीय प्रजातियों साल, साजा, महुआ, नीम, शिशु, चीम, बहेड़ा इत्यादि के पौधो का रोपण किया गया है।	

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स.क्र.	द्वितीय चरण स्वीकृति की शर्त का विवरण क्रमांक सहित	आवेदक संस्थान से प्राप्त पालन (01 जुलाई 2021 की स्थिति में)	निरीक्षण प्रतिवेदन के आधार पर वनमण्डलाधिकारी की टीप	रिमार्क
1	2	3	4	5
	(C) Wherever possible and technically feasible, the User Agency shall undertake afforestation measures in the blanks within the lease area, as well as along the roads outside the lease area diverted under this approval, in consultation with the State Forest Department at the project cost.	A total of 698528 sapling numbers trees have been planted in internal and external over burden dumps and 8946 nos of trees also transplanted in mining and infrastructure areas till 30th June 2021. **Detailed Plan is enclosed as Annexure I.** **List of species-wise trees planted enclosed as Annexure-II.**	उप वनमण्डलाधिकारी उदयपुर के प्रतिवेदन के अनुसार 20 प्रतिशत मृत पौधों के पुन: रोपित करने तथा रोपित पौधों के वृद्धि एवं विकास हेतु पर्याप्त मात्रा में खाद पानी एवं रक्षित देखभाल हेतु आवेदक संस्थान को निर्देशित किया गया एवं आवेदक संस्थान द्वारा कार्य कराया जा रहा है। कार्य संतोषप्रद पाया गया।	
2	Following activities undertaken by the project proponent under the supervision of the State Forest Department at the project cost			
	(i) Proper mitigate measures to minimize soil erosion and choking of streams shall be prepared and implemented.	Following mitigative measures have been undertaken to minimize soil erosion and choking of streams such as (i) construction of approx 13.50 KM of drainage system, (ii) 11 nos. of settling ponds, and construction of approx 2.5 KM of permanent toes walls along completed dump slopes (iii) 30000 sq. mtr. of geo-textiling over the dump slopes (iv) Sowing of grass seeds on dump slopes.	उप वनमण्डलाधिकारी उदयपुर के द्वारा प्रस्तुत प्रतिवेदन अनुसार आवेदक संस्थान द्वारा प्रस्तुत जानकारी का स्थल सत्यापन किया गया। सत्यापन में कार्य सही पाया गया।	

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उदयपुर (छ.ग.)

स.क्र.	द्वितीय चरण स्वीकृति की शर्त का विवरण क्रमांक सहित	आवेदक संस्थान द्वारा शर्त पालन (01 जुलाई 2021 की स्थिति में).	निरीक्षण प्रतिवेदन के आधार पर वनमण्डलाधिकारी की टीप	रिमार्क
1	2	3	4	5
	(ii) Planting of adequate drought hardy plant species and sowing of seeds to arrest soil erosion.	Sowing of grass seeds and plantation of drought hardy species has been done over all vulnerable areas including slopes of completed dumps.	प्रस्तावित संस्थान द्वारा भू-क्षरण रोकने के लिए वानस्पतिज एवं मरू सदृश्य स्थलीय प्रजातियां (डीर, बबूल, आस्ट्रेलियन बबूल, इजराईली बबूल) की प्रजातियों के बीजों की बुवाई का कार्य कराया जाना उल्लेखित है। जो सत्यापन के दौरान मौके पर कार्य होना संतोषप्रद पाया गया।	
	(iii) Construction of check dams, retention / toe walls to arrest sliding down of the excavated material along the contour.	Check dams, retention / toe walls (2.5 KM) have been constructed to arrest sliding down of the excavated material along the contour.	प्रस्तावित संस्थान द्वारा OB dumping क्षेत्र के स्थाईकरण हेतु terracing/benching कार्य कराकर भूमि कटाव रोकने का कार्य कराया गया है इसके अलावा 2.500 K.M Retaining Wall पत्थर टो-वाल का निर्माण कराया गया है। जो सत्यापन के दौरान मौके पर कार्य होना पाया गया।	
	(iv) The areas shall be reclaimed keeping in view the international practice of stabilizing the dumps by grading / benching so that angles of repose (normally less than 28 at any given place) are maintained.	Reclamation of internal & external over burden dumps are being done through proper grading and benching and thus making the dumps stable and the ultimate slope of all the dumps is less than 28°. **Dump Cross –Section is enclosed as Annexure III.** **Reclamation details enclosed as Annexure-IV.**	कोयला उत्खनन उपरान्त प्रभावित क्षेत्र के पुर्नउद्धार हेतु OB की मिट्टी को भराई कार्य कर समतलीकरण कार्य कराया गया है। जो क्षेत्र भ्रमण के दौरान कार्य मौके पर होना पाया गया।	
	(v) No damage shall be caused to the top-soil and the user agency will follow the top soil management plan.	No damage is being done to the top soil. Top soil generated during mining activities is being stored in separate top soil dump as per top soil management plan and same is being re-used in reclamation.	प्रस्तावित संस्थान द्वारा क्षेत्र की उपरी सतह की मृदा (Top soil) को खनन कार्य प्रारंभ करने के पूर्व क्षेत्र से सुरक्षित हटवाकर पृथक से संग्रहित कराया गया है। सत्यापन के दौरान मौके पर कार्य होना पाया गया।	

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स.क्र.	द्वितीय चरण स्वीकृति की शर्त का विवरण क्रमांक सहित	आवेदक संस्थान से प्राप्त पालन (01 जुलाई 2021 की स्थिति में)	निरीक्षण प्रतिवेदन के आधार पर वनमण्डलाधिकारी की टीप	रिमार्क
1	2	3	4	5
		Drainage system has been constructed along top-soil dump. Soil grass seeds are also being used to maintain fertility of soil and to control erosion.		
3	The approval under the Forest (Conservation) Act, 1980 is subject to the clearance under the Environment (Protection) Act, 1986 and any other Acts/Regulation/Rules.	Environment Clearance for the project has been granted by Ministry of Environment & Forests vide letter no. J-1015/03/2008- IA.II (M) dated 21.12.2011&10.08.2018.	माईनिंग लीज की अवधि 30 वर्ष है	
4	The period of diversion of the said forest land under this approval shall be for a period co-terminus with the period of the mining lease proposed to be granted under the Mines and Minerals (Development & Regulating) Act, 1957, or Rules framed there under, subject to a maximum period of 30 years.	Period of the Mining lease is 30 years	माननीय सर्वोच्च न्यायालय के निर्णय अनुसार भविष्य में निर्धारित की जाने वाली प्रत्याशा मूल्य की अतिरिक्त राशि जमा करने के लिये प्रबंधित संस्थान द्वारा वचन पत्र प्रस्तुत किया गया है	
5	The User Agency shall furnish an undertaking to pay the additional NPV, if so determined, as per the final decision of Hon'ble Supreme Court of India.	The Undertaking has been given for the same.	प्रबंधित संस्थान द्वारा माईनिंग लीज क्षेत्र को चिन्हांकित कर सीमेन्ट कंक्रीट के 120 सेमी. उंचाई के सीमा स्तंभ लगाये गये हैं तथा उस पर खनन का क्षेत्रांश एवं देशान्तर लेख किया गया है उप वनमण्डलाधिकारी उदयपुर के प्रतिवेदन के अनुसार सत्यापन के दौरान मौके पर कार्य होना पाया गया। क्षतिग्रस्त पीलर को मरम्मत करने हेतु निर्देशित	
6	Demarcation of mining lease area will be done on the ground at project cost using four feet high reinforced cement concrete pillars with serial numbers, forward and back bearings and distance from pillar to pillar.	Demarcation of mining lease area has been completed using 4 feet high reinforced cement concrete pillars with Geographical co-ordinates, serial numbers and distance from pillar to pillar.		

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1	2		3	4	5
				किया गया	
7	Mining/reclamation schedule shall be implemented by the user agency at their cost as per Environmental Management Plan / phased reclamation programme. The annual report about the progress of reclamation should be submitted to the CCF (Central), Regional Office, Bhopal.		Progress of Mining/Reclamation work is being submitted annually to CCF (Central), Regional Office, Nagpur along with FC compliance. **Reclamation details enclosed as Annexure-IV.**	आवेदक संस्थान द्वारा रिजनल ऑफिस को माईनिंग/रिक्लेमेशन कार्यों की प्रगति एवं अधिरोपित शर्तों का पालन प्रतिवेदन प्रतिवर्ष प्रस्तुत किया जाता है।	
8	**The mining shall be done in two phases**				
	(i)	During phases-I, covering 15 years, the mining shall be restricted to 762.00 ha of forest land	Presently mining activities are being done in the phase – I area of 762 Ha in forest land only and it will be restricted to 762 Ha of forest land during entire period of 15 years of phase –I	प्रयोक्ता संस्थान द्वारा दिये गये अपने प्रतिवेदन में इस बात का उल्लेख किया गया है कि फेज- 1 के 762 हेक्टे वनक्षेत्र के अन्दर चरणबद्ध अनुमति के उपरान्त ही खनन कार्य किया जा रहा है।	
	(ii)	During phase -II the mining permission over remaining 1136.6 ha will be linked to the reforestation and biodiversity management in phase -I	Agreed.	मौका सत्यापन के दौरान फेज–2 के निर्धारित क्षेत्र में कोई भी खनन कार्य होना नहीं पाया गया।	
	(iii)	The project proponent will submit the application for permission for mining in phase - II along with compliance report of phase-I	Agreed.	आवेदक संस्थान द्वारा फेज 2 की अनुमति हेतु आवेदन पत्र प्रस्तुत किया गया। अधिरोपित शर्तों का मौका सत्यापन उपरांत प्रकरण अग्रिम कार्यवाही हेतु प्रेषित किया गया।	

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1	2	3	4	5
9	The user agency will ensure the dumping of OB and phase wise rehabilitation and afforestation of the used / mined out pits / voids as per the approved plan under the supervision of the State Forest Department.	OB dumping and phase-wise rehabilitation and afforestation is being done in mined out pits under supervision of Forest Department. Reclamation details enclosed as Annexure-IV.	आवेदक संस्थान द्वारा प्रस्तुत रिक्लेमेशन प्लान अनुसार कार्य कराया जा रहा है। माईनिंग प्लान के अनुसार कुल 586.879 है. क्षेत्र को बैक फिलिंग किया जाना है। संस्थान द्वारा उपलब्ध कराई गई जानकारी अनुसार 516.343 है. क्षेत्र में बैक फिलिंग कार्य किया गया है जिसमें नैतिक रिक्लेमेशन कार्य 262.630 है क्षेत्र में किया गया है, रिक्लेमेशन उपरांत वृक्षारोपण कार्य किया गया है एवं वर्तमान में रिक्लेमेशन कार्य प्रगति पर है। आवेदक संस्थान को रिक्लेमेशन कार्य लक्ष्य के अनुरूप पूर्ण करने एवं रिक्लेमेशन उपरांत वृक्षारोपण कार्य पूर्ण करने हेतु निर्देशित किया गया है।	
10	The user agency will make arrangement for free supply of alternate fuels to labourers and staff working on the project site so as to avoid any pressure on the adjacent forest areas.	Free supply of alternate fuel such as L.P.G has been made for laborers and staff working on the project site which has ensured that there is no pressure on the adjacent forest areas for availability of fuel.	उप वनमण्डलाधिकारी, उदयपुर के प्रतिवेदन अनुसार परियोजना क्षेत्र में कार्यरत श्रमिकों एवं स्टेफ्फ्स्टियों के लिए कैन्टीन की व्यवस्था की गयी है। कैन्टीन में L.P.G. का उपयोग किया जा रहा है।	
11	The forest land shall not be used for any purpose other than that specified in the proposal.	Forest land is being used only for specified purpose	उप वनमण्डलाधिकारी, उदयपुर के प्रतिवेदन अनुसार आवेदक संस्थान द्वारा प्रत्यावर्तित वनभूमि का उपयोग प्रस्तावित कार्यों के अलावा अन्य कार्यों में नहीं किया गया है.	
12	Any tree felling shall be done only when it is unavoidable and under strict supervision of the State Forest Department	Tree felling is being done only when it is required to be done under supervision of the State Forest Department.	प्रत्यावर्तित भूमि में केवल उन्हीं वृक्षों का पातन कराया गया है जो निर्माण पातन हेतु प्रस्तावित थे। यह कार्य विभाग द्वारा विदोहन योजना तैयार कर नियमानुसार कराया गया है।	
13	No damage to the flora and fauna of the area shall be caused	No damage is being done to flora and fauna of the surrounding areas.	उप वनमण्डलाधिकारी, उदयपुर के प्रतिवेदन अनुसार आवेदक संस्थान द्वारा रिक्लेमेशन क्षेत्र के बाहर में flora and fauna को कोई क्षति नहीं पहुंचाई गई है	

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स.क्र.	द्वितीय चरण स्वीकृति की शर्त का विवरण क्रमांक सहित	आवेदक संस्थान से प्राप्त पालन (01 जुलाई 21 की स्थिति में)	निरीक्षण प्रतिवेदन के आधार पर वनमण्डलाधिकारी की टीप	रिमार्क
1	2	3	4	5
14	No labour camps shall be set up inside the forest area.	No labour camps have been established inside the forest area.	उप वनमण्डलाधिकारी, उदयपुर के प्रतिवेदन अनुसार आवेदक संस्थान द्वारा वनभूमि में लेबर कैम्प नहीं लगाया गया है।	
15	The forest land proposed to be diverted shall under no circumstances shall be transferred to any other agency, department or person without prior approval of the Central Government.	Diverted forest land has not been transferred to any other agency, department or person.	आवेदक संस्थान द्वारा दिये गये प्रतिवेदन अनुसार प्रत्यावर्तित वनभूमि को किसी संस्थान या व्यक्ति को हस्तांतरित नहीं किया गया।	
16	The user agency will implement the Resettlement and Rehabilitation Plan as per the R&R Policy of State Government.	Resettlement and Rehabilitation Plan has been prepared as per AdarshPunarwasNeyam of the State Government and same has been implemented as per approved plan. Following benefits have accrued to the project affected people . I. Rs. 79.55 Cr. has been paid against land compensation in four villages for acquisition of 368.190 ha private land. II. Rs. 29.70 cr. has been paid as compensation for settling the forest rights of dwellers under the Forest Rights Act 2006 to 338 Forest right holders. III. 398 persons have been given employment and Rs. 8.91 cr has been paid as one time compensation (@ Rs. 3 lacs per person) to	आवेदक संस्थान द्वारा प्रस्तुत जानकारी का परीक्षण एवं सत्यापन उप वनमण्डलाधिकारी, उदयपुर एवं वन परिक्षेत्राधिकारी, उदयपुर द्वारा किया गया। व्यवस्थापन एवं पुर्नवास की समीक्षा जिला स्तरीय पुर्नवास समिति द्वारा किया जाता है। पुर्नवास एवं व्यवस्थापन के संबंध में किसी प्रकार की शिकायत वनमण्डल कार्यालय में विचाराधीन नहीं है।	

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1	2	3	4	5
		330 persons in lieu of employment. IV. A monthly pension of Rs. 500 is being given to all persons who have attained the age of 60 years in the affected villages. This benefit is also going to the people who have not given their lands for the project. 240 people got benefited under this scheme during 2018-19. V. 165 no of plots having area as per the approved R&R Plan of Chhattisgarh state has been offered to Kete villagers (Project affected) in the R&R colony at Basen village. In addition to these plots, 68 numbers of houses have also been constructed in the R&R colony where other facilities such as roads, drains, lighting, water supply, school, Community center and health center etc. have been provided. A lump sum amount of Rs. 3 lacs is also		

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1	2	3	4	5
		being given to families who are opting to construct their own houses either on the plots given or elsewhere. VI-A State of the Art Vocational Training Center has been established in one of the project affected villages (Salhi) to impart training to youths of the affected villages as well as the nearby areas for developing skills under different trades such as, Industrial sewing machine operator, mechanical fitter, electrician, welder and hospitality. This VTC is equipped with residential facilities for all the male and female trainees who will require stay in the campus **CSR Details -** I A model school of 10+ 2 under CBSE has been established in village Salhi for imparting education to boys and girls of the entire project affected villages. It is equipped with all modern facilities and infrastructure such as	प्रयोक्ता संस्थान द्वारा दिये गये प्रतिवेदन में क्षेत्र भ्रमण के दौरान कार्य संतोषप्रद होना पाया गया।	

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1	2	3	4	5
		standard class rooms, library, computer room, science and math labs, art and music, audio visuals aids, CC TV cameras, WiFi, assembly point, play grounds etc. II. The education including tuition fees, uniforms, study materials, meals and transportation is absolutely free. III. A number of initiatives in form of project has been started under health, education, self-employment generation, agriculture, sports and culture and women empowerment etc for uplifting the socio-economic status of the project affected people in 14 villages. IV. Health was Organised at three Different hamlets of Parsa Village around 60 People attended the camp and Were administered free of cost. V. Model Organic Manure		

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1	2	3	4	5
		Production Unit has been developed in Parsa Gram Panchayat following participatory approach to promote organic farming in the Gram Panchayat, Parsa benefitting more than 200 families. VI. Production capacity of Sanitary Pad Making Unit has been enhanced with induction of 2 sets of semi-automatic machines creating opportunities to rural women for self-employment VII. In Order to generate sustainable livelihood for women in the mine peripheral village, training was conducted on turmeric cultivation and mixed pickle making. VIII. Around 80 hand pumps were repaired in the mine peripheral village in order to ensure that the villagers have easy access to clean drinking water IX SRI cultivation of Paddy seeds is going on in around		

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1	2	3	4	5
		100 acres of land at Parsa Village.		
17	The user agency will undertake transplantation of important tree species under 60 cm girth under the supervision of State Forest Department	Transplantation of important tree species under 60 cm girths is being done through transplanting equipment under the supervision of State Forest Department. 8946 number of trees has been transplanted as on 30th June 2021	प्रभेदक संस्थान द्वारा दिये गये प्रतिवेदन में परियोजना क्षेत्र के चयनित क्षेत्र में 60 से.मी. गोलाई से कम के उपलब्ध स्वस्थ महत्वपूर्ण प्रजातियों के 8946 वृक्षों का प्रत्यारोपण कार्य दिनांक 30.06.2021 तक किया जाना उल्लेखित है। उप वनमण्डलाधिकारी अंबिकापुर के प्रतिवेदन अनुसार क्षेत्र भ्रमण के दौरान लगभग 80 प्रतिशत पौधे जीवित होना पाये गये। ट्रान्सलोकेशन कार्य में जीवित पौधों के उचित रख रखाव हेतु राजपत्र के निर्देशित किया गया है	
18	The State Government will not come up for opening up of the main Hasdeo-Arand area.	Matter is related to the State Govt.	राज्य शासन से सम्बंधित है।	
19	The user agency will ensure proper implementation of Wildlife Management Plan prepared by the State Government.	An amount of 22 Crore has been deposited in CAMPA by user agency for implementation of the approved Wild Life Management Plan.	आवेदक संस्थान द्वारा वन्यप्राणी प्रबंधन योजना के क्रियान्वयन हेतु 22 करोड़ की राशि कैम्पा खाता में दिनांक 13.03.2012 तक आर.टी.जी.एस. के माध्यम से जमा किया गया है। प्रधान मुख्य वन संरक्षक (वन्यप्राणी) छ.ग. रायपुर के पत्र क्रमांक/437 दिनांक 06.03.2013 द्वारा वन्यप्राणी योजना राशि रूपये 22.00 करोड़ का अनुमोदन/स्वीकृति प्रदान किया गया है कैम्पा छ. ग रायपुर द्वारा वन्यप्राणी योजना अन्तर्गत वर्ष 2014–15 से वर्ष 2020–21 तक कुल राशि 308.3 लाख की स्वीकृति प्रदान की गई स्वीकृति उपरांत दिनांक 31.10.2021 की स्थिति में 318.99 लाख का कार्य पूर्ण किया गया है। किसी नये कार्य का स्थलवार जानकारी संलग्न है।	

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स.क्र.	द्वितीय चरण स्वीकृति की शर्त का विवरण क्रमांक सहित	आवेदक संस्थान से प्राप्त पालन (01 जुलाई 2021 की स्थिति में)	निरीक्षण प्रतिवेदन के आधार पर वनमण्डलाधिकारी की टीप	रिमार्क
-	2	3	4	5
20	The user agency will assist the State Government in conservation and preservation of the flora and fauna of the area.	The user agency has been assisting the State Govt. in conservation and preservation of the flora and fauna of the areas as and when advised by the Forest Dept. I. For fire protections an amount of 3.11 lakh at nearby forest area. II. An amount of 2 cr. has been deposit in state govt. for "Hurihar Chhattisgarh" (plantation & conservation flora) on 28th June 2016 III. An amount of Rs. 12 lacs have been deposited in forest dept. for ungradation of Sanjay Park at Amekapur.	आवेदक संस्थान द्वारा उल्लेखित राशि का भुगतान किया गया है।	
21	The State Government will suitably incorporate the comments, as suggested by of the WII, Dehradun, into the Wildlife Management Plan prepared for the area. The project proponent has deposited an amount of Rs. 22 crores (Rs. Twenty two crores) towards cost of implementation of the Wildlife Management Plan. Increased costs, if any, due to incorporation of the suggestions of WII, Dehradun will be borne by the user agency. Final copy of the Wildlife Management Plan will be	The suggestions put forward by the WII Dehradun were incorporated by the State Govt. in the Wild Life Management Plan (WLMP) which has a financial assurance of Rs. 22 Crores. The revised WLMP has been submitted to all Offices including the Regional Office of MOEF&CC.	भारतीय वन्यजीव एवं अनुसंधान परिषद (डब्ल्यू आई.आई.) देहरादून द्वारा बायोडायवर्सिटी एसिसमेंट प्लान तथा इंटिग्रेटेड वाईल्ड लाईफ प्लान तैयार करने हेतु राशि रूपये 474.18 लाख का भुगतान दिनांक 04.04.2019 एवं रू 34,83,050 दिनांक 8.10.2021 को वनमण्डल के पी.डी. खाते से किया गया है। भारतीय वन्यजीव एवं अनुसंधान परिषद (डब्ल्यू.आई.आई.) देहरादून द्वारा हसदो अरण्य क्षेत्र के लिए, परसा परसा ईस्ट एवं केते एक्सटेंशन कोल ब्लॉक के क्लेवलन क्षेत्रों का सर्वेक्षण एवं स्टडी कार्य प्रगति पर है। बायोडायवर्सिटी एसिसमेंट रिपोर्ट एवं	

Dev/FCA Proposal/Parsa East & Ketebasen/Compliance Report

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क्र.क्र.	द्वितीय वन स्वीकृति की शर्त के विवरण क्रमांक सहित	आवेदन सम्पन्न की प्राप्ति स्थिति (01 जुलाई 2021 की स्थिति में)	निरीक्षण प्रतिवेदन के आधार पर वनमण्डलाधिकारी की टीप	टिप्पणी
1	2	3	4	5
	submitted to this Ministry and the Regional Office, Bhopal within a period of three months for the purpose of monitoring. A soft copy in PDF format will also be submitted to the Ministry.		इंटीग्रेटेड मैनेजमेंट प्लान तैयार होने के उपरान्त शासन निर्देशानुसार कार्य किया जायेगा।	
22	The user agency will make provision for appropriate financial outlay for the establishment of Rescue and Rehabilitation Centre to mitigate human-wildlife conflicts	A financial outlay has been made for establishment of the Rescue & Rehabilitation of Human-wildlife conflicts in the approved Wild Life Management Plan.	प्रस्तावित प्रबंधन योजना अवधि हेतु वन्यजीवों के रेस्क्यू एवं बचाव कार्य हेतु राशि का प्रावधान है। वन्यप्राणी प्रबंधन योजनानुसार वन्यक्षेत्रों के विकास एवं संवर्धन हेतु कार्य किया जाना है।	
23	The Wildlife Management Plan will be implemented by the State Government and independent institutions like the Nature Conservation Foundation, Wildlife Trust of India and the Center for Ecological Studies at the Indian Institute of Science apart from the Wildlife Institute of India may be involved in implementation of the Plan. In order to ensure proper implementation of the Wildlife Management Plan, the State Government shall make necessary provisions for carrying out the monitoring and evaluation of the plan. It would be appropriate to include, Chief Wildlife Warden of the State in monitoring the implementation of the Plan.	Related to State Govt.	वाईल्ड लाईफ मैनेजमेंट प्लान योजनांतर्गत प्रधान मुख्य वन संरक्षक (वन्यप्राणी) एवं रायपुर के निर्देशानुसार वन्यक्षेत्र में कार्यों को संपादित किया जा रहा है।	

Dm/FCA Proposal/Parsa East & Kete Basen/Compliance Report

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स.क्र.	द्वितीय चरण स्वीकृति की शर्त का विवरण क्रमांक सहित	आवेदक संस्थान से प्राप्त पालन (01 जुलाई 2021 की स्थिति में)	निरीक्षण प्रतिवेदन के आधार पर वनमण्डलाधिकारी की टीप	रिमार्क
1	2	3	4	5
24	The user agency will undertake and implement suitable Mitigative measures as prescribed in the Wildlife Management Plan for reducing the dependency of cattle and people on the surrounding forest area.	Financial budget has been provided to undertake necessary steps for reducing dependency of cattle and people on the surrounding forest areas in the approved Wild Life Management Plan. Details of Cattle and Dairy Development and CSR Initiatives at PEKB site Surguja enclosed as annexure-V	प्रस्तावित संस्थान द्वारा चलतू पशुओं एवं आसपास के ग्रामीणों को वन क्षेत्र के उपर निर्भरता को घटाने के लिए कार्य किया जा रहा है जिसके अन्तर्गत उच्चगुणवत्ता के दुधारू पशु एवं स्टाल फीडिंग हेतु नस्ल सुधार को बढ़ावा देकर वनों पर चलतू पशुओं की निर्भरता को कम करने हेतु कार्य किया जा रहा है।	
25	Any other condition that the Chief Conservator of Forests (Central), Regional Office, Bhopal may impose from time to in the interest of conservation, protection or development of forests	Undertaking has already been given for compliance of this condition.	आवेदक संस्थान द्वारा इस संबंध में आवश्यक वचन पत्र प्रस्तुत किया गया है।	
26	The user agency shall submit the annual compliance report in respect of the above conditions to the State Government and to the Regional Office, Bhopal regularly.	Compliance Report is being regularly submitted to the State Govt. and Regional Office MoEF&CC, Bhopal/Nagpur.	आवेदक संस्थान द्वारा वार्षिक कम्प्लायन्स रिपोर्ट प्रत्येक वर्ष प्रस्तुत किया जा रहा है।	

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4 CLOSURE PLAN

4.1 MINED OUT LAND

The lease is being freshly allotted. The area has never been mined. The mined out land will be reclaimed through plantation on dumping material. The detail plans of reclamation are provided in Drawing-III.

The Mined out area will be backfilled by internal dumping.

The top soil kept separately will be spreaded over to the dumps and fast growing plants species and grass will be planted to restore the biological and ecological system at the earliest.

New drainages will be designed to avoid erosion.

The land profile will be kept closest to the profile of nearby areas as shown in reclamation plan.

ANNEXURE : CLOSURE PLAN OF PAKRA EAST & KRISTA BASAN COAL BLOCK [illegible]

Action plan for Technical and biological reclamation presented in table below

Year wise	Cummulative Area "Ha"							Cummulative Plantation Area "Ha"				Agriculture Land	Total
	Excavation	Back Filling	Void	Temporary Soil	External Dump	Others	Total	Back Filling	External Dump	Green Area	Infrastructure/ Others		
PRESENT	206.27	68.64	137.63	5.000	112.66	176.95	906.377						
UP TO YEAR-01	368.46	123.63	244.85	5.000	112.66	176.95	663.093	-			37.120		37.120
UP TO YEAR-03	602.40	336.14	267.27	5.000	112.66	176.95	897.014		-		53.411		53.411
UP TO YEAR-05	829.64	586.87	238.77	5.000	112.66	176.95	1.120.248	-	112.655		54.674		167.329
UP TO YEAR-10	1,226.34	957.77	268.56	5.000	112.66	176.95	1520.945	-	112.655		54.674		167.329
UP TO YEAR-20	1,949.06	1,365.35	383.72	5.000	112.66	176.95	2,243.673	-	112.655		54.674		167.329
UP TO FINAL YEAR	2,368.25	2157.56	230.69	5.000	112.66	176.95	2,682.856	2127.535	112.655		54.674		2.294.864
END OF MINE CLOSURE	2368.25	2157.55	230.69	5.000	112.66	176.95	2,682.856	2127.535	112.655		54.674		2 294 884

93

[illegible]

4.2 WATER QUALITY MANAGEMENT

➢ ***Water Resources***

The daily water requirement for the mine with coal washery operations and colony will be approximately 2650 m^3/day. The water for mine area will be sourced from the mine sump and for the colony it will be sourced from the dug bore wells.

The generation of wastewater from the mine operations is expected to be approximately 20 m^3/day from workshop which will be treated in the Effluent Treatment Plant (ETP) provided at the mine location and will be reused for workshop.

The generation of domestic wastewater from the colony located outside mine area will be approximately 492 m^3/day, which will be treated in the Sewage Water Reclamation Plant (SWRP) provided near the colony. The treated domestic wastewater will be used in plantations

➢ ***Surface Water Pollution Control Measures***

- Retaining walls will be provided at the toe of dumps and the unstable overburden benches within the mine to prevent wash off from dumps and sliding of material from benches. This will help in preventing silting of water drains/channels;
- The water channels/drains carrying the rain water from the mine will be provided with baffles and settling pits to arrest the suspended solids, if any, present in this water;
- The worked out slopes will be stabilized by planting appropriate shrub/grass species on the slopes.

- The mine water will be regularly tested for presence of any undesirable elements and appropriate measures will be taken in case any element is found exceeding the limits; and
- Seepage water and rain water collected in the open pits will be pumped out and discharged with natural drainage system after de-silting in settling ponds.

➢ ***Ground Water Pollution Control Measures***

- The domestic sewage from the canteen and toilets will be routed to septic tanks followed by soak pits. The domestic wastewater from the colony will be treated in sewage treatment plant and used for horticulture;
- The workshop effluent will be routed through oil and grease trap and treated to the discharge standards and reused for mining operations;
- Regular monitoring of water levels and quality in the existing open wells and bore well in the vicinity will be carried out both with reference to area spread and time intervals so as to study the hydrology of the area. If found necessary, additional observation wells will be sunk for monitoring the water table levels and quality around the mine representing both upstream and downstream conditions.

Suitable rainwater harvesting structures will be planned and constructed in-order to augment the ground water resources in the region.

The area is incised by several mostly northerly and easterly flowing streamlets in the northern and western part of the block that join the Atem nala flowing from southeast to northwest almost along the entire length and breadth of the block. The Atem nala and these streams together control the drainage of the area in the northern and central parts of the area. The drainage in the southern and southeastern parts is controlled by several southerly and southeasterly flowing streams. Some of the streams

deeply incise the ground where it encounters softer and friable litho units of Barakar Formation. Small ponds and dug wells are common in the area. These are utilized for irrigation and drinking water purpose.

Ground water pollution can take place only if the mining rejects contain chemical substances

Regular monitoring of ground water quality is essential to prevent and control the pollution of the nearby ground water contamination. The likely chances of the ground water getting contaminated are very rare.

Garland drains around the quarry with settling tanks will arrest suspended solid matter. Effluents from the workshop and the CHP will be collected and treated before discharge.

The study reveals that there will not be any negative impact due to mining on water regime of the area

Selected water quality parameters of ground and surface water resources within 10 km radius of the study area has been studied for assessing the water environment and evaluate anticipated impact of the proposed project. Understanding the water quality is essential in preparation of Environmental Impact Assessment and to identify critical issues with a view to suggest appropriate mitigation measures for implementation.

Ground Water

The maximum pH of 6.9 was observed at patelpura and the maximum conductivity was observed at Parsa.

Sodium and Potassium content is found to be in the range of 0.5-10.5 mg/l and 0.2-2.5 mg/l respectively. Calcium and magnesium content varies between 7.0- 22.0 mg/l and 1.3-9.7 mg/l respectively. Total hardness and alkalinity expressed as $CaCO_3$ ranges between 20-95 mg/l and 11-48 mg/l respectively. Chlorides and Sulphates are found to be in the range of 11.3-27.0 mg/l and 7.7-30.0 mg/l respectively. Nitrates and fluorides are found to be in the range of 0.2-2.6 mg/l and 0.3-0.5 mg/l respectively.

[illegible]

Zinc and iron content is found to be in the range of [illegible] 0.21 mg/l and 0.01-0.08 mg/l respectively. Mercury and lead content is found to be well within the permissible limits.

TDS and the heavy metal contents are found to be well within the limit. Insecticides and pesticides were found to be absent. The physico-chemical and biological analysis revealed that most of the parameters are well within the permissible limits.

Surface Water

The pH range is 7.0-7.2 which is well within the specified standard of 6.5 to 8.5.

The Chlorides and sulphates were found to be 2.3-2.8 mg/l, 3.5-4.2 mg/l respectively. It is observed that chlorides and sulphates are well within the permissible limits of 600 mg/l and 400 mg/l. Bacteriological studies reveal the presence of bacteria but within the limits. The heavy metal contents are below detectable limits. Based on the results, the surface water has been found to be suitable for drinking after the conventional treatment followed by disinfection.

4.3 AIR QUALITY MANAGEMENT

The ambient air quality with respect to the study zone of 10-km radius around the project site forms the baseline information. There are no industries in the study area and present major source of air pollution in the region is due to domestic activities and rural conditions.

The baseline data of air environment is generated for the following parameters:

- PM_{10}

- $PM_{2.5}$
- Sulphur dioxide (SO_2);
- Oxides of Nitrogen (NOx);
- Carbon Monoxide (CO); and
- Dust fall.

Source : Pre-monsoon Season, Vimta Labs Limited, Hyderabad

Summary of Observations

The results of the monitored data indicate that the ambient air quality of the region in general is in conformity with respect to rural / residential norms of the National Ambient Air Quality Standards of CPCB, with present level of activities.

3] SO_2: The maximum value for SO_2 is observed to be 20.1 $\mu g/m^3$ at Coal Mine area station with the minimum value observed at Arsinya Village station as 8.1 $\mu g/m^3$ during the study period.

4] NOx: The maximum value for NOx is observed at Arsinya station, as 10.6 $\mu g/m^3$ with the minimum value observed at Paraglya station as 5.3 $\mu g/m^3$ during the study period.

5] CO: The maximum value for CO is observed at Ingamar station, as 418 $\mu g/m^3$ with the minimum value observed at Basan station as 203 $\mu g/m^3$ during the study period.

6] Dust fall: The maximum concentration of total solids in the collected dust fall sample during the study period was found at Parsa village, which is about 228 mg/m^2/day. The minimum concentration of 152 mg/m^2/day in Tara the core area.

Air quality has been presented below:

SUMMARY OF AMBIENT AIR QUALITY RESULTS – PREMONSOON

Station Code	Name of the Location	PM_{10} (µg/m^3)				$PM_{2.5}$ (µg/m^3)			
		Min	Max	Avg	98th %le	Min	Max	Avg	98th %le
AAQ1	Coal Mine Area	59.1	70.5	66.3	70.0	24.8	28.9	27.1	28.9
AAQ2	Coal Washery Area	58.4	69.6	65.4	69.1	23.9	28.6	26.3	28.5
AAQ3	Parsa Village	56.7	68.2	64.0	67.7	23.5	27.6	25.8	27.6
AAQ4	Basan Village	56.8	65.1	61.6	65.0	23 1	26.4	24.5	25.9
AAQ5	Paroglya Village	49.9	58.2	54.7	58.2	19.9	23.2	21.3	22.7
AAQ6	Near Saidu Village	52.4	60.7	57.2	60.6	20.9	24.2	22.3	23.7
AAQ7	Gidmuri Village	46.6	55.2	50.9	5	19.7	23.2	21 1	22.8
AAQ8	Arsinya Village	42.2	50.5	47.0	50.4	18 1	21.9	19.7	21.6
AAQ9	Ingamar Village	53.2	61.3	57.9	61.2	22.1	25.4	23.5	24.9
AAQ10	Baigapara Village	55 1	63.4	60.0	63 3	22.6	25.9	24.0	25.4
AAQ11	Salka Village	43.2	51.5	48.0	51 4	18.8	22.6	20.4	22.6

AAQ12	Salba Village	44.5	53.1	48.8	52.5	19.3	22.8	20.7	22.2
Study Area Range		42.2 – 70.5				18.1 – 28.9			

Station Code	Name of the Location	SO_2 (µg/m³)				NOx (µg/m³)			
		Min	Max	Avg	98th %le	Min	Max	Avg	98th %le
AAQ1	Coal Mine Area	14.5	20.1	17.4	20.1	18.3	23.6	20.6	23.5
AAQ2	Coal Washery Area	13.2	18.8	16.1	18.8	17.1	22.6	19.4	22.5
AAQ3	Parsa Village	13.3	18.9	16.2	18.9	17.1	22.4	19.4	22.3
AAQ4	Basan Village	10.1	15.2	13.0	14.9	13.4	16.9	15.3	16.9
AAQ5	Parogiya Village	10.4	13.2	11.5	12.9	11.9	14.8	13.3	14.7
AAQ6	Near Saidu Village	10.1	13.7	12.0	13.6	12.8	15.9	14.3	15.9
AAQ7	Gidmuri Village	10.5	12.9	11.4	12.6	11.6	14.1	12.9	14.0
AAQ8	Arsiriya Village	8.1	10.5	9.0	10.2	9.2	11.7	10.5	11.6
AAQ9	Ingamai Village	11.1	13.9	12.2	13.6	12.4	15.3	13.8	15.2
AAQ10	Baigapara Village	12.4	14.2	13.2	14.2	13.4	15.9	14.7	15.8
AAQ11	Salka Village	9.1	11.5	10.1	11.3	10.4	12.7	11.6	12.6
AAQ12	Salba Village	9.8	12.2	10.8	12.0	11.1	13.4	12.3	13.3
Study Area Range		8.1 – 20.1				9.2 – 23.6			

Station Code	Name of the Location	CO (ug/m³)			
		Min	Max	Avg	98 %le
AAQ1	Coal Mine Area	321	484	419	477
AAQ2	Coal Washery Area	316	479	414	472
AAQ3	Parsa Village	309	472	407	465
AAQ4	Basan Village	233	396	331	389
AAQ5	Parogiya Village	196	359	294	352
AAQ6	Near Saidu Village	203	362	282	351
AAQ7	Gidmuri Village	192	355	290	348
AAQ8	Arsinya Village	179	342	277	335
AAQ9	Ingamar Village	202	365	298	350
AAQ10	Baigapara Village	241	375	324	373
AAQ11	Salka Village	203	348	275	333
AAQ12	Salba Village	208	353	279	338
Study Area Range		179 - 484			

Conclusions

From the above analysis of the data, it infers that the air quality levels in the study area are of fairly good quality and devoid of any industrial pollution.

There will be constant monitoring of air quality to keep within the prescribed norms. Dust suppression measures will be operative. Plantation

around the quarry and CHP will put up a green belt for mitigating air pollution. External OB dump afforested.

Measures of Minimizing Adverse Impacts

A. The production of blast fumes containing noxious gases should be reduced by the following methods:

- Proper and proportionate mixing of fuel oil with ammonium nitrate to ensure complete detonation;
- Use of adequate booster/prime; and
- Proper stemming of the blast hole.

B. Dust due to drilling should be minimized by using water tankers and sprinklers;

C. Regular maintenance of vehicles and machinery should be carried out in order to control emissions;

D. Cabins for shovel and dumpers and dust respirators to workmen should be provided;

- Depending on the water availability, sprayer system should be incorporated with shovel loaders, which can also wet the coal during loading, and unloading.

E. Dust suppression will be done on exposed area using water trucks and sprinkler.

F. Dust generated due to traffic on haul roads will be reduced by water spraying at regular intervals;

G. Greenbelt development should be taken up all along the haul roads and overburden dumps;

MINE CLOSURE PLAN

h. Dust respirators will be provided to all workers working in dusty environment; and

i. A good house keeping and proper maintenance will be practiced which will help in controlling pollution

4.4 NOISE LEVELS

OBSERVATION OF RESULTS

a) Day time Noise Levels (L_{day})

The daytime (L_{day}) noise levels are observed to be in the range of 44.1-57.5 dB (A). The maximum noise level of 57.5 dB (A) was observed at Coal Mine Area (N11) and the minimum noise level of 44.1 dB (A) was observed at Arsinya (N6).

b) Night time Noise Levels (L_{night})

The nighttime (L_{night}) noise levels are observed to be in the range of 40.5 dB-53.9 dB (A). The maximum noise level of 53.9 dB (A) was observed at Coal Mine Area (N11) and the minimum noise level of 40.5 dB (A) was observed at Arsinya (N6).

4.5 WASTE MANAGEMENT

The opencast mine is planned upto 225 m depth with overall average stripping ratio of 5.24.

The total volume of OB has been estimated as 2368.72 Mcum. The OB removed during initial years will be placed beyond the incrop of the seam IV. The total volume of external dump has been estimated as 43.52 Mcum solid. Rest of the OB will be placed in internal dumps. The total volume of

Internal OB, i.e. the volume which will be accommodated internally by backfilling has been estimated as 2325.20 Mcum.

The Internal dumping will start when about 100 m space is available on quarry floor. By adopting the proposed sequence of mining, as the quarry advances, the amount of internal dump will increase as more space for the internal dumping is created. For external dumps no additional land will be required outside the block boundary. External dump will be accommodated inside the block boundary. Two external dumps i.e external dump west and external dump east has been proposed on the north western and north eastern side of the block boundary respectively. Two internal dumps i.e internal dump west and internal dump east has also been proposed.

Internal dumping has been from 3rd year of mine operation. As the gradient of the seam is flat, during working of the quarry substantial amount of OB will be accommodated in internal dump. During 5th and 6th year of mine operation, overburden dump will be accommodated in external and internal dump. From 6th year of mine operation, no external dumping will be required. Hence, OB will be entirely accommodated in internal dump for rest of the mine life.

Overburden will be dumped in external as well as internal dump. Dumping has been planned assuming 15 % swelling factor.

During 1st year of mine operation, height of external dump has been kept at only 15 m. During 3rd year of mine operation, height of western external dump and eastern external dump has been kept as 30m. At the end of 5th year of mine operation height of west external dump and east external dump will be 30 m and 60 m respectively. Final height of western and eastern external dump will be 30 m and 60 m respectively. During closure of mine, overburden dumped above ground level will be used to fill void upto 30 m below ground level. It is proposed to maintained water body in the final void that is 30 m below ground level.

The land reclamation will be taken progressively after exhaustion of coal and completion of internal back dumping and flushing with external dumps.

The top soil is to be used with minimum time lag for spreading over the reclaimed area of the dumps.

It is proposed to reclaim dump with plantation etc after dumping / spreading top soil over the external and internal dumps.

Out of 2368.72 Mcum of OBR, 43.52 Mcum have been accommodated in external dumps, which constitutes about 1.84 % of total dumping.

Phased dump planning along with dump capacity has been given in table below:

YEAR	External Dump		Internal Dump		Total OB	
	Yearly Mcum	Cummu. Mcum	Yearly Mcum	Cummu. Mcum	Yearly Mcum	Cummu. Mcum
As on March 2016	13.53	13.53	12.80	12.80	26.34	26.34
1	3.46	16.99	24.53	37.33	27.99	54.32
2	22.92	39.91	21.23	58.56	44.15	98.47
3	3.61	43.52	40.72	99.28	44.33	142.80
4	0	43.52	53.87	153.15	53.87	196.67
5	0	43.52	53.88	207.03	53.88	250.55
6	0	43.52	60.00	267.03	60.00	310.55
7	0	43.52	62.00	329.03	62.00	372.55
8	0	43.52	62.00	391.03	62.00	434.55
9	0	43.52	63.00	454.03	63.00	497.55

MINE CLOSURE PLAN OF PARSA EAST & KANTA BASAN COAL BLOCK - 15 MTY (SECOND REVISION)

YEAR	External Dump		Internal Dump		Total OB	
	Yearly Mcum	Cummu. Mcum	Yearly Mcum	Cummu Mcum	Yearly Mcum	Cummu. Mcum
10	0	43.52	63.96	517.99	63.96	561.51
11	0	43.52	70.93	588.92	70.93	632.44
12	0	43.52	70.00	658.92	70.00	702.44
13	0	43.52	80.00	738.92	80.00	782.44
14	0	43.52	80.00	818.92	80.00	862.44
15	0	43.52	85.00	903.92	85.00	947.44
16	0	43.52	90.00	993.92	90.00	1037.44
17	0	43.52	90.00	1083.92	90.00	1127.44
18	0	43.52	95.00	1178.92	95.00	1222.44
19	0	43.52	105.00	1283.92	105.00	1327.44
20	0	43.52	115.00	1398.92	115.00	1442.44
21	0	43.52	115.00	1513.92	115.00	1557.44
22	0	43.52	117.00	1630.92	117.00	1674.44
23	0	43.52	117.00	1747.92	117.00	1791.44
24	0	43.52	115.00	1862.92	115.00	1906.44
25	0	43.52	115.00	1977.92	115.00	2021.44
26	0	43.52	115.00	2092.92	115.00	2136.44
27	0	43.52	112.00	2204.92	112.00	2248.44
28	0	43.52	95.00	2299.92	95.00	2343.44

YEAR	External Dump		Internal Dump		Total OB	
	Yearly Mcum	Cummu. Mcum	Yearly Mcum	Cummu. Mcum	Yearly Mcum	Cummu. Mcum
29	0	43.52	1741	2317.552	7.86	2360.80
30	0	43.52	7.86	2325.20	7.86	2368.72
31	0	43.52	0.00	2325.20	0.00	2368.72

4.6 TOPSOIL MANAGEMENT

Top Soil is excavating and segregate separately. Top soil is scrapped by dozer before the ground preparation for drilling and blasting. Scrapped top soil is being transported to the top soil storage area. During initial period of mining the top soil is being directly utilized for plantation of saplings along the proposed roads and barren land. As and when the external waste dump gets stabilized the stored top soil will be spread over the area of dump to facilitate plantation.

Top soil is proposed to be removed separately and dumped outside the quarry in a manner so as not to loose its fertility. The top soil would be spread over the reclaimed land, afterward.

Top soil being removed and dumped on the area shown on surface plan. Top soil will be stored for initial years and during subsequent years it will be directly spread over the reclaimed area.

Top soil details:

1. Height of Top soil 10 meters.
2. Year of reclamation : Already started and the mine is

under operation.

Top soil quantities for 1st 3 years of mine operation are as follows:

Sl No.	Year of mine operation	Top soil (Mcum)
1	1st	1.65
2	2nd	1.80
3	3rd	2.45

4.7 MANAGEMENT OF COAL REJECTS FROM WASHARY

The rejects generated from the washery should be utilized for power generation in an FBC based Thermal Power plant

4.8 MANAGEMENT OF ASH LIKELY TO BE GENERATED FROM THE REJECT BASED POWER PLANT

Methodology of Fly Ash Disposal

CSIR-CIMFR, Dhanbad has been engaged to provide the methodology for environment friendly dumping of coal ash generated from proposed Reject Based power plant in the nearby coal mine. The report embodies the field and laboratory investigation carried out by CIMFR and the design guidelines provided based on numerical modeling.

The ash generated from proposed Reject Based Power Project shall be disposed-off by backfilling of Parsa East and Kanta Basan (PEKB) Coal Mines. An admixture of Ash and Overburden in proposed mix ratio based on the stability analysis results and factor of safety shall be used to backfill the mines.

Following Methodology is proposed for dumping Pond ash along with overburden:

- Initially a bund of OB shall be formed all along the periphery in dumping area in phases. Some phases shall be filled with Pond ash + OB admixture randomly in the ratio of 1:3 while alternate phases shall be filled with only overburden.
- Two or three phases of dumping shall be done as required to achieve the required height of the bench.
- After the completion of the first stage, dozing, compaction and levelling is required to be done (by dozers) so as to mix the ash and overburden as thoroughly as possible. Similarly, subsequent stages of ash-overburden are formed
- Alternate layers shall have only overburden to ensure that the ash OB admixture is totally covered and protected from the OB dumps all around. At the top of the dump i.e. at the finishing stage, the dump shall be covered with 2 m thick soil and adequately compacted by dozing.
- The sides of the OB dumps shall be kept benched and maintain requisite height and angle of slope.
- This methodology is valid with well-developed drainage system as ground water and rain water conditions greatly influence slope stability. Therefore every effort should be made to minimize the water infiltration into the slopes.

4.9 FINAL STAGE RECLAMATION PLAN

The Final Stage Reclamation plan has been provided in Drawing

4.10 TAILING DUMP MANAGEMENT

Tailing pond will be made of adequate capacity. All waste water from mine, washery, workshop, colony will be first allow to settle down in this pond before discharging it to nearby water stream.

4.11 INFRASTRUCTURE

Proposed Infrastructures to be dismantled following facilities :-

Sl. No.	Proposed Infrastructures to be dismantled
1	Electrical and excavation workshop facilities
2	Washery plant
3	Fuel station
4	Explosive magazine
5	Coal handling plant
6	Effluent treatment plant
7	FBC based Thermal Power plant

Proposed to retain following facilities with proposed uses:-

Sl no	Facilities to be retain	uses of facilities to be retained by the local community
1	Office of the project	Recreation club
2	VTC centre	Skilled Training of the local people
3	Hostel	Primary school
4	Canteen	Fooding arrangement of VTC center and Primary school
5	Water facilities	It is proposed to maintain water facilities for the local people
6	Water body in the final void area	It will be used for water sport, fishery and tourism
7	land occupied by washery, workshop, coal handling plant	Park or playground for the local people

2000 Lakhs of financial corpus will be provided, the interest earning from which will be utilized for maintenance of the retained facilities.

4.12 DISPOSAL OF MINING MACHINERY

Nearly all the mining machinery will be moved to the other units of the owner. Only the scraps and non-usable machines, if any, will be auctioned.

4.12 SAFETY & SECURITY

Measures for fire at coal face and stockyard will be adopted. Proper safety will be adopted during mine closure. Proper measures also to be adopted to avoid mine inundation. Security Personnel will be detailed for a period of two years after mine closure for protecting new plantations in the reclamation area and look after the protective fence around the boundary of the mine to prevent any stray animal/man entering the area. It is also proposed to fence all the water body for the safety of man/animals.

4.13 DISASTER MANAGEMENT & RISK ASSESSMENT

Provisions under coal mines regulation and rules made there under and different circulars of DGMS will be strictly followed. Safety training will be imparted in the vocational training center to the workers for protection against landslide/fall, moving equipment and precautions during blasting, electrical shock protection and against accidental fire.

4.14 CARE & MAINTENANCE DURING TEMPORARY DISCONTINUAL

During such period round the clock security guard will be provided to prevent stray animal or persons entering mining area. Temporary fencing with notice about danger will be erected.

4.15 REHABILITATION AND RESETTLEMENT

Total families of Parsa, Kete, Ghatbarra, Salhi and Hariharpur village to be resettled will be 580. Rehabilitation and resettlement package of Rs 212.64 crores has been prepared as per the compensation guidelines of the state govt.

8 ECONOMIC REPERCUSSIONS OF CLOSURE OF CLOSURE OF MINE AND MANPOWER RETRENCHMENTS

To mitigate any hardship the company will do the following.

1) Transfer all the skilled employees to other mining areas.

2) Skill of the unskilled workers will be developed through structured programme to the extent possible so that they can be absorbed in other units of they can follow some self-employment.

3) Suitable VRS or other compensation as per law in consultation with the district labour commissioner will be followed

4) Effort will be taken to reclaim land to its natural contour so that it can be used for agriculture, plantation purpose. Water body will be developed in the void area which will be used for water sports, pisci culture etc. Secondary employment will be generated using reclaimed land and water body.

[illegible] P. NAGPAL
[illegible]
[illegible]

Annexure 940

वन एवं जलवायु परिवर्तन विभाग

:: मंत्रालय ::

महानदी भवन, नवा रायपुर, अटल नगर

क्रमांक एफ 8-6/2007/10-2, नवा रायपुर, अटल नगर दिनांक 07/10/2021

प्रति,

उप संचालक,
शासकीय क्षेत्रीय मुद्रणालय,
खैरागढ़ रोड़,
राजनांदगांव, छत्तीसगढ़ ।

विषयः- लेमरू हाथी रिजर्व गठित करने के संबंध में ।

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उपरोक्त विषय में लेमरू हाथी रिजर्व लेमरू हाथी रिजर्व के 1995.48 वर्ग कि.मी. वन क्षेत्र घोषित किए जाने संबंधित इस विभाग की अधिसूचना दिनांक 07/10/2021 की प्रति संलग्न है।

2/- अनुरोध है कि संलग्न अधिसूचना को छत्तीसगढ़ साधारण राजपत्र के आगामी अंक में प्रकाशित कर, प्रकाशित अधिसूचना की 100-100 प्रतियां तत्काल उपलब्ध कराने की व्यवस्था करें।

संलग्नः- उपरोक्तानुसार।

(के.पी. राजपूत)
अवर सचिव
छत्तीसगढ़ शासन,
वन एवं जलवायु परिवर्तन विभाग

पृष्ठां.क्रमांक एफ 8-6/2007/10-2, नवा रायपुर, अटल नगर दिनांक /10/2021

प्रतिलिपि :-

1. प्रधान मुख्य वन संरक्षक, छत्तीसगढ़ अरण्य भवन, सेक्टर-19,नवा रायपुर, अटल नगर (छ.ग.) ।
2. प्रधान मुख्य वन संरक्षक, (वन्यप्राणी) छत्तीसगढ़ अरण्य भवन, सेक्टर-19, नवा रायपुर, अटल नगर (छ.ग.) ।
3. वनमंडलाधिकारी, राजनांदगांव की ओर अग्रेषित कर निर्देशित किया जाता है कि प्रकाशन उपरांत अधिसूचना की प्रतियां प्राप्त कर शासन को उपलब्ध करावें।

अवर सचिव
छत्तीसगढ़ शासन,
वन एवं जलवायु परिवर्तन विभाग

छत्तीसगढ़ शासन
वन एवं जलवायु परिवर्तन विभाग
मंत्रालय महानदी भवन, नवा रायपुर अटल नगर
//अधिसूचना//

क्रमांक/एफ 8–5/2007/10–2 नवा रायपुर, अटल नगर, दिनांक 07/10/2021

जंगली हाथियों को अनुकूल प्राकृतिक रहवास उपलब्ध कराने, मानव–हाथी द्वंद कम करने तथा बेहतर वन्यप्राणी प्रबंधन के उद्देश्य से छत्तीसगढ़ शासन एतद द्वारा निम्न अनुसूची में दर्शाये अनुसार 'लेमरू हाथी रिजर्व' घोषित करता है :–

"अनुसूची"

जिला	कोरबा, सरगुजा, रायगढ़
परिक्षेत्र	केंदई, एतमानगर, उदयपुर, लखनपुर, लुण्ड्रा, पसरखेत, बालको, लेमरू, बोरैं, कापू, धरमजयगढ़
हाथी रिजर्व का नाम	लेमरू हाथी रिजर्व
क्षेत्रफल	199548.00 हेक्टेयर = 1995.48 वर्ग किमी

सीमाएं

अ. क्र.	वनमंडल	उप वनमंडल	परिक्षेत्र	कक्ष क्रमांक	रकबा हे. में		सीमाएं
					वनभूमि	राजस्व भूमि	
1	2	3	4	5	6	7	8
1	कटघोरा	कटघोरा	केंदई	OA698, OA699, OA700, OA701, OA707, OA724, OA725, OA726, OA727, P355, P356, P357, P358, P359, P360, P361, P362, P363, P364, P365, P366, P367, P368, P369, P370, P371, P372, P373, P374, P375, P376, P377, P378, P379, P380, P381, P382, P383, P384, P385, P386, P387, P388,	26798.568	5492.714	उत्तर सीमा – हसदेव नदी एवं मनारी नाला का संगम जिसके दक्षिण में कटघोरा वनमण्डल के कक्ष क्रमांक 355 की उत्तरी सीमा एवं सूरजपुर वनमण्डल के कक्ष क्र. पी.1902 की दक्षिणी सीमा बनाता है, पूर्व की ओर बढ़ते हुए कटघोरा वनमण्डल के केन्दई परिक्षेत्र के कक्ष क्र. पी. 356 की उत्तरी सीमा आगे पूर्व ओर कक्ष क्र. पी.357

वनमंडल	उप वनमंडल	परिक्षेत्र	कक्ष क्रमांक	कबा हे. में भूमि	राजस्व भूमि	सीमाएं
1	2	3	4	5	6	7	8
			P389, P390, P391, P392, P393, P394, P395, P396, P397, P398, P399, P400, P401, P402, P403, P404, P405, P406, P407, P408, P409, P410, P411 P412, P413, P414, P415, P416, P417, P418, P419, P420, P421, P422, P423, P424, P425, P426, P427, P428, P429, P430, P431, P432, P433, P434, P435, P436, P437, P438, P439, P440, P441, P442, P443, P444, P445, P446, P447, P448, P449, P450, P451, P452,			की उत्तरी सीमा लाईन बनाते हुए सुरजपुर एवं कटघोरा वनमण्डल की सीमा लाईन बनाता है आगे पूर्व की ओर बढ़ते हुए कक्ष क्र. पी.351, पी.358, पी. 359, पी.360, पी.361, से ओ.ए.724 की उत्तर पूर्व सीमा जो उदयपुर व केन्दई परीक्षेत्र की उभयनिष्ठ सीमा बनाते हुए नेशनल हाईवे को पार कर कक्ष क्र. पी.432, पी.433, पी.434, पी.440, पी.441, पी. 445, पी.446 उत्तरी सीमा बनाता है एवं कोरबा वनमण्डल के लेमरू परीक्षेत्र अंतर्गत कक्ष क्र. पी. 865 व पी.866 की उत्तरी सीमा, ओ.ए.1189 के उत्तर पूर्वी सीमा को स्पर्श करते हुए दक्षिण पूर्व की ओर कक्ष क्र. पी. 867 की पूर्वी सीमा लाईन बनाता है। आगे ग्राम मुनरी दादर की पूर्वी सीमा जो आगे ओ.ए. 1190 की उत्तरी सीमा लाईन को स्पर्श कर आगे दक्षिण पूर्व की ओर बढ़ते हुए कक्ष क्र. पी. 876 की उत्तर पूर्वी सीमा बनाते हुए पूर्व की ओर सरगुजा वनमंडल के उदयपुर परिक्षेत्र में प्रवेश कर कक्ष क्र. पी 2151 की पश्चिमी छोर से शुरू होकर उत्तर एवं दक्षिण पूर्व की ओर कक्ष क्र. पी. 2152 के उत्तर पूर्वी किनारे को स्पर्श कर पूर्व की ओर बढ़ते हुए कक्ष क्र. पी. 2159, 2160 की पश्चिमी सीमा लाईन एवं 2161 की पश्चिम, उत्तर व पूर्वी सीमा बनाता है। तत्पश्चात 2162 की उत्तर, पूर्व, दक्षिणी सीमा बनाते हुए दक्षिण की ओर पी. 2160 की पूर्वी सीमा बनाकर दक्षिण से पूर्व की ओर बढ़ते हुए कक्ष क्र. 2156 की उत्तरी सीमा लाईन बनाता है। पूर्व की ओर कक्ष क्र. 2163 की उत्तरी सीमा बनाकर उत्तर की ओर कक्ष क्र. 2182 की पश्चिम व उत्तरी सीमा एवं 2180 की उत्तर पूर्व सीमा बनाते हुए 2181 की उत्तरी सीमा लाईन को स्पर्श कर उत्तर पूर्व की ओर बढ़ता है एवं कक्ष क्र. पी. 2178 की उत्तरी
2	कटघोरा	कटघोरा	एतमानगर	OA758, P496, P497, P498, P499, P500, P501, P502, P503, P504, P505, P506, P507, P508, P509, P510, P511, P517, P519, P520, P521, P522, P523, P524, P525	6950.333	6707.373	
3	सरगुजा	उदयपुर	उदयपुर	P2151, P2152, P2153, P2154, P2155, P2156, P2157, P2158, P2159, P2160, P2161, P2162, P2177, P2179, P2180, P2181, P2182, P2183, P2184, P2185, P2192, P2193, P2194, P2195,	5381.351	0.000	
4	सरगुजा	उदयपुर	लखनपुर	P2206, P2207, P2208, P2209	856.320	0.000	
5	कोरबा	तत्तर कोरबा	कुदमुरा	OA1359, OA1360, OA1361, OA1362, OA1363, OA1364, OA1365, OA1366, OA1367, OA1368, OA1369, OA1370, OA1371, OA1372, OA1373, OA1374, OA1375, OA1376, OA1377, OA1378, OA1379, OA1380, OA1381, OA1382, OA1383, OA1384, OA1385, OA1386, OA1387, OA1388, OA1389, OA1390, OA1391, OA1392, OA1393, OA1394,	19549.649	7084.854	

वनमंडल	उप वनमंडल	परिक्षेत्र	कक्ष क्रमांक	रकबा हे. में		सीमाएं
				वन भूमि	राजस्व भूमि	
1	2	3	4	5	6	7	8
			OA1395, OA1396, OA1402, OA1403, OA1404, OA1405, OA1406, P1053, P1054, P1070, P1071, P1072, P1073, P1074, P1075 ,P1076 ,P1077, P1078, P1079, P1080, P1081, P1082, P1083, P1084, P1085, P1086 P1087, P1088, P1089, P1090 P1091, P1092, P1093, P1094, P1095, P1096, P1097, P1098 P1099, P1100, P1101, P1102, P1103, P1104, P1105, P1107 P1113, P1114, P1119			सीमा एवं दक्षिण की ओर बढ़ते हुए 2178 की पूर्वी सीमा लाईन बनाता है' 2177 की पूर्वी सीमा व खोरीम गढ़ की सीमा को स्पर्श कर दक्षिण की ओर बढ़ते हुए पूर्वी व दक्षिणी सीमा लाईन बनाता है। कक्ष क्र. 2194, 2195 की पूर्वी व दक्षिणी सीमा बनाकर पूर्व की ओर बढ़ते हुए 2199 की उत्तरी सीमा बनाकर कोरबा वनमंडल के कुदमुरा परिक्षेत्र में प्रवेश करता है। कक्ष क्र. पी. 1077 की उत्तरी सीमा को स्पर्श कर पूर्व की ओर बढ़ते हुए कक्ष क्र. पी 1078, 1079, 1080, 1081 की उत्तरी सीमा लाईन बनाते हुए धरमजयगढ वनमंडल के बोरो परिक्षेत्र में प्रवेश करता है कक्ष क्र. 690 की पश्चिम सीमा से उत्तर की ओर बढ़कर 693 की पश्चिमी सीमा लाईन, 694, 696, 697 की पश्चिम सीमा लाईन एवं 698 की पश्चिमी सीमा लाईन बनाकर 699 को स्पर्श कर उत्तर की ओर बढ़ते हुए सरगुजा वनमंडल के लखनपुर परिक्षेत्र में प्रवेश करता है' कक्ष क्र. 2207 की पश्चिमी सीमा लाईन पी.2206, पी.2208 की उत्तर पश्चिम सीमा एवं कक्ष क्र पी.2209 को विभाजित कर धरमजयगढ़ वनमण्डल बोरो परीक्षेत्र के कक्ष क्र. 706, 707, 708 की उत्तरी सीमा एवं कापू परीक्षेत्र में कक्ष क्र. 1, 2 6, 7, 8, 11, 12, 13 15, 17, 18, 19 की उत्तरी सीमा लाईन बनाते हुए कक्ष क्र. 23 की उत्तर पूर्वी सीमा कक्ष क्र. 22 की पूर्वी सीमा व कक्ष क्र. 24 की उत्तरी सीमा बनाते हुए पूर्वी सीमा में प्रवेश करता है।
6	कोरबा	दक्षिण कोरबा	पसरखेत	OA1329, P1016, P1017, P1018, P1019, P1020, P1021, P1022, P1023, P1024, P1025, P1026, P1027, P1043, P1044, P1045, P1046, P1047, P1048, P1049, P1052, P1055, P1056, P1057, P1058, P1059, P1060, P1061, P1062, P1063, P1066, P1067 P1068, P1069, P1115, P1116	14157.449	170.718	
7	कोरबा	उत्तर कोरबा	बालको	P919, P920, P921, P928, P933, P934, P935, P936, P937, P938, P939, P940, P941, P942, P943, P944, P945, P946, P950, P951, P954, P955, P956, P957, P958, P959, P960, P961 P964, P965, P966, P967, P968, P969, P970	14204.825	0.000	
8	कोरबा	उत्तर कोरबा	लेमरू	OA 1178, OA 1179, OA 1180, OA 1181, OA 1182, OA 1183, OA 1184, OA 1185, OA 1186, OA 1187, OA 1188, OA 1189, OA 1190, OA 1191,	45674.451	6790.601	पूर्वी सीमा – धरमजयगढ वनमण्डल के कापू परिक्षेत्र के कक्ष क्र.51 पी. की पूर्वी एवं दक्षिणी सीमा कक्ष क्र. 50पी., 49पी. 48पी., 46पी., 47पी., 12 पी., 17पी., 16पी. 14पी. की दक्षिणी सीमा लाईन कक्ष क्र. 13 की दक्षिण पूर्वी सीमा कक्ष

क्र.	वनमंडल	उप वनमंडल	परिक्षेत्र	कक्ष क्रमांक	रकबा है. में वन भूमि	राजस्व भूमि	सीमाएं
1	2	3	4	5	6	7	8
				OA 1192, OA 1193, OA 1194, OA 1195, OA 1196, OA 1197, OA 1198, OA 1199, OA 1200, OA 1201, OA 1202, OA 1203, OA 1204, OA 1205, OA 1206, OA 1207, OA 1208, OA 1209, OA 1210, OA 1211, OA 1212, OA 1213, P801, P802, P803, P804, P805, P806, P807, P808, P809, P810, P811, P812, P813, P814, P815, P816, P817, P818, P819, P820, P821, P822, P823, P824, P825, P826, P827, P828, P829, P830, P831, P832, P835, P836, P837, P838, P839, P840, P841, P842, P843, P844, P845, P846, P847, P848, P849, P850, P851, P852,P853, P854, P855, P856, P857, P858, P859, P860, P861, P862, P863, P864, P865, P866, P867, P868, P869, P870, P871, P872, P873, P874, P875, P876, P877, P878, P879, P880, P881, P882, P883, P884, P885, P886, P887, P888, P889, P890, P891, P892, P893, P894, P895, P896, P897, P898, P899, P900, P901, P902, P903, P904, P905, P906, P907, P908, P909, P910, P911, P912, P913			25पी., 48पी., 44पी., 45पी.की पूर्वी सीमा कक्ष क्र. 43पी. की दक्षिणी सीमा तथा कक्ष क्र. 32, 33 की पूर्वी सीमा एवं कक्ष 34 की दक्षिण सीमा लाईन बोरो परिक्षेत्र के कक्ष क्र. 631 की पूर्वी सीमा लाईन कक्ष क्र 630पी. की उत्तरी भाग को विभाजित करते हुए पश्चिम दिशा में कक्ष क्र. 658, 657, 653, 651, 650 की दक्षिणी सीमा एवं 621 पी. 602,605 पश्चिमी सीमा धरमजयगढ़ परिक्षेत्र के कक्ष क्र. 475 474, ओ.ए. 1382 को स्पर्श करते हुए 473 पी. के उत्तरी सीमा व राजस्व भूमि से होते हुए दक्षिण की ओर 466 पी. 457, 450 पी. की सीमा बनाते हुए मांड नदी तक दक्षिण सीमा की ओर चला जाता है। दक्षिणी सीमा — मांड नदी से पश्चिम की ओर बढ़ते हुए कक्ष क्र. 458 पी., 459पी. दक्षिणी सीमा बनाते हुए व 463 पी. पश्चिमी सीमा बनाकर कोरबा वन के कुदमुरा परिक्षेत्र में प्रवेश कर जाता है। तत्पश्चात, पश्चिम की ओर बढ़ते हुए पी.1103, 1105पी दक्षिण सीमा व ओ.ए.1390, पी.1119 की दक्षिण पूर्व सीमा बनाते हुए पसरखेत परिक्षेत्र में प्रवेश करता है। कक्ष क्र. 1115, 1116 पूर्वी सीमा, 1068, 1067 की दक्षिण पूर्वी सीमा दक्षिण की ओर जाते हुए कक्ष क्र 1066 को विभाजित करते हुए 1063, 1026, 1025 के दक्षिणी सीमा से उत्तर की जाते हुए कक्ष क्र. 1025 के पश्चिमी सीमा के साथ उत्तर की ओर जाकर पुन: पश्चिम की ओर जाते हुए कक्ष क्र. 1044 की दक्षिणी सीमा के बाद कक्ष क्र. 1043 के दक्षिणी एवं पश्चिमी सीमा से 1046 की दक्षिणी व पश्चिमी सीमा बनाता है तथा 1047 की पश्चिमी सीमा बनाकर पश्चिम की ओर बढ़ते हुए 1048 की दक्षिणी सीमा से पश्चिम की ओर बढ़ते हुए लेमरू परिक्षेत्र के 933 व 944 की दक्षिणी सीमा तथा दक्षिण की ओर बढ़ते हुए	

क्र. क्र.	वनमंडल	उप वनमंडल	परिक्षेत्र	कक्ष क्रमांक	रकबा है. में वन भूमि	रकबा है. में राजस्व भूमि	सीमाएं
1	2	3	4	5	6	7	8
							बालको परिक्षेत्र के 948 की पूर्वी व दक्षिणी सीमा बनाता है। कक्ष क्र. 950, 951 की दक्षिणी सीमा तथा उत्तर की ओर बढ़ते हुए 951 की पश्चिमी सीमा बनाता है। **पश्चिम सीमा** – बालको परिक्षेत्र के कक्ष क्र. 951 की पश्चिमी सीमा बनाते हुए उत्तर दिशा में 955 की दक्षिण पश्चिम किनारे को स्पर्श कर पश्चिम दिशा में मुड़ जाता है एवं 954, 961, 964 की दक्षिण सीमा लाईन बनाता है तथा उत्तर की ओर बढ़ते हुए 965, 966, 967 की पश्चिमी सीमा लाईन बनाते हुए 968 व 970 की पश्चिमी सीमा तथा 970 की उत्तरी सीमा लाईन के मध्य से उत्तर की ओर पी. 831 की पश्चिम सीमा लाईन बनाता है। तत्पश्चात् उत्तर की ओर बढ़ते हुए कक्ष क्र. पी. 829, 828 की पश्चिम सीमा से होकर पश्चिम की ओर बढ़कर पी.830 की. दक्षिण सीमा बनाकर बांगो डेम को क्रॉस करते हुए कटघोरा वनमंडल के एतमानगर परिक्षेत्र में प्रवेश करता है। एतमानगर परिक्षेत्र के कक्ष क्र. पी. 505 की पूर्वी सीमा जो डेम का डूबान क्षेत्र है, स्पर्श कर दक्षिण की ओर बोडानाला गांव से होकर कक्ष क्र. पी. 525 की पूर्वी सीमा से होकर दक्षिण पश्चिम की ओर बालको परिक्षेत्र में प्रवेश करते हुए कक्ष क्र. पी 921, 919 एवं 928 की उत्तरी सीमा से होकर पुनः पश्चिम की ओर कक्ष क्र. 928 की दक्षिणी पश्चिमी सीमा से दक्षिणी पश्चिमी सीमा एवं 920 की दक्षिणी सीमा से होकर पुनः एतमानगर परिक्षेत्र में प्रवेश करते हुए पी. 524 की पूर्वी, दक्षिणी एवं पश्चिमी सीमा बनाकर पी. 525 की पश्चिमी सीमा एवं 498 की दक्षिणी सीमा व 496 की दक्षिण पश्चिम सीमा लाईन एवं 497, 499, 500 की पश्चिमी सीमा

वनमंडल	उप वनमंडल	परिक्षेत्र	कक्ष क्रमांक	एकड़ा हे. में वनभूमि	राजस्व भूमि	सीमाएं
2	3	4	5	6	7	8
						लाईन बनाते हुए कक्ष क्र. 511 की पश्चिम व उत्तरी सीमा लाईन व उत्तरी सीमा के मध्य से उत्तर की ओर 510 एवं 517 की पश्चिमी सीमा लाईन से पश्चिम दिशा में ओए. 753, 519, 520 की दक्षिणी सीमा लाईन बनाकर तथा 520 की पश्चिमी सीमा बनाते हुए उत्तर दिशा में बढ़ते हुए 521, 522, 523 की पश्चिमी सीमा बनाते हुए केन्दई परिक्षेत्र में प्रवेश बांगो डेम के डूबान क्षेत्र से होते हुए पी. 381 की पश्चिमी सीमा लाईन, पी. 377 376 की पश्चिमी सीमा एवं 375 की उत्तर पश्चिम सीमा बनाकर कक्ष क्र. पी. 365 की पश्चिमी सीमा बनाते हुए उत्तरी सीमा से मिल जाता है।
9 धरमजयगढ़	धरमजयगढ़	देवसे	601P, 602, 604P, 605P, 606P, 607P, 608P, 609P, 610P, 611P, 612P, 613P, 614P, 615P, 616P, 617P, 618P, 619P, 620P, 621P, 622P, 623P, 631P, 632P, 634P, 635P, 636P, 637P, 638P, 639, 640, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708	17113.520	6207.292	
10 धरमजयगढ़	लैलूंगा	कापू	1, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 36, 37, 38, 39P, 40, 41P, 42, 43P, 44P, 45P, 46P, 47P, 48P, 49P, 5, 50P, 51P, 6, 7, 8, 9	10676.974	2616.386	

क्र.	डिवीजन	एरिया नेम	परिक्षेत्र	वाद क्रमांक	रकबा है. में वन भूमि	रकबा है. में राजस्व भूमि	सीमाएं
1	2	3	4	5	6	7	8
1	रायगढ़	धरमजयगढ़	धरमजयगढ़	456P, 457P, 458P, 459, 461P, 462P, 463, 464P, 466P, 473P, 474, 475	1857.325	1257.322	
				कुल योग –	163220.769	36327.231	
				महायोग –	199548.000		

छत्तीसगढ़ के राज्यपाल के नाम से
तथा आदेशानुसार,

(अभिषेक कुमार सिंह)
उप सचिव
छत्तीसगढ़ शासन,
वन एवं जलवायु परिवर्तन विभाग

क्रमांक/एफ 8–6/2007/10–2 भारत सरकार के संविधान के अनुच्छेद 348 के खण्ड (3) के अनुसरण में वन एवं जलवायु परिवर्तन विभाग की अधिसूचना क्रमांक/एफ 8–6/2007/10–2 दिनांक 07/10/2021 को अंग्रेजी अनुवाद राज्यपाल के प्राधिकार से एतद्द्वारा प्रकाशित किया जाता है।

छत्तीसगढ़ के राज्यपाल के नाम से
तथा आदेशानुसार,

(अभिषेक कुमार सिंह)
उप सचिव
छत्तीसगढ़ शासन,
वन एवं जलवायु परिवर्तन विभाग

GOVERNMENT OF CHHATTISGARH
FOREST & CLIMATE CHANGE DEPARTMENT
MANTRALAY MAHANADI BHAVAN, NAVA RAIPUR ATAL NAGAR

//NOTIFICATION//

No. F 8-6/2007/10-2

Nava Raipur, Atal Nagar Date : 27./10/2021

With a view to provide Natural Habitat for Wild Elephants Mitigate Human-Elephant Conflict and with the objective of Better Wildlife Management practices, the Government of Chhattisgarh hereby declares "Lemru Elephant Reserve" as specified in the following schedule :-

SCHEDULE

District	Korba, Surguja, Raigarh
Forest Division	Korba, Katghora, Surguja, Dharamjaigarh
Forest Rangy	Kendai, Atmanagar, Udaipur, Lakhanpur, Kudmura, Pasarkhet, Balco, Lemru, Bore, Kapu, Dharamjaigarh
Name of Elephant Reserve	Lemru Elephant Reserve
Area	199548.00 Ha. = 1995.48 Sqkm

BOUNDARIES

SN.	DIVISION	SUB DIVISION	RANGE	COMPARTMENT NUMBER	AREA (in ha)		BOUNDARIES
					Forest Land	Revenue Land	
1	2	3	4	5	6	7	8
1	KATGHORA	KATGHORA	KENDAI	OA698, OA699, OA700, OA701, OA702, OA724, OA725, OA727, OA727, P355, P356, P357, P358, P359, P360, P361, P362, P363, P364, P365, P366, P367, P368, P369, P370, P371, P372, P373, P374, P375, P376, P377, P378, P379, P380, P381, P382, P383, P384, P385, P386, P387, P388, P389, P390, P391, P392, P393, P394, P395, P396, P397, P398, P399, P400, P401, P402, P403, P404, P405, P406, P407, P408, P409, P410, P411, P412, P413, P414, P415, P416, P417, P418, P419, P420, P421, P422, P423, P424, P425, P426, P427, P428, P429, P430, P431, P432, P433, P434, P435, P436, P437, P438, P439, P440, P441, P442, P443, P444, P445, P446, P447, P448, P449, P450,	26798.565	5402.714	Northern Boundary- Confluence of the Hasdeo River and Manashi Nala, makes northern boundary of comp no 355, Katghora division and Southern boundary of comp no P1902, Surguja division. Moving towards east it forms, boundary of compartment no P356 & P357 of Kendai range, Katghora division. Moving further east, Northeast boundary of compartment no. P357, P358, P359, P360, P361 and OA724 makes common boundary of Udaipur and Kendai ranges. It further crosses national highway and makes northern boundary of comp no P432, P433, P434, P439, P440, P441, P445 & P446. Forming northern boundary of Comp no. P865 and P866 of Lemru range Korba division, touches north boundary of OA1189,it further moves south-east and makes boundary of comp no. P867. It now proceeds to village Munari Dadar, touching eastern boundary of OA1190. Moving southeast it makes Northeast boundary of P876 and enters Udaipur range of Surguja Division. Now it proceeds from western end of comp no P2151, moves toward north and southeast direction touching north-eastern end of comp P2152 and then moves further toward east

				P451, P452.			and making western boundary of comp no P2159, 2160 it forms west, north and eastern boundary of comp no 2161. Now it makes north, east, south boundary of comp no 2162 it moves south making eastern boundary of comp no 2160, moves towards east from south, and makes northern boundary of comp no 2156. In the east, making north boundary of comp no 2183, it moves toward north, making west and north boundary of comp no 2182 and north east boundary of comp no 2180, it further touches northern boundary of comp no 2181 and proceeds further north east direction. It further creates north boundary of comp no P2178, and moving toward south it create eastern boundary of comp no 2178. In the east, it touches eastern boundary of comp no 2177 and Khoram village and proceeds towards south and creates east and south boundary line. Further, it creates east and south boundary of comp no 2194, 2195 and proceeds eastward forming northern boundary of comp no 2195 and enters Kudmura range of Korba division. It further touches north boundary of comp no. P1077; creating northern boundary of comp no P1078, 1079, 1080 and 1081, it enters Boro range of Dharamjaigarh Division. From western boundary of comp no 690, it progresses toward comp no 695 and forms western boundary of it. Then it creates western boundary of comp no 698 and touching north boundary of comp no 699, it enters Lakhanpur range of Surguja division. It further divides comp no P2209 and making north boundary of comp no 706, 707, 708 of Boro range and comp no 1, 2, 6, 7, 8, 11, 12, 13, 15, 17, 18 and 19 of Kapu range Dharamjaigarh division and moves towards
2	KATGHORA	KATGHORA	ATMA-NAGAR	OA753, P496, P497, P498, P499, P500, P501, P502, P503, P504, P505, P506, P507, P508, P509, P510, P511, P517, P519, P520, P521, P522, P523, P524, P525	6950.330	6707.333	
3	SURGUJA	UDAIPUR	UDAIPUR	P2151, P2152, P2153, P2154, P2155, P2156, P2157, P2158, P2159, P2160, P2161, P2162, P2177, P2178, P2180, P2181, P2182, P2183, P2184, P2185, P2192, P2193, P2194, P2195,	5381.351	0.000	
4	SURGUJA	UDAIPUR	LAKHAN PUR	P2206, P2207, P2208, P2209	856.330	0.000	
5	KORBA	NORTH KORBA	KUDMURA	OA1359, OA1360, OA1361, OA1362, OA1363, OA1364, OA1365, OA1366, OA1367, OA1368, OA1369, OA1370, OA1371, OA1372, OA1373, OA1374, OA1375, OA1376, OA1377, OA1378, OA1379, OA1380, OA1381, OA1382, OA1383, OA1384, OA1385,	10549.649	7084.854	

				OA1386, OA1387, OA1388, OA1389, OA1390, OA1392, OA1393, OA1394, OA1395, OA1396, OA1402, OA1403, OA1404, OA1405, OA1406, P1053, P1054, P1070, P1071, P1072, P1073, P1074, P1075, P1076, P1077, P1078, P1079, P1080, P1081, P1082, P1083, P1084, P1085, P1086, P1087, P1088, P1089, P1090, P1091, P1092, P1093, P1094, P1095, P1096, P1097, P1098, P1099, P1100, P1101, P1102, P1103, P1104, P1105, P1107, P1113, P1114, P1115			east, making east boundary of comp no 22 and north boundary of comp no 24. Eastern Boundary – Lemru Elephant reserve boundary moves further towards East and South boundary of comp no 51P, South boundary of comp no 50P, 49P, 48P, 46P, 47P, 17P, 16P, 14P, South-East boundary of comp no 13, East boundary of 25, 45P, 44P, South boundary of comp no 43P and East boundary of comp no 32, 33 in Kapu Range of Dharamjaigarh division and south boundary of comp no 34 of Kapu range, then divides north side of comp no 630P and moves South toward comp no 658, 657, 653, 651, 650 and south boundary of 621P touches east boundary of comp no 602,605, 475, 474, OA1382, 1089, 473P and further moves toward south, making boundary of comp no 458P, 457P, 456P and meets near Mand river.
6	KORBA	SOUTH KORBA	PASARKHET	OA1359, P1015, P1017, P1018, P1019, P1020, P1021, P1022, P1023, P1024, P1025, P1026, P1027, P1043, P1044, P1045, P1046, P1047, P1048, P1049, P1052, P1053, P1056, P1057, P1058, P1059, P1060, P1061, P1062, P1063, P1066, P1067, P1068, P1069, P1115, P1116	14157.449	170.718	Southern Boundary – From Mand river it moves further West, making south boundary of comp no 456P and 459P and making western boundary of comp no 463P; it enters Kudmura range of Korba division. Moving further west, making south boundary of P1103, OA1405 and southeast boundary of comp no OA1390 and P1119; it enters Pasarkhet range. It further divides eastern boundary of comp no 1115, 1116 and southern boundary of 1068, 1067, moves further west making southern boundary of comp no 1063, 1026, 1025, 1044, 1043 and moves toward north and forming western boundary of comp no 1043, it proceeds toward west and makes southwest boundary of comp no 1043 and 1046. It further creates western boundary of comp no 1047 and proceeds more west forming southern
7	KORBA	NORTH KORBA	DALDO	P919, P920, P921, P928, P932, P934, P935, P937, P938, P939, P940, P941, P942, P944, P945, P946, P950, P954, P955, P956, P957, P958	14204.825	0.000	

			P950, P955, P969, P970			boundary of comp no 1048, southern boundary of comp no 933, 944 and moves toward south it creates east and south boundary of comp no 945. It further proceeds toward west and creates southern boundary of comp no 950, 951 and while moving towards north it creates southern and western boundary of comp no 951.
6	KORBA	NORTH KORBA	KEMRI	OA 1178, OA 1179, OA 1180, OA 1181, OA 1182, OA 1183, OA 1184, OA 1185, OA 1186, OA 1187, OA 1188, OA 1189, OA 1190, OA 1191, OA 1192, OA 1193, OA 1194, OA 1195, OA 1196, OA 1197, OA 1198, OA 1199, OA 1200, OA 1201, OA 1202, OA 1203, OA 1204, OA 1205, OA 1206, OA 1207, OA 1208, OA 1209, OA 1210, OA 1211, OA 1212, OA1213, P801, P802, P803, P804, P805, P806, P807, P808, P809, P810, P811, P812, P813, P814, P815, P816, P817, P818, P819, P820, P821, P822, P823, P824, P825, P826, P827, P828, P829, P830, P831, P832, P833, P835, P837, P838, P839, P840, P841, P842, P843, P844, P845, P846, P847, P848, P849, P850, P851, P852, P853, P854, P855, P856, P857, P858, P859, P860, P861, P862, P863, P864, P865, P866, P867, P868, P869, P870, P871, P872, P873, P874, P875, P876, P877, P878, P879, P880, P881, P882, P883, P884, P885,	45634.451	6799.601	Western Boundary- From comp no. 951, Balco range, it continues towards North, touching South-West boundary of comp no. 955 and moves toward West. Now it makes Southern boundary of comp no. 956, 961, 964 and while moving toward North it makes Western boundary of comp no. 965, 966, 967, Western boundary of comp no 968, 970 and North boundary of comp no 970 and makes Western boundary of comp no. P831. Then it moves towards north, touching southern boundary of P829, P828 while making southern boundary of comp no P830 and crossing Bango Dam; it enters Atmanagar Range of Katghora Division. On Eastern boundary of comp no P505 of Atmanagar Range (which is also subdivision zone), it moves South via Bodamala village making Eastern boundary of comp no. P525 and enters balco range and moves towards south east along the northern boundary of 921, 919 and south Western boundary of P928 and continues along the south western boundary of 928 and 920 touching the tip of the southern boundary of P921 and moves and enters Atmanagar range and moves along the southern boundary of comp no. P524 and along western boundary of 524, 525 and forms the southern boundary of comp no. P498, southwest boundary of comp no. 498 and western boundary of comp no. 497, 499

			P856 P887, P891, P892, P893, P894, P895 P896 P897, P898, P899 P900 P901, P902, P903, P904, P905, P906, P907, P908, P909, P910, P911, P912, P913			and 500. It continues west making west-north boundary of comp no 511, making western boundary of comp no. 510 and 517, moves further west making southern boundary of comp no. 753, 519, 520 and touching west side of comp no. 520 it moves towards north. While progressing north, it makes western boundary of comp no. 521, 522, 523 and enters Kendai mouza meets with Sink zone of Bango Dam and forms western boundary of P381, P377, P376 and North-west boundary of comp no. 375 along Hasdeo river. It further moves toward north and making western boundary of comp no. P355, it finally meets the northern boundary at the confluence of Hasdeo river and Manashi nala
9	DHARAM JAIGARH	DHARAM JAIGARH	BORE	601P 602, 604 606P 606P, 607P, 608 609P, 610P 611P, 612 613P 614P 615P, 616 617P, 618P, 619P, 620 621P, 623P, 625P, 626P, 6 632P, 634P 635P, 636 637P, 638P, 639, 640, 648, 649, 650, 651 652, 653, 654 655, 656, 657, 658, 659, 660, 661 662, 663, 664, 665 666, 667, 668 669, 670, 671 672, 673, 674, 675, 676, 677 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688P, 689, 690, 691, 692, 693, 694, 695 696, 697, 698, 699, 700, 701, 702 703, 704, 705, 706, 707 708	17113.590	6207.202	
10	DHARAM JAIGARH	LAKHNGA	BORE	1, 1 11, 12, 13, 14, 15, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 3, 30,	10576.574	2616.386	

				31, 32, 33, 3[illegible] 39P, 4, 43, 45P, [illegible] 44P, 45P, 46P, 47P, 48P, 49P, 5, 50P, 51P, [illegible], 9			
11	DHARAM JAIGARH	DHARAM JAIGARH	DHARAM JAIGARH	456P, 457P, 458P, 459, 461P, 462P, 463, 464P, 466P, 473P, 474, 475	1897.325	1257.332	
					Total -	163220.769	36327.231	
					Grand Total -	199548.000	

By order and in the name of the
Governor of Chhattisgarh,

(Abhishek Kumar Singh)
Deputy Secretary
Government of Chhattisgarh
Department of Forest & Climate Change

Annexure-9

वन परिक्षेत्र उदयपुर अन्तर्गत वर्ष 2012 से 25.11.2021 तक जनहानि, जनघायल, पशुहा
के प्रकरणों की संख्या वर्ष वार

क्र.	वर्ष	जन्हानि के प्रकरण संख्या		जनघायल के प्रकरण संख्या	पशुहानि के प्रकरण संख्या	योग
		हाथी द्वारा	भालू द्वारा			
1	2012	0	1	14	4	[illegible]
2	2013	0	0	11	5	[illegible]
3	2014	0	1	18	3	22
4	2015	1	1	21	8	[illegible]
5	2016	0	0	12	3	[illegible]
6	2017	1	0	14	15	[illegible]
7	2018	5	0	28	5	[illegible]
8	2019	2	1	22	6	[illegible]
9	2020	0	0	17	8	[illegible]
10	2021	3	[illegible]	41	[illegible]	[illegible]
कुल योग		12	5	208	61	[illegible]

वन परिक्षेत्राधिकारी
उदयपुर

...वन परिक्षेत्र सदरपुर अन्तर्गत वर्ष 2012 से 25.11.2021 तक मृत वन्यप्राणियों की ...

क्र.	वर्ष	चीतल	कोटरी	भालू	जंगली सूअर	...
1	2012	0	0	0	0	
2	2013	0	1	1	0	
3	2014	0	1	2	0	
4	2015	0	1	2	0	
5	2016	0	0	1	0	
6	2017	1	0	0	0	
7	2018	1	1	0	0	
8	2019	0	0	1	0	
9	2020	0	0	1	0	
10	2021	1	0	0	1	
कुल योग		3	4	[illegible]	1	

...वनक्षेत्राधिकारी
...

वन्य जन्तुओं द्वारा की गई जनहानि एवं सम्पत्ति की क्षति के एवज में प्रतिपूर्ति का पिछले 10 वर्षों का विवरण

Number of Cases of Human Death Caused by Wild Animal Six Last Ten Year

जिला	2011-12		2012-13		2013-14		2014-15		2015-16		2016-17		2017-18		2018-19		2019-20		2020-21	
	प्रकरण संख्या	प्रतिपूर्ति राशि	प्रकरण संख्या	प्रतिपूर्ति राशि	प्रकरण संख्या	प्रतिपूर्ति राशि	प्रकरण संख्या	प्रतिपूर्ति राशि	प्रकरण संख्या	प्रतिपूर्ति राशि	प्रकरण संख्या	प्रतिपूर्ति राशि	प्रकरण संख्या	प्रतिपूर्ति राशि	प्रकरण संख्या	प्रतिपूर्ति राशि	प्रकरण संख्या	प्रतिपूर्ति राशि	प्रकरण संख्या	प्रतिपूर्ति राशि
अनूपपुर	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
अलिराजपुर	0	0	0	0	0	0	0	200000	0	0	1	400000	0	0	0	0	0	0	0	0
बालाघाट	1	200000	0	0	1	200000	0	0	0	0	0	0	0	0	0	0	1	600000	0	0
बड़वानी	0	0	0	0	0	0	1	300000	0	0	0	0	0	0	0	0	0	0	0	0
बैतूल	1	0	1	300000	0	0	1	300000	1	300000	0	0	0	0	0	0	1	600000	0	0
बेरसिया	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
योग	2	200000	1	300000	1	200000	1	800000	1	300000	1	400000	0	0	0	0	2	1200000	0	0
छतरपुर	1	6250	1	58475	2	52313	1	5539	0	0	2	92236	2	44813	0	0	0	0	0	1
छिंदवाड़ा	0	0	0	0	10	93016	3	49201	3	47850	1	5175	0	0	1	6000	0	0	0	0
दतिया	5	36248	3	21162	1	7317	0	0	3	15665	3	0	0	0	2	40030	2	2115	3	14992
दमोह	0	0	0	0	2	3300	0	0	1	16500	0	0	3	91538	3	50248	3	114915	2	53934
देवास	1	6250	11	78250	8	25370	1	50893	1	10749	2	9100	20	55782	13	32042	18	50910	5	23428
धार	3	3975	0	0	3	33870	4	46575	7	58408	3	3739	3	9950	1	30308	4	27079	2	2182
योग	12	143572	15	159213	32	128457	9	147207	6	149265	8	113004	28	171893	23	158634	26	195019	12	96234
धनबाद	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	55507
डिंडोरी	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	17791	0	0
गुना	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ग्वालियर	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
हरदा	0	0	0	0	0	0	0	0	0	0	0	0	1	1080	0	0	0	0	0	0
होशंगाबाद	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
योग	0	0	0	0	0	0	0	0	0	0	0	0	1	1080	0	0	1	17791	1	55507
इंदौर	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
खंडवा	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
खरगोन	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
मंडला	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
रतलाम	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
योग	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
अलिराजपुर	0	0	0	0	1	10000	0	0	0	0	0	0	0	0	0	0	0	0	0	0
बैतूल	0	0	1	30000	1	50000	1	50000	0	0	0	0	0	0	0	0	0	0	0	0
बीजाडांडा	1	40000	2	120000	2	170000	0	0	1	50000	3	295000	3	0	0	0	0	0	0	0
बैरसिया	0	0	0	0	0	0	0	0	0	0	1	150000	2	53000	0	0	1	250000	3	490000
भोपाल	1	50000	1	80000	1	150000	2	240000	1	60000	10	422000	13	289000	3	190000	5	690000	4	320000
रायसेन	0	0	1	270000	0	0	0	0	2	65000	2	177000	1	330000	3	330000	12	234800	1	60000
योग	5	510000	9	730000	7	410000	4	590000	5	1030000	16	1044000	16	674300	8	520000	18	1174800	8	870000

D.F.O.
Sarguja Division

जंगली प्राणियों द्वारा की गई जन-[illegible] एवं क्षतिपूर्ति का विगत 10 वर्षों का विवरण

Year wise Cases of Human Being Attacked by Wild Animal Six Last Ten Year

जनपद	2011–12		2012–13		2013–14		2014–15		2015–16		2016–17		2017–18		2018–19		2019–20		2020–21	
	प्रकरण संख्या	क्षतिपूर्ति राशि	प्रकरण संख्या	क्षतिपूर्ति राशि	प्रकरण संख्या	क्षतिपूर्ति राशि	प्रकरण संख्या	क्षतिपूर्ति राशि	प्रकरण संख्या	क्षतिपूर्ति राशि	प्रकरण संख्या	क्षतिपूर्ति राशि	प्रकरण संख्या	क्षतिपूर्ति राशि	प्रकरण संख्या	क्षतिपूर्ति राशि	प्रकरण संख्या	क्षतिपूर्ति राशि	प्रकरण संख्या	क्षतिपूर्ति राशि
मानव क्षति																				
[illegible]	0	0	0	0	0	0	0	0	0	0	1	400000	0	0	0	0	1	25000	0	0
[illegible]	0	0	0	0	0	0	1	300000	3	1200000	5	2400000	1	400000	1	400000	0	0	0	0
[illegible]	2	600000	0	0	1	300000	3	0	3	2700000	1	400000	4	1600000	1	400000	0	0	0	0
[illegible]	0	0	1	0	0	0	0	0	0	0	2	800000	5	2000000	0	0	2	800000	0	0
[illegible]	1	200000	1	0	0	0	2	0	1	400000	0	0	5	2000000	3	1200000	0	0	0	0
[illegible]	0	0	0	0	0	0	1	0	3	3	0	0	0	0	0	0	1	600000	0	0
योग –	3	800000	1	0	1	300000	1	300000	7	3700000	10	3800000	15	5200000	5	2000000	4	1425000	0	0
जानवर																				
[illegible]	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4780
[illegible]	0	3	0	0	0	0	1	35510	1	62951	0	0	0	0	0	0	0	0	0	0
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[illegible]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
योग –	2	0	0	0	0	0	2	45510	3	65303	0	0	3	14361	0	0	0	0	1	4780
जनहानि																				
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योग –	1134	4456649	1055	7142579	278	6829922	1503	4555345	3300	13513624	2539	9478248	2673	9793423	2428	9514484	1785	7284469	531	3362537
पशु क्षति																				
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योग –	284	1193430	254	3233280	109	624386	121	930484	252	3462810	454	9869953	517	16211865	473	13042244	186	3981538	121	13527351
घायल																				
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[illegible]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	84500	0	0
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[illegible]	0	0	0	0	0	0	0	0	0	0	0	0	1	6000	4	29000	0	0	0	0
योग –	3	0	0	0	0	0	1	3	0	0	0	0	4	73000	6	41000	7	119500	0	0

D.F.O.
Surguja Division

Actual Reclamation Status

Annexure-10

Particulars		YEAR 2012-13	YEAR 2013-14	YEAR 2014-15	YEAR 2015-16	YEAR 2016-17	YEAR 2017-18	YEAR 2018-19	YEAR 2019-20	YEAR 2020-21	YEAR 2021-22 Up to Sept-21	Total
Broken Area (Ha)		60	28	45	97.4	92.1	115.4	183.94	100.441	23.482	78.713	824.476
Excavation Area (Coal)		4.5	13.2	26.2	52.5	75.8	81.-	137.7	47.12	106.989	54.73	600.689
External dump area (Ha)		20	17.4	1.9	18.7	7	29.1	0	0	15.78	0	112.98
Backfilled area / Internal dump area (Ha)		0	14.4	16.7	29.1	33.8	21	153.5	97.61	72.747	80.186	516.343
Physical Reclamation (Ha)		0	12.7	1.3	10.94	10.96	22	37.93	82.64	32.01	52.85	262.83
Plantation / Biological reclamation (Ha)	Others Area (Ha)	1.5	2.3	5.1	4.6	9.85	3.61	1.59	0	0	0	28.05
	External dump area (Ha)	0	0	0	1	21.65	14.19	26.59	9.63	25.82	6.98	105.16
	Internal dump Area (Ha)			0.8	3.1	8.2	10.2	27.9	56.1	29.35	57.11	192.76
	Total Area	1.5	2.3	5.9	7.7	39.2	28.3	56.08	65.73	55.17	64.09	325.97
Total plantation (Nos.)		3732	5852	14799	19296	97903	70705	140189	141213	155105	162348	811142



Plantation Year 2014-15



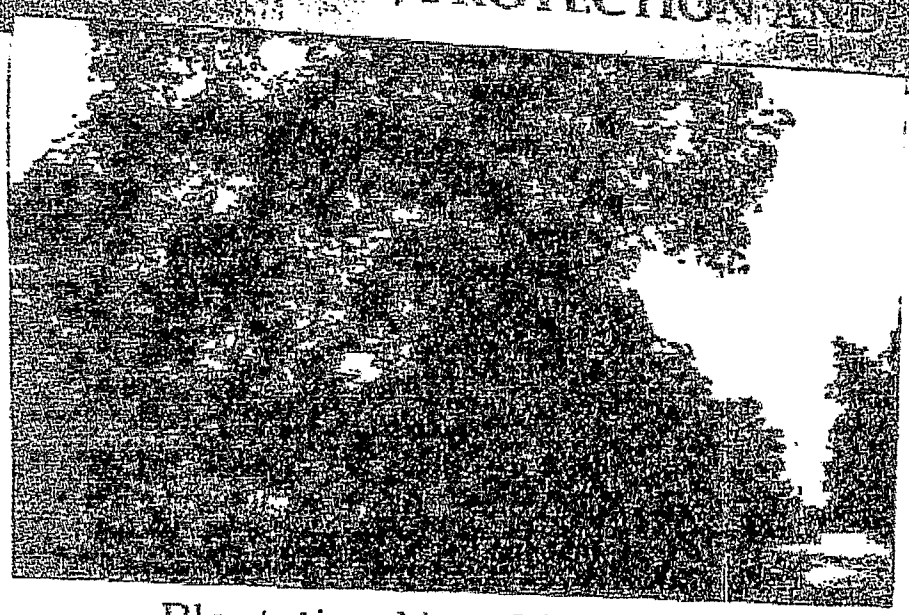
Plantation Year 2014-15



Plantation Year 2014-15



Plantation Year 2014-15



Plantation Year 2015-16



Plantation Year 2015-16



Plantation Year 2015-16



Plantation Year 2015-16



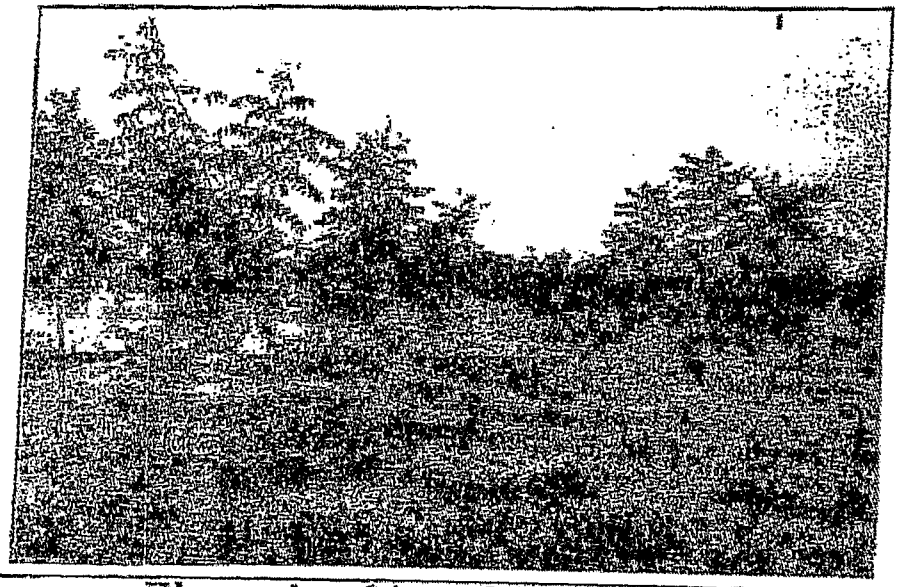
Plantation Year 2016-17



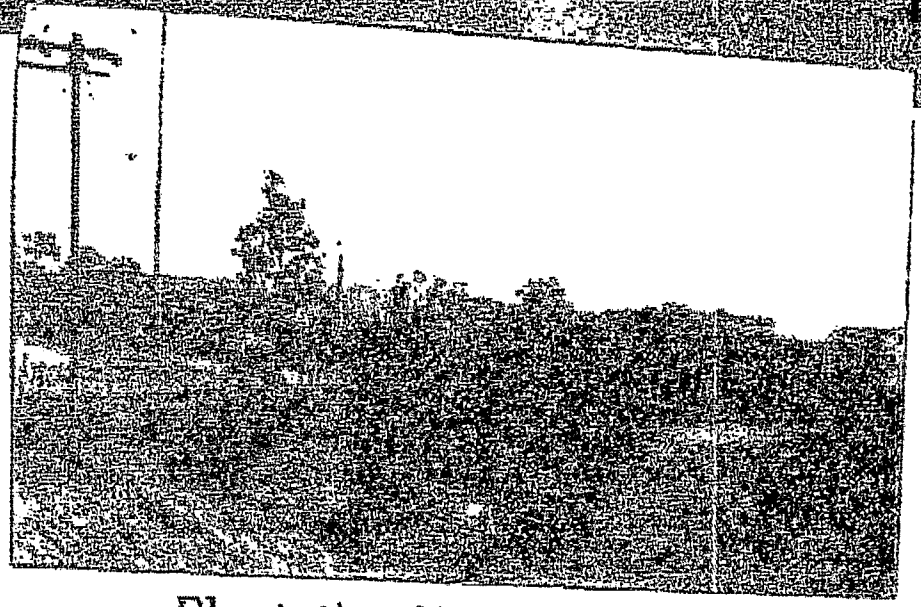
Plantation Year 2016-17



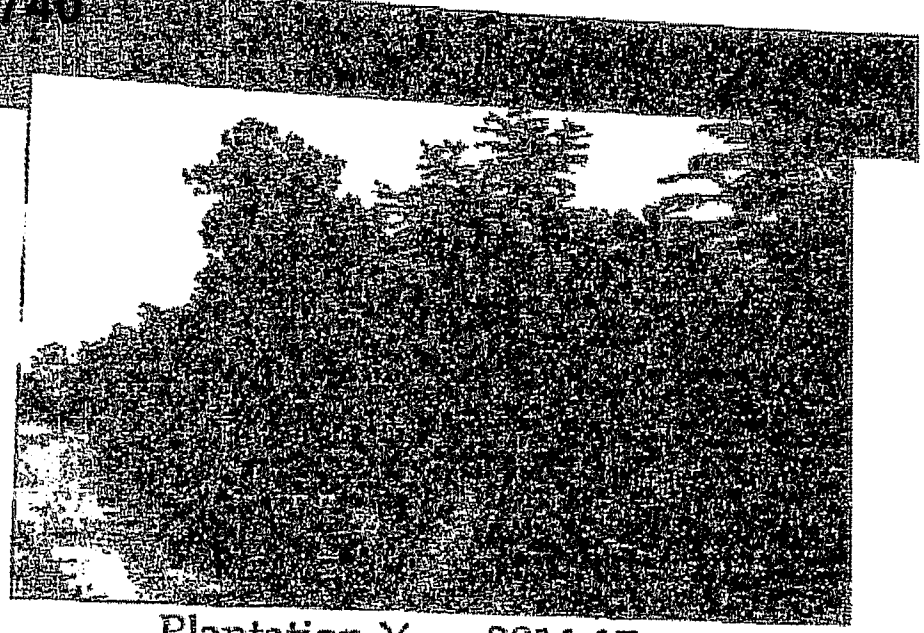
Plantation Year 2017-18



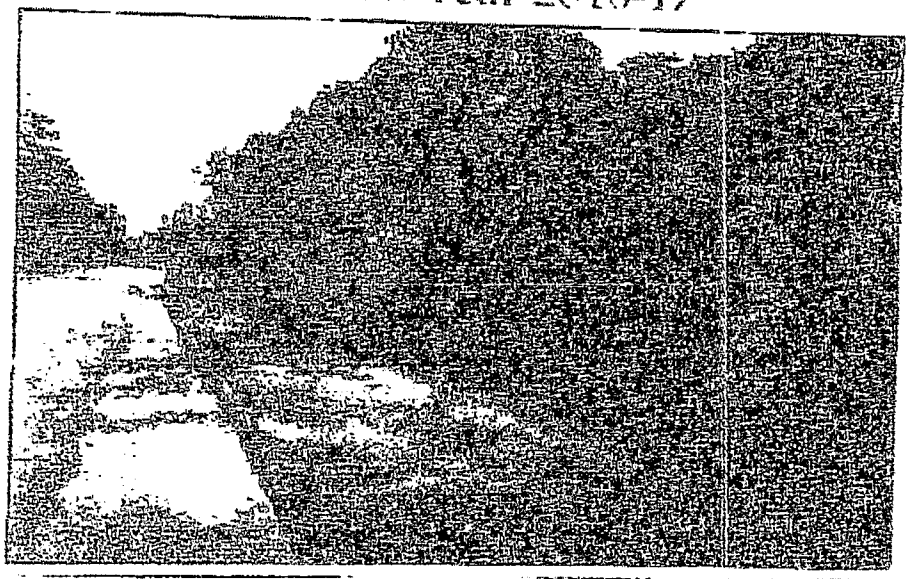
Plantation Year 2017-18



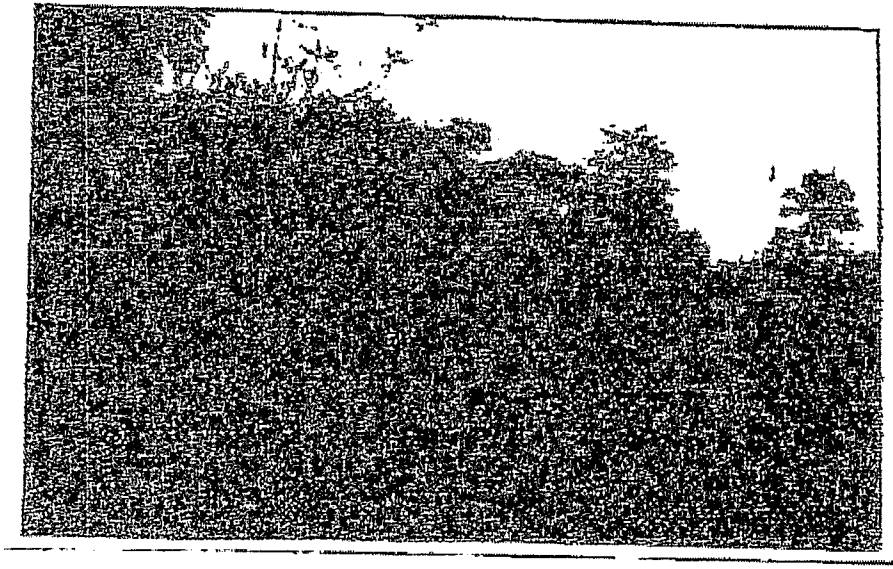
Plantation Year 2016-17



Plantation Year 2016-17

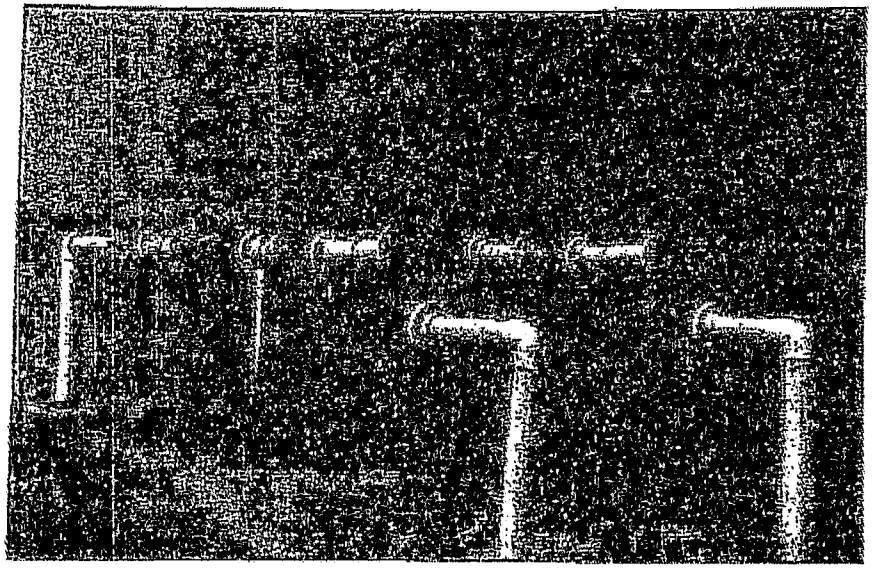


Plantation Year 2017-18



Plantation Year 2017-18





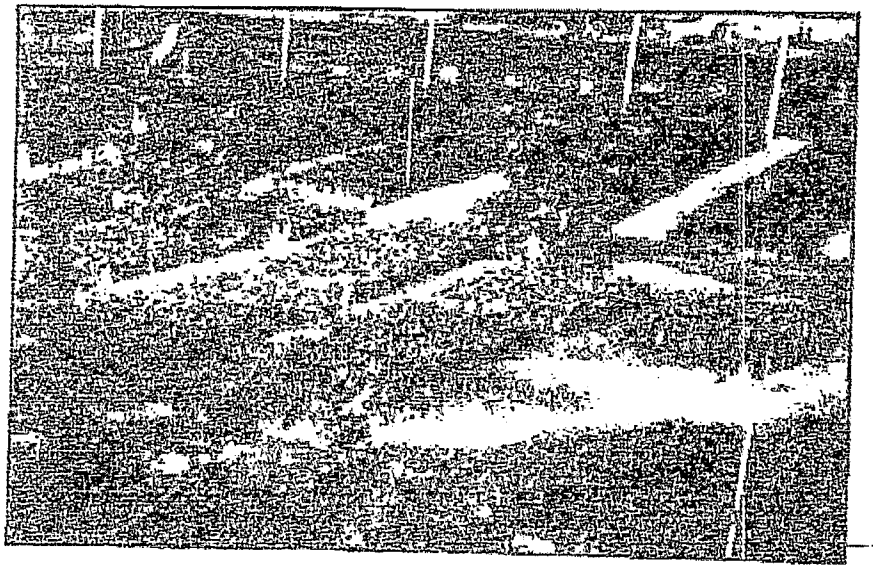


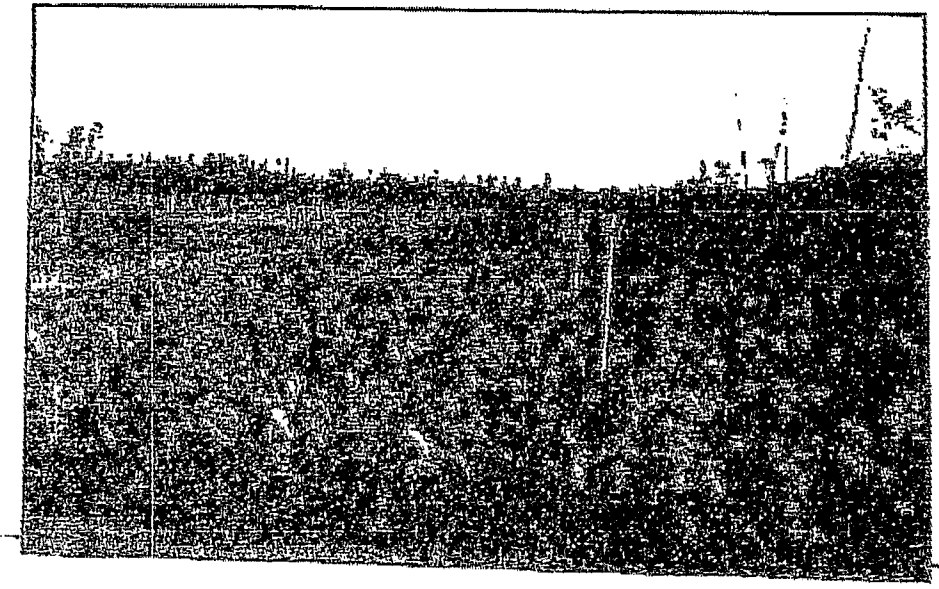


45









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Annexure-12

Photos of CSR Activity





Profiles of the coal block in the entire Hasdeo-Arand coal field area

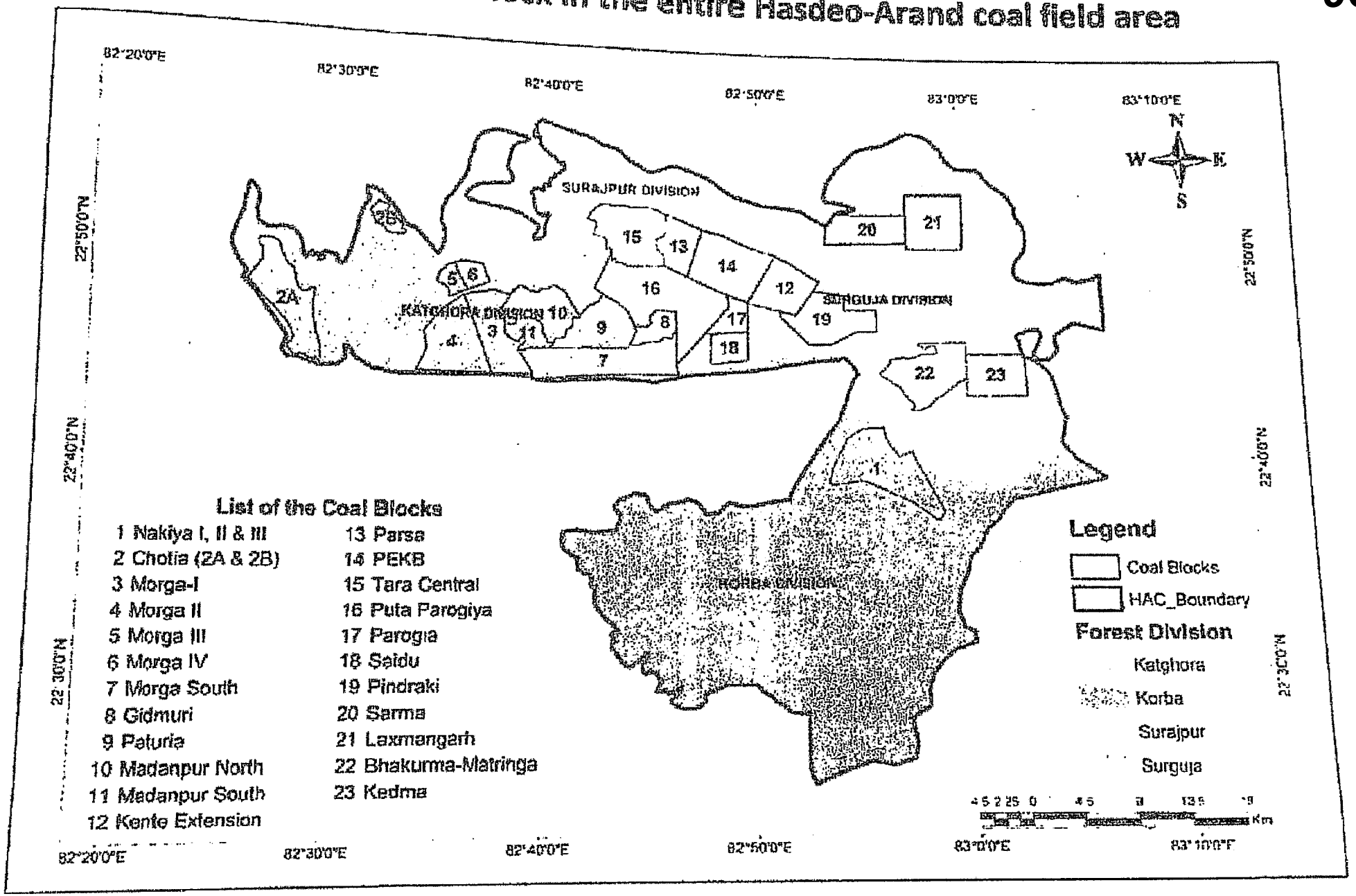


Table ES.1: Profiles of the coal block in the entire Hasdeo-Arand Coalfield area that fall within Surguja, Surajpur and Korba Districts of Chhattisgarh

Sl. No.	Name of Coal Block as per coal block allocation rule	Block No.	District	Latitude	Longitude	Allotment status	Extent sq.km.	Geological Reserves in MT	Remarks/Status
Allotted									
1	Parsa East Kanta Basan - CMSP (OC)	14	Surguja	22°47'38.02"N to 22°51'16.65"N	82°49'39.01"E to 82°47'23.51"E	Allotted to M/s. Rajasthan Rajya Vidyut Utpadan Nigam Limited	26.83	532.86	Mine is in operation in the Ist Phase
2	Parsa-CMSP (OC)	13	Surguja & Surajpur	22°48'56.76"N to 22°52'00.66"N	82°46'41.08"E to 82°45'35.84"E		12.52	256.40	EC awaited
3	Kente Extension- MMDR(OC)	12	Surguja	22°47'00.72"N to 22°50'01.14"N	82°51'59.32"E to 82°50'58.41"E		17.60	369.22	TOR accorded
4	Chotia - Sub block-2A – CMSP (OC/UG)	02	Korba	22°50'08.23"N to 22°44'24.40"N	82°26'10.87"E to 82°29'10.75"E	Allotted to M/s. Bharat Aluminium Company Ltd. (BALCO) (Vedanta Group).	8.63	29.187	The ML has 2 sub blocks. Sub block 2A is under Fly ash dumping & backfilling; Sub block 2B is in operation
	Chotia-Sub block-2B			22°52'03.70"N to 22°50'35.42"N	82°31'37.96"E to 82°32'47.17"E		3.17	10.832	
Identified									
5	Tara-CMSP (OC)	15	Surajpur	22°49'25.44"N to 22°52'25.87"N	82°45'21.34"E to 82°42'48.95"E	Identified	24.00	317.35	Block initially allotted to CMDC
6	Madanpur North-CMSP (OC/UG)	10	Surajpur & Korba	22°45'34.81"N to 22°48'23.62"N	82°40'16.79"E to 82°38'36.67"E	Identified	21.39	213.46	Unallocated
7	Madanpur South-CMSP (OC)	11	Korba	22°45'11.15"N to 22°46'58.97"N	82°38'48.11"E to 82°38'32.10"E	Identified	7.14	169.83	APMDC Ltd.
8	Gidmuri-CMSP (OC/UG)	08	Korba	22°45'29.56"N to 22°47'14.87"N	82°44'16.63"E to 82°45'10.66"E	Identified	7.33	80.27	Chhattisgarh State Power generation Co. Ltd.
9	Patuia-CMSP (OC/UG)	09	Korba	22°45'21.64"N to 22°48'00.56"N	82°43'50.93"E to 82°42'37.53"E	Identified	16.14	269.25	NA
10	Morga– II-CMSP	04	Korba	22°47'48.78"N to 22°44'05.68"N	82°35'52.05"E to 82°37'19.42"E	Identified	26.64	350.70	NA
11	Morga– III-CMSP	05	Korba	22°47'42.56"N to 22°49'21.71"N	82°35'10.69"E to 82°35'22.65"E	Identified	6.00	36.00	M.P state Mining Corp. Ltd.,
12	Morga– IV-CMSP	06	Korba	22°48'05.66"N to 22°49'28.05"N	82°36'04.17"E to 82°35'53.02"E	Identified	6.87	54.78	M.P state Mining Corp. Ltd.,
13	Morga South-MMDR	07	Korba	22°43'48.13"N to 22°46'07.89"N	82°39'21.49"E to 82°36'10.17"E	Identified	21.92	432.54	Unallocated
14	Saidu-MMDR	18	Surguja & Korba	22°44'33.17"N to 22°46'10.26"N	82°47'54.65"E to 82°49'38.68"E	Identified	6.72	27.49	Identified Geological Report
15	Puta Parogiya-MMDR	16	Surguja, Surajpur & Korba	22°44'30.66"N to 22°49'56.74"N	82°46'12.32"E to 82°42'58.64"E	Identified	48.04*	NA	Identified
16	Parogia#	17	Surguja	22°46'03.96"N to 22°48'02.08"N	82°47'56.01"E to 82°48'40.46"E	Regionally promotionally explored block	7.16*	NA	Regionally promotionally explored block
17	Pindraki -MMDR	19	Surguja	22°45'31.36"N to 22°48'11.95"N	82°53'48.75"E to 82°52'50.52"E	Identified	23.94*	NA	Identified
18	Sarna#	20	Surguja	22°50'38.86"N to 22°52'05.64"N	82°57'28.97"E to 82°53'55.90"E	Regionally promotionally explored block	18.18*	NA	Regionally promotionally explored block
19	Laxmangarh#	21	Surguja	22°50'20.31"N to 22°53'04.94"N	83°00'10.39"E to 82°57'27.55"E	Regionally promotionally	23.64*	NA	Regionally promotionally explored block

Sl. No.	Name of Coal Block as per coal block allocation rule	Block No.	District	Latitude	Longitude	Allotment status	Extent sq.km.	Geological Reserves in MT	Remarks/Status
						explored block			
20	Bhaksuma-Mainpat- MMDR	22	Surguja	22°42'15.26"N to 22°45'34.39"N	82°57'55.95"E to 82°57'58.66"E	Identified	26.00*	NA	Identified
21	Kedmali	23	Surguja	22°43'01.00"N to 22°45'02.10"N	83°03'12.53"E to 83°00'12.67"E	Regionally promotionally explored block	18.95*	NA	Regionally promotionally explored block
22	Morga-I,CH&SP	03	Korba	22°48'06.34"N to 22°44'04.24"N	82°37'21.81"E to 82°39'15.02"E	Identified	21.62*	NA	Identified
23	Nakia-I, II & III -MMDR	01	Korba	22°36'57.05"N to 22°41'23.19"N	82°58'39.69"E to 82°55'11.75"E	Identified	34.29*	NA	Identified
						Total	434.72		

Sources: The shape files provided by RVUNL, extent of area worked out using GIS by ICFRE.
CMPDI- OCHS four mine, regionally promotionally explored blocks, will be included in HAC only after finalization of block boundary
*No documents available and therefore the area of extent was estimated using GIS & RS

Tip on "Chhattisgarh pushes Adani-run coal block despite WII red flag"

S. No.	News Article dated 27.11.2021	Comments
1.	DESPITE A biodiversity report from the Wildlife Institute of India (WII) warning that the forests in Chhattisgarh's Hasdeo Aranya Coal Field (HACF) (an idea of the then UPA government) should be declared a "no-go area", the state government is pushing for permission to start phase II of mining in the PEKB coal block, in the same area, records reviewed by The Indian Express show.	No report from the Wildlife Institute of India (WII) is received to the state govt. As far as the concept of Go-No-Go area is concerned, it was decided by the Group of Ministers (GoM) constituted by the Cabinet Secretariat *vide their O.M. No. 121/4/3/2010-Cab. Dated 3rd February 2011* that *the concept of Go-No-Go area for coal mining should be done away with and each of the proposals seeking diversion of forest land for coal mining be processed and considered by this Ministry on its merits*, which had been communicated to Chhattisgarh govt vide letter dated 30.08.2012.
2.	The PEKB — Parsa (East) and Kete Basan — coal block is owned by Rajasthan Rajya Vidyut Utpadan Nigam Limited and run by Adani Enterprises, which is the official Mine Developer and Operator (MDO) in this venture.	
3.	The records from a meeting of the Union Environment Ministry's Forest Advisory Committee (FAC) on October 28 show the committee analysed an "instant request" for clearance filed by the state government. The FAC was discussing on diversion of forest land for PEKB coal block's phase II spread across 1,136 hectare forests.	The Stage II forest clearance for PEKB coal block (operational)) was granted by MoEF to Rajasthan Rajya Vidyut Utpadan Nigam Ltd (RRVUNL) on 15.03.2012. The clearance stipulated a condition that the mining shall be done in two-phases. It also mentioned that *the project proponent will submit the application for permission for mining in phase – II along with compliance report of phase-I.* In compliance with the above-mentioned condition of the Forest Clearance and as per the FCA guidelines, the state govt only forwarded the phase I compliance for consideration of phase II request of the User Agency (RRVUNL). It was not the case of "instant request" for clearance filed by the state govt, as the final clearance/approval is given by the MoEF&CC itself as per the FCA

		guidelines.
4.	According to the minutes of the meeting, the state forwarded an opinion of its Advocate on Record that the PEKB proposal may be considered as per law as issues related to biodiversity are being addressed in the Biodiversity Assessment Report submitted by the Indian Council of Forestry Research and Education (ICFRE), Dehradun.	The Ministry of Environment, Forest and Climate Change (MoEF&CC) vide its letter dated 25th May 2021 stated the following, *"...it is to inform that matter has been examined in the Ministry and it is revealed that biodiversity assessment study of the area is currently under consideration in the State Government and also various issues emanating from mining the PEKB Coal Block are sub-judice in the Hon'ble Supreme Court.* *In view of the above, I am directed to request the State Government to submit its considered opinion in the matter in light of various orders of Hon'ble Supreme Court to the Ministry for further necessary action in the matter."* Therefore, the State govt. took the opinion of the Standing Counsel of the Hon'ble Supreme Court which was forwarded to MoEF&CC.
5.	On its part, the records show, the ICFRE showed the green signal for mining in "four contiguous coal blocks" in the HACF area. "Tara, Parsa, PEKB and Kete extension, that are either already opened or in advanced stage of getting statutory clearances/TOR approved, can be considered for mining," the ICFRE said in its report.	-
6.	According to the minutes, the EAC finally deferred a decision on the issue. But the minutes also show that the ICFRE and the state ignored several red flags raised by the WII in its own assessment, which was included as Volume II in the ICFRE's report. "The coal mines along with the associated infrastructure development would result in loss and fragmentation of habitat. Mitigating such effects on wildlife, particularly the animals with large home ranges such as elephants is seldom possible," the WII said.	The the para 2 and 3 of the operative part of the NGT's judgment dated 24.03.2014 states, *"2. ...Liberty is granted to the EAC to seek advice/opinion/specialised knowledge from any authoritative source such as Indian Council of Forestry Research and Education Dehradun...* *3. The MoEF shall pass a reasoned order in light of the advice given by the EAC in accordance with law and pass appropriate order in accordance with law."* In compliance with the same, the work of the Biodiversity Assessment Study for the whole Hasdeo Arand Area was

		allotted to ICFRE, Dehradun only, not WII. The WII report is the internal report received by the ICFRE and has never been received to the state govt as the work was allotted only to ICFRE. Moreover, as stated in the judgment dated 24.03.2014, it is for the MoEF&CC, not state govt., to consider the Biodiversity Assessment Study report and pass a reasoned order accordingly.
7.	The WII called the human-elephant conflict in the state "already acute" and "escalating" and warned that any further threat to the landscape could make the "conflict mitigation impossible for the state to manage". It said: "Opening up of the demarcated coal blocks in the HACF would compromise the imperatives of biodiversity conservation and livelihood of forest-dependent local communities. Even the effects of the operational mines of PEKB and Chotia need to be tactfully mitigated too, wherever possible."	WII report was part of the internal consultation of the committee of the ICFRE responsible for the preparation of the final Biodiversity Assessment Study report. As stated earlier, the WII report is the internal report received by the ICFRE and has never been received to the state govt as the work of study was allotted only to ICFRE.
8.	The ICFRE report was prepared in association with WII as it was one of the conditions stipulated by the National Green Tribunal after the stage I clearance was given to the coal block in 2012.	The judgment dated 24.03.2014 clearly states that the liberty is given to FAC to seek advice/opinion/specialised knowledge from any authoritative source such as Indian Council of Forestry Research and Education Dehradun.
9.	The WII did not respond to requests for comment from The Indian Express. The ICFRE did not respond to queries from The Indian Express on why it gave the green signal for mining in four blocks despite warnings from WII. "Following orders of hon. National Green Tribunal, dated. 24.3.2014, the Chhattisgarh government assigned ICFRE (Indian Council of Forestry Research and Education) to conduct a biodiversity assessment study of the entire Hasdeo Aranya on January 29, 2019," the state government said in a statement issued in Hindi.	-

10.	"Parantu kewal unhi binduon par jin par antim roop se sehmati bani, use hi vistrut report par shamil karte hue rajya shasan ko aawashyak karyawahi hetu bheja gaya (Only those points were included in the report submitted to the government for necessary action on which there was mutual agreement)," it said, referring to ICFRE and WII. The state government said it never appointed the WII for any report. It said that a "brief report on limited points related to wildlife was sought from the WII by ICFRE through an internal report" responding to a list of questions by The Indian Express.	
11.	So far, six coal blocks have been allocated in HACF, of which two are operational for mining: PEKB block, and Chotia I and II block. PEKB was to be mined in two stages, with the first starting in 2013 and continuing for at least 15 years. In the second stage, records show, an extended area of 1,136 hectares would be mined. However, according to minutes of the FAC meeting, "due to enhanced production capacity, the mining activities of phase I would be over in 2021" – hence permission has been sought to divert forest land for phase II.	
12.	According to Chhattisgarh government sources, Rajasthan, which has invested Rs 40,000 crore in thermal power projects in Chhattisgarh, had also written to it on the issue. Another block in HACF owned by RRVUNL, Parsa, has received forest and environment clearance, although the tribal community in the area is protesting the allocation. It received stage II clearance on October 21, upon recommendation from the government.	According to the to ICFRE report Parsa Open Cast Coal Block can be considered for the mining. As per the guidelines, the state govt. forwards the proposal of the forest clearance to MoEF&C and further the in-principle approval and Stage II forest clearances for the coal blocks are given by MoEF&CC.
13.	On October 13, over 350 tribals from two districts walked over 300 km to Raipur to register their protest. A day later, Chief Minister Bhupesh Baghel met the protesters and assured them that	It is erroneous to say that the state govt. pushed for the clearances in front of the FAC. MoEF puts the proposal of any forest clearance before the FAC for consideration and final approval, not

	the "Congress government has been standing with the tribals and will continue to do so".	the state govt. PEKB coal block is an operational coal block and is sub-judice in the Hon'ble Supreme Court pending the final disposal of Civil Appeal No. 4395 of 2014. The mining stay order of NGT dated 24.03.2014 was duly vacated by the Hon'ble Supreme Court of India.
14.	Alok Shukla, the convenor of Chhattisgarh Bachao Andolan who had marched with the tribals to Raipur, claimed both the state and the Centre were encouraging an environmental crisis, which even experts believed would be unmanageable. "They are ignoring the warnings, and pushing for clearances in front of the FAC. This was clearly done under corporate pressure," he alleged.	In order to manage and control the Human-Wildlife conflicts in the area, the Chhattisgarh govt. has already notified the Lemru Elephant Reserve admeasuring 1995 sq. km containing 39 coal blocks. Further, as per the judgement of the NGT dated 24.03.2014, the report of the ICFRE shall be considered by MoEF&CC.

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अशोक गहलोत
मुख्य मंत्री, राजस्थान

8, सिविल लाइन्स, जयपुर-302006
दूरभाष : 0141-2228712-13
फैक्स : 2228705

अ.जा. पत्र क्रः मु.म./ऊर्जा/21/114369
जयपुर, दिनांक 15-11-2021

प्रिय श्री भूपेश बघेल जी,

कृपया मेरे द्वारा पूर्व में प्रेषित पत्र दिनांक 11 अक्टूबर, 2021 का संदर्भ लें। मैं आपका ध्यान आकर्षित कर बताना चाहूँगा कि राजस्थान सरकार के उपक्रम "राजस्थान राज्य विद्युत उत्पादन निगम लिमिटेड" को विद्युत उत्पादन के लिए कोयले की आपूर्ति हेतु कोयला मंत्रालय, भारत सरकार द्वारा छत्तीसगढ़ राज्य के सरगुजा जिले में कोल ब्लॉक आवंटित किए हैं।

उल्लेखनीय है कि "परसा" कोल ब्लॉक (क्षमता–5 एमटीपीए) का आवंटन हसदेव–अरंद कोलफिल्ड क्षेत्र में वर्ष 2015 में हुआ। इसकी द्वितीय चरण की वन स्वीकृति (Forest Clearance Stage-II) हेतु पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार ने पत्र दिनांक 21 अक्टूबर, 2021 (प्रति संलग्न) द्वारा जारी कर दी गई है। इस सन्दर्भ में दिनांक 02 नवम्बर, 2021 को उपायुक्त सहायक कोयला नियंत्रक द्वारा राजस्थान विद्युत उत्पादन निगम की परसा ओपनकास्ट कोयला खदान में सीम IV खोलने की अनुमति प्राप्त हुई है। इस कोल ब्लॉक से खनन कार्य प्रारंभ करने हेतु छत्तीसगढ़ शासन के विभिन्न विभागों द्वारा निम्न स्वीकृतियां प्राप्त होना शेष हैं:–

(i) वन विभाग, छत्तीसगढ़ शासन द्वारा द्वितीय चरण की वन स्वीकृति (Forest Clearance Stage-II)।
(ii) संभागीय वन अधिकारी (DFO), सूरजपुर द्वारा वृक्ष गणना।
(iii) जिलाधिकारी सरगुजा एवं सूरजपुर द्वारा संपत्ति सत्यापन और प्रमाणन।
(iv) छत्तीसगढ़ पर्यावरण संरक्षण बोर्ड (CECB) द्वारा संचालन हेतु सहमति।

इसके अतिरिक्त "केंटे एक्सटेंशन" कोल ब्लॉक (क्षमता–9 एमटीपीए) का आवंटन वर्ष 2015 में हुआ। इस कोल ब्लॉक हेतु पर्यावरण स्वीकृति के लिए आवश्यक "जनसुनवाई" जिला अधिकारी, सरगुजा द्वारा दो बार स्थगित की जा चुकी है।

अतः आपसे अनुरोध है कि :–

(i) परसा कोल ब्लॉक हेतु द्वितीय चरण की वन स्वीकृति (Forest Clearance Stage-II) सहित विभिन्न स्वीकृतियां शीघ्र जारी करवाने का श्रम करें।

(ii) "केंटे एक्सटेंशन" कोल ब्लॉक हेतु आवश्यक जनसुनवाई शीघ्र आयोजित करने के लिए जिला अधिकारी, सरगुजा को निर्देशित करने का श्रम करें।

सद्भावी,

(अशोक गहलोत)

श्री भूपेश बघेल
मुख्यमंत्री, छत्तीसगढ़
छत्तीसगढ़ शासन, रायपुर।

संलग्नः– उपरोक्तानुसार

अशोक गहलोत
मुख्य मंत्री, राजस्थान

8, सिविल लाइन्स, जयपुर-302006
दूरभाष : 0141-2228712-13
फैक्स : 2228705

अ.शा. पत्र क्र. मु.म./ऊर्जा/21/114359
जयपुर, दिनांक 15-11-2021

प्रिय श्री प्रल्हाद जोशी जी,

कृपया मेरे द्वारा पूर्व में प्रेषित पत्र दिनांक 09 सितम्बर, 2021 का संदर्भ लें। मैं आपका ध्यान राज्य सरकार के उपक्रम राजस्थान राज्य विद्युत उत्पादन निगम लिमिटेड के तापीय विद्युतगृहों में कोयले की आपूर्ति एवं कोयले की कमी की ओर आकर्षित करना चाहूँगा। वर्तमान में कोयले की कमी एवं ऊर्जा खपत में वृद्धि के चलते राजस्थान राज्य में विद्युत की मांग एवं उपलब्धता में बड़ा अंतर आया है।

उल्लेखनीय है कि राजस्थान राज्य विद्युत उत्पादन निगम द्वारा विद्युत उत्पादन के लिए कोयले की आपूर्ति हेतु कोयला मंत्रालय, भारत सरकार द्वारा छत्तीसगढ़ राज्य के सरगुजा जिले में "परसा" कोल ब्लॉक (क्षमता–5 एमटीपीए) का आवंटन वर्ष 2015 में किया गया। इसकी द्वितीय चरण की वन स्वीकृति (Forest Clearance Stage-II) हेतु पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार के पत्र दिनांक 21 अक्टूबर, 2021 (प्रति संलग्न) द्वारा वन विभाग, छत्तीसगढ़ शासन को प्रेषित कर दी गई है। इस सन्दर्भ में दिनांक 02 नवम्बर, 2021 को उपायुक्त सहायक कोयला नियंत्रक द्वारा राजस्थान विद्युत उत्पादन निगम की परसा ओपनकास्ट कोयला खदान में सीम IV खोलने की अनुमति प्राप्त हुई है। इस कोल ब्लॉक से खनन कार्य प्रारंभ करने हेतु छत्तीसगढ़ शासन द्वारा द्वितीय चरण की वन स्वीकृति (Forest Clearance Stage-II) सहित विभिन्न स्वीकृतियां प्राप्त होना शेष है।

मैं यह भी बताना चाहूँगा कि राजस्थान राज्य विद्युत उत्पादन निगम लिमिटेड की 3240 मेगावॉट की तापीय इकाइयों से विद्युत उत्पादन हेतु कोल इंडिया लिमिटेड की अनुषंगी (Subsidiary) कम्पनियों एन.सी.एल. (NCL) एवं एस.ई.सी.एल. (SECL) से प्रतिवर्ष 170 मिलियन टन कोयले की आपूर्ति हेतु अनुबंध है। अनुबंध के अनुसार, राजस्थान राज्य विद्युत उत्पादन निगम लिमिटेड को औसतन लगभग 11.5 कोल रैक प्रतिदिन की आवश्यकता होती है। परंतु अभी कोल इंडिया लिमिटेड से प्रतिदिन औसतन मात्र 7 कोल रैक ही प्राप्त हो पा रही हैं। वर्तमान में कोल इंडिया लिमिटेड से लिंक 500 मेगावॉट की इकाइयों को कोयले की आपूर्ति उत्पादन निगम के स्वयं के कोल ब्लॉक से की जा रही है।

अतः आपसे यह अनुरोध है कि :–

(i) परसा कोल ब्लॉक हेतु छत्तीसगढ़ शासन द्वारा द्वितीय चरण की वन स्वीकृति (Forest Clearence Stage-II) सहित विभिन्न स्वीकृतियां शीघ्र जारी करवाने का श्रम करें।

(ii) कोल इंडिया लिमिटेड (CIL) को उनकी अनुषंगी (Subsidiary) कम्पनियों एन.सी.एल. (NCL) एवं एस.ई.सी.एल. (SECL) द्वारा उत्पादन निगम को अविलम्ब 3–4 कोल रैक प्रतिदिन की अतिरिक्त आपूर्ति सुनिश्चित करवाने का श्रम करें।

भवदीय,

(अशोक गहलोत)

श्री प्रल्हाद जोशी
संसदीय कार्य, कोयला एवं खान मंत्री
भारत सरकार
नई दिल्ली।

संलग्न:– उपरोक्तानुसार

अशोक गहलोत
मुख्य मंत्री, राजस्थान

8, सिविल लाइन्स, जयपुर-302006
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अ.भा. पत्र सं: मु.म./ऊर्जा /21/111369
जयपुर, दिनांक: 15-11-2021

प्रिय श्री भूपेन्द्र यादव जी,

कृपया मेरे द्वारा पूर्व में प्रेषित पत्र दिनांक 11 अक्टूबर, 2021 का संदर्भ लें। मैं आपका ध्यान आकर्षित कर बताना चाहूँगा कि राज्य सरकार के उपक्रम "राजस्थान राज्य विद्युत उत्पादन निगम" को विद्युत उत्पादन के लिए कोयले की आपूर्ति हेतु कोयला मंत्रालय, भारत सरकार द्वारा छत्तीसगढ़ राज्य के सरगुजा जिले में "परसा ईस्ट एवं कांता बासन" कोल ब्लॉक आवंटित किया है।

उल्लेखनीय है कि "परसा ईस्ट एवं कांता बासन" (क्षमता–10 एमटीपीए) कोल ब्लॉक वर्ष 2007 में आवंटित हुआ। आवश्यक स्वीकृतियां मय प्रथम चरण वन भूमि (Phase-I Forest land) 762 हैक्टेयर 15 वर्ष खनन हेतु हस्तानांतरण के उपरांत इस कोल ब्लॉक से वर्ष 2013 में खनन प्रारंभ हुआ। तदोपरांत वर्ष 2018 में इस कोल ब्लॉक की क्षमता 10 एमटीपीए से 15 एमटीपीए की गई एवं वर्ष 2018 से पूर्ण क्षमता खनन निरंतर जारी है।

निम्नलिखित तकनीकी कारणों से नवम्बर, 2021 उपरांत इस कोल ब्लॉक से कोयला खनन बंद होने की संभावना है:–

(i) प्रथम चरण वन भूमि (Phase-I Forest land) एवं द्वितीय चरण वन भूमि (Phase-II Forest land) की सीमा रेखा सटी हुई होने के कारण कोल रिजर्व अवरूद्ध होना।

(ii) कोल ब्लॉक की क्षमता 10 एमटीपीए से बढ़कर 15 एमटीपीए होने के कारण प्रथम चरण वन भूमि की खनन अवधि 15 वर्ष से कम होना।

(iii) द्वितीय चरण वन भूमि (Phase-II Forest land) 1136 हैक्टेयर का हस्तानांतरण न होना।

राजस्थान राज्य विद्युत उत्पादन निगम द्वारा द्वितीय चरण वन भूमि (Phase-II Forest land) 1136 हैक्टेयर हस्तानांतरण हेतु छत्तीसगढ़ शासन को आवेदन किया गया। तदोपरांत छत्तीसगढ़ शासन ने पत्र दिनांक 22 फरवरी, 2021 द्वारा पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार को अनुशंषा की, जिसकी स्वीकृति प्राप्त होना शेष है।

यहां यह उल्लेखनीय है कि "परसा ईस्ट एवं कांता बासन" कोल ब्लॉक की क्षमता 40 प्रतिशत बढ़ाने (15 MTPA से 21 MTPA) हेतु पर्यावरण स्वीकृति में संशोधन आवश्यक है।

इस हेतु तर्कसंगत दस्तावेज मय केस फाइल उत्पादन निगम द्वारा पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार को प्रेषित कर दिए गए हैं।

अतः आपसे अनुरोध है कि:–

(i) "परसा ईस्ट एवं कांता बासन" कोल ब्लॉक हेतु द्वितीय चरण वन भूमि (Phase-II Forest land) 1136 हैक्टेयर हस्तानांतरण की स्वीकृति शीघ्र जारी करवाने का श्रम करें।

(ii) "परसा ईस्ट एवं कांता बासन" कोल ब्लॉक की क्षमता 40 प्रतिशत बढ़ाने (15 MTPA से 20-21 MTPA) हेतु पर्यावरण स्वीकृति में शीघ्र संशोधन करवाने का श्रम करें।

सद्भावी,

(अशोक गहलोत)

श्री भूपेन्द्र यादव
मंत्री, पर्यावरण, वन एवं जलवायु परिवर्तन
भारत सरकार
नई दिल्ली

अशोक गहलोत
मुख्य मंत्री, राजस्थान

8, सिविल लाइन्स, जयपुर-302006
दूरभाष : 0141-2228712-13
फैक्स : 2228705

आ.शा पत्र क्र. मु.म./ऊर्जा/21/114359
जयपुर, दिनांक: 15-11-2021

प्रिय श्री आर. के. सिंह जी,

कृपया मेरे द्वारा पूर्व में प्रेषित पत्र दिनांक 09 सितम्बर, 2021 का संदर्भ लें। मैं आपका ध्यान राज्य सरकार के उपक्रम राजस्थान राज्य विद्युत उत्पादन निगम लिमिटेड के तापीय विद्युतगृहों में कोयले की आपूर्ति की कमी की ओर आकर्षित करना चाहूँगा। वर्तमान में कोयले की कमी एवं ऊर्जा खपत में वृद्धि के चलते राज्य में विद्युत की मांग एवं उपलब्धता में बड़ा अंतर आया है।

उल्लेखनीय है कि राजस्थान राज्य विद्युत उत्पादन निगम लिमिटेड की 3240 मेगावॉट की तापीय इकाइयों से विद्युत उत्पादन हेतु कोल इंडिया लिमिटेड की अनुषंगी (Subsidiary) कम्पनियों एन.सी.एल. (NCL) एवं एस.ई.सी.एल. (SECL) से प्रतिवर्ष 170 मिलियन टन कोयले की आपूर्ति हेतु अनुबंध है। अनुबंध के अनुसार, राजस्थान राज्य विद्युत उत्पादन निगम लिमिटेड को औसतन लगभग 11.5 कोल रैक प्रतिदिन की आवश्यकता होती है, परंतु अभी कोल इंडिया लिमिटेड से प्रतिदिन औसतन मात्र 7 कोल रैक ही प्राप्त हो पा रही हैं। वर्तमान में कोल इंडिया लिमिटेड से लिंक 500 मेगावॉट की इकाइयों को कोयले की आपूर्ति उत्पादन निगम के स्वयं के कोल ब्लॉक से की जा रही है।

इसके अतिरिक्त राजस्थान राज्य विद्युत उत्पादन निगम लिमिटेड की 4340 मेगावॉट की तापीय इकाइयों से विद्युत उत्पादन के लिए कोयले की आपूर्ति हेतु कोयला मंत्रालय, भारत सरकार द्वारा छत्तीसगढ़ राज्य के सरगुजा जिले में तीन कोल ब्लॉक (i)"परसा ईस्ट एवं कांता बासन" (ii)"परसा" एवं (iii)"केंते एक्सटेंशन" आवंटित किए गए हैं।

परसा ईस्ट एवं कांता बासन–कोल ब्लॉक (क्षमता–15 MTPA) हेतु पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार द्वारा द्वितीय चरण वन भूमि (Phase-II Forest land) 1136 हैक्टेयर का हस्तानांतरण एवं कोल ब्लॉक की क्षमता 40 प्रतिशत बढ़ाने (15 MTPA से 21 MTPA) हेतु पर्यावरण स्वीकृति में संशोधन होना शेष है। परसा – कोल ब्लॉक (क्षमता – 5 MTPA) की द्वितीय चरण की वन स्वीकृति (Forest Clearance Stage-II) हेतु पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार के पत्र दिनांक 21 अक्टूबर, 2021 (प्रति संलग्न) द्वारा वन विभाग, छत्तीसगढ़ शासन को प्रेषित कर दी गई है। इस सन्दर्भ में दिनांक 02 नवम्बर, 2021 को उपायुक्त सहायक कोयला नियंत्रक द्वारा राजस्थान विद्युत उत्पादन निगम की परसा ओपनकास्ट कोयला खदान में सीम IV खोलने की अनुमति प्राप्त हुई है। इस कोल ब्लॉक से खनन कार्य प्रारंभ करने हेतु छत्तीसगढ़ शासन द्वारा द्वितीय चरण की वन स्वीकृति (Forest Clearance Stage-II) सहित विभिन्न

स्वीकृतियां प्राप्त होना शेष है। केंते एक्सटेंशन – कोल ब्लॉक (क्षमता–9 MTPA) हेतु पर्यावरण स्वीकृति के लिए आवश्यक "जनसुनवाई" जिला अधिकारी, सरगुजा द्वारा दो बार स्थगित की जा चुकी है।

मैंने छत्तीसगढ़ राज्य सरकार से परसा कोल ब्लॉक हेतु द्वितीय चरण की वन स्वीकृति (Forest Clearance Stage-II) सहित विभिन्न स्वीकृतियां शीघ्र जारी करवाने एवं केंते एक्सटेंशन कोल ब्लॉक हेतु पर्यावरण स्वीकृति के लिए आवश्यक "जनसुनवाई" जिला अधिकारी, सरगुजा द्वारा शीघ्र आयोजित करवाने हेतु अनुरोध किया है।

आपसे अनुरोध है कि:–

(i) परसा ईस्ट एवं कांता बासन कोल ब्लॉक हेतु पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार द्वारा द्वितीय चरण वन भूमि (Phase-II Forest land) 1136 हैक्टेयर का शीघ्र हस्तानांतरण एवं कोल ब्लॉक की क्षमता 40 प्रतिशत बढ़ाने (15 MTPA to 21 MTPA) हेतु पर्यावरण स्वीकृति में शीघ्र संशोधन करवाने का श्रम करें।

(ii) कोल इंडिया लिमिटेड (CIL) को उनकी अनुषंगी (Subsidiary) कंपनियों एन.सी.एल. (NCL) एवं एस.ई.सी.एल. (SECL) द्वारा उत्पादन निगम को अविलम्ब 3–4 कोल रैक प्रतिदिन की अतिरिक्त आपूर्ति सुनिश्चित करवाने का श्रम करें।

भवदीय,

(अशोक गहलोत)

श्री आर. के. सिंह,
विद्युत एवं नवीन और नवीकरणीय ऊर्जा मंत्री,
भारत सरकार,
नई दिल्ली।

संलग्न:– उपरोक्तानुसार

डॉ. सुबोध अग्रवाल, आई.ए.एस.
Dr. Subodh Agarwal, I.A.S.

अतिरिक्त मुख्य सचिव
ऊर्जा, खान एवं पैट्रोलियम विभाग
राजस्थान सरकार
Additional Chief Secretary
Energy, Mines & Petroleum Department
Government of Rajasthan

अ0शा0 पत्रांक प.12(2)ऊर्जा/2004
अक्टूबर , 2021

प्रिय अमिताभ जी,

मैं आपका ध्यान आकर्षित कर बताना चाहूंगा कि राजस्थान सरकार के उपक्रम "राजस्थान राज्य विद्युत उत्पादन निगम लिमिटेड" को विद्युत उत्पादन के लिए कोयले की आपूर्ति हेतु कोयला मंत्रालय, भारत सरकार द्वारा छत्तीसगढ़ राज्य के सरगुजा जिले में कोल ब्लॉक आवंटित किए हैं।

उल्लेखनीय है कि "परसा" कोल ब्लॉक (क्षमता – 5 एमटीपीए) का आवंटन हसदेव–अरंद कोलफिल्ड क्षेत्र में वर्ष 2015 में हुआ। इसकी द्वितीय चरण की वन स्वीकृति (Forest Clearance Stage-II) हेतु पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार ने पत्र दिनांक 21.10.2021 (प्रति संलग्न) द्वारा जारी कर दी गई है। इस कोल ब्लॉक से खनन कार्य प्रारंभ करने हेतु छत्तीसगढ़ शासन के विभिन्न विभागों द्वारा निम्न स्वीकृतियां प्राप्त होना शेष हैं:–

(i) वन विभाग, छत्तीसगढ़ शासन द्वारा द्वितीय चरण की वन स्वीकृति (Forest Clearance Stage-II)।
(ii) क्षेत्रीय वन अधिकारी (DFO), सूरजपुर द्वारा वृक्ष गणना।
(iii) जिलाधिकारी सरगुजा एवं सूरजपुर द्वारा सीमांकन सत्यापन और प्रमाणन।
(iv) छत्तीसगढ़ पर्यावरण संरक्षण बोर्ड (CECB) द्वारा संचालन हेतु सहमति।

इसके अतिरिक्त "कॉंटे एक्सटेंशन" कोल ब्लॉक (क्षमता – 5 एमटीपीए) का आवंटन वर्ष 2015 में हुआ। इस कोल ब्लॉक हेतु पर्यावरण स्वीकृति के लिए आवश्यक "जनसुनवाई" जिला अधिकारी, सरगुजा द्वारा दो बार स्थगित की जा चुकी है।

अतः आपसे अनुरोध है कि :–

(i) परसा कोल ब्लॉक हेतु द्वितीय चरण की वन स्वीकृति (Forest Clearance Stage-II) सहित विभिन्न स्वीकृतियां शीघ्र जारी करवाने का श्रम करें।

523205, Second Floor, Main Building, Govt. Secretariat, Jaipur-302005 (Raj.)
Tel.: +91-141-2227053 (O), E-mail : secy-mines@rajasthan.gov.in, ps.energy@rajasthan.gov.in

(ii) "कॉटे एक्सटेंशन" कोल ब्लॉक हेतु आवश्यक जनसुनवाई शीघ्र आयोजित करने के लिए जिला अधिकारी, सरगुजा को निर्देशित करने का श्रम करें।

अनुलग्नक:– उपरोक्तानुसार।

सादर,

सदभावी,

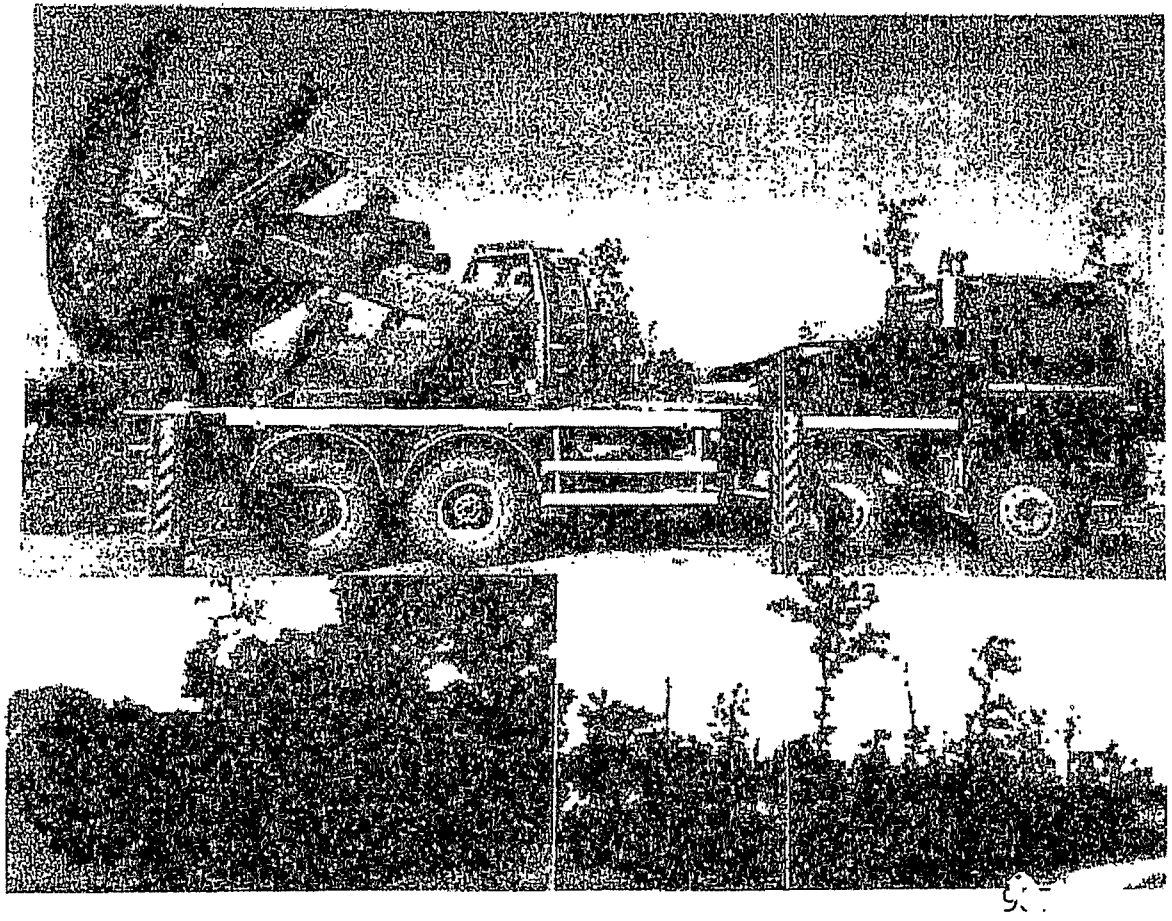
29/10/2024

(डॉ. सुबोध अग्रवाल)

श्री अमिताभ जैन, IAS
मुख्य सचिव, छत्तीसगढ़ शासन,
रायपुर, छत्तीसगढ़ –492002

Tree Translocation

- An innovative & unique technique has been adopted to save maximum trees from felling in mining operations.
- Imported tree-transplanter Machine is being used to relocate all the suitable trees below girth of 60 cm. About 8946 trees including Sal trees (7124 nos.) have been transplanted till October 2021 with the survival rate of more than 80%.



Sal	*Shorea robusta*	7124
Mahuwa	*Madhuca longifolia*	1366
Char	*Buchanania cochinchinensis*	240
Amaltas	*Casia Fistula*	33
Mango	*Mangifera indica*	14
Bhelva	*Semecarpus Anacardium*	15
Tendu	*Diospyros tomentosa*	62
Jamun	*Syzygium cumini*	7
Sidha	*Justicia adhatoda*	61
Kutaja	*Holarrhena antidysenterica*	6
Others		18
Total		8946

वन्यप्राणी प्रबंधन योजना अंतर्गत ए.पी.ओ. वार स्वीकृति एवं व्यय की जानकारी दिनांक 31.10.2021 की स्थिति में

APO वर्ष	कार्य का नाम	कार्यस्थल	प्रशासकीय स्वीकृति	स्वीकृति		व्यय राशि	शेष राशि
				भौतिक	आर्थिक		
	परसा ईस्ट एण्ड केते बासेन कैप्टीव कोल ब्लाक ओपन कास्ट माईनिंग						
2014-15	Fire Protection works		95/26.04.2018		14.82	7.09	7.73
2014-15	Protection from grazing and illicit felling				16.18	16.10	0.08
2014-15	Soil and moisture conservation works				79.00	75.54	3.46
2014-15	Weed management and assisting natural regeneration under the guidance of expert scientist and experienced forester				3.54	3.54	0.00
2014-15	हाथी रहवास सुधार				30.00	29.99	0.01
2014-15	जन जागरण प्रचार–प्रसार				6.50	6.50	0.00
2014-15	हुल्ला पार्टी का गठन				7.00	6.86	0.14
	योग				157.04	145.61	11.43
	वन्यप्राणी प्रबंधन अंतर्गत सोलर फेंसिंग कार्य कोर एरिया क्षेत्र संरक्षण परसा ईस्ट केते बासेन कोल परियोजना						
2018-19	सोलर फेंसिंग कार्य उदयपुर	ग्राम खाटवरी, सुसकम	20/15.01.2019	8000 rmt	20.00	0.00	20.00
2018-19	सोलर फेंसिंग कार्य उदयपुर	ग्राम फतेहपुर, हरिश्चन्द्रपुर		5500 rmt.	13.75	0.00	13.75
2018-19	सोलर फेंसिंग कार्य उदयपुर	ग्राम पसीगिया		2500 rmt.	6.25	0.00	6.25
2018-19	सोलर फेंसिंग कार्य उदयपुर	ग्राम सेंदू		2000 rmt.	5.00	0.00	5.00
2018-19	मीटिंग हॉल निर्माण कार्य	उदयपुर	389/09.04.2019		36.00	21.83	14.17
	योग				81.00	21.83	59.17
2019-20	कोर एरिया वैनलिंक फेंसिंग कार्य, उदयपुर	पी 2009, गुमना	80/02.01.2020	1950 Rmt.	7.00	6.84	0.16
2019-20	घासगाह विकास कार्य, उदयपुर	पी 2102	84/02.01.2020	30.000	5.02	4.65	0.37
2019-20	घासगाह विकास कार्य, उदयपुर	पी 2102		10.000	1.68	1.57	0.11
2019-20	तालाब निर्माण कार्य, उदयपुर	कक्ष क्र. 2225 सुईया जंगल, केदमा (अ)	86/02.01.2020	1	10.00	9.94	0.06
2019-20	तालाब निर्माण कार्य, उदयपुर	कक्ष क्र. 2040 सुईया जंगल, सावर		1	10.00	10.00	0.00
2019-20	Empowering and sensitizing people for protection of wild life and Eco development works etc.	उदयपुर	88/02.01.2020	-	6.00	2.07	3.93
2019-20	Establishment and activation of Research center with trained and skilled person for mitigation human-wild conflict.	उदयपुर		-	1.70	0.00	1.70
2019-20	Provisions for compensation to loss of crop, property, human life and injury caused by wild life.	उदयपुर		-	10.00	1.21	8.79
2019-20	Elephant awareness campaign	उदयपुर		-	1.30	1.30	0.00
2019-20	Formation of " Hathi Mitra Dal"	उदयपुर		-	2.70	2.69	0.01
2019-20	Miscellaneous works	उदयपुर		-	5.00	4.99	0.01
2019-20	Conservation of Endangered Vulnerable Flora, Udaipur	पी 2050	89/02.01.2020	30.000	3.30	2.81	0.49

APO वर्ष	कार्य का नाम	कम्पार्टमेन्ट	प्रशासकीय स्वीकृति	स्वीकृति		व्यय राशि	शेष राशि
				वित्तीय	अवित्तीय		
2019-20	[illegible]	पी 2013, पुनर्गी	91/02.01.2020	30.000	10.30	9.37	0.93
2019-20	[illegible]	पी 2009	107/16.01.2020	300.458	3.23	3.21	0.02
2019-20	[illegible]	पी 2014		214.290	2.32	1.93	0.39
2019-20	[illegible]	पी 2074		413.150	6.25	6.25	0.00
2019-20	[illegible]	पी 2101		339.958	1.66	1.35	0.31
2019-20	[illegible]	पी 2102		247.539	5.46	5.39	0.07
2019-20	[illegible]	पी 2119		229.671	4.93	4.52	0.41
2019-20	[illegible]	पी 2123		226.120	3.40	3.39	0.01
2019-20	[illegible]	पी 2139		326.387	5.28	5.28	0.00
2019-20	[illegible]	पी 2147		251.901	3.45	3.26	0.19
2019-20	रायपेरियन जोन्स मेनजमेन्ट प्लान Riparian Zones	पी 2050	105/16.01.2020	20.000	3.30	3.23	0.07
	योग				113.38	91.44	21.94
2020-21	Wild Life Conservation and Soil Moisture Conservation Work Ambikapur	P 2320	140/07.11.2020	370.008	2.50	2.46	0.04
2020-21	Wild Life Conservation and Soil Moisture Conservation Work Ambikapur	P 2527		294.769	3.00	2.91	0.09
2020-21	Wild Life Conservation and Soil Moisture Conservation Work Ambikapur	P 2496		444.876	1.48	1.46	0.02
2020-21	Wild Life Conservation and Soil Moisture Conservation Work Ambikapur	RF 2495		279.750	2.50	2.48	0.02
2020-21	Wild Life Conservation and Soil Moisture Conservation Work Ambikapur	RF 2494		214.725	2.52	2.50	0.02
2020-21	Wild Life Conservation and weed management Plan Ambikapur	P 2514	139/07.11.2020	30.000	6.00	0.00	6.00
2020-21	Wild Life Conservation and weed management Plan Ambikapur	P 2319		50.000			
2020-21	Wild Life Conservation and Fire Protection / Weed management / Soil & Moisture Conservation Works Udaipur	पी 2054, पी 2055, पी 2064 से 2069, पी 2073 से 2075, पी 2077 से 2080, पी 2082 से 2100, पी 2141, पी 2142 से 2161 से 2165, पी 2170 से 2173 से 2174 पी 2201 से 2209 से 2213 पी 2036, से 2044, पी 2045 से [illegible]	141/07.11.2020 142/07.11.2020 143/10.11.2020	7446.850	74.27	70.83	3.44
2020-21	Weed Management Work, Sitapur	पी 2422	190/24.11.2020	20.000	1.31	1.31	0.00
2020-21	Weed Management Work, Sitapur	पी 2444		25.000	1.63	1.63	0.00
2020-21	Weed Management Work, Sitapur	पी 2443		25.000	1.63	1.63	0.00
2020-21	Weed Management Work, Sitapur	पी 2412		22.000	1.44	1.44	0.00

APO वर्ष	कार्य का नाम	कार्यस्थल	प्रशासकीय स्वीकृति	स्वीकृति		व्यय राशि	शेष राशि
				भौतिक	आर्थिक		
2020-21	Weed Management work, Mainpat	पी 2336	189/24.11.2020	20.000	1.66	1.65	0.01
2020-21	Weed Management work, Mainpat	पी 2299		16.000	1.35	1.33	0.02
2020-21	Weed Management work, Mainpat	पी 2296		16.000	1.28	1.27	0.01
2020-21	Weed Management work, Mainpat	पी 2334		22.000	1.73	1.72	0.01
2020-21	Natural Water Body Maintanance Works (तालाब निर्माण कार्य), उदयपुर	पी 2031	167/10.11.2020	01 नग	20.00	16.81	3.19
2020-21	Improvement of Elephant Habitat (तालाब निर्माण कार्य), उदयपुर	पी 2201		01 नग	20.00	4.27	15.73
2020-21	Elephant Awareness Campaigning	उदयपुर			10.00	3.35	6.65
2020-21	चारागाह विकास कार्य, उदयपुर	पी 2008	159/10.11.2020	24.000	7.50	3.71	3.79
2020-21	चारागाह विकास कार्य, उदयपुर	पी 2097		40.000	12.50	6.16	6.34
2020-21	बांस वृक्षारोपण कार्य, उदयपुर	पी 2101	163/10.11.2020	30.000	27.89	12.77	15.12
2020-21	बांस वृक्षारोपण कार्य उदयपुर	पी 2009		40.000	34.69	20.12	14.57
2020-21	Improvement of Elephant Habitat Ambikapur	RF 2581	192/24.11.2020	1	5.00	4.98	0.02
2020-21	Improvement of Elephant Habitat Lundra	P 2613		1	5.00	4.99	0.01
2020-21	Improvement of Elephant Habitat Lakhanpur	तिरकेला		1	5.00	4.99	0.01
2020-21	Improvement of Elephant Habitat Sitapur	P 2424		1	5.00	5.00	0.00
2020-21	Improvement of Elephant Habitat Mainpat	P 2374		1	5.00	4.99	0.01
2020-21	Fire Protection Work Mainpat	P 2334	193/24.11.2020	201.017	3.85	2.88	0.97
2020-21	Fire Protection Work Mainpat	P 2336		342.639			
2020-21	Fire Protection Work Mainpat	P 2337		516.187			
2020-21	Fire Protection Work Mainpat	P 2307		275.979	4.14	3.18	0.96
2020-21	Fire Protection Work Mainpat	P 2308		434.244			
2020-21	Fire Protection Work Mainpat	P 2309		364.879			
2020-21	Fire Protection Work Mainpat	P 2301		358.560	3.95	3.59	0.36
2020-21	Fire Protection Work Mainpat	P 2303		220.186			
2020-21	Fire Protection Work Mainpat	P 2290		290.215			
2020-21	Fire Protection Work Mainpat	P 2295		353.834			
2020-21	Fire Protection Work Mainpat	P 2374		270.425	3.25	2.88	0.37
2020-21	Fire Protection Work Mainpat	P 2375		248.274			
2020-21	Fire Protection Work Mainpat	P 2373		208.733			
2020-21	Fire Protection Work Mainpat	P 2340		192.413			
2020-21	Fire Protection Work Mainpat	P 2300		314.336	3.00	2.83	0.26
2020-21	Fire Protection Work Mainpat	P 2302		324.920			
2020-21	Fire Protection Work Mainpat	P 2382		183.100			
2020-21	Fire Protection Work Mainpat						

APO वर्ष	कार्य का नाम	कार्यस्थल	प्रशासकीय स्वीकृति	स्वीकृति		व्यय राशि	शेष राशि
				भौतिक	वार्षिक		
2020-21	Fire Protection Work Mainpat	P 2396	193/24.11.2020	439.734	4.74	4.29	0.45
2020-21	Fire Protection Work Mainpat	P 2339		247.500			
2020-21	Fire Protection Work Mainpat	P 2338		221.443			
2020-21	Fire Protection Work Mainpat	P 2398		211.748			
2020-21	Fire Protection Work Mainpat	P 2297		270.425			
2020-21	Fire Protection Work Sitapur	P 2640	191.24.11.2020	280.720	4.37	3.96	0.41
2020-21	Fire Protection Work Sitapur	RF 2647		271.860			
2020-21	Fire Protection Work Sitapur	P 2648		390.430			
2020-21	Fire Protection Work Sitapur	P 2649		389.810			
2020-21	Fire Protection Work Sitapur	P 2651		321.290			
2020-21	Fire Protection Work Sitapur	P 2403		256.267	4.15	3.54	0.62
2020-21	Fire Protection Work Sitapur	P 2404		156.616			
2020-21	Fire Protection Work Sitapur	P 2402		338.297			
2020-21	Fire Protection Work Sitapur	P 2434		119.880			
2020-21	Fire Protection Work Sitapur	P 2437		115.860			
2020-21	Fire Protection Work Sitapur	P 2394		218.045			
2020-21	Fire Protection Work Sitapur	P 2396		218.349			
2020-21	Fire Protection Work Sitapur	RF 2426		266.636	4.14	3.52	0.62
2020-21	Fire Protection Work Sitapur	RF 2427		217.350			
2020-21	Fire Protection Work Sitapur	RF 2428		185.665			
2020-21	Fire Protection Work Sitapur	P 2442		147.353			
2020-21	Fire Protection Work Sitapur	P 2446		158.477			
2020-21	Fire Protection Work Sitapur	RF 2425		228.150			
2020-21	Fire Protection Work Sitapur	P 2407		115.420			
2020-21	Fire Protection Work Sitapur	P 2417		233.374	3.07	2.74	0.33
2020-21	Fire Protection Work Sitapur	P 2656		279.390			
2020-21	Fire Protection Work Sitapur	P 2418		358.199			
2020-21	Fire Protection Work Sitapur	P 2419		225.737			
2020-21	Fire Protection Work Sitapur	P 2447		345.250	4.27	3.86	0.41
2020-21	Fire Protection Work Sitapur	RF 2422		364.917			
2020-21	Fire Protection Work Sitapur	RF 2424		240.075			
2020-21	Fire Protection Work Sitapur	P 2641		237.700			
2020-21	Fire Protection Work Sitapur	P 2654		346.990			

APO वर्ष	कार्य का नाम	कार्यस्थल	प्रशासकीय स्वीकृति	स्वीकृति		व्यय राशि	शेष राशि
				परिमाण	वार्षिक		
2020-21	Soil & Moisture Conservation Works Mainpat	P 2373	194/24.11.2020	208.733	1.50	1.50	0.00
2020-21	Soil & Moisture Conservation Works Mainpat	P 2336		342.639	2.10	2.05	0.05
2020-21	Soil & Moisture Conservation Works Mainpat	P 2308		454.244	2.25	2.25	0.00
2020-21	Soil & Moisture Conservation Works Mainpat	P 2295		333.834	2.40	2.39	0.01
2020-21	Soil & Moisture Conservation Works Mainpat	P 2303		220.186	1.75	1.75	0.00
2020-21	Soil & Moisture Conservation Works Mainpat	P 2307		273.979	2.00	2.00	0.00
2020-21	Soil & Moisture Conservation Works Sitapur	P 2396	195/24.11.2020	218.349	1.65	1.65	0.00
2020-21	Soil & Moisture Conservation Works Sitapur	P 2437		115.860	1.85	1.85	0.00
2020-21	Soil & Moisture Conservation Works Sitapur	P 2650		242.770	3.25	3.25	0.00
2020-21	Soil & Moisture Conservation Works Sitapur	P 2445		242.000	2.75	2.75	0.00
2020-21	Soil & Moisture Conservation Works Sitapur	P 2423		178.013	2.50	2.50	0.00
2020-21	चैनलिंक फेंसिंग कार्य, उदयपुर	पी 2217	165/10.11.2020	1700 रनी.	30.50	16.21	14.29
2020-21	चैनलिंक फेंसिंग कार्य, उदयपुर	पी 2176		3344 रनी.	60.00	27.01	32.99
2020-21	चैनलिंक फेंसिंग कार्य, सीतापुर	पी 2490		2520 रनी.	45.21	27.79	17.42
2020-21	चैनलिंक फेंसिंग कार्य, मैनपाट	पी 2375		2436 रनी.	43.70	0.00	43.70
	योग				508.31	318.99	189.32

नोट :– वर्ष 2021–22 में वन्यप्राणी प्रबंधन योजना अन्तर्गत किये जाने वाले कार्यों की स्वीकृति अप्राप्त है।

वनमण्डलाधिकारी
सरगुजा वनमण्डल अम्बिकापुर

Annexure - IV.

NAFR

HIGH COURT OF CHHATTISGARH, BILASPUR

WPC No. 1346 of 2016

1 - Forest Right Committee Ghatbarra thorugh its President Banas kumar S/o Shri Sundar Sai, Aged About 40 years, R/o Village Ghatbarra, Tehsil Udaypur, District Sarguja Chhattisgarh, Chhattisgarh

2 - Hasdeo Arand Bachao Sangharsh Samiti, through its Covenor Umeshwar Singh Armo S/o Shri Siyambar Singh, Aged About 35 Years, R/o Village Jampani, Post Madanpur, Tehsil Podi, District Korba Chhattisgarh, District : Korba, Chhattisgarh

3 - Jainandan Singh Porte S/o Shri Sukalu Ram, Aged About 40 Years, R/o Village Ghatbarra, Tehsil Udaypur, District Sarguja Chhattisgarh, District : Surguja (Ambikapur), Chhattisgarh

---- Petitioners

Versus

1 - Union of India Through Secretary, Ministry of Environment and Forest, Government of India, Paryawaran Bhawan, C.G.O. Complex Lodhi, Road, New Delhi, 11003, Delhi

2 - Union of India, through Secretary, Ministry of Tribal Affairs, Government of India, Shastri Bhawan, New Delhi, 110001, Delhi

3 - State of Chhattisgarh through Secretary, Department of Forest, Mantralaya, Naya Raipur Chhattisgarh, District : Raipur, Chhattisgarh

4 - District Level Forest Rights Committee (DLC) Sarguja, through O/o. Collector (Tribal Welfare), Ambikapur, District Sarguja Chhattisgarh, District : Surguja (Ambikapur), Chhattisgarh

5 - Rajasthan Rajya Vidyut Utpadan Nigam Ltd., Vidyut Bhawan, Jyoti Nagar Janpath, Jaipur Rajasthan,, District : Jaipur, Rajasthan

---- Respondents

(Cause-title taken from Case Information System)

02-05-2024	Ms. Shalini Gera, Mr. Amit K. Verma and Ms. Anushri Rajput, Advocates for the petitioners. Mr. Sumit Singh, Advocate for respondents No.1 and 2. Mr. Santosh Bharat, Panel Lawyer for the State/respondents No.3 and 4.

Dr. N.K. Shukla, Senior Advocate with Ms. Priya Mishra, Advocate for respondent No.5.

I.A. No.10/2023 (application for amending the petition)

Learned counsel for the petitioners have submitted that the present petition has been filed against the order dated 08-01-2016 issued by respondent No.4 and for protection of the rights to the petitioners granted under the Scheduled Tribes and Other Forest Dwellers (Recognition of Forest Rights) Act, 2006 (hereinafter called as 'Forest Rights Act').

It is submitted by the petitioners that the village Ghatbarra comprises mostly of triable population and have granted community rights under the provisions of Forest Rights Act, through order No.10378/a-19(1) 2012-13. On 08-01-2016 an order is issued by respondent No.4 that forest rights granted to village Ghabarra is cancelled. To protect the forest and biodiversity and the rights and duty to the villagers they moved their representation on 26-02-2016 to various authorities including organizing protest against the said order and the memorandum were submitted before the various authorities, higher authorities also. When the authorities have not responded, they have filed the instant petition.

In the instant petition application for grant of interim relief has been dismissed by the Coordinate Bench of this Court vide order dated 30-09-2022. Thereafter, the order dated 30-09-2022 was challenged by the petitioners before the Hon'ble Supreme Court by filing Special Leave Petition (Civil) No.18103/2022. The said special leave petition came up for hearing before the Hon'ble Supreme Court on 16-10-2023 and the same is decided along with another petition, i.e. Civil Appeal No.4395/2014 as Rajashan Rajya Vidyut Utpadan Nigam Limited Vs. Sudiep Shrivastava

and others. It has been submitted before the Hon'ble Supreme Court ;that the application for amendment filed before the High Court which is pending. While passing the order dated 16-10-2023 the Hon'ble Supreme Court has observed in para 4 of its judgment that:-

> "4. Since the writ petition under Article 226 of the Constitution is pending before the High Court, it would be appropriate and proper to relegate the petitioners to pursue their rights and remedies in accordance with law. Since the application for interim relief in IA No 5 of 2022 was not considered by the High Court for the reasons which have been indicated above, we clarify that it will be open to the petitioners to move an application for seeking interim relief. The above liberty is subject to such objections which the contesting respondents may have to the grant of interim relief. This Court has not expressed any opinion on the merits of the challenge before the High Court."

It is further submitted by learned counsel for the petitioners that during pendency of this writ petition and without settlement of any community forest rights of Ghatbarra village respondent No.5 applied for permission to start mining in phase II forest area. The respondent No.1 Ministry of MoEFCC, granted approval to commence Phase II mining operations in the balance forest area of 1136 hectares vide order dated 02-02-2022 (Annexure -P/23) and consequently, respondent No.3/State has also granted permission for diversion of 1136 hectares of forest land to start Phase II mining operations in the remaining forest area, vide order dated 25 -03-2022 (Annexure-P/24). The APCCF granted permission vide

order dated 05-05-2022 to the respondent No.5 to fell 7960 trees in 43.63 hectares of forest land in Phase II mining area which completely overlapped forest area in the CFR Title which is subject to the present writ petition.

It is also submitted by learned counsel for the petitioners the order dated 02-02-2022 passed by the MoEFCC granting permission for Phase II mining in 1136 hectares of forest land and second order of the State Govt. passed on 25-03-2022 and 05-05-2022 has been passed without prior settlement of forest rights in that area which is violation of Section 4(5) of the Forest Right Act as well as the Forest (Conservation) Rules of 2003. It is further submitted that before granting of final approval the settlement of forest rights and approval of Gram Sabhas concerned must be considered before grant of final approval. Learned counsel for the petitioners further submits that by filing the application I.A.No.3/2022 filed on 06-05-2022 the petitioners brought to the notice of this Court the order dated 02-02-2022 and 25-03-2022 passed by the State Government with respect to diversion of 1136 hectares of forest land for mining. He would also submitted that an application for grant of ad-interim relief, I.A. No.4/2022 filed on 06-05-2022 the petitioner have stated that operation of abovementioned orders would destroy the forest rights of the petitioners and it would render the instant writ petition infructuous and prayed for grant of ad-interim relief. In these I.As. no effective hearing could take place and on 27-09-2022 tree felling and forest destruction started. On 28-09-2022 the petitioners filed another I.A. seeking interim relief and prayed that the respondents be restrained from felling of trees and from further destruction of forests of village Ghatbarra. Vide order dated 30-09-2022

the Coordinate Bench of this Court has denied the interim relief and it was pointed out that the petitioners had not challenged the relevant orders permitting mining in the said forest land, viz. orders dated 02-02-2022, 25-03-2022 and 05-05-2022.

The order dated 30-09-2022 was challenged by the petitioners before the Hon'ble Supreme Court by filing Special Leave Petition (Civil) No.18103/2022 which was came up for hearing on 16-10-2023 along with Civil Appeal No.4395/2014 and after hearing the parties the SLP(C) No.18103/2022 is disposed of with certain observations made in para 4 of the order dated 16-10-2023. It was submitted before the Hon'ble Supreme Court during course of the hearing that amendment application filed before this Court is pending. The petitioners are relegated to this Court to pursue their rights and remedies in accordance with law. Since the Coordinate Bench of this Court, while passing the order dated 30-09-2022 observed in its order that the orders dated 02-02-2022, 25-03-2022 and 05-05-2022 have not been challenged and further before the Hon'ble Supreme Court the non-challenge of the aforesaid orders were raised and the parties are relegated to this Court to pursue their remedies, the petitioners are claiming amendment in their writ petition with respect to challenge these three orders and the ground of challenge in the following manners :-

"17. The petitioners prays that in order to challenge the validity of the said orders dated 2.2.2022, 25.3.2022 and 5.5.2022, the following grounds may be incorporated:

"**9(v)** For the reason that the approval of the Central Government u/s 2 of the Forest Conservation Act 1980 dated 15.03.2012 was set aside as a necessary implication of the NGT dated 24.03.2014, as it

sets aside the MoEF order dated 23.06.2011 (Annexure P-27). Till date, there is no new approval u/s 2 of the FCA for the entire forest area of 1898.328 ha. Without such an approval, no mining can be permitted in the forest area under the PEKB coal block, and thus the orders of the R-1 Respondent Ministry, MoEFCC dated 2.2.2022 allowing commencement of Phase II mining in PEKB and consequential orders of the State government dated 25.03.2022 and 5.5.2022 diverting forest land for mining purposes are bad in law and illegal.

9(vi) For the reason that section 4(5) of the FRA 2006 specifically prohibits any eviction or removal of forest dwellers from forest land without the complete settlement of forest rights on that forest land. Since community forest rights have not yet been settled with respect to the claims of the Gram Sabha of village Ghatbarra, the three above orders dated 02.02.2022, 25.03.2022 and 05.05.2022 are in violation of the FRA, and hence, illegal and *non est.*

9(vii) For the reason that the Forest (Conservation) Rules of 2003 (as applicable at the time of the orders dated 02.02.2022, 25.03.2022 and 05.05.2022) clearly stipulate that the final approval of the Central Government for diversion of forest land for non-forestry purposes under section 2 of the FCA can only be made after the settlement of forest rights over the concerned forest land, and the consent of the Gram Sabhas has been obtained. This is evident in the following rules-

Rule 6. *"Submission of proposal seeking approval of the Central Government under section 2 of the Acts*

.....

(3)(e) The District Collector shall-

(i) complete the process of recognition and vesting of forest rights in accordance with the provisions of the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 (2 of 2007) for the entire forest land indicated in the proposal;

(ii) obtain consent of each Gram Sabha having jurisdiction over the whole or a part of the forest land indicated in the proposal for the diversion of such forest land and compensatory and ameliorative measures, if any, having understood the purposes and details of diversion, wherever required; and

(iii) forward his findings in this regard to the Conservator of Forests;"

Rule 8. "Submission of report on compliance to conditions stipulated in the in-principle approval and grant of final approval

.....

(g) in case the Conservator of Forests finds that the compliance report is complete in all respect, he shall forward such report along with the report on completion of the process of recognition and vesting of forest rights and consent of the each Gram Sabha received from the District Collector referred to in sub-clause (f) of sub-rule (3) of rule 6, to the Nodal Officer within a period of fifteen days of its receipt from the Divisional

Forest Officer:

Provided that in case the Conservator of Forests finds that the compliance report is incomplete, he shall communicate the shortcoming or shortcomings in the compliance report to the User Agency and the Divisional Forest Officer within a period of fifteen days of its receipt from the Divisional Forest Officer,"

9(vii) For the reason that by way of compliance with Rule 6(3)(e) of the Forest Conservation Rules of 2003, the Handbook issued by the Respondent Ministry R-1 contains detailed set of forms to be filled out by the District Collector (Annexure P-29) that certifies, inter alia, that

(a) the complete process of recognition and vesting of forest rights under the FRA, 2006 has been carried out for the entire forest land proposed for diversion.

(b) the proposal for such diversion (with full details of the project and its implications, vernacular/ local language) have been placed before each concerned Gram Sabha or forest-dwellers, who are eligible under the FRA, 2006;

(c) each of the concerned Gram Sabha(s), has certified that all formalities/ processes under the FRA have been carried out, and that they have given their consent to the proposed diversion and the compensation and ameliorative measures, if any, having understood the purpose and details of proposed diversion.

(d) the discussion and decisions on such proposals had taken pace only when there was a quorum of minimum 50 % of the members of Gram Sabhas present

(e) the diversion of forest land for facilities managed by the

Government as required under Section 3 (2) of tine FRA have been completed and the Gram Sabhas have given their consent to it.

As no such certificate by the District Collector has been prepared in the instant case, no approval or order for diversion of forest land is valid, and hence, the orders dated 02.02.2022, 25.03.2022 and 05.05.2022 are invalid and illegal.

9(viii) For the reason that the claims of the Ghatbarra Gram Sabha under sections 3(1)(d) with respect to water bodies, 3(1)(i), 3(1)(k) and 3(1)(l) have neither been recognized, nor have they been rejected by the District Level Committee. In respect of 3(1)(i), Rule 12B(3) of the Forest Rights Rules, 2008 specifically entrust the DLC with the responsibility of settling these rights -

"The District Level Committee shall ensure that the forest rights under clause (i) of sub-section (1) of Section 3 relating to protection, regeneration or conservation or management of any community forest resource, which forest dwellers might have traditionally been protecting and conserving for sustainable use, are recognized in all villages with forest dwellers and the titles are issued."

18. The Petitioners pray that in order to challenge the validity of the said orders dated 2.2.2022, 25.3.2022 and 5.5.2022, the Reliefs Prayed may be amended to include the following:

"10(iv). Set aside the order dated 02.02.2022 issued by Respondent R-1, and the consequential orders dated 25.03.2022 and 05.05.2022 issued by Respondent State Government R-3.

10(v). Direct the DLC to expeditiously verify and vest the remaining community forest rights claims of the village Ghatbarra as made in their claim application dated 12.6.2013."

Learned counsel for the petitioners would further submits that the proposed amendments have been necessitated by the subsequent developments and do not change the basic character of the instant writ petition. No prejudice is caused to the respondents since the orders dated 02-02-2022 and 25-03-2022 are sub-judice before the Hon'ble Supreme Court in Civil Appeal No.4395/2014 and WPC No.510/2023. It is further submitted that the amendments sought by the application in the writ petition are clarificatory in nature. The respondents have rights consequential amendment in their reply or to file additional reply if the same is being allowed and they have every right to defend their case and therefore, they may be permitted to carry out the necessary amendment in the writ petition.

Learned counsel for the respondent No.5 would submit that by way of proposed amendments the petitioners seeks to incorporate the documents which has been filed along with I.A. No.3 dated 06-05-2022. Unless the petitioners press that I.A. No.3 and the documents are become the part of the writ petition it cannot be presumed that the documents has been made part of the writ petition. He would further submit that the application I.A. No.3 dated 06-05-2022 is for taking additional facts on record which refers to the document Ex.-P/23 and P/24 which are the orders dated 02-02-2022 and 15-03-2022.

In the earlier hearing Mr. Mukul Rohtagi, learned Senior Advocate would submit that the petitioners got rights of forest dwellers in 2012 that

was challenged in the National Green Tribunal (hereinafter called as 'the NGT') and that was set aside by the NGT in the year 2014. The order passed by the NGT was challenged before the Hon'ble Supreme Court in appeal. The Hon'ble Supreme Court by the order dated 28-04-2014 granted interim relief that there will be stay of the orders by which the works which commenced was suspended by the NGT. In other words the stay of the NGT was stayed by the Hon'ble Supreme Court by order dated 28-04-2014. The respondent No.5 commenced mining thereafter under the orders of the Hon'ble Supreme Court. Suffice to say that while the NGT passed the order suspending the mining activities the NGT has directed the respondent to get fresh permission and fresh biodiversity reports etc. then only recommence their mining activities. Though in the passage of 10 years before the Hon'ble Supreme Court the interim order continued the respondent No.5 worked under the direction of the NGT and when their appeal came up for hearing before the Hon'ble Supreme Court on 16-10-2023 the Hon'ble Supreme Court passed the order that since the order of the NGT, the Ministry of Environment, Forest and Climate Change (MoEF&CC) has granted approval for commencing Phase II mining operation for the Parsa East and Kete Basan (PEKB) Coal Block on 2 February 2022. Thereafter, the State of Chhattisgarh has on 25 March 2022 accorded permission for coal mining and for non-forest activity in respect of the Parsa East and Kete Basan Coal Block comprising 1136 hectares. Further observed that the above facts are not in dispute and has ordered that since the order of the NGT has resulted in the above orders of MoEF&CC dated 2 February 2022 and of the State of Chhattisgarh dated 25 March 2022, Mr. A.N.S. Nadkarni, learned Senior counsel

appearing on behalf of the appellant states that the appeal is not pressed and then the appeal was accordingly disposed of. He would further submit that the work of phase-I was exhausted under the cover of the interim order passed by the Hon'ble Supreme Court and thereafter orders dated 02-02-2022 and 25-03-2022 are passed approving the permission of mining for phase II. Since the respondent No.5 has obtained fresh permission for phase II, he did not therefore, prays the appeal before the Hon'ble Supreme Court because the old permission was suspended by the NGT which was suspended by the Hon'ble Supreme Court and then that matter is over. The later part that arose from the present proceeding are present before the Court. The Special Leave Petition (Civil) No.18103/2022 arose against the order dated 30-09-2022 in WPC No.1346/2016, the Single Judge declined to entertain the interim relief application on the ground that the proceedings were pending before this Court, but the order dated 02-02-2022 and 25-03-2022 is challengeable before the NGT and are not challengeable before the High Court. The petitioners have rights to file appeal before the NGT against the order granting fresh approval. The mining is to somehow challenge the order dated 02-02-2022 and 25-03-2022 but these two orders passed MoEFCC granting approval for mining area is challengeable in NGT. He would also submit that respondent No.5 have right to cut trees under the mining plan with the condition to put 10 times plantation of trees. Therefore, their purpose to amend and to challenge these orders in order to obviate the result of the appeal which they should prefer before the NGT. The writ petition is filed in the year 2016 and they are now wantingto amend the writ petition and want to bring two things, i.e., challenge the order dated

02-02-2022 and 25-03-2022 and vesting of the remaining community forest rights claims fo the village Ghatbarra as made in their claim application dated 12-06-2013 and therefore the scope of the writ petition is entirely different from which now introduced. The amendment would not be granted for the simple reason that the order which they wish to impugn are orders challengeable before the NGT under Section 16 of the NGT Act 2010 and secondly in the while before the Hon'ble Supreme Court in last so many years the petitioners have not secured any orders and they made innocent statement that they will go and amend their writ petition, therefore the proposed amendments are not liable to be allowed.

In the earlier hearing Mr. Naman Nagarath, learned counsel for respondent No.5 would submit that merely because the petitioners have got certain rights does not act as the perpetual injunction in their favour so as to stop all activities, purpose of act is only even those who have been ousted they also needs to be recognized so that they may also be compensated. The petitioners have claimed in their writ petition that the order dated 08.01.2016 (Annexure-P/1) by which the rights of the petitioners is snatched away ultimately the relief would be that they would be entitled for certain compensation for the reason that they have certain rights over the forest land. The orders dated 02.02.2022 and 25.03.2022 are passed in consequence of the NGT's order.

Before adverting to the rival contentions put-forth by the either sides it would be required to consider the occasion arises for the amendment in the pleadings of the writ petition.

The present writ petition has been filed on 11 May, 2016 with the pleading and prayer to set aside the order dated 08.01.2016 issued by

respondent No.4 and to hold that the rights granted under the Scheduled Tribes and Other Traditional Dwellers (Recognition of Forest Rights Act), 2006 cannot be cancelled or revoked.

In the present case it is the pleading of the petitioners that they have been granted forest rights under the Forest Rigths Act by order No.10378/a - 19(1) 2012-13, but vide order dated 08.01.2016 (Annexure-P/1) the forest rights of the petitioners have been cancelled. Thereafter the petitioners have approached before this Court to protect their forest rights. Although there is no interim order in favour of the petitioners, but they are pursuing their remedy by filing various applications either in the Court or before the appropriate authorities for redressal of their grievances. During pendency of the writ petition before this Court on 02.02.2022 the respondent No.1, Ministry of Environment, Forests and Climate Change (MoEFCC) granted approval to commence Phase – II mining operations in the balance forest area of 1136 hectares 6 years ahead of schedule. Subsequently, the State of C.G. has also granted approval for diversion of 1136 hectares of forest land to commence Phase- II mining operations in the remaining forest area vide order dated 25.03.2022. In furtherance thereof the APCCF also granted permission vide order dated 05.05.2022 to respondent No.5 to fell 7960 trees in 43.63 hectares of forest land in Phase – II mining area.

Since these three orders, i.e., orders dated 02.02.2022, 25.03.2022 and 05.05.2022 have been passed during pendency of the writ petition which give cause of action to the petitioners to challenge the orders by carrying out the amendment in the pleadings of the writ petition for which the application for amendment in the writ petition has been filed by the

petitioners.

It is well settled that the Court must be liberal in granting the prayer for amendment, if the court is of the view that if such amendment is not allowed, a party, who has prayed for such an amendment, shall suffer irreparably. It is always open to the Court to allow an amendment if it is of the view that allowing of an amendment shall really sub-serve the ultimate cause of justice and avoid further litigation.

In the matter of **Life Insurance Corporation of India Vs. Sanjeev Builders Private Limited and Another, reported in 2022 SCC OnLine SC** 1128, in para 22, 26, 27 and 29 of the judgment the Hon'ble Supreme Court has held as under :-

"**22.** It would be useful to also notice the observations of this Court in, Pirgonda Hongonda Ptil v. Kalgonda Shidgonda Patil, 1957 SCR 595 : AIR 1957 SC 363, wherein this Court considered an objection to the amendment on the ground that the same amounted to a new case and a new cause of action. In this case, this Court laid down the principles which would govern the exercise of discretion as to whether the court ought to permit an amendment of the pleadings or not. This Court approved the observations of Batchelor, J., in the case of Kisandas Rupchand v. Rachappa Vithoba Shilwant reported in ILR (1909) 33 Bom 644, when he laid down the principles thus:

"**10.** ..... "All amendments ought to be allowed which satisfy the two conditions (a) of not working injustice to the other side, and (b) of being necessary for the purpose of determining the real questions in controversy between the parties .... but I refrain from citing further authorities, as, in my opinion, they all

lay down precisely the same doctrine. That doctrine, as I understand it, is that amendments should be refused only where the other party cannot be placed in the same position as if the pleading had been originally correct, but the amendment would cause him an injury which could not be compensated in costs. It is merely a particular case of this general rule that where a plaintiff seeks to amend by setting up a fresh claim in respect of a cause of action which since the institution of the suit had become bared by limitation, the amendment must be refused; to allow it would be to cause the defendant an injury which could not be compensated in costs by depriving him of a good defence to the claim. The ultimate test therefore still remains the same : can the amendment be allowed without injustice to the other side, or can it not." ...."

26. But undoubtedly, every case and every application for amendment has to be tested in the applicable facts and circumstances of the case. As the proposed amendment of the pleadings amounts to only a different or an additional approach to the same facts, this Court has repeatedly laid down the principle that such an amendment would be allowed even after the expiry of statutory period of limitation.

27. In this behalf, in A.K. Gupta & Sons Ltd. v. Damodar Valley Corporation, AIR 1967 SC 96 : (1996) 1 SCR 796, this Court held thus:

"**7.** ..... a new case or a new cause of action particularly when a suit on the new case or cause of action is barred: Weldon v. Neale [[L.R.] 19 Q.B. 394]. But it is also well recognised that where the amendment does not constitute the

addition of a new cause of action or raise a different case, but amounts to no more than a different or additional approach to the same facts, the amendment will be allowed even after the expiry of the statutory period of limitation:....."

29. In Pankaja v. Yellappa (dead) by lrs., (2004) 6 SCC 415, this Court held that it was in the discretion of the court to allow an application under Order VI Rule 17 of the CPC seeking amendment of the plaint even where the relief sought to be added by amendment was allegedly barred by limitation. The Court noticed that there was no absolute rule that the amendment in such a case should not be allowed. It was pointed out that the court's discretion in this regard depends on the facts and circumstances of the case and has to be exercised on a judicial evaluation thereof. It would apposite to notice the observations of this Court in this pronouncement in extenso. The principles where laid down by this Court thus:

"**12.** So far as the court's jurisdiction to allow an amendment of pleadings is concerned, there can be no two opinions that the same is wide enough to permit amendments even in cases where there has been substantial delay in filing such amendment applications. This Court in numerous cases has held that the dominant purpose of allowing the amendment is to minimise the litigation, therefore, if the facts of the case so permit, it is always open to the court to allow applications in spite of the delay and laches in moving such amendment application.

13. But the question for our consideration is whether in

cases where the delay has extinguished the right of the party by virtue of expiry of the period of limitation prescribed in law, can the court in the exercise of its discretion take away the right accrued to another party by allowing such belated amendments.

14. The law in this regard is also quite clear and consistent that there is no absolute rule that in every case whee a relief is barred because of limitations an amendment should not be allowed. Discretion in such cases depends on the facts and circumstances of the case. The jurisdiction to allow or not allow an amendment being discretionary, the same will have to be exercised on a judicious evaluation of the facts and circumstances in which the amendment is sought. I the granting of an amendment really subserves the ultimate cause of justice and avoids further litigation the same should be allowed. There can be no straitjacket formula for allowing or disallowing an amendment of pleadings. Each case depends on the factual background of that case.

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16. This view of this Court has, since, been followed by a three-Judge Bench of this Court in the case of T.N. Alloy Foundry Co. Ltd. v. T.N. Electricity Board [(2004) 3 SCC 392]. Therefore, an application for amendment of the pleading should not be disallowed merely because it is opposed on the ground that the same is barred by limitation, on the contrary, application will have to be considered bearing in mind the

discretion that is vested with the court in allowing or disallowing such amendment in the interest of judtice.

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18. We think that the course adopted by this Court in Ragu Thilak D. John case [(2001) 2 SCC 472] applies appropriately to the facts of this case. The courts below have proceeded on an assumption that the amendment sought for by the appellants is ipso facto barred by the law of limitation and amounts to introduction of different relief than what the plaintiff had asked for in the original plaint. We do not agree with the courts below that the amendment sought for by the plaintiff introduces a different relief so as to bar the grant of prayer for amendment, necessary factual basis has already been laid down in the plaint in regard to the title which, of course, was denied by the respondent in his written statement which will be an issue to be decided in a trial. Therefore, in the facts of this case, it will be incorrect to come to the conclusion that by the amendment the plaintiff will be introducing a different relief."

Hon'ble the Supreme Court in the matter of **M/s. Estralla Rubber Vs. Dass Estate (Private) Ltd**, reported in 2001 (8) SCC 97 held that mere delay in making the amendment application itself is not enough to reject the application for amendment, unless a new case is made out or serious prejudice is shown to have been caused to the other side so as to take away any accrued right.

The power to allow an amendment is undoubtedly wide and may at any stage be appropriately exercised in the interest of justice, the law of

limitation notwithstanding. But the exercise of such far reaching discretionary powers is governed by judicial considerations and wider the discretion, greater ought to be the care and circumspection on the part of the Court. Where amendment is found to be necessary for promoting the ends of justice and not for defeating the same, the application should be allowed.

As has been held in the matter of **Radhika Devi Vs. Bajrangi Singh and others**, reported in AIR 1996 SC 2358 and **Dondapati Narrayana Reddy Vs. Duggireddy Venkatanarayana Reddy**, reported in (2001) 8 SCC 115 it is settled that if a right accrues in favour of a party as the order impugn has not been challenged in time the said right cannot be taken away by seeking amendment in pleading. Further, normally amendment is not allowed if it changes the cause of action, but where the amendment does not constitute the addition of a new cause of action, or raises a new case, but amounts to not more than adding to the facts already on record, the amendment should be allowed even after the statutory period of limitation.

In **G. Nagamma & Ors. Vs. Siromanamma & Anr.**, reported in JT 1998 (4) SC 484, the Hon'ble Supreme Court observed that in an application for amendment, even an alternative relief can be sought; however, it should not change the cause of action or materially affect the relief claimed earlier. The Court may to certain extent allow the conversion of the nature of the suit provided it does not give rise to an entire new cause of action.

In the matter of **Pithanee Suryanarayana and Another Vs. Repaka**

Venkata Ramana Kishore and Others, reported in (2009) 11 SCC 308 it was held by the Hon'ble Supreme Court that court holds the power to allow such amendment provided: (i) application is bonafide, (ii) does not cause injustice to other side, (iii) does not affect the right(s) already accured to the other side and the amendment should not change the basic structure of the proceeding.

While allowing the prayer for amendment of pleadings the court should avoid hypertechnical approach.

The respondents raised objection in proposed amendments on the ground that the three orders which the petitioners want to challenge by way of amendment in this petition is appeallable before the NGT under Section 16 of the NGT Act would not be hurdle to incorporate the amendment in the present writ petition. The petitioners simply inserting the proposed amendment in their writ petition. The respondents are very well having their right to deny the pleadings and the prayer and may also raise their objection regarding maintainability of the writ petition if the proposed amendment is permitted to be incorporated in the writ petition which ultimately become a part of the pleadings and prayer. It is foreign to consider the merits of the amendment at the stage of considering the amendment application in the pleadings of the writ petition except while it changes the nature of writ petition. The merits of the amendment are to be examined only after incorporating the amendment in the pleadings and replied by the opposite party.

The petitioners would further submit that the rights of the villagers under the Scheduled Tribes and other Forest Dwellers (Recognition of

Forest Rights) Act, 2006 were protected by the statute itself and on their application partial rights were granted which have been withdrawn by the impugned order dated 08-01-2016 but for the remaining rights they are claiming since then by their application dated 12-06-2013 and the authorities have not decided their claim. Therefore, they want to amend the prayer for that also as para 10(v) in prayer column of the writ petition.

The present writ petition is filed on 11-05-2016 and on the date of filing of the writ petition, the cause of action for claim was already exist on that day itself because, the part of the claim which was granted earlier has been withdrawn and therefore, there was a threat on their right on that day itself when their rights have not been granted or when the partially granted rights have been withdrawn, the petitioners may claim at that time itself. In the opinion of this Court, permitting incorporation of new prayer as para 10(v) of prayer clause of writ petition as claimed by the petitioners, would amounts to change the very nature of the petition which take the prayer on the date of filing of the writ petition back under the Doctrine of relation back and entire scenario of the case would be reopened.

One more favourable aspect of the matter in favour of the petitioners is that all these three orders for which the petitioners seeking amendment in the writ petition has come into existence during pendency of the writ petition filed by the petitioners.

Considering the above factual aspects of the case and the law laid down by the Hon'ble Supreme Court, I am of the view that no prejudice will be caused to the opposite side if the petitioners are allowed to carry out the necessary amendments in their writ petition as sought for by them except

the prayer for amendment of prayer **clause 10(v)**. In the opinion of this Court the proposed amendment as sought for by them in 10(v) changes the complex of the writ petition and vary nature of the case. The said proposed amendment in the relief clause would take the matter back in the year 2013, that relief is claimed in the interest of public in general of village Ghatbarra which, if allowed, would certainly change the entire complexion of the writ petition.

For the foregoing reasons I.A. No.10 filed by the petitioners for amendment in the writ petition is partly allowed. The petitioners are entitled to carry out the amendment proposed in the pleadings in the writ petition as claimed in para 17 of the application I.A. No.10 and in para 18 upto the amendment in relief clause No.10(iv) and the prayer for amendment of the writ petition in relief clause by inserting a new prayer, i.e. "10 (v)" is rejected.

The respondents are at liberty to make their consequential amendments in their return/reply and may file necessary documents to rebut the amendment of the writ petition. The respondents are also at liberty to raise their objections available to them in the amended part of the writ petition, if so advised. Consequently, I.A. No.10/2023 is partly allowed.

The petitioners are directed to carry out the necessary amendment in the writ petition and to file the amended copy of writ petition as per rules.

I.A. No.13/2023

This is an application for appropriate orders filed by the petitioners on 21-12-2023.

By way of this application the petitioners prayed for appropriate order

to restrain the respondents from further destruction of forest area in PEKB Phase II mining till disposal of the instant writ petition.

As it has already been considered by the Coordinate Bench of this Court vide order dated 30-09-2022 and the application for grant of interim relief (I.A. No.5) has been rejected. The Coordinate Bench has already considered that the orders dated 02-02-2022, 25-03-2022 and 05-05-2022 have not been challenged in the writ petition. The order dated 30-09-2022 was challenged in the Hon'ble Supreme Court in Special Leave Petition (Civil) No.18103/2022. The said SLP has relegated the petitioners to this Court to pursue their rights and remedies in accordance with law. Since the application for interim relief in I.A. No.5 was not considered by this Court on the ground that the above three orders have not been challenged in the writ petition, the Hon'ble Supreme Court have given liberty to the petitioners to move an application for seeking interim relief and such liberty is subject to such objection which the contesting respondents may have to grant of interim relief.

Since the petitioners' application for amendment in the writ petition is partly allowed and they are permitted to carry out the necessary amendment and therefore, at this stage, this Court is not inclined to pass any orders on the application I.A. No.13 which is an application for appropriate orders and consequently, the same is rejected.

Sd/-
(Ravindra Kumar Agrawal)
Judge

Aadil

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भारतसरकार
पर्यावरणवन एवंजलवायुपरिवर्तनमंत्रालय
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GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT, FOREST & CLIMATE CHANGE,
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Email – iro.raipur-mefcc@gov.in

Court Matter
By Post / By E-mail

F.No: CC-49/IRO/RPR/2024/ 62

Date: ~~05~~ 13/06/2024

To,

Advocate Upender Thakur,
Central Government Counsel,
A-9, LGF, South Extension, Part-1, New Delhi, 11049
(Mobile: 9711984890; E-mail: thakur.upender911@gmail.com).

Subject: O.A No. 59/2024 with IA No. 137/2024 and IA No. 136/2024 in the matter News item titled "Deforestation for mining resumes in Hasdeo locals activists allege detention" appearing in The Hindu dated 22.12.2023.- Regarding.

Ref: E- mail communication and letter dated 31/05/2024 of MoEF&CC, New Delhi.

Sir,

In response to the e-mail communication dated 31/05/2024 of MoEF&CC, New Delhi, as directed by the competent Authority, I am herewith forwarding duly signed and notarized approved reply Affidavit with Annexures in the O.A No. 59/2024 with IA No. 137/2024 and IA No. 136/2024 in the matter News item titled "Deforestation for mining resumes in Hasdeo locals activists allege detention" appearing in The Hindu dated 22.12.2023 before Hon'ble NGT (PB), at New Delhi as an attachment for further needful action please.

2. It is requested that the above reply affidavit may kindly be filed. Further, appearance on behalf of MoEF&CC may be ensured in the matter as and when it is listed for hearing with the view to protecting the interest of Union of India. The progress in the matter may be updated to the Ministry endorsing a copy to this Sub-Office.

This issues with the approval of Competent Authority.

Yours faithfully,

Encls: As Above

Shri. C.B. Tashildar, IFS
Assistant Inspector General of Forest (C)

Copy to: Shri Charanjeet Singh, Scientist-D, FC Division, Ministry of Environment, Forest & Climate Change, Indira Paryavaran Bhavan, Jorbagh Road, Aliganj, New Delhi-110003, (E-mail:c.jsingh1@gov.in) ***-with reference to your letter dated 31/05/2024.***

Shri. C.B. Tashildar, IFS
Assistant Inspector General of Forest (C)

Government of India
Ministry of Environment, Forest and Climate Change
Legal Monitoring Cell

Date: 19/04/2024

Subject: Engagement of Panel Counsel

Respected Sir,

Shri Upender Thakur (9711984890 & thakur.updender911@gmail.com/thakurupender@yahoo.com)

You are engaged to appear and conduct the case mentioned below for all purposes on behalf of this Ministry till the disposal of the case or expiry of your term of engagement or until further orders, whichever is earlier.

2. Details of the case are as follows:-

Court: **NGT (PB), New Delhi**

Case No.: **OA No. 59/2024 (IA Nos. 136-137/2024)**

Title of the Case: **News item titled "Deforestation for mining resumes in Hasdeo locals activities allege detention" appearing in The Hindu dated 22.12.2023**

Concerned Division of the Ministry: **FC**

Name and contact of the Divisional Head: **IGF (RKP) & 011-20819352**

Email ID: **ramesh.pandey@nic.in**

Name and contact of the dealing Associate (Legal): **Mr. Syed Shams Abbas & Mr. Prabhakar Kandpal**

Ph. No. **9582466338 & 9582016525**

Email ID: **shamsabbasmoef@gmail.com & kprabhakarmoef@gmail.com**

Next Date of hearing: **03/07/2024**

3. **This engagement is subject to the following conditions**:-

i. The engagement is governed by **O.M. No. 17(21)/2020-PL/NGT Dated 22.08.2022, 02.03.2023** and O.M. No. 17(21)/2017-PL/NGT on dated 01.12.2017, 07/02/2019 and 04/05/2020, Policy and Law Division, Ministry of Environment, Forest and Climate Change, Indira Paryavaran Bhawan, New Delhi read with relevant circulars/instruct tions issued by this Ministry from time to time.

ii. In case you are unable to attend the case for some reason, sufficient advance intimation should be given to the concerned Division.

iii. To return the brief on expiry of your term/disposal of the case to the Ministry of Environment, Forest and Climate Change, or till further orders.

iv. To intimate the Ministry the progress of the case regularly including obtaining and forwarding certified copy of the Order/Judgement to the concerned Division whenever necessary.

v. To appear on behalf of this Ministry in person, and **not through a junior counsel** in the matters marked to you.

vi. The engagement is acknowledged.

(Legal Monitoring Cell)
MoEF&CC, New Delhi
स्मिता सालवे/Smita H. Salve
वरिष्ठ परामर्शी (विधिक)
Senior Consultant Legal
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय
M/o Environment, Forest and Climate Change
भारत सरकार, नई दिल्ली
Govt. of India, New Delhi