**BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL**

**PRINCIPLE BENCH AT NEW DELHI**

**I.A.NO. 342 OF 2018**

**IN**

**ORIGINAL APPLICATION NO. 935 OF 2018**

**IN THE MATTER OF:**

STATE OF ANDHRA PRADESH .....APPLICANT

VERSUS

ANUMOLU GANDHI .....RESPONDENT

**AND IN THE MATTER OF:**

STATE OF ANDHRA PRADESH .....APPLICANT

VERSUS

ANUMOLU GANDHI .....RESPONDENT

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Secretary to Government (Mines)
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A.P. Secretariat, Velagapudi,
AMARAVATI - 522 238.

**BEFORE THE NATIONAL GREEN TRIBUNAL**

**NEW DELHI**

O.A.No. 935 of 2018

**Between:**

Sri Anumolu Gandhi. ...Applicant

Vs.

State of Andhra Pradesh & others ...Respondents

**AFFIDAVIT FILED ON BEHALF OF THE RESPONDANT No.1**

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I, Kolli Ramgopal, S/o. Dali Naidu Kolli, aged about 58 years, occupation: Indian Administrative Service, working as Secretary to Government of Andhra Pradesh, Industries & Commerce (Mines and Geology) Department and holding Full Additional Charge of Director of Mines & Geology, Government of Andhra Pradesh, AP Secretariat, Velagapudi, Amaravathi, Andhra Pradesh do hereby state on solemn affirmation as under.

1. I am on behalf of the Respondent No. 1 in the above said matter and am authorized to swear to this affidavit and am conversant with the facts and circumstances of the said matter. Hence I am competent to swear this affidavit.
2. It is humbly submitted that the Hon'ble National Green Tribunal in its Order dated 23.07.2019 in O.A. No:935 of 2018, has directed to undertake certain studies and land survey as detailed below:

   a. That at para No: 6 of the Order, this Hon'ble Tribunal directed the Respondent State to clarify:-

      i. Whether any Environmental Impact Assessment (EIA) has been done in accordance with Environmental Clearance

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Regulations 2006 as per the Project of Dredging doing by Inland Waterways Authority of India, falls under Entry 7(e) of the Schedule of the Regulations except maintenance dredging which forms part of a proposal for which Environmental Management Plan (EMP) is prepared and submitted.

ii. With regard to de-silting, it is not clear whether any replenishment study has been carried out before de-silting which is a pre-requisite for the purpose and what is the status of the Free Sand Policy which is said to be actual basis and what quantum of sand extracted and the un-scientific manner used as per earlier joint report was incorrect.

b. That at para No: 7 of the Order, while mentioning the Joint Committee Report dated:04.07.2019 in pursuance of order dated 04.04.2019, the Hon'ble National Green Tribunal has instructed the State of AP to undertake the following studies as recommended by the Joint Committee and submit report:

i. A detailed study covering the scope of work mentioned in **Annexure - 2** with regard to assess the extent of the damage to the Avifauna, Aquatic Flora & Fauna including benthic community is to be carried out by assigning to a reputed Institution based on the expertise.

ii. A detailed land survey was required for the volume of sand required to restore the flood plain and the cost of the restoration

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at Lingayapalem and Rayapudi where extensive sand mining has been carried out.

iii. A bathymetric survey of the reservoir is to be carried out for the assessment of depth of mining and siltation in the reservoir to assess the extent of the mining from the river bed.

3. In this regard, it is humbly submitted that a status report through an affidavit dated 25th of October 2019 was filed before the Hon'ble National Green Tribunal duly informing that:

a. With reference to para 6(i) of the Hon'ble National Green Tribunal order dt. 23.07.2019, it was informed that the Chairman, Inland Waterways Authority of India (IWAI) vide Letter no. IWAI/Legal/L/08/2019, dated 28.08.2019 has informed that under the mandate of IWAI Act, 1985 Section-14(I)(a&c), IWAI is mandated to carry out various river conservancy measures/ training works for improvement of National Waterways for shipping and navigation. Dredging is one of the river conservancy measures being adopted by IWAI. Further he has informed that, in terms of the provisions of extant MoEF guidelines, maintenance dredging for the purpose of inland navigation does not require Environmental Clearance. True copy of the letter of the Chairman, IWAI was annexed as ANNEXURE - R/1 along with the affidavit dated 25.10.2019 filed by this respondent.

b. With regard to para 6(ii) and para 7 of the Hon'ble National Green Tribunal order dt.23.07.2019, it was submitted in the affidavit dated 25.10.2019 that:

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i. Regarding the replenishment study for taking up de-siltation activity, Water Resources Department has informed that the Bathymetric survey work may take around four months from the date of award of the tender for completing the survey and to submit the survey report.

ii. Regarding the detailed study, covering the scope of work to assess the extent of the damage to Avifauna, Aquatic flora and fauna including benthic community, Acharya Nagarjuna University has informed that the study would require three months period.

4. I respectfully submit that, upon consideration of the Affidavit dated: 25.10.2019 submitted by this respondent, the Hon'ble National Green Tribunal in its order dated 19.12.2019, has given one month time from 19.12.2019 for the studies to be under taken with involvement of the CPCB and to submit the reports.

5. It is humbly submitted that, in compliance to the Hon'ble National Green Tribunal order dated 19.12.2019, a meeting was convened by this Respondent on 30.12.2019, with officials of the following departments and Higher Educational Institution to finalize the comprehensive report to be submitted to the Hon'ble National Green Tribunal.

1. Central Pollution Control Board (CPCB),
2. Water Resources Department, GoAP,
3. Acharya Nagarjuna University, Guntur &
4. Mines & Geology Department, GoAP

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It is submitted that Miss. Mahima, Senior Environmental Engineer, CPCB has inspected the study area of Prakasam Barrage with the Officials of Acharya Nagarjuna University and Mines & Geology Department on the same day and reviewed the study work undertaken by the Water Resources Department and Acharya Nagarjuna University.

6. It is respectfully submitted that the Water Resources department informed that the Bathymetric survey work has been entrusted to M/s BSP Hydro Dredging works through tender process and submitted the Bathymetric survey report duly scrutinised by the Central Pollution Control Board (CPCB). The said report is enclosed as **Annexure – R1**. As per the said report:

   a. Siltation and Shoal Formation in the barrage

      - Due to the operational constraints for keeping a Pond level of +17.39m to facilitate the passage of water into the Vijayawada thermal power station cooling canal, drinking water to Vijayawada and Guntur cites, the scour gates could not be operated for almost 10years. This has resulted in heavy sediment deposit in the reservoir and reduced by approximately 25% of the live capacity i.e., about 0.767 TMC.
      - The frequency of operating the gates has become very low because the discharge of flood decreases gradually after 2009 floods but the accumulated silt is gradually increases due to receiving of water from Upstream of the Barrage for regular needs. Further, on completion of Pattiseema lift scheme (lifting of water from River Godavari to River Krishna

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through Polavaram Right Main Canal) the water contains high silt content and resulted deposition of sediment from the year 2015-16 onwards.

b. Assessment of Silt Quantities using Sounding Data in 2015 and using Remote Sensing Data in 2016:

- In the year 2015, a total quantity of 71 Lakh Cum of the sediments was accumulated in the reservoir as per the study conducted by the Irrigation Department taking up soundings (which was approximate method).
- In the year 2016, the Irrigation Department has conducted a study using Remote Sensing Data in foreshore of Prakasam Barrage and found approximately 272.66 Lakh Cubic meters of deposits have been formed in the Prakasam Barrage reservoir by identifying the shoals from satellite imagery from 1988 to 2016 and Remote sensing data and levels from the Topographic & Bathometry survey data.

c. In view of the rapid changes in the catchment and flash floods due to climate change, the rate of sedimentation has increased in the recent days, which is diminishing the economic life of the reservoir gradually.

d. Need for desiltation:

- Heavy siltation coupled with increased water demand in the region necessitated de-siltation. Besides Irrigation needs, the Prakasam barrage also caters the drinking & industrial water needs all along River Krishna below Nagarjuna sagar Project, of four districts namely Krishna, West Godavari,

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Guntur and Prakasam districts and major source of drinking water for Vijayawada Corporation, Municipalities Gudivada, Jaggaiahpeta, Machilipatnam, Nuzivid, Pedana, Guntur Corporation, Municipalities Magalagiri, Tadepalle, Tenali and part of West Godavari district.

- After Government of Andhra Pradesh declared "Amaravathi" as New Capital city in 2015, as of October 2016, majority of departments and officials of the Andhra Pradesh State Government are now functioning from Velagapudi area of Amaravati. Meanwhile High Court for the state of Andhra Pradesh is also established in January 2019 in Amaravathi. The surrounding areas Vijayawada, Mangalagiri, and Tadepalli became more convenient residential zone for employees. Hence, the population is increasing day by day simultaneously Industrial and commercial zone is growing rapidly mainly in Vijayawada Corporation and Mangalagiri municipality which are adjacent to River Krishna. It results requirement of water is increased in both Vijayawada Corporation and Mangalagiri municipality. The only source to meet the additional requirement is Prakasam Barrage.
- The designed storage capacity of the barrage is 3.071 TMC at pond level (+) 57.05 Ft.The Barrage has 70 no. of Flood gates of 40' X 12' each to dispose of Max flood designed of 12 lakh cusecs. Besides this, there are 6 no's of scour sluices on left sides and 8 no's of scour sluices on right side of the barrage to dispose of the sediment deposits

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accumulated in the fore shore of the barrage.

- Prakasam Barrage has been receiving heavy sediment inflows from the catchment due to change in climatic conditions, deforestation and urbanization. The sediment expulsion devises of the barrage could not be operated for the last 10 years due to the operational constraints, resulting in accumulation of the sediment/silt and shoal formation in the reservoir bed. Resulting in-change of flow pattern, concentrated flows, cross currents, scouring near the structure and gradual shifting of Islands towards the Structure. The heavy shoal/deposit formation endangers the safety of Barrage & flood banks and damages the environment and infrastructure.
- Hence, to safeguard the structural and economical life of Barrage and flood banks, as a part of maintenance in accordance with the Indian Standard Recommendations (IS 7349:2012), de-siltation of the mounds and shoals were taken up. This is only removal of the accumulated sediment deposits using dredging operation, and cannot be classified as mining activity as there is no commercial intent. There is zero or negligible disturbance to the environment and ecology owing to the de-siltation of Barrage.

f. <u>De-siltation of Prakasam Barrage:</u>

- The Indian Standard Code for BARRAGES AND WEIRS – OPERATION AND MAINTANANCE GUIDE LINES (IS: 7349: 2012), Under section 6.5 suggests "If a study of the

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survey data indicates that shoal formation has occurred on the upstream and /or downstream of the barrage in spite of judicious operation of gate, during normal and flushing operation of reservoir, the shoal should be removed by dredging by the use of suitable dredgers to the extent possible so that satisfactory flowing conditions are established and also desired capacity is restored".

- Hence, to safeguard the barrage, as a part of maintenance activity and to regain the storage of the reservoir it is decided to remove the shoals and sediment deposits formed on the riverbed.
- In Phase-I it is decided to remove 33 Lakh cum of silt through Mechanised Boats and 10 Lakh cum silt through dredging operation, out of the total preliminary estimated silt quantity 71 Lakh cum. The total de-silted quantities and locations where de-silting activity carried out through Mechanised boats in both districts of Krishna and Guntur.

g. Methods adopted for De-siltation:

- The Dredging/De-silting operations is done in submergence area of irrigation reservoirs/streams/rivers, it does not need mining plan and Environmental Clearance, as it is a restoration process as per clause 6.5 of ISI Code IS: 7349: 2012.
- Two methods were adopted for de-siltation activity i.e., through Dredger and Mechanised boats.

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- The Government has decided vide G.O.Rt.No. 148 WR (WRG:GRC) Dept. dt.24-02-2016 to de-silting work of reservoir of Prakasam Barrage at Vijayawada using dredgers in the water spread area on pilot basis for increasing the storage capacity above Prakasam Barrage.
- The work has been entrusted to M/s NAS Babu Constructions Pvt Ltd, Gudivada to a quantity of 10 Lakh Cum. The de-silting activity was started on 27.06.2016 in Thallayapalem Village limits of Thullur Mandal in Guntur District, but limited quantity of silt about 15,822 cum only could be de-silted in this reach.
- Later, the work was shifted to Lingayapalem Village of Thullur Mandal in Guntur District and Ibrahimpatnam Village/Mandal in Krishna district on 06.11.2016 where huge quantity of silt was observed in middle of reservoir.
- Hence, the de-silting activity through dredging operation was carried out in between Ibrahimpatnam and Lingayapalem village limits and about 9,78,930 cum was dredged and the de-silted material was supplied to Government works taken up in the Amaravathi Capital city.
- The dredging work was completed on 24.09.2018 as the permitted quantity was reached i.e, 9,94,752 cum.
- A total quantity of 33,00,000 cum of sand and silt was de-silted and locations where de-silting activity carried out

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through mechanized boats in both districts are shown below.

a. In Guntur District side

| Sl. No. | Location above Barrage | De-silted Qty in Cum | Ramp Point |
|---|---|---|---|
| 1. | Undavalli from Km 2.000 to Km 3.200 of K.R.F Bank. | 2,00,000 | At 3.200 Km |
| 2. | Penumaka from Km. 3.200 to Km 4.400 of K.R.F Bank | 3,00,000 | At 4.20 Km |
| 3. | Venkatapalem from Km 5.000 to Km 6.400 of K.R.F Bank | 6,00,000 | At 6.400 Km |
| 4. | Uddandarayunipalem from Km 9.000 to Km 10.800 of K.R.F Bank | 2,00,000 | At 10.800 Km |
| 5. | Lingayapalem from Km 12.000 to Km 12.750 of K.R.F Bank | 4,00,000 | B/W 10.800 Km to 12.000 Km |
| 6. | Rayapudi – 1 from Km 12.000 to Km 12.750 of K.R.F Bank | 4,00,000 | B/W 12.000 Km to 12.750 Km |
| 7. | Rayapudi – 2 from Km 12.750 to Km 13.500 of K.R.F Bank | 3,00,000 | B/W 12.750 Km to 13.500 Km |
| | **Total Quantity Cum** | **24,00,000** | |

b. In Krishna District side

| Sl. No. | Location above Barrage | De-silted Qty in Cum | Ramp Point |
|---|---|---|---|
| 1. | Bhavanipuram from Km 1.00 to Km 2.500 of K.L.F Bank | 1,00,000 | At 1.136 Km |
| 2. | Gollapudi from Km 2.000 to Km. 4.500 of K.L.F Bank | 2,00,000 | At. 3.443 Km |
| 3. | Surayyapalem from Km 6.000 to Km 7.000 of K.L.F Bank | 2,00,000 | At 6.015 Km |
| 4. | Guntupalli from Km 7.000 to Km 9.000 of K.L.F Bank | 2,00,000 | At 7.450 Km |
| 5. | Ibrahimpatnam from Km 10.000 to Km 13.500 of K.L.F Bank | 2,00,000 | At 13.500 Km |
| | **Total Quantity Cum** | **9,00,000** | |

- As a whole, a total quantity of 42,94,752 Cum of sand was de-silted in Krishna River above Prakasam Barrage in both Krishna and Guntur Districts.

h. Findings of Bathymetric Survey done as per directions of Hon'ble National Green Tribunal

- Irrigation department has carried out bathymetric survey in upstream of Prakasam Barrage i.e., (From KM 0.00 to KM 13.50). It is a scientific study done by using Single Beam Echo Sounder(SBES), Positioning and Navigation systems from Prakasam Barrage to Ibrahimpatnam (About 13.50 km

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upstream of Barrage) in Krishna River in regular grid intervals of 10m (Both in X & Y Planes). Downstream areas not come under the purview of de-siltation. The area of study is only foreshore water submerged area which will be considered as reservoir. The study was carried out by hiring the services of M/S BSP Hydro Dredging Works, Bhimavaram. M/S BSP Hydro Dredging Works, Bhimavaram has prior experience in conducting Hydrographic Surveys required for National Waterway-4 in Krishna River from Harischandrapuram to Chamarru and conducted Bathymetry surveys in Krishna River. Further, the firm has conducted Bathymetry & Hydrographic Survey for design of floating.

- The capacity of Prakasam Barrage is 3.071 TMC at 12' (+17.39 Mts) Level from crest level i.e., F.R.L (Full Reservoir Level).
- After conducting the Bathymetric survey, the capacity of Prakasam barrage is observed as 2.982 TMC at 12' (+17.39 Mts)
- Critical areas in barrage in barrage w.r.t bed level along with GPS coordinates indicating in reservoir area are as follows:

| S.No | Village name | DepthinMt | GPS Coordinates |
|---|---|---|---|
| 1 | Gollapudi | 3.0 | 1632.2381,8033.3658 |
| 2 | Venkatayapalem | 3.0 | 1631.3973,8032.5441 |
| 3 | Lingayapalem | 3.0 | 1634.8838,8030.5596 |
| 4 | Surayapalem | 4.0 | 1632.4663,8033.1526 |
| 5 | Guntupalli | 4.5 | 1634.1632,8031.5177 |
| 6 | Uddandrayunipalem | 5.0 | 1633.5291,8031.2338 |

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- As per the Bathymetric survey in foreshore area of Prakasam Barrage from KM0.00 to KM13.50, the capacity of Prakasam barrage is arrived as 2.982 TMC and the silt volume above original Bed Level to be removed is 1,24,77,704 Cum.

**TOTAL VOLUME OF WATER FROM KM 0.000 TO KM 13.500 AS PER BATHYMETRIC SURVEY**

| Sl. No. | Mileage | Water Volume | | | | Silt volume to be removed above original bed level ( in Cum) |
|---|---|---|---|---|---|---|
| | | Water Spread Area (in Sqm) | Average Depth in Mts | Volume (in Cum) | Total Volume of Water (in TMC) | |
| 1 | From Km 0.000 to Km 2.000 | 2671237.75 | 5.910 | 15787314.79 | 0.558 | 2021790 |
| 2 | From Km 2.000 to Km 3.000 | 1487279.16 | 5.259 | 7821388.16 | 0.276 | 1627318 |
| 3 | From Km 3.000 to Km 4.000 | 1593436.71 | 4.521 | 7203199.65 | 0.254 | 2346845 |
| 4 | From Km 4.000 to Km 5.000 | 1859762.88 | 4.606 | 8566502.61 | 0.303 | 2148367 |
| 5 | From Km 5.000 to Km 6.000 | 1523688.22 | 5.181 | 7893813.06 | 0.279 | 1079361 |
| 6 | From Km 6.000 to Km 7.000 | 1066669.47 | 5.380 | 5739206.71 | 0.203 | 357011 |
| 7 | From Km 7.000 to Km 8.000 | 1499978.08 | 4.996 | 7493786.48 | 0.265 | 392878 |
| 8 | From Km 8.000 to Km 9.000 | 1439689.88 | 3.419 | 4922549.82 | 0.174 | 1310469 |
| 9 | From Km 9.000 to Km 10.000 | 1176250.15 | 4.401 | 5177135.73 | 0.183 | 508263 |
| 10 | From Km 10.000 to Km 11.000 | 1024197.37 | 4.146 | 4246709.11 | 0.150 | 184515 |
| 11 | From Km 11.000 to Km 12.000 | 1251583.74 | 3.657 | 4576726.21 | 0.162 | 278960 |
| 12 | From Km 12.000 to Km 13.000 | 1138964.68 | 3.343 | 3807335.09 | 0.134 | 215358 |

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| | | | | | | |
|---|---|---|---|---|---|---|
| 13 | From Km 13.000 to Km 13.500 | 396600.48 | 3.002 | 1190437.48 | 0.042 | 6570 |
| **TOTAL** | | **18129338.57** | | | **2.982** | **12477704** |

- Increase in Water storage capacity after conducting de-siltation of 1,24,77,704 cum quantity as per Bathymetry survey will be 0.441 TMC.

g. Depth of accumulation and quantity of sand that can be removed in the Villages of Lingayapalem and Rayapudi

- After conducting the bathymetric survey, it is observed that the silt accumulated as patches in between KM 10.80 to KM12.700 in Lingayapalem Village to a total quantity of 4,29,710 Cum and in between KM 12.700 to 13.500 in Rayapudi Village to a quantity of 71,177 cum can be proposed for De-Siltation.

h. No Affect In Flood Banks Above Anicut (Foreshore Area)

- The Left Flood Bank above the Anicut extends from 0.00Km 13.00Km to a point where it abuts on the Ibrahimpatnam Hills.
- The Right Flood Bank above the Anicut/Starts from Tadepalli Hill and extends up to Undavalli Hills distance of 1.32Km. Later under Flood Control Programme, this Flood Bank is extended up to Vaikuntapuram Hill for a further distance of 22.60Km.
- The flood Banks were stable and no damage was occurred in floods occurred during 2009 and 2019 where the discharge was recorded on 11.10 Lakh Cusecs and 8.05 Lakh Cusecs respectively.

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i. Present status on Bhawani Island and measures taken to protect the island due to de-siltation activities.

- As per the records, no de-silting activity conducted surroundings of Bhavani Island and no damage was caused due to de-siltation.

**7.** It is further humbly submitted that the Barrage area falls up to 13.5 km from the Prakasam barrage. After the Hon'ble National Green Tribunal Order dated 04.04.2019, all the de-siltation works have been stopped in Prakasam barrage. In this regard, it is to submit that, after general elections conducted in May-2019, the new State Government, in the interest of sustainable sand mining, compliance to environmental regulations, ensuring affordable prices of sand and raising valuable public revenues to the state exchequer, has reviewed the existing Free Sand Policy and introduced New Sand Policy-2019 w.e.f. 05.09.2019 in place of Free Sand Policy, by appointing M/s Andhra Pradesh Mineral Development Corporation (APMDC) Ltd., a State Government Corporation, as an agent to operate on behalf of Government to undertake Sand quarrying and supply of Sand to the public, vide G.O.Ms.Nos. 70,71,72,73 of Industries, Infrastructure, Investment & Commerce (Mines-II) Department dt. 04.09.2019. **(Annexures – R2 to R5)**.

The salient features as per New Sand policy, 2019 are:-

- Sand excavation from reaches, transportation to stockyards and loading and transportation from stockyard to end consumers shall be undertaken by APMDC.

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- Sale price:
    - Sale price of sand is fixed at Rs. 375/- per ton at the stockyards established near the sand reaches.
    - Sand depots are also established near to the urban centres and District Headquarters where there are no nearby sand reaches. At Sand depots, sale price of sand shall be fixed by adding transportation and loading charges in addition to Rs. 375/- per ton for bringing the sand to the sand depot.
    - Transportation charges from Stockyards and Sand depots to the consumer destination are additional.
- De-casting of Pattalands:
    - APMDC shall undertake De-casting of sand from patta lands with the consent of pattadars.
- De-siltation of Sand
    - Irrigation Department shall take-up de-siltation of Dams, Reservoirs, Barrages and large tanks directly or by allotting the work to M/s APMDC Ltd.
    - In case of Irrigation Department undertaking the de-siltation work directly, they shall put in place a suitable administrative mechanism, to efficiently supervise the de-siltation process.
    - The sand available after de-silting should be handed over to M/s APMDC Ltd. for transporting to stockyards for supply to Government works and public use

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Government of Andhra pradesh
A.P. Secretariat, Velagapudi,
AMARAVATI - 522 238

- In case of handing over De-siltation areas to M/s APMDC Ltd., M/s APMDC Ltd., shall undertake de-siltation works and dispose the sand.

- Sand extraction in Scheduled areas:
  - Excavation and transportation of Sand to the Specified stockyards from Sand bearing areas located partially/fully in Scheduled Areas shall be done by forming Tribal Societies as per the Panchayats Extension to Scheduled Areas (PESA) Rules, 2011 with Technical and Administrative support from M/s APMDC Ltd. under the direct supervision and control of the Agency ITDA / District Collector & Magistrate concerned. M/s APMDC Ltd. shall dispose the sand from the stockyards.

- GPS tracking system:
  - GPS to be fitted in the vehicles carrying sand from sand reach to the stockyard and from stockyard to the consumer.
  - Vehicles without GPS are not permitted to transport Sand

- No transportation of the sand outside the state is allowed

- Stringent punishment and penalties will be levied if sand is transported illegally.

It is further submitted that, beyond the Prakasam Barrage area , there are 20 Open sand reaches (11 in Guntur district and 9 in Krishna district) which are having valid Environmental Clearances (EC), CFE & CFO from SEIAA and Andhra Pradesh Pollution Control Board (APPCB) as per New Sand Policy - 2019.

M. SEETHARAMA SWAMY, GAYATRI NAGAR, VIJAYAWADA-3 G.O.M.S.NO:666 NOTARY GOVT OF A.P. INDIA

Secretary to Government (Mines)
Industries, Infrastructure, Investment
and Commerce Department
Government of Andhra pradesh
A.P. Secretariat, Velagapudi,
AMARAVATI - 522 238

8. I, respectfully submit that with regard to the detailed study, covering the scope of work to assess the extent of the damage to Avifauna, Aquatic flora and fauna including benthic community, Acharya Nagarjuna University, a university accredited by NAAC – A Grade and recognised by University Grants Commission (UGC), involving the Departments of Botany and Microbiology, Zoology and Aquaculture, Environmental Sciences and Sociology and Social Work of Acharya Nagarjuna University and Central Pollution Control Board (CPCB) has undertaken the detailed study to assess the extent of the damage to the Avifauna, Aquatic Flora & Fauna including benthic community in the Prakasam Barrage up to 13.5 km's on the upstream side. The said report is enclosed as **Annexure – R6**. The conclusion of the study is reported as follows:

*"Basing on the above conclusions drawn from different studies, the members opined that there was no notable negative impact on water quality regarding TSS & Turbidity, Phytoplankton, Riparian vegetation, Zooplankton, Benthos, Fishes and Avian fauna at de-siltation sites in river Krishna during the study period."*

9. It is respectfully submitted that with regard to Para 7(ii) of the Hon'ble NGT Order dt.23.07.2019 on sand mining carried out in the flood plain at Lingayapalem and Rayapudi places as reported by the Joint Committee, it is submitted that, the Chief Engineer, Krishna Delta System, Vijayawada addressed to the Special Chief Secretary to Government, Water Resources Department vide Letter dated 28.08.2019, informed that, the Lingayapalem de-silted area is located at KM 12.800 and Rayapudi de-silted area is located at KM 13.200 of Krishna Right Flood

NOTARY M. SEETARAMA SWAMY GAYATRI NAGAR, VIJAYAWADA-8 G.O.M.S.NO.666 GOVERNMENT OF A.P. INDIA

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Industries, Infrastructure, Investment
and Commerce Department
Government of Andhra pradesh

Bank and falls in Prakasam Barrage Reservoir foreshore area. In the Bathymetric survey report, at para no –VIII.e., submitted by the Water Resources Department, it is stated that the silt accumulated as patches in between KM 10.80 to KM12.700 in Lingayapalem Village to a total quantity of 4,29,710 Cum and in between KM 12.700 to 13.500 in Rayapudi Village to a quantity of 71,177 cum can be proposed for de-siltation. From the report of Water Resources Department, it is clear that these two areas which are falling in foreshore area of Barrage does not require any replenishment activity as the said areas are already accumulated with 4,29,710 cum of sand and silt in Lingayapalem village and 71,177 cum of sand and silt in Rayapudi village and are not falling in flood plain.

10. It is respectfully submitted that as per the findings of the Bathymetric Survey Report submitted by the Water Resources Department and the study report submitted by the Acharya Nagarjuna University with regard to assess the extent of the damage to the Avifauna, Aquatic Flora & Fauna including benthic community in the Prakasam Barrage, no damage was caused to the Prakasam Barrage or to the Benthic Community in the water due to de-siltation activity undertaken earlier. Even in the report submitted by the Joint Committee constituted by Hon'ble NGT, it was reported that, no physical damage was occurred to the Krishna river banks, permanent structures like bridges, scours, vents, rail cum Road Bridge available in the vicinity of Prakasam Barrage.

NOTARY M. SEETHARAMA SWAMY GAYATRI NAGAR, VIJAYAWADA-8 G.O.M.S.NO:666 GOVERNMENT OF A.P. INDIA

Secretary to Government (Mines)
Industries, Infrastructure, Investment
and Commerce Department
Government of Andhra pradesh
A.P. Secretariat, Velagapudi,
AMARAVATI - 522 238.

11. In view of the above facts and circumstances, it is most respectfully prayed that this Hon'ble Tribunal may be pleased to dismiss/dispose off the above O.A. in the interest of justice.

Secretary to Government (Mines)
Industries, Infrastructure, Investment
and Commerce Department
Government of Andhra pradesh
A.P. Secretariat, Velagapudi,
AMARAVATI - 522 238.

## VERIFICATION

I, the above name deponent do hereby state on solemn affirmation that the contents of above Affidavit are true and correct to my knowledge and belief derived from the record of the case, no part of it is false nor anything material has been concealed there from and the Annexures annexed to the Affidavit are true and correct.

Verified at Vijayawada on this 17th day of January 2020.

Solemnly Affirmed
& Signed Before me

DEPONENT

Secretary to Government (Mines)
Industries, Infrastructure, Investment
and Commerce Department
Government of Andhra pradesh
A.P. Secretariat, Velagapudi,
AMARAVATI - 522 238.

NOTARY ★ GOVERNMENT OF A.P. INDIA ★
M. SEETHARAMA SWAMY
GAYATRI NAGAR,
VIJAYAWADA-8
G.O.M.S.NO:666
NOTARIAL

M. Seetha Rama Swamy
B.Com.,B.L.
Advocate/Notary
No.59-12-9, Gayatri Nagar,
VIJAYAWADA-8. (A.P)

17/1/2020.

**REPORT SUBMITTED TOHON'BLE NGT, PRINCIPAL BENCH, DELHI IN THE MATTER OF M.A. No. 152/2019 IN ORIGINAL APPLICATION No.516/2015 AND O.A. No. 935/2018, AS PER HON'BLE NGT ORDERS DATED 19.12.2019.**

## I History of Prakasam Barrage:

Prakasam Barrage was constructed upstream of the breached and damaged century old Anicut across the River Krishna near Vijayawada city in Andhra Pradesh. It is a regulator built on sand foundations, combined with a road bridge for two lane traffic with 1.52m (5ft) wide footpath on either side, connecting Chennai – Kolkata Highway.

Fig.1.Prakasam Barrage

The River Krishna drains a total area of 2,58,948Sq.Km at the barrage site. The structure was designed for a maximum flood level observed over the Anicut during its 100 years life, with an ample free board of 2.74 m over the maximum observed M.F.L. to account for a probable higher flood that may occur in future during the life span of the barrage. It was

located with its gates at a distance of 31.83m upstream of the line of shutters of the old Anicut. The regulator floor was designed as per Khosla's theory for the design of weirs on permeable foundations with three rows of R.C.C. well cut-offs. It was joined into the body wall of the Anicut after removing its upstream jeddystone apron. The entire Anicut structure with its system of aprons on the downstream side is made to function as an integral part of the regulator, after reconstructing the first rough stone sloping apron of the Anicut as a stepped apron in cement concrete. The barrage was constructed during the years 1954 –57 at a total cost of Rs.2.78 Crores.

The Prakasam Barrage was constructed during 1954-57 across River Krishna abutting the old Krishna Anicut for a maximum flood discharge of 12.00 Lakhs cusecs and serves an ayacut of 13.08 Lakh Acres.

**Salient features**:

| **Barrage** | | |
|---|---|---|
| Constructed Year | : | 1957 |
| Length of Barrage | : | 1232.92 Mt (4045.00 Ft) |
| Length of Reservoirforeshore | : | 13.50KM |
| Average width of Reservoir foreshore | : | 2500 Mt |
| Average depth of Reservoir foreshore | : | 6 Mt |
| Latitude | : | $16^0$30'34" |
| Longitude | : | $80^0$37'57" |
| Total Catchment area(Sq.Kms) | : | 251372 |
| Area capacity Curves (Water spread area) | : | 30.00 Sq. Kms |
| Regulator | : | 70 Nos of 12.19 M X 3.66 |



16.01.2017

| | | |
|---|---|---|
| | | M (40' X 12') each |
| **Scouring sluices** | | |
| Left Side | : | 6 Nos of 5.18 M X 3.66 M (17' X 12') each |
| Right Side | : | 8 Nos of 5.18 M X 3.66 M (17' X 12') each |
| **Levels** | | |
| Floor of Regulator | : | + 12.21 M (+40.05 Ft) |
| Floor of Scour Vents | : | + 11.06 M (+36.30 Ft) |
| Sill Level of Regulator gates | : | + 13.73 M (+45.05 Ft) |
| Top of Regulator gates | : | + 17.39 M (+57.05 Ft) |
| Average River Bed Level at Regulator site | : | + 11.28 M (+37.00 Ft) |
| Bottom Level of the Floor of Sitanagaram Under sluices | : | + 8.53 M (+28.00 Ft) |
| Vijayawada Under Sluices | : | + 9.69 M (+31.80 Ft) |
| Bottom of Wells | : | + 4.88 M (+ 16.00 Ft) |
| M.F.L. of Barrage (Designed) | : | + 22.13 M (+72.60 Ft) |
| Bottom of "T" Beams | : | + 23.65 M (+ 77.60 Ft) |
| Top of Road way on Bridge | : | + 25.02 M (+ 82.10 Ft) |
| Top of Regulator Hoist Bridge | : | + 30.36 M (+ 99.06 Ft) |
| Height of Shutters | : | 3.66 M (+ 12-0 Ft) |
| Three rows of cutoff wells of size | : | 2.13 M X 3.81 M (7 X 12.5 Ft) |

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## II Siltation and Shoal Formation in the barrage

Usually, the sediment in the reservoir is to be flushed out by operating the scour sluices located on either side of the barrage in every flood season.

But, due to the operational constraints for keeping a Pond level of +17.39m to facilitate the passage of water into the Vijayawada thermal power station cooling canal, drinking water to Vijayawada and Guntur cites, the scour gates could not be operated for almost 10years. This has resulted in heavy sediment deposit in the reservoir and reduced by approximately 25% of the live capacity i.e.,about 0.767 TMC.

The frequency of operating the gates has become very low because the discharge of flood decreases gradually after 2009 floods but the accumulated silt is gradually increases due to receiving of water from Upstream of the Barrage for regular needs. Further, on completion of Pattiseema lift scheme (lifting of water from River Godavari to River Krishna through Polavaram Right Main Canal) the water contains high silt content and resulted deposition of sediment from the year 2015-16 onwards.

Statement showing the water lifted from River Godavari to River Krishna through Pattiseema:

| S.No | Year | Pattiseema Water reached at Prakasam Barrage in TMC |
|---|---|---|
| 1 | 2015-16 | 8.99 |
| 2 | 2016-17 | 48.47 |
| 3 | 2017-18 | 90.19 |
| 4 | 2018-19 | 81.39 |
| 5 | 2019-20 | 26.69 |
| Total | | 255.73 |

## III Assessment of Silt Deposits by Scientific Studies

III.a. Assessment of Silt Quantities using Sounding Data in 2015:



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In the year 2015 to assess the siltation in reservoir, a study was conducted by the Irrigation Department taking up soundings (which was approximate method).The sedimentation areas of the Krishna River upto 13.50 Kms upstream and to assess the quantum of de-silting quantity are calculated by taking river cross sections at an interval of 1 km upstream from location 0.50 km upstream of the barrage. Also from the total river width at each location, the width of lanka lands, margin lands and below bed level portion are deducted out of the available extraction and considering the essential area to be de-silted is assumed as 71 Lakh Cum of the sediments.

| STATEMENT OF QUANTITIES OF SAND /SILT PROPOSED TO BE DESILTED FROM THE RIVER BED AT U/S OF PRAKASAM BARRAGE. | | | | |
|---|---|---|---|---|
| KM | Length | Area | Mean Area | Quantity in m3 |
| 0.00 i.e 0.50 KM | | 1323.5 | | |
| 1.00 | 1000 | 1145.13 | 1234.31 | 1234313 |
| 2.00 | 1000 | 1955.38 | 1550.25 | 1550250 |
| 3.00 | 1000 | 467.63 | 1211.5 | 1211500 |
| 4.00 | 1000 | 804.13 | 635.88 | 635875 |
| 5.00 | 1000 | 0.00 | 402.06 | 402063 |
| 6.00 | 1000 | 0.00 | 0.00 | 0 |
| 7.00 | 1000 | 0.00 | 0.00 | 0 |
| 8.00 | 1000 | 0.00 | 0.00 | 0 |
| 9.00 | 1000 | 0.00 | 0.00 | 0 |
| 10.00 | 1000 | 0.00 | 0.00 | 0 |
| 11.00 | 1000 | 1947.47 | 973.73 | 973734 |
| 12.00 | 1000 | 0.00 | 973.73 | 973734 |
| 13.00 | 1000 | 116.16 | 58.08 | 58081 |
| 14.00 | 1000 | 0.00 | 58.08 | 58081 |
| Total | | | | 7097631 |
| Total Quantity In lakhs | | | | 70.97 Lakhs |
| Add Extra | | | | 0.03 Lakhs |
| Grand Total | | | | **71 Lakhs** |



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III.b. Assessment of Silt Quantities using Remote Sensing Data in 2016:

In the year 2016, the IrrigationDepartmentwas conducted a study to assess the silt quantities using Remote Sensing Data in foreshore of PrakasamBarrage.The approximate quantity of the silt has been computed by identifying the shoals from satellite imagery from 1988 to 2016 and Remote sensing data and levels from the Topographic & Bathometry survey data and found approximately 272.66 Lakh Cubic meters of deposits have been formed in the Prakasam Barrage reservoir. This quantity represents the formations visible in the satellite images only.

In view of the rapid changes in the catchment and flash floods due to climate change, the rate of sedimentation has increased in the recent days, which is diminishing the economic life of the reservoir gradually.

Approximate Silt Volume occupied by Shoals in the Prakasam Barrage Reservoir:

| S. No | Shoal | Approximate Area in Sq.m | Average Top level | Average Bed Level | Depth in m | Approximate Quantity in Cum |
|---|---|---|---|---|---|---|
| 1 | Area 1 | 93105.643 | +18.79 m | +11.39 m | 7.4 | 688982 |
| 2 | Area 2 | 138595.00 | +16.39 m | +11.39 m | 5 | 692975 |
| 3 | Area 3 | 579300.756 | +19.85 m | +11.39 m | 8.46 | 4900884 |
| 4 | Area 4 | 148189.026 | +17.60 m | +11.39 m | 6.21 | 920254 |
| 5 | Area 5 | 84395.999 | +18.05 m | +11.39 m | 6.658 | 561909 |
| 6 | Area 6 | 2081000.00 | +17.07 m | +11.39 m | 5.683 | 11826323 |
| 7 | Area 7 | 286841.22 | +18.89 m | +11.39 m | 7.501 | 2151596 |
| 8 | Area 8 | 942693.923 | +17.25 m | +11.39 m | 5.859 | 5523244 |
| | Total | 4354122 m2 | | | | 27266166 Cum |

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## IV Need for desiltation

As mentioned in above a paragraph there was heavy deposition of silt in prakasam Barrage. Heavy siltation coupled with increased water demand in the region necessitated desiltation. Besides Irrigation needs, the Prakasam barrage also caters the drinking & industrial water needs all along River Krishna below Nagarjunasagar Project, of four districts namely Krishna, West Godavari, Guntur and Prakasam districts and major source of drinking water for Vijayawada Corporation, Municipalities Gudivada, Jaggaiahpeta, Machilipatnam, Nuzivid, Pedana, Guntur Corporation, Municipalities Magalagiri, Tadepalle, Tenali and part of West Godavari district.

After Government of Andhra Pradesh declared "Amaravathi" as New Capital city in 2015, as of October 2016, majority of departments and officials of the Andhra Pradesh State Government are now functioning from Velagapudi area of Amaravati. Meanwhile High Court for the state of Andhra Pradesh is also established in January 2019 in Amaravathi. The surrounding areas Vijayawada, Mangalagiri, and Tadepalli became more convenient residential zone for employees. Hence, the population is increasing day by day simultaneously Industrial and commercial zone is growing rapidly mainly in Vijayawada Corporation and Mangalagiri municipality which are adjacent to River Krishna. It results requirement of water is increased in both Vijayawada Corporation and Mangalagiri municipality. The only source to meet the additional requirement is Prakasam Barrage.

Due to in-operation of scour gates the age of Barrage will decrease. As per ISI Code IS: 7349: 2012 for BARRAGES AND WEIRS – OPERATION AND MAINTANANCE Guide lines Under



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section 6.5 stated that if a study of the survey data indicates that shoal formation has occurred on the upstream and /or downstream of the barrage in spite of judicious operation of gate, during normal and flushing operation of reservoir, the shoal should be removed by dredging by using suitable dredgers to the extent possible so that satisfactory flowing conditions are established and also desired capacity is re-stored.

De-siltation of Irrigation Structures is done periodically and it is a continuous process. The de-siltation process of sediment in the barrage is difficult and expensive in under water. It requires lot of Government land along the banks of river practically very difficult to place the de-silted sediment.

The designed storage capacity of the barrage is 3.071 TMC at pond level (+) 57.05 Ft.The Barrage has 70 no. of Flood gates of 40' X 12' each to dispose of Max flood designed of 12 lakh cusecs. Besides this, there are 6 no's of scour sluices on left sides and 8 no's of scour sluices on right side of the barrage to dispose of the sediment deposits accumulated in the fore shore of the barrage.

Prakasam Barrage has been receiving heavy sediment inflows from the catchment due to change in climatic conditions, deforestation and urbanization.The sediment expulsion devises of the barrage could not be operated for the last 10 years due to the operational constraints, resulting in accumulation of the sediment/silt and shoal formation in the reservoir bed. Scientific studies proved that the shoals and sediment deposits have occupied considerable portion of the live storage capacity. Study of available satellite images from 1988 to 2016 and change detection analysis proved that the



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heavy shoal formation has occurred in the barrage leading to the erosion of the islands and marginal lands. Resulting in-change of flow pattern, concentrated flows, cross currents, scouring near the structure and gradual shifting of Islands towards the Structure. The heavy shoal/deposit formation endangers the safety of Barrage & flood banks and damages the environment and infrastructure.

Hence, to safeguard the structural and economical life of Barrage and flood banks, as a part of maintenance in accordance with the Indian Standard Recommendations (IS 7349:2012), de-siltation of the mounds and shoals were taken up.This is only removal of the accumulated sediment deposits using dredging operation, and cannot be classified as mining activity as there is no commercial intent. There is zero or negligible disturbance to the environment and ecology owing to the de-siltation of Barrage. To have a correct idea of exact quantity of siltation bathymetric survey has been conducted as directed by the Hon'ble NGT.

**V Sand Policy of Government**

**Mention about prevailing sand mining/ de-silting rules/ acts in A.P and what does the Rule say (A.P WALTA Rules etc)**

As per Andhra Pradesh Government New Sand Mining Policy-2019 GO.MS.No:70, INDUSTRIES, INFRASTRUCTURE, INVESTMENT AND COMMERCE (MINES-II) DEPARTMENTDated:04/09/2019

De-silting of dams/reservoirs/Barrage/Large Tanks:

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(a)The Irrigation Department shall take-up de-siltation of Dams, Reservoirs, Barrages and large tanks directly or by allotting the work to M/s APMDC Ltd.

(1) In case of Irrigation Department undertaking the de-silting work directly, they shell put in place a suitable administrative mechanism, as per the rules, at the field level to efficiently supervise the de-silting process.

The sand available after de-silting should be handed over to M/s APMDC Ltd for transporting to stockyards for supply to Government works and public use as per the procedures laid down by M/s APMDC Ltd.

(2) In case of handing over the De-silting areas to M/s APMDC Ltd shall undertake the de-siltation works by following the norms.

As per Andhra Pradesh Government New Sand Mining Policy-2019 GO.MS.No:71 INDUSTRIES, INFRASTRUCTURE, INVESTMENT AND COMMERCE (MINES-II) DEPARTMENTDated:04/09/2019

Identification of Sand Reaches in IV, V and Higher order streams:

(1)Constitution of District Level Sand Committee (DLSC):

The identification of feasible sand bearing areas in IV, V and above order streams/ rivers for extraction shall be done by the District Level Sand committee. The members of the committee are as follows:

a. District Collector: Chairman
b. Joint Collector : Vice Chairman
c. *Project Officer, ITDA concerned.: Member



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d. Superintendent of police: Member
e. District Panchayat Officer: Member
f. Regional Transport Officer: Member
g. Dy.Director, Ground Water Dept.: Member
h. Executive Engineer, Irrigation/River Conservator : Member
i. Executive Engineer, Rural Water Supply : Member
j. Environmental Engineer, Andhra Pradesh state Pollution Control Board. Member
k. Assistant Director of Mines & Geology concerned: Member
l. Deputy Director of Mines & Geology concerned: Member
m. Representative from M/s Andhra Pradesh Mineral Development Corporation Limited: Member
n. Any other invitees as suggested by the Chairman

*incase of sand reaches falling partly or fully in scheduled Areas.

(2)The Member-Convener shall convene the District Level Sand Committee (DLSC) meetings frequently to ensure sand availability in the District.

(3)The Deputy Director of Mines & Geology concerned shall identify the potential sand bearing areas on regular basis and place proposals for extraction before District Level Sand Committee.

(4) The chairman, District Level Sand Committee shall order for joint inspection of identified sand bearing areas and obtain reports from the following:

a. The Revenue Department shall demarcate the specified sand bearing area, where sand is feasible for extraction, as



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per the geo-coordinates recorded along with two permanent references points and furnish the sketch.

b. The Ground water Dept. shall issue the feasibility report under Water, Land and Tree Rules, 2004 or any subsequent rules/ amendments to be issued by the Govt. from time to time, record the geo- coordinates of the specified sand bearing area as marked on ground by the Revenue Dept., with two permanent reference points along with specific recommendations on the thickness and mode of sand extraction.

c. The Executive Engineer/ River Conservator shall issue clearance for the specified sand bearing areas with Geo-coordinates along with details of the ramps.

d. The Assistant Director of Mines & Geology concerned shall arrive at the quantity of sand feasible to be extracted basing on the Ground water Department's feasibility report.

e. Representation from M/s Andhra Pradesh Mineral Development Corporation Limited shall accompany the team during the joint inspection to plan the subsequent operations.

(5)The Collector & Chairman, District Level Sand Committee shall finalize the specified sand bearing areas based on Joint Inspection report and order the Deputy Director of Mines & Geology to obtain Approved Mining Plan, environmental Clearance, Consent for Establishment and consent for operation from the competent authorities in the name of District Collector.

(6)After obtaining Statutory Clearances, District Collector shall entrust the work to M/s APMDC Ltd. And M/s APMDC Ltd. shall start extraction from the specified sand bearing area.

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The General conditions imposed by River Conservator, River Krishna.

1. The Clearance is valid for one year only i.e from issue of work order to boats men Societies and the Societies should take clearance for in case of lease period was extended.
2. The sand quarry shall not be permitted within 15 mts or $1/5^{th}$ of width of the stream bed from bank whichever is more.
3. The sand quarrying operations should be done by leaving a safe margin of 100 Mts from the toe of flood bank of river.
4. The societies should approach the River Conservator before taking over the site with specific boundaries where the quarrying is proposed to be done by abiding the rules according to R.C act.
5. No Damages shall be caused to the river bank and high margin due to in discrimination quarrying and plying of vehicles.
6. The existing notified ramps should be renovated before plying the vehicles at their own cost of lease by getting permission from the river conservator as the existing ramps may be in dilapidated condition.
7. The societies should abide by the R.C Act- 1884 and other conditions as stipulated by the Irrigation Department.
8. The societies should not excavate the sand by using machinery.
9. The societies should not obstruct the improvement works on Flood Banks of Krishna River.
10. The societies should not excavated the sand with in the 500 Mts distance on either side of structures, bridges R.S. groins, revetments permanent structures and prohibited areas like public utility places including Historical places, temples etc.,

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11. The sand vehicles should not ply along the flood bank except crossing at the authorized ramps where ever permitted.
12. The societies should attend repairs required for ramps on bank, margins and Donka Roads etc.,
13. The societies should leave safe a margin of 200 M around the Lanka Land in Krishna River.
14. The societies should not enter in to the leased lands of societies and individuals in certain Lanka and Margin Lands.
15. The societies should not utilize the Ramps & paths which are not notified by the River Conservator and should not open any new Ramps.
16. The societies should not excavate the sand more than specified considering the thickness specified.
17. The River Conservator and his nominee reserve the right to stop the quarrying of sand for violation of conditions of R.C Act without assigning any notice.
18. The societies should not conduct any other operations except the sand quarrying operations.
19. The societies should not have any right on Lanka lands.
20. The societies should not obstruct of the vehicles of ryots of the neighbouring villages on ramps and open for public utility purpose.
21. The societies should not stock the sand either on marginal land or by the side of the Flood flank.
22. The societies shall be responsible for any damages caused to the Government property and will be recovered from the lessee of the respective sand reaches.
23. The societies should obtain necessary clearance from concern Tahsildar if any patta land comes into ramp where ever required.
24. The non-refundable amount will paid only after expiry of lease period of sand reach and removal of temporary path.



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25. The societies should close the ramps during the flood period duly considering the flood warnings issued from the Irrigation department.
26. The societies should not transport the sand during the flood and the Department is no way responsible for any loss of lives and properties etc.
27. The societies should produce his valid permits seigniorage receipts, Records to the conservator and his nominee on demand for checking.
28. The societies should not cause any pollution of River water while utilizing the boats or any other equipment.
29. The societies should use the fitness certified boats only.
30. The societies should not use the heavy dredger.
31. The depth of sand excavation for quarrying shall be as per the recommendation of A.P Ground Water Department and AP WALTA Rules.

As per the above conditions the Irrigation Department monitor the excavation and depth.

AS per the ANDHRA PRADESH WATER, LAND AND TREES RULES, 2004 of section 23:

Sand mining:-

1. In areas where sand mining is affecting ground water regime, such of the areas shall be notified and transportation of sand shall be prohibited and mining and transportation of sand shall be banned in notified over exploited ground water micro basins / mandals and for other areas the following conditions shall apply for exploitation of sand.

(1) (a) Sand mining shall not be permitted in notified areas except for local use in the Village or towns bordering the streams. Transportation of sand from these notified areas

through mechanical means out of the local jurisdiction shall be banned.

(b) In IVth orders stream, sand mining shall be restricted to specified areas.

(c) In Vth order and above rivers, viz., Godavari, Krishna, Pennar etc., Sand mining may be permitted without affecting the existing sources for Irrigation for drinking water or industrial purpose.

(2) The sand leaseholders shall not carryout quarrying within 500m. Of any existing structure such as bridges, dams, weirs or any other cross drainage structure.

(3) Vehicles carrying sand shall not ply over the flood banks except at crossing points or bridges or on a metal road.

(4) Permission to quarry sand shall not be granted within 500 Meters of any ground water extraction structures (s) either for irrigation or drinking water purposes.

(5) The streams / rivers where the thickness of sand is quite good (more than 8.00 Meters) the depth of removal may be extended to 2.00 Meters but in no case beyond two meters.

(6) Sand quarrying shall not be permitted within 15 meters or 1/5 of the width of the stream bed from the bank whichever is more.

(7) Sand mining shall not be permitted in streams where the thickness of sand deposition is less than 2.00 meters.

(8) The depth of removal of sand shall be restricted to one meter particularly in minor streams where the thickness is more than 3.00 meters and less than 8.00 meters.

(9) The sand quarrying shall be restricted to depths above the water table recorded during monsoon and in no case effect / disturb the water table.

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(10) The quantity of sand deposited annually in every stream or river shall be monitored by establishing observation stations along the stream course.

2. The Ground Water Department shall take up joint inspection along with officials of Mines and Geology Department or other concerned departments whenever cases are referred to study the impact of sand mining in an area and shall give its recommendations.

As per Government New Sand Policy-2016 GO.MS.Nos:19,20INDUSTRIES & COMMERCE ( MII ) DEPARTMENT Dated:15/01/2016. The then Executive Engineer/ River Conservator, Krishna Central Division, Vijayawada vide letter nos camp-1 Dated:18/01/2016 while addressing both the Chairman's of district level sand committee's Guntur & Krishna has informed that, huge quantities of sand / silts is accumulating in either side of the Krishna reservoir area up to a length of 13.50 Kms of Prakasam Barrage. i.e, in Krishna District 9 lakh Cum and Guntur District 24 lakh Cum.

Later free sand policy came into force vide Memo No.3066/MII(1)/2016-3 Dated:04-03-2016. The Government has reviewed the sand policy announced vide Go.MS.Nos: 19& 20 INDUSTRIES & COMMERCE ( MII ) DEPARTMENT Dated:15/01/2016 and decided to change the policy as Sand shall be made available to the public without charging any fee from 2nd March 2016.

**VI De-siltation of PrakasamBarrage:**

The Indian Standard Code for BARRAGES AND WEIRS – OPERATION AND MAINTANANCE GUIDE LINES (IS: 7349:

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2012), Under section 6.5 suggests "If a study of the survey data indicates that shoal formation has occurred on the upstream and /or downstream of the barrage in spite of judicious operation of gate, during normal and flushing operation of reservoir, the shoal should be removed by dredging by the use of suitable dredgers to the extent possible so that satisfactory flowing conditions are established and also desired capacity is re stored".

Hence, to safeguard the barrage, as a part of maintenance activity and to regain the storage of the reservoir it is decided to remove the shoals and sediment deposits formed on the riverbed. In Phase-I it is decided to remove 33 Lakh cum of silt through Mechanised Boats and 10 Lakh cum silt through dredging operation, out of the total preliminary estimated silt quantity 71 Lakh cum. The total de-silted quantities and locations where de-silting activity carried out through Mechanised boats in both districts as shown below.

In Guntur District side

| Sl. No. | Location above Barrage | De-silted Qty in Cum | Ramp Point |
|---|---|---|---|
| 1. | Undavalli from Km 2.000 to Km 3.200 of K.R.F Bank. | 2,00,000 | At 3.200 Km |
| 2. | Penumaka from Km. 3.200 to Km 4.400 of K.R.F Bank | 3,00,000 | At 4.20 Km |
| 3. | Venkatapalem from Km 5.000 to Km 6.400 of K.R.F Bank | 6,00,000 | At 6.400 Km |
| 4. | Uddandarayunipalem from Km 9.000 to Km 10.800 of K.R.F Bank | 2,00,000 | At 10.800 Km |
| 5. | Lingayapalem from Km 12.000 to Km 12.750 of K.R.F Bank | 4,00,000 | B/W 10.800 Km to 12.000 Km |
| 6. | Rayapudi – 1 from Km 12.000 to Km 12.750 of K.R.F Bank | 4,00,000 | B/W 12.000 Km to 12.750 Km |
| 7. | Rayapudi – 2 from Km | 3,00,000 | B/W 12.750 |

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| | | | |
|---|---|---|---|
| | 12.750 to Km 13.500 of K.R.F Bank | | Km to 13.500 Km |
| | **Total Quantity Cum** | **24,00,000** | |

In Krishna District side

| Sl. No. | Location above Barrage | De-silted Qty in Cum | Ramp Point |
|---|---|---|---|
| 1. | Bhavanipuram from Km 1.00 to Km 2.500 of K.L.F Bank | 1,00,000 | At 1.136 Km |
| 2. | Gollapudi from Km 2.000 to Km. 4.500 of K.L.F Bank | 2,00,000 | At. 3.443 Km |
| 3. | Surayyapalem from Km 6.000 to Km 7.000 of K.L.F Bank | 2,00,000 | At 6.015 Km |
| 4. | Guntupalli from Km 7.000 to Km 9.000 of K.L.F Bank | 2,00,000 | At 7.450 Km |
| 5. | Ibrahimpatnam from Km 10.000 to Km 13.500 of K.L.F Bank | 2,00,000 | At 13.500 Km |
| | **Total Quantity Cum** | **9,00,000** | |

## VI.a. Methods adopted for De-siltation:

The Dredging/De-silting operations is not a mining/ quarrying activity and that too, it is done in submergence area of irrigation reservoirs/streams/rivers, it does not need mining plan and Environmental Clearance, as it is a restoration process as per clause 6.5 of ISI Code IS: 7349: 2012.

There are two methods are available for de-siltation activity

1) Dredger:

In dredging operation the total slurry will be pumped into a pond with surrounding bunds of suitable strength for containing dredged material with a facility to drain out the clear water.

The Dredger deployed is ELLICOT-370 model with a capacity of 250 cum of silt + water to be dredged per hour. Assuming 60% of silt& 40% of water to be dredged. The siltdredged per hour is 250 x 60% = 150

cum/per hour. The machinery works for 12 hours per day and 22 days per month leaving the remaining time for maintenance.

Fig.2.ELLICOT-370 Dredger

Fig.3. Discharge Pipe

Specification of Dredger:

- Fuel consumption 16 to 84 Lts per hour
- Idle Fuel consumption 6 Lts per hour
- Family series 370 HP
- Discharge Pipe dimension 10" (245 mm)
- Suction Pipe Dimension 12"(304 mm)
- Maximum Dredging Depth 20' (6.1 m)
- Dredger total Power 440 HP (328 KW)
- Dredge Pump Power 320 HP (239 KW)
- Cutter Power 40 HP (30 KW)
- Nominal Pump capacity range – upto 250 Cum per hour

- Dredger RPM 1800 RPM(full)
- Length of Delivery – 1 KM
- Capacity of dredger to dredge coarse sand at 1800 RPM – 100 to 200 Cum per hour
- Fine Sand or silt at 1800 RPM – 200 to 240 Cum per hour(only sand output)
- Engine model No. Caterpilar 3406
- Fuel tank capacity 3050 Lts (including both sides)
- Hydraulic tank capacity (920 Lts)
- Hydraulic capacity 140 HP
- Swing Distance 22 to 25 m.

2) Mechanised Boats:

De-silting through mechanised Boats, the total slurry would be pumped into boat through sucking pump and the dredged material will remain in cargo portion of boat mean while water will be drained out.

Specification of Mechanised Boat:

- Length over all 19.90Mts
- Breadth 6.50Mts
- Depth 2.70m Mts
- Main Engine 108HP@2000RPM
- Sucking pump 6"X6"
- Water Pump (jet pressure) 3"X2.5"
- Cargo capacity 93MT
- Gross Tonnage 73MT
- Net Tonnage 22MT

**VI.b. De-siltation:**

Further, the Government has decided vide G.O.Rt.No. 148 WR (WRG:GRC) Dept. dt.24-02-2016 to de-silting work of reservoir of Prakasam Barrage at Vijayawada using dredgers in the water spread area on pilot basis for increasing the storage capacity above Prakasam Barrage. Accordingly, the tenders were called for the work " Dredging of silt and sand from the foreshore of Prakasam barrage by deploying suitable inland cutter suction Dredger and depositing the dredging material on either side of banks of Krishna River wherever government land is available". The work has been entrusted to M/s NAS Babu Constructions Pvt Ltd, Gudivada to a quantity of 10Lakh Cum.The de-silting activity was started on 27/6/2016 in Thallayapalem Village limits of ThullurMandal in Guntur District, but limited quantity of silt about 15,822cum only could be de-silted in this reach. Later, the work was shifted to Lingayapalem Village of Thullur Mandal in Guntur District and Ibrahimpatnam Village/Mandal in Krishna district on 06/11/2016 where huge quantity of silt was observed in middle of reservoir. Hence, the de-silting activity through dredging operation was carried out in between Ibrahimpatnam and Lingayapalem village limits and about 9,78,930 cum was dredged and the de-silted material was supplied to Government works taken up in the Amaravathi Capital city. The dredging work was completed on 24/09/2018 as the permitted quantity was reached i.e, 9,94,752 cum.

**VII Bathymetric survey**

In compliance with Hon'ble NGT directions, Irrigation department has carried out bathymetric survey in upstream of

Prakasam Barrage i.e., (From KM 0.00 to KM 13.50). "Bathymetric is the study of underwater depth of river.Bathymetric surveys allow us to measure the depth of a river as well as map the underwater features of a riverand it also called as Hydro-graphic survey". It is a scientific study done by using Single Beam Echo Sounder(SBES),Positioning and Navigation systems from Prakasam Barrage to Ibrahimpatnam(About 13.50 km upstream of Barrage) in Krishna River in regular grid intervals of 10m (Both in X & Y Planes). Downstream areas not come under the purview of de-siltation. The area of study is only foreshore water submerged area which will be considered as reservoir. The study was carried out by hiring the services of M/S BSP Hydro Dredging Works, Bhimavaram. M/S BSP Hydro Dredging Works, Bhimavaram has prior experience in conducting Hydrographic Surveys required for National Waterway-4 in Krishna River from Harischandrapuram to Chamarru and conducted Bathymetry surveys in Krishna River. Further, the firm has conducted Bathymetry &Hydrographic Survey for design of floating barge in Krishna River for CRDA Zone-1, Amaravathi.

**Methodology followed to undertake Bathymetric survey indicating the technical points.**

METHODOLOGY:

Prior to rigging up of survey equipment on to survey boat, a pre-task meeting was held at the AP Irrigation Office between project team to determine and adopt best strategies for executing the survey. Preliminary installation of equipment on board the survey boat commenced after the pre-task meeting.

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Bathymetry and positioning equipment were installed and tested prior to commencement of survey activities. All relevant location data, geodetic parameters, as well as, working drawings of the survey areas were provided by Executive Engineer, K.C Division, Water Resources Department, Vijayawada.

Fig.4.Bathymetry survey Boat.

1. Calibration:

Integrity tests on all analog survey equipment were carried out before commencement of the Survey.

2. Bar Check:

Bar check was carried out on the Single Beam Echo Sounder (SBES) in order to check for index error. The bar check was carried out using a bar plate tied with marine rope and calibrated every 1m.

DATA AQUISITION:

Bathymetry Survey data acquisition was carried out using Single Beam Echo Sounder. Water level in Krishna River observed during the survey.

The Survey lines were run at line spacing of 10m perpendicular to channel centre line to achieve full data coverage

Bathymetric data have been reduced using Sounding Datum referenced to the FRL of Prakasam Barrage on Krishna River, which is +17.39m above MSL.

Field operations were conducted with FRP Speed boat fitted with Outboard Motor

1.Navigation/Positioning:

The Navigation system was properly checked with given geodetic parameters. All equipment interfaces were properly checked for established communication with the sensors. The Differential Global Positioning System (DGPS) Satellites Receiver received not less than 8 satellites and Position Dilution of Precision (PDOP) of less than 3 throughout the duration of the survey. This provided a very high level of positional accuracy throughout the survey. All positioning data was referenced to the World Geodetic Spheroid (WGS–1984) datum and Universal Transverse Mercator (U.T.M.) Zone 44 Projection parameter.

2.Bathymetry:

Syqwest BATHY-500 Multi-Frequency Single Beam EchoSounder was used for the bathymetric survey with associated cabling and all necessary software so that when interfaced to appropriate peripheral sensors, the user can acquire, process, display, present and print high resolution bathymetry data.

Data received from the transducer was synchronized with the online navigation computer where they were dumped with each fix by the graphic recorder. Bathymetric data was recorded with the SBES for acquisition.

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Bathymetry and positioning equipment were installed and tested prior to commencement of survey activities. All relevant location data, geodetic parameters, as well as, working drawings of the survey areas were provided by AP irrigation. All coordinates quoted in this report and shown on the charts are referenced to UTM/WGS84 Projection.

The following equipment and software were deployed for acquisition and processing:

1. Survey Boat with Outboard Motor (OBM)
2. Hemisphere R-110 DGPS Satellite Receiver Unit and accessories
3. Syqwest BATHY-500 DF Single Beam EchoSounder
4. Hypack Navigation System and Accessories

POSITIONING SYSTEM:

All positioning were referenced to the WGS-84 Spheroid, and UTM Zone 44 Projection. The spheroid and grid projection parameters used in computations are tabulated below:

| WGS-84 –Spheroid Parameters | |
|---|---|
| Ellipsoid | WGS-84 |
| Semi Major Axis | 6378137.000 meters |
| Semi Minor Axis | 6356752.314 meters |
| Flattening(1/f) | 298.2572236 |
| Projection Parameters | |
| Projection Type | UTMZone44 |
| Central Meridian | 081°00'00''E |
| ReferenceLatitude | $00^0$00'0.00"N |
| ScaleFactor | 0.9996000 |
| FalseEasting | 500000m |
| FalseNorthing | 0m |

Geodetic Parameters.

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## VIII Findings of Bathymetric Survey

### VIII.a.Details on Siltation with qty removed.

As explained in point number VI, the total de-silted quantity in Krishna River above Prakasam Barrage in both Krishna and Guntur Districts is 42,94,752 Cum.

The capacity of Prakasam Barrage is 3.071 TMC at 12' (+17.39 Mts) Level from crest level i.e., F.R.L (Full Reservoir Level). After conducting the Bathymetric survey, based on the reports the capacity of Prakasam barrage is observed as 2.982 TMC at 12' (+17.39 Mts)

### VIII.b.Critical areas in barrage i.e., low/medium/high in barrage w.r.t bed level along with GPS coordinates indicating in reservoir area.

After conducting the bathymetric survey, analysing the data the following areas are critical.

| S.No | Village name | DepthinMt | GPS Coordinates |
|---|---|---|---|
| 1 | Gollapudi | 3.0 | 1632.2381,8033.3658 |
| 2 | Venkatayapalem | 3.0 | 1631.3973,8032.5441 |
| 3 | Lingayapalem | 3.0 | 1634.8838,8030.5596 |
| 4 | Surayapalem | 4.0 | 1632.4663,8033.1526 |
| 5 | Guntupalli | 4.5 | 1634.1632,8031.5177 |
| 6 | Uddandrayunipalem | 5.0 | 1633.5291,8031.2338 |

### VIII.c.Areas that can be proposed for de-siltation w.r.t original bed levels.

As per the Bathymetric survey in foreshore area of Prakasam Barrage from KM0.00 to KM13.50 the capacity of



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Prakasambarrage is arrived as 2.982 TMC and the silt volume above original Bed Level to be removed is 1,24,77,704 Cum.

**TOTAL VOLUME OF WATER FROM KM 0.000 TO KM 13.500 AS PER BATHYMETRIC SURVEY**

| Sl. No. | Mileage | Water Volume | | | | Silt volume to be removed above original bed level ( in Cum) |
|---|---|---|---|---|---|---|
| | | Water Spread Area (in Sqm) | Average Depth in Mts | Volume (in Cum) | Total Volume of Water (in TMC) | |
| 1 | From Km 0.000 to Km 2.000 | 2671237.75 | 5.910 | 15787314.79 | 0.558 | 2021790 |
| 2 | From Km 2.000 to Km 3.000 | 1487279.16 | 5.259 | 7821388.16 | 0.276 | 1627318 |
| 3 | From Km 3.000 to Km 4.000 | 1593436.71 | 4.521 | 7203199.65 | 0.254 | 2346845 |
| 4 | From Km 4.000 to Km 5.000 | 1859762.88 | 4.606 | 8566502.61 | 0.303 | 2148367 |
| 5 | From Km 5.000 to Km 6.000 | 1523688.22 | 5.181 | 7893813.06 | 0.279 | 1079361 |
| 6 | From Km 6.000 to Km 7.000 | 1066669.47 | 5.380 | 5739206.71 | 0.203 | 357011 |
| 7 | From Km 7.000 to Km 8.000 | 1499978.08 | 4.996 | 7493786.48 | 0.265 | 392878 |
| 8 | From Km 8.000 to Km 9.000 | 1439689.88 | 3.419 | 4922549.82 | 0.174 | 1310469 |
| 9 | From Km 9.000 to Km 10.000 | 1176250.15 | 4.401 | 5177135.73 | 0.183 | 508263 |
| 10 | From Km 10.000 to Km 11.000 | 1024197.37 | 4.146 | 4246709.11 | 0.150 | 184515 |
| 11 | From Km 11.000 to Km 12.000 | 1251583.74 | 3.657 | 4576726.21 | 0.162 | 278960 |
| 12 | From Km 12.000 to Km 13.000 | 1138964.68 | 3.343 | 3807335.09 | 0.134 | 215358 |
| 13 | From Km 13.000 to Km 13.500 | 396600.48 | 3.002 | 1190437.48 | 0.042 | 6570 |
| **TOTAL** | | **18129338.57** | | | **2.982** | **12477704** |

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**VIII. d. Increase in Water storage capacity after conducting de- siltation activity.**

After conducting the bathymetric survey the total existing capacity of the Prakasam Barrage reservoir is arrived at 2.982 TMC.Increase in Water storage capacity after conducting de-siltation of 1,24,77,704 cum quantity as per Bathymetry survey will be 0.441TMC.

**VIII.e.Depth of accumulation and quantity of sand that can be removed in the Villages of Lingayapalem and Rayapudi and indicate the foreshore area boundary map covering these two Villages.**

After conducting the bathymetric survey it is observed the silt accumulated as patches in between KM 10.80 to KM12.700 in Lingayapalem Village to a total quantity of 4,29,710 Cum and in between KM 12.700 to 13.500 in Rayapudi Village to a quantity of 71,177 cum can be proposed for di-siltation.

Fig.5.Lingayapalem

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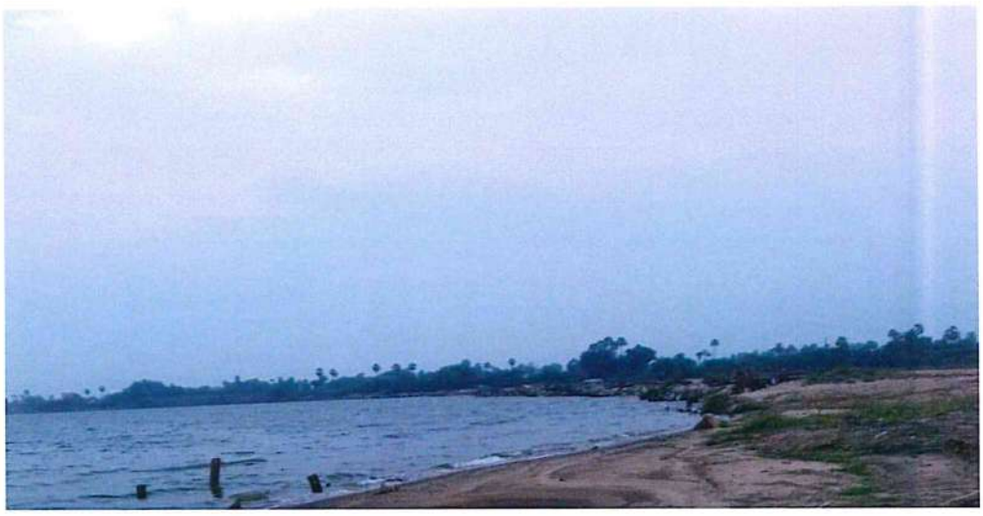

Fig.6.Rayapudi

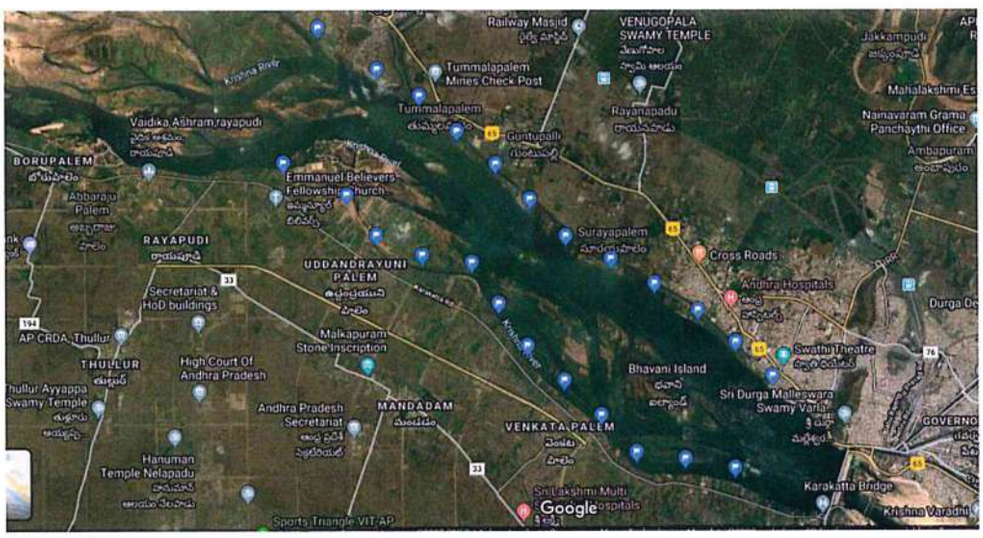


Fig.7.Foreshore area of Prakasam Barrage Boundary Map.

## VIII.f.Details of Flood Bank in the foreshore area:

The original flood banks have been formed between the years 1882 and 1892. One perusal of the maximum flood levels, it can be seen that there were high floods in the years 1882, 1896, 1903, 1916 and 1949. Prior to 1903, the flood banks were not sufficiently high and had no standards. Since, the

flood of 1903 was the highest recorded flood recorded till then, it was decided to raise the tops of flood banks by 2'.

Subsequently high floods occurred again in 1914 and 1916. As a result of these floods, a committee had been appointed in 1917 to enquire in to and report on the causes of the breaches and to indicate the nature of special improvements which may be necessary in order to minimize the danger in future.

Based on their recommendations, the flood banks have been raised to 3' over the highest recorded levels during the years 1903, 1914 and 1916. Subsequently another high flood occurred in 1949. Though the maximum flood level at the Anicut in 1949 is actually less than the level observed in 1903 by 2.4' the observed high flood levels in the River in the tail reaches were higher than those observed in 1903 by about 0.3Mt. The flood levels in higher reaches were more or less same as those observed in 1903. This lead to the conclusion that the River bed is getting silted up with the consequent higher M.F.L.S.

These Flood banks were raised to higher standards with respect to the observed high flood levels of 1949. Flood Banks have been reformed after the Floods of 1949 to standards, keeping the top of flood bank at 0.91Mt above the maximum observed flood levels in 1949 (Free Board). The top width of the flood banks is 5.50 mts of carriage way 3.75 Mts with 1 ½ : 1 slope on the waterside and 2:1 slope on the landside.

The flood banks above been generally formed with a minimum distance of 300' from the actual margin of the River. When this minimum distance gets reduced due to erosion of the margins immediately steps will be taken to protect the

margins by various methods appropriate to the please such as Nanal plantation, Revetment Spuns, groynes etc.

As per the records, in the last 10 years no repair works were taken up for restoring the flood banks damaged due to erosion.

Fig.8.Krishnna Right Flood Bank

FLOOD BANKS ABOVE ANICUT (Foreshore Area)

The Left Flood Bank above the Anicut extends from 0.00Km 13.00Km to a point where it abuts on the Ibrahimpatnam Hills.

The Right Flood Bank above the Anicut/Starts from Tadepalli Hill and extends up to Undavalli Hills distance of 1.32Km. Later under Flood Control Programme, this Flood Bank is extended up to Vaikuntapuram Hill for a further distance of 22.60Km.

The flood Banks were stable and no damage was occurred in floods occurred during 2009 and 2019 where the discharge was recorded on 11.10 Lakh Cusecs and 8.05 Lakh Cusecs respectively.

**VIII.g.Present status on Bhawani Island and measures taken to protect the island due to de-siltation activities.**

As per the records no de-silting activity conducted surroundings of Bhavani Island and no damage was caused due to de-siltation.

Fig.9.Bhavani Island

Due to heavy silt deposits in foreshore of Prakasam Barrage. It is observed that the flow facing portions of the islands are being eroded and the eroded material being deposited on the other side of the island. This phenomenon is causing the islands gradually shifting towards the Barrage structure. Due to which, the flow pattern changes pattern especially during floods and causes erratic and concentrated flows.

Fig.10.Sheet Piling to Bhavani Island

Hence, the Tourism Department has taken up the protection work with Sheet Piling to flow facing portion of Bhavani Island to protect from erosion.

16/1/2018

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River Conservator
River Krishna
Vijayawada

Mahima.T

2. Mahima .T
Scientist 'D'
Central Pollution Control Board
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**GOVERNMENT OF ANDHRA PRADESH**
**ABSTRACT**

Mines & Minerals – New Sand Mining Policy, 2019 for the State of Andhra Pradesh - Orders – Issued.

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INDUSTRIES, INFRASTRUCTURE, INVESTMENT AND COMMERCE (MINES-II) DEPARTMENT

G.O.MS.No. 70 Dated: 04-09-2019

Read the following:

(1) Govt. Memo.No.3066/M.II(1)/2016-3, Dt:04.03.2016.
(2) Govt. Memo.No.3066/M.II(1)/2016-4, Dt:10.03.2016.
(3) Govt. Memo.No.3066/M.II(1)/2016-7, Dt:22.03.2016.
(4) G.O.Ms.No.42, Ind. & Com. (M.II) Dept., Dt:29.03.2016.
(5) G.O.Ms.No.43, Ind. & Com. (M.II) Dept., Dt:06.04.2016.
(6) G.O.Ms.No.104, Ind. & Com. (M.II) Dept., Dt:26.07.2017.
(7) Govt. Memo No.6950/M.II(1)/2017-4, Dt. 07-06-2018
(8) G.O.Ms.No.76, Ind. & Com. (M.II) Dept., Dt:25.06.2018
(9) Govt. Memo.No.3066/M-II(1)/2016-12 & 13, Dt. 11.06.2019
(10) Govt. Memo.No.3066/M-II(1)/2016-14 Dt. 12.06.2019
(11) G.O.Ms.No.38, Ind. & Com. (M.II) Dept., Dt:17.03.2016.

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**ORDER**

In the reference 1st read above, Government have made sand available to the public without charging any fee from 02.03.2016.

2. In the references 2nd to 8th read above, Government issued instructions to deal with the matters relating to quarrying, prohibiting illegal excavation and illegal transportation of sand.

3. In the reference 9th read above, Government have issued instructions to withdraw forth with the existing Free Sand Policy, the permissions that are in force for de-casting patta lands and issued instructions to all the District Collectors, Superintendents of Police/Commissioners to stop sand quarrying, de-casting of sand from patta lands and transportation of sand.

4. In the reference 10th read above, Government put in place a contingent plan until a new sand policy is implemented in the state to prevent hardship to the public, curtail hoarding and black marketing of the sand and to bring down the prevailing abnormal prices of sand.

5. The Government constituted a Group of Ministers comprising of Hon'ble Deputy Chief Minister for Revenue, Hon'ble Minister for Finance, Hon'ble Minister for Home, Hon'ble Minister for PR&RD; Mines & Geology, Hon'ble Minister for Water Resources to finalize the modalities of New Sand Policy in the interest of sustainable sand mining, compliance to environmental regulations, ensuring affordable prices of sand and raising valuable public revenues to the state exchequer. The Group of Ministers studied the existing

policy framework of various states and the Government of India guidelines on sand mining and made certain recommendations for the policy.

6. The Government, after careful examination and consideration of the matter in detail and in supersession of the notification, orders issued by the State Government vide references 1st to 8th read above, hereby introduces the New Sand Mining Policy-2019 for the State of Andhra Pradesh.

**I. Preamble:**

Article 39 (B) of Directive Principles of State Policy states that the natural resources of the community have to be distributed so as to subserve the common good. Natural resources are legally owned by the State on behalf of the people and the State is under an obligation to ensure equitable, sustainable and affordable distribution of natural resources among the community Under Section 15 of the Mines & Minerals (Development and Regulation) Act, 1957, the State Government is empowered to make rules in respect of minor minerals.

The new policy aims to address the issues of indiscriminate mining of sand, black marketing, hoarding, skyrocketing of sand prices for consumers, artificial supply shortages and illegal cross border transportation of sand which were the concomitants of the Free Sand policy. To effectively regulate the extraction, transportation and disposal of River Sand, the Government intends to have M/s. Andhra Pradesh Mineral Development Corporation Limited (APMDC) as an agent.

As Sand is created by slow geological processes and it is not evenly distributed, the State intends to regulate its extraction and consumption in a scientific manner by prescribing operational guidelines to M/s APMDC Ltd. and District Collectors which shall be scrupulously implemented.

In the greater public interest, the Government intends to have various checks and balances to ensure sustainability, affordability and availability of Sand to the public.

**II. The Salient features of the New Sand Mining Policy-2019 are as follows:-**

**(A)** The Government has decided to undertake Sand quarrying and supply of Sand to the public by appointing M/s APMDC Ltd. as an agent to operate on behalf of Government in order to achieve the objectives of sustainable sand mining, compliance to environmental regulations, ensuring affordable prices of sand and raising valuable public revenues to the state exchequer.

**(B)** **<u>Rivers & Streams:</u>**

(a) Sand excavation in river streams of I, II& III order will be regulated by the District Administration for consumption within the District for local domestic needs and Government sponsored weaker section Housing schemes. The excavation of sand shall be manual and no mechanical means be allowed for excavation. Sand sourced from the streams of I, II & III order shall be transported to nearest specified Stockyards for subsequent disposal by M/s APMDC Ltd. to the end consumers. Sand should be made available for Government sponsored weaker section housing schemes free of cost duly paying applicable charges.

(b) Sand may be sourced from the streams of I, II and III order for local needs by bullock carts. In such cases, the Tahsildar of the Mandal concerned shall issue a permit on payment of sale price per ton, as fixed by the Government.

(c) Sand excavation in river streams of IV, V & higher order will be permitted subject to Andhra Pradesh Minor Mineral Concession Rules (APMMC) 1966, Environment Protection Act (EPA), 1996, Environment Impact Assessment (EIA) Notification, 2006 issued by Ministry of Environment Forest & Climate Change (MoEF & CC) and the rules made there under and all other applicable Rules and Regulations in vogue.

(d) The District Collector shall obtain all statutory clearances such as Approved Mining Plan, Environmental Clearance, Consent for Establishment and Consent for Operation from the competent authorities prior to commencement of operations and handover the sand reaches to M/s APMDC Ltd. for operations.

**(C) <u>De-Siltation of Dams/Reservoirs/Barrages/Large Tanks:</u>**

(a) The Irrigation Department shall take-up de-siltation of Dams, Reservoirs, Barrages and large tanks directly or by allotting the work to M/s APMDC Ltd.

(i) In case of Irrigation Department undertaking the de-siltation work directly, they shall put in place a suitable administrative mechanism, as per the rules, at the field level to efficiently supervise the de-siltation process.

The sand available after de-silting should be handed over to M/s APMDC Ltd. for transporting to stockyards for supply to Government works and public use as per the procedures laid down by M/s APMDC Ltd.

(ii) In case of handing over the De-siltation areas to M/s APMDC Ltd., M/s APMDC Ltd., shall undertake the de-siltation works by following the norms.

**(D) De-casting of Sand in Patta lands:**

Sand is casted in patta lands, which may fall within River bed or outside river bed, either due to river floods or marine sea transgression and regression. The sand shall have to be removed in order to make the patta lands fit for agriculture purposes as stated below.

(a) In case of Patta lands falling within River bed:

(i) The District Collector shall obtain all statutory clearances such as Approved Mining Plan, Environmental Clearance, Consent for Establishment and Consent for Operation.

(ii) The excavation rights shall be allotted to M/s. APMDC Ltd., by the District Collector.

(b) In case of Patta lands falling outside the River bed

The District Collector shall allot the excavation rights to M/s APMDC Ltd. after obtaining consent from the pattadars.

(c) In both the cases of (a) & (b) above, the Pattadar may be paid a beneficiary amount as fixed by the Government for the excavated and dispatched sand. The sand shall be disposed by M/s APMDC Ltd. only as per the sale price of the Sand fixed by the Government.

**(E) Sand extraction in Scheduled areas:**

Excavation and transportation of Sand to the Specified stockyards from Sand bearing areas located partially/fully in Scheduled Areas shall be done by forming Tribal Societies as per the Panchayats Extension to Scheduled Areas (PESA) Rules, 2011 or any Rules/Amendments made there under with Technical and Administrative support from M/s APMDC Ltd., under the direct supervision and control of the Agency ITDA / District Collector & Magistrate concerned. M/s APMDC Ltd., shall dispose the sand from the stockyards by following the prescribed norms.

**(F)** All Vehicles carrying sand from Sand reach to Stockyard and subsequently from stockyard to end consumers shall have to be equipped with GPS devices and get registered with M/s APMDC Ltd / Director of Mines & Geology.

**(G)** No transportation of Sand outside the state of Andhra Pradesh is allowed.

**(H)** The sand shall be disposed to the end consumer from the specified stockyards at a sale price as fixed by the Government plus Transportation charges and other applicable taxes and charges.

**(I)** The sale proceeds from the sale of Sand shall be credited directly to the treasury account of the State Government through online Net Banking/Debit card/Credit card/others or through Mee-Seva centers by the end consumers.

**(J)** M/s APMDC Ltd., shall

(i) Put in place an online system for registration of end consumers and transporters, receipt of orders directly from the end consumers, collection of payments and remittance to the treasury account of the State Government online and maintenance of stockyards, disposal of sand from the stockyards and real time tracking of Sand carrying vehicles.
(ii) Allot the work of sand extraction, loading and transportation of sand to stockyard, ramp maintenance, loading of sand into dispatch vehicles at the stockyard through a competitive reverse tendering process.
(iii) Install weighbridges at the stockyards and CCTV cameras at Sand reaches and Stockyards to monitor sand operations and vehicular movement.

**(K)** The operating costs, administrative and service charges incurred by M/s APMDC Ltd., shall be reimbursed by the Government.

7. The Director of Mines and Geology, Andhra Pradesh, Ibrahimpatnam shall submit proposals for amendments to Andhra Pradesh Minor Mineral Concession Rules (APMMC) Rules, 1966.

8. The Government may review the Sand Policy in future as and when required from time to time and issue the Guidelines/Amendments accordingly.

9. The New Sand Mining policy, 2019 shall come into force with effect from 05.09.2019.

(BY ORDER IN THE NAME OF THE GOVERNOR OF ANDHRA PRADESH)

K. RAMGOPAL
SECRETARY TO GOVERNMENT (MINES)

To
The Director of Mines & Geology, A.P, Ibrahimpatnam.
The VC & MD, APMDC Ltd., Kanuru, Vijayawada

Copy to:

All the District Collectors in the State of A.P.
All the District Treasury Officers in the State of A.P.
The Director, Treasuries & Accounts, A.P., Vijayawada.
The Pay and Accounts Officer, Vijayawada.
The Accountant General of Andhra Pradesh, Vijayawada.
The P.S. to Hon'ble Deputy Chief Minister for Revenue
The P.S. to Hon'ble Minister for PR & RD and Mines & Geology
The P.S. to Hon'ble Minister for Water Resources (Irrigation)
The P.S. to Hon'ble Minister for Finance & Planning
The P.S. to Hon'ble Minister for Home
The P.S.to Hon'ble Minister for Housing
The P.S. to Secy. (Mines)
The Finance (FMU-REV-I&C) Department
The Law (H) Department.
Sf/Sc (File No: INC01-MG0POLI/18/2019.M.II) (Com. No. 910066)

//FORWARDED :: BY ORDER//

SECTION OFFICER

GOVERNMENT OF ANDHRA PRADESH
ABSTRACT

Mines & Minerals - Regulation of Sand Mining in the State – Amendment to Andhra Pradesh Minor Mineral Concession Rules, 1966 - Orders – Issued

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INDUSTRIES, INFRASTRUCTURE, INVESTMENT & COMMERCE (MINES-II) DEPARTMENT

G.O.MS.No. 71 Dated: 04-09-2019.
Read the following:

1. G.O.Ms.No.1172, Ind. & Com. Dept, dt:04-09-1967.
2. Govt. Memo.No.3066/M.II(1)/2016-3, Dt:04.03.2016.
3. Govt. Memo.No.3066/M.II(1)/2016-4, Dt:10.03.2016.
4. Govt. Memo.No.3066/M.II(1)/2016-7, Dt:22.03.2016.
5. G.O.Ms.No.42, Ind. & Com. (M.II) Dept., Dt:29.03.2016.
6. G.O.Ms.No.43, Ind. & Com. (M.II) Dept., Dt:06.04.2016.
7. G.O.Ms.No.104, Ind. & Com. (M.II) Dept., Dt:26.07.2017.
8. Government Memo No.6950/M.II(1)/2017-4, Dt. 07-06-2018
9. G.O.Ms.No.76, Ind. & Com. (M.II) Dept., Dt:25.06.2018
10. Govt. Memo.No. 3066/M-II(1)/2016-12 dt. 11.06.2019
11. Govt. Memo.No. 3066/M-II(1)/2016-14 dt. 12.06.2019
12. G.O.Ms.No.38, Ind. & Com. (M.II) Dept., Dt:17.03.2016
13. G.O.Ms.No.70, Ind. & Com. (M.II) Dept., Dt:04.09.2019
14. From the DMG, A.P., e-file No.INC01/MG0-POLI/18/2019–M.II (Computer No.910066)

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O R D E R:-

In the G.O. 13th read above, Government have introduced a New Sand Policy 2019, and decided to issue amendments to the Andhra Pradesh Minor Mineral Concession Rules, 1966.

2. Accordingly, the following notification shall be published in the Extra-Ordinary issue of the Andhra Pradesh Gazette dt.04.09.2019.

NOTIFICATION

In supersession of the orders issued in the references 2nd to 10th read above and other relevant notification / orders issued if any on the subject and in exercise of the powers conferred under sections 15 (1), (1A), 21 (2),22, 23 and 23(c) of MMDR Act, 1957, the Government hereby makes the following amendments to the Andhra Pradesh Minor Mineral Concession Rules, 1966 issued in G.O.Ms.No.1172, Industries (B-1), 4th September, 1967 as subsequently amended.

AMENDMENT

In the said rules, for the rule 9-B and the paras appended therein, the following shall be substituted namely,-

**(1)** Sand sourced from Rivers & Streams

(a) Sand extraction in I, II and III order streams:

(i) Sand extraction shall not be permitted in notified over-exploited areas except for local use in villages or towns bordering the Streams for bonafide purposes

(ii) The Sand extraction shall be as per Rule 23-(1) (a) of Water Land and Tree Rules, 2004 or any subsequent rules/amendments to be issued by Government from time to time.

(iii) Transportation of sand shall be by means of bullock carts/Tractors to the nearest specified stockyard only within the jurisdiction of the concerned Districts.

(iv) The sand shall be supplied for local use within the District from the Specified stockyards as follows:

(a) Sand may be sourced from streams of I, II and III order for local needs by bullock carts. In such cases, the Tahsildar of Mandal concerned shall issue a permit on payment of sale price per ton, as fixed by the Government.

(b) Sand should be made available for Government sponsored weaker section housing schemes free of cost duly paying applicable charges on a certificate issued by the District Collector or any officer authorized by the District Collector;

(c) Sand is supplied for local use of sand in Government works on payment of Sale price and other applicable taxes & charges.

(d) M/s APMDC Ltd shall dispose the Sand as per the procedure laid down in the sub-rule 1(d) of Rule 9-Bbelow.

(v) The District Collector shall put in place proper administrative mechanism for enforcement of WALTA regulations in extraction and transportation of sand in I, II and III order Streams comprising of:

(a) Tahsildar concerned
(b) Representative of Deputy Director, Ground water Department.
(c) Assistant Engineer / Deputy Executive Engineer (concerned), RWS/Irrigation Department
(d) Station House Officer (concerned), Police Department
(e) Assistant Motor Vehicle Inspector / Motor Vehicle Inspector (concerned) from Transport Department

(b) Identification of Sand reaches in IV, V and Higher order streams

(i) Constitution of District Level Sand Committee (DLSC):

The identification of feasible sand bearing areas in IV, V and above

order streams/rivers for extraction shall be done by the District Level Sand Committee. The members of the committee are as follows:

(a) District Collector : Chairman
(b) Joint Collector : Vice-Chairman
(c) *Project Officer, ITDA concerned. : Member
(d) Superintendent of Police: Member
(e) District Panchayat Officer : Member
(f) Regional Transport Officer: Member
(g) Dy. Director, Ground Water Dept. : Member
(h) Executive Engineer, Irrigation/River Conservator. : Member
(i) Executive Engineer, Rural Water Supply : Member
(j) Environmental Engineer, Andhra Pradesh State Pollution Control Board. Member
(k) Assistant Director of Mines & Geology concerned: Member
(l) Deputy Director of Mines & Geology concerned. : Member-Convener
(m) Representative from M/s Andhra Pradesh Mineral Development Corporation Limited : Member
(n) Any other invitees as suggested by the Chairman

*In case of sand reaches falling partly or fully in Scheduled Areas.

(ii) The Member-Convener shall convene the District Level Sand Committee (DLSC) meetings frequently to ensure sand availability in the District.
(iii) The Deputy Director of Mines & Geology concerned shall identify the potential sand bearing areas on regular basis and place proposals for extraction before District Level Sand Committee.
(iv) The Chairman, District Level Sand Committee shall order for joint inspection of identified sand bearing areas and obtain reports from the following:

(a) The Revenue Department shall demarcate the specified sand bearing area, where Sand is feasible for extraction, as per the geo-coordinates recorded along with two permanent references points and furnish the sketch.

(b) The Ground Water Dept. shall issue the feasibility report under Water, Land and Tree Rules, 2004 or any subsequent rules/ amendments to be issued by the Govt. from time to time, record the geo-coordinates of the specified sand bearing area as marked on ground by the Revenue Dept., with two permanent reference points along with specific recommendations on the thickness and mode of sand extraction.
(c) The Executive Engineer/River Conservator shall issue clearance for the specified sand bearing areas with Geo-coordinates along with details of the ramps.
(d) The Assistant Director of Mines & Geology concerned shall arrive at the quantity of sand feasible to be extracted basing on the Ground Water Department's feasibility report.

(e) Representative from M/s Andhra Pradesh Mineral Development Corporation Limited shall accompany the team during the joint inspection to plan the subsequent operations.

(v) The Collector & Chairman, District Level Sand Committee shall finalize the specified sand bearing areas based on Joint Inspection report and order the Deputy Director of Mines & Geology to obtain Approved Mining Plan, Environmental Clearance, Consent for Establishment and Consent for Operation from the competent authorities in the name of District Collector.

(vi) After obtaining Statutory Clearances, District Collector shall entrust the work to M/s APMDC Ltd. and M/s APMDC Ltd.shall start extraction from the specified sand bearing area.

(c) Extraction of sand from specified sand bearing areas:

M/s.Andhra Pradesh Mineral Development Corporation Ltd. shall:

(i) Extract sand by engaging a raising contractor from the specified sand bearing area to an approved stock yard. The raising contractor will be selected through a competitive reverse bidding process.

(ii) Ensure the extraction of sand shall be as per the approved mining plan, Environment Clearance & CFE/CFO.

(iii) Ensure that the extracted sand shall be moved to specified stock yards along with the Trip sheet in Form-S1.

(iv) Establish CCTV cameras for monitoring of sand operations and vehicular movement.

(d) Disposal of sand from specified Stockyards:

M/s. Andhra Pradesh Mineral Development Corporation Ltd. shall:

(i) Collect sale price and other applicable taxes and charges from the purchaser of Sand and credit the same to the Government Treasury account through the online system and issue Sand Sale Booking order in Form– S2 to the customer.

(ii) Load the sand as per the approved capacity of the vehicle through weighment. In case of exigency, volume based loading is permitted for only a limited period.

(iii) Issue Sand Waybill in Form –S3to the vehicle driver prior to dispatch of sand from the stockyard

(iv) Maintain daily production and dispatch register and statutory returns/clearances prescribed under various statutes

(v) Furnish a sand reach area-wise monthly and yearly returns statement in Form –S4and Form –S5on the quantity of sand excavated and transported to specified stockyard(s) as well as sand dispatched from the specified stockyard to the end customers.

(vi) Establish weighbridges and CCTV cameras to monitor sand operations and vehicular movement

(vii) Put in place a system for real time tracking of sand carrying vehicles with GPS devices till the sand is delivered to the end consumer.

(e) Regulation of sand transportation in IV, V and above order streams/ Rivers:

(i) The sand extracted from IV, V and above order Streams/Rivers shall be utilized anywhere within the State.
(ii) The District Collector shall put in place a proper administrative mechanism for enforcement of extraction and transportation of sand by constituting Mandal level teams
(iii) Sand used in the weaker section housing programme shall be exempted from any fee on a certificate issued by the District Collector or any officer authorized by District Collector.
(iv) The period of extraction shall be One (1) year from the date of Consent for Operation (CFO) or exhaustion of permitted quantity whichever is earlier.
(v) The DLSC shall review the status of Sand quarry at least thirty (30) days before the date of expiry of CFO or exhaustion of permitted quantity and order for joint inspection to explore continuation of extraction.
  (a) If the specified sand bearing area is feasible for sand extraction, the Chairman-DLSC shall call for Approved Mining Plan, EC, CFE &CFO and approve for continuation of extraction upon receipt of statutory clearances.
  (b) If the specified sand bearing area is not feasible for sand extraction, the Chairman-DLSC shall order for stoppage of sand extraction for a specified period

(f) Constitution of State Level Committee (SLC):

(i) The State Level Committee shall consists of the following Officers:

| State Level Committee | |
|---|---|
| Chief Secretary | Chairman |
| Director General of Police | Member |
| Secretary, Mines, III & Com. Dept | Member |
| Secretary, Revenue Dept. | Member |
| Secretary, PR & RD Dept.. | Member |
| Secretary, Water Resource Dept. | Member |
| VC&MD, M/s APMDC Ltd | Member |
| Commissioner, Rural Development | Member |
| Commissioner, Transport Dept. | Member |
| Member-Secretary, APPCB | Member |
| Director, Ground Water Dept. | Member |

| | |
|---|---|
| Engineer-in-Chief, Irrigation Dept. | Member |
| Director of Mines & Geology | Member – Secretary |
| And any invitees as suggested by the Chairman | |

(ii) The State Level Committee shall meet periodically to take up review of the performance of Sand extraction in the state, examine the matters referred by District Level Sand Committee for review of any statutory provisions and issue necessary guidelines for proper implementation of the Rules.

(g) Complaint Redressal Mechanism:

A complaint Redressal mechanism is established to redress the grievances/complaints made by any citizen/NGOs in an effective and time bound manner:

(i) Complaint Redressal Committee comprises of the following:

(a) Collector and District Magistrate concerned –Chairman.
(b) Superintendent of Police of concerned District –Member.
(c) Deputy Director of Mines and Geology concerned–Member – Convener.

(ii) Enquiry Team comprises of:

(a) Revenue Divisional Officer concerned.
(b) Deputy Superintendent of Police concerned.
(c) Assistant Director of Mines and Geology concerned.

(iii) The procedure of the Complaint Redressal Committee (CRC) is as follows:

(a) Any person/Non-Governmental Organization/party may file a complaint regarding illegal sand mining, illegal transportation and illegal stocking to the Collector and District Magistrate with material evidence either through online or otherwise. Each such complaint will be uniquely numbered.

(b) On receipt of such complaint, the Collector and District Magistrate, shall forward the complaint to the enquiry team to conduct enquiry by duly causing inspection by calling the complainant and the other party if any, and submit enquiry report within thirty (30) days from the date of receipt of complaint.

(c) On receipt of enquiry report, the Complaint Redressal Committee shall take the decision on the report of the Enquiry team and pass speaking orders within fifteen (15) days.

(d) If aggrieved by the orders passed by the complaint redressal committee, the complainant may prefer an appeal before the State Level Redressal Committee comprising of :

(i) Prl. Secretary/Secretary Mines, Industries & Commerce Department - Chairman
(ii) Additional Director General (Law and order) of Police - Member
(iii) Director of Mines & Geology – Member - Convener

The State Level Redressal Committee after due consideration shall dispose the appeal and pass speaking orders within thirty (30) days from the date of filing of appeal.

**(2)** De-Siltation of Dams/Reservoirs/Barrages/Large Tanks:

The Irrigation Department shall take-up de-siltation of Dams, Reservoirs, Barrages and large tanks directly or by allotting the work to M/s APMDC Ltd.

(a) De-siltation of sand by Irrigation Department

(i) The Executive Engineer, Irrigation Department shall define and demarcate the area to be de-silted with Geo-coordinates for the purpose.

(ii) There shall be joint inspection of the demarcated area by the Assistant Director of Mines & Geology concerned, Executive Engineer, Irrigation Department and nominee of M/s. Andhra Pradesh Mineral Development Corporation Ltd. to ensure that the demarcated area to be de-silted by Irrigation Department shall not overlap with any of the area(s) already under de-siltation or likely to be de-silted by M/s. Andhra Pradesh Mineral Development Corporation Limited.

(iii) The Executive Engineer, Irrigation Department shall quantify the sand likely to be sourced by de-silting process.

(iv) The Irrigation Department shall put in place a suitable administrative mechanism, as per the rules, at the field level to efficiently supervise the de-siltation process, for monitoring of dispatched sand and also to prevent any misuse of sand sourced from de-siltation.

(v) The sand available after desilting should be handed over to M/s APMDC Ltd. for transporting to stockyards in Form S1 for supply to Government works and public use as per the procedures laid down by M/s APMDC Ltd.

(b) De-siltation of Sand in Irrigation Projects by M/s APMDC Ltd.

In case of handing over the areas to M/s APMDC Ltd., M/s APMDC Ltd. shall undertake the de-siltation work by following the norms.

(c) Disposal of sand sourced from Irrigation Projects from Stockyards

M/s APMDC Ltd shall dispose the sand from the specified stockyards as per the procedure laid down in the sub-rule 1(d) of Rule 9-B.

**(3)** De-casting sand from Patta lands:

(a) De-casting in patta lands falling within River bed:

(i) The pattadar shall apply to the District Collector along with copy of pattadar pass book and Title deed book and location of the land on village map.

(ii) District Collector shall forward the application to the Asst. Director of Mines & Geology(ADMG) concerned and the ADMG shall take up joint inspection of the patta land with the following:

(a) Tahsildar shall identify the patta land, possessor/ occupier and furnish attested sketch demarcating the area. The boundaries will then be fixed on ground.

(b) The project officer/nominee of M/s APMDC Ltd. shall also be part of joint inspection team for the patta land where the pattadar is giving willingness/consent for de-casting sand to M/s APMDCLtd.

(c) Mandal Agriculture Officer shall assess the thickness of the sand to be removed to make the land fit for agriculture.

(d) The Ground Water Dept. shall record the geo coordinates of the pattaland as per boundaries fixed by the Tahsildar and give feasibility report.

(e) Executive Engineer, Irrigation Dept., concerned shall issue clearance for de-casting of patta lands and the location of patta land with reference to river course/bed along with the ramp points.

(f) Assistant Director of Mines & Geology shall stipulate the period of de-casting and assess the feasible quantity of sand to be de-casted.

(iii) After receipt of joint inspection report, the Deputy Director of Mines & Geology concerned shall place the proposals for de-casting sand before the District Level Sand Committee.

(iv) The District Level Sand Committee (DLSC) shall examine the proposals on de-casting sand from patta lands and accord its approval duly imposing the conditions as deemed fit.

(v) After receipt of orders from the District Level Sand Committee (DLSC), District Collector shall issue necessary permission to the Deputy Director of Mines & Geology to obtain necessary statutory clearances from the competent authorities in the name of District Collector.

(vi) Upon receipt of the statutory clearances, the District Collector shall entrust the work to M/s APMDC Ltd. for de-casting.

(vii) M/s. Andhra Pradesh Mineral Development Corporation Limited shall enter into an agreement with the pattadar as per mutually agreed terms and conditions to undertake de-casting of sand from patta lands and for payment of beneficiary amount to the pattadars.

(viii) The Pattadar will be paid a beneficiary amount as fixed by the Government.

(ix) M/s APMDC Ltd. shall appoint a raising contractor under competitive reverse bidding process.

(x) The sand so de-casted shall be moved to stockyards managed by M/s. APMDC Ltd. for subsequent disposal to end consumers as per the procedure laid down in sub-rule 1(d) of Rule 9-B above.

(b) De-casting in patta lands falling outside River bed and sand casted due to Marine sea transgression & regression

(i) The pattadar shall apply to the District Collector along with copy of pattadar pass book and Title deed book and location of the land on village map.

(ii) District Collector shall forward the application to the Asst. Director of Mines & Geology(ADMG) concerned

(iii) The ADMG along with the concerned officials, as per the procedure laid down in sub-rule 3 (a)(ii) of Rule 9-B, shall take up joint inspection of the patta lands and submit the joint inspection report to DLSC.

(iv) After receipt of joint inspection report, the Deputy Director of Mines & Geology concerned shall place the proposals for de-casting sand before the District Level Sand Committee.

(v) The District Level Sand Committee (DLSC) shall examine the proposals on de-casting sand from patta lands and accord its approval duly imposing the conditions as deemed fit.

(vi) The District Collector shall entrust the work to M/s APMDC Ltd. for de-casting and disposal of the sand.

(vii) M/s. Andhra Pradesh Mineral Development Corporation Limited shall enter into an agreement with the pattadar as per mutually agreed terms and conditions to undertake de-casting of sand from patta lands and for payment of beneficiary amount to the pattadars.

(viii) The pattadar will be paid a beneficiary amount as fixed by the Government.

(ix) Depending upon the extent of patta land or quantity of sand to be de-casted, the Andhra Pradesh Mineral Development Corporation shall appoint a raising contractor under competitive bidding process.

(x) The sand so de-casted shall be moved to stockyards managed by the Andhra Pradesh Mineral Development Corporation for subsequent disposal to end consumers as per the procedure laid down in sub-rule 1(d) of Rule 9-B above.

(xi) Any contravention of conditions for de-casting by the pattadar, the Chairman, DLSC may order for collection of:

(a) Rs.1,00,000/- or Rs.500/- per TON whichever is higher as penalty on de-casting sand beyond the specified extent or in excess of permitted depth.

(b) Repeated violations will result in cancellation of permission

(xii) To prevent indiscriminate removal of sand from patta lands abutting the Riverbed, more rigorous vigilance and inspections shall be taken up.

**(4)** <u>Fixation/Revision of Sale price of Sand:</u>

(a) The sand shall be disposed to the end consumer from the specified

stockyards at a sale price as fixed by the Government plus transportation charges and other applicable taxes and charges.

(b) Sale price of sand per ton shall be reviewed and revised by the State Government as and when necessary.

**(5)** Incidental charges:

M/s APMDC Ltd. may, with the prior approval of the Government, collect incidental charges additionally towards maintenance of village link roads and service charges for stockyard maintenance.

**(6)** Apportionment of Seigniorage Fee to Zilla Parishad General Funds:

100% Seigniorage Fee shall be remitted to the General Funds under the Head of Account of Zilla Parishad concerned. The same shall be apportioned in the ratio of 25:50:25 among Zilla Parishad, Mandal Parishad and Gram Panchayat respectively.

**(7)** Contribution to DMF:

The Director of Mines & Geology shall issue apportionment orders to the districts.

**(8)** Contribution to MERIT:

The Director of Mines & Geology shall issue apportionment orders to the MERIT.

**(9)** Remittance of sale proceeds of the Sand:

The sale proceeds of the sand shall be remitted to the Government as per the procedure laid down by the Finance Department.

**(10)** Release of operating expenditure to M/s APMDC Ltd.:

The operating costs, administrative charges and Service charges incurred by M/s APMDC Ltd, shall be reimbursed by the Government and will be released by Director of Mines &Geology, Ibrahimpatnam periodically to M/s APMDC Ltd.

**(11)** Sand extraction in Scheduled areas:

(a) Excavation and transportation of Sand to the designated stockyards from Sand bearing areas located partially/fully in Scheduled Areas shall be done by forming Tribal Societies as per the Panchayats Extension to Scheduled Areas (PESA) Rules, 2011 or any rules/amendments made there under with Technical and Administrative support from M/s APMDC Ltd. under the direct supervision and control of the Agency Magistrate/District Collector concerned. M/s APMDC Ltd. shall dispose the sand from the stockyards by following the norms as per sub-rule 1 (d) of Rule 9-B.

(b) Operational guidelines shall be issued by the District Collector from time to time.

**(12)** Registration of Vehicles/carriers/lorries for Sand Transportation:

All the vehicles/carriers/lorries involved in sand transportation shall be registered online with M/s. APMDC Ltd. / Director of Mines & Geology for detection from other vehicles transporting sand through un-authorized sources. All Sand carrying vehicles shall have to be equipped with AIS 140 GPS devices.

**(13)** Prohibition of sand quarrying within Safety zones

Excavation and transportation of sand is prohibited within the safety zones of 500 meters, or as prescribed by the concerned Departments, from the Groundwater structures, road & railway bridges, railway lines and cross drainage structures, National and state highways etc. The concerned Departments shall protect the structures by displaying Boards near the prohibited structures. The officers shall be nominated by the concerned Heads of the Departments to exercise the powers mentioned in the sub-rule 16 of Rule 9-B to prevent unauthorized sand quarrying in prohibited areas.

**(14)** Prohibition of stocking of sand

No person, unless permitted by the Government, is allowed to stock the sand beyond the stated requirement in its application made online and shall not sell nor involve in any re-sale of sand. The applicant at all times would be obliged to utilize the sand only for the purpose stated in the application.

**(15)** Ban on sand transportation across the border:

Transportation of sand beyond the borders of the state is prohibited.

**(16)** Offences and Penalties:

The following penal provisions are applicable against the persons who involved in sale/illegal extraction/un-authorized excavation of sand in prohibited areas, trading and selling of sand, charging beyond cost of transportation and excavation, transporting sand without GPS devices, use or usage of machinery and vehicles in un-authorized excavation and transportation of sand to other States.

(a) In the case of the vehicles engaged in illegal/ un-authorized excavation in the prohibited areas (i.e. within 500 meters from the Ground water structures, Bridges, Dams, Railway lines and cross drainage structures etc.), transportation of sand outside the State and found transporting sand without valid Sand Way bill issued by the Asst. Director of Mines & Geology concerned, shall be penalized as follows:

| Vehicle Type | First time (In Rs.) | Second time (In Rs.) |
|---|---|---|
| Tractor | Upto 10,000/- | Rs. 10,001 to 20,000/- |
| Lorry fitted with upto 10 tires capacity | Upto 25,000/- | Rs. 25,001/ to -50,000/- |
| Lorry fitted with above 10 tires | Upto 50,000/- | Rs. 50,001/- to 1,00,000/- |
| Machinery | Upto 50,000/- | Rs. 50,001/- to 1,00,000/- |

(b) Any vehicle transporting sand, if found, carrying sand in excess of the quantity specified in the Sand Way bill OR in excess of quantity permitted by the Transport Dept., penalty shall be levied on such excess quantity @ Rs.2000/- per MT.

(c) Any vehicle transporting sand, if found, without installing GPS devices, shall be considered as illegal transportation of sand and the penalty shall be levied on the total quantity of sand available in the truck @ Rs.2000/- per ton.

(d) Whenever any person extracts sand or has extracted sand in the areas other than those notified for lawful excavation, the officer authorized under sub-rule 16(f) of Rule 9-B shall assess such quantity of sand and levy and collect@ Rs.2,000/-per ton of sand or Rs.2.00 lakhs, whichever is higher, as penalty.

(e) If any stock of sand beyond a person's reasonable requirement is stocked / hoarded / black marketed / sold, it shall be seized by the officer authorized under sub-rule 16(f) of Rule 9-B. The person shall be penalized as per sub-rule 16(d) of Rule 9-B.

(f) Officers authorized to levy, collect penalties and seizure of vehicles from the persons involved in illegal mining / stocking / hoarding / selling / black marketing in the State authorized under these rules are as follows:

(i) District Collector(Concerned)
(ii) Joint Collector(Concerned)
(iii) Superintendent of Police(Concerned)
(iv) Additional Superintendent of Police/OSD(Concerned)
(v) Sub-Collector/ Revenue Divisional Officer (Concerned).
(vi) Tahsildar (Concerned) Mandal.
(vii) Sub-Divisional Police Officer (Concerned).
(viii) Station House Officer (Concerned).
(ix) District/Divisional Panchayat Officer
(x) Deputy Director of Mines and Geology (Concerned)
(xi) Asst. Director of Mines & Geology (Concerned).
(xii) Any other officer nominated by Dist. Collector (Concerned)

(g) The vehicle/machinery, found involved in any violation more than two times, such vehicle/machinery along with sand shall be seized by officers authorized in sub-rule 16 (f)of Rule 9-B duly following the procedure as under:

(i) Issue show cause notice to the person/owner from whom the vehicle/machinery is seized.
(ii) Immediately take steps by preparing seizure report and produce the vehicle/machinery before the Competent Court to enable the person/owner from whom the vehicle/machinery is seized to file an application under Section 451 of Criminal Procedure Code (Cr.P.C) for release of vehicle/machinery.

(iii) In the alternative, the person/owner from whom vehicle/machinery is to be seized shall be permitted to submit explanation to the show cause notice along with an application to the authorized officer seeking release of vehicle/machinery.

(iv) Upon receipt of explanation to the show cause notice and the application for release of vehicle/machinery, the authorized officer shall consider the application and pass appropriate orders in accordance with law, within a period of two weeks there from, on production of security of Rs.25,000/- in case of tractor;Rs.1,00,000/- in case of vehicle upto 10 tonnes capacity; Rs.1,50,000/- in case of vehicle above 10 tonnes capacity and Rs.2,00,000/- for any machinery, in the form of Demand Draft drawn in favour of the authorized officer along with an affidavit/undertaking to produce the seized vehicle/machinery as and when required.

(v) The fine paid as per the orders of Competent Court; the security furnished as per clause (iv)above shall be deposited in the head of account '0853- 102-81–other receipts' and the original challan shall be sent to the Asst. Director of Mines & Geology concerned.

(h) Disposal of seized sand illegally stored:

(i) The Tahsildar (or) the officers nominated by Tahsildar at Mandal Level; Sub-Collector/Revenue Divisional Officer (or) the officers nominated by the Sub-Collector/Revenue Divisional Officerat Divisional Level; the Joint Collector/the District Collector (or) the Officers nominated by the Joint Collector/the District Collector at District Level shall seize illegal sand stocks.

(ii) Such seized sand shall be disposed by concerned Tahsildar/Sub Collector/RDO or any officer nominated by District Collector with the approval of the District Collector & Chairman of the District Level Sand Committee (DLSC)at the sale price as adopted and sale proceeds shall be remitted to the Government treasury.

(iii) The Sand Way bill for the seized sand shall be issued by the Asst. Director of Mines & Geology concerned in Form-S3.

(i) M/s Andhra Pradesh Mineral Development Corporation Ltd. being the agent, shall be penalized for any extraction of sand beyond the specified area beyond the specified thickness and for any other violations by levying penalty of Rs.1,00,000/- or Rs.500/- per TON of sand quarried beyond the specified limits or in excess of thickness stipulated, whichever is higher.

**(17)** Appeals and Revisions:

(a) In case of I, II & III order (notified over exploited) streams:

(i) Any person aggrieved by an order passed by the Authority at mandal level may prefer the appeal before the Joint Collector within fifteen (15) days from the date of receipt of such order.

(ii) Any person aggrieved by an order of the Joint Collector may prefer revision before the District Collector within fifteen (15) days from the date of receipt of such order.

(b) In case of IV, V (non-notified) and above order streams/rivers:

Against any order passed by the Chairman, DLSC, Deputy Director of Mines & Geology or Asst. Director of Mines & Geology, the aggrieved person may prefer a revision to the Government within thirty (30) days from the date of receipt of such order.

**(18)** Powers to issue Orders/Clarifications/Guidelines:

The Government shall be the sole Authority to issue clarifications, exemptions, guidelines or relaxation orders from time to time, in implementation of these rules.

**(19)** Applicability of General Provisions:

The General provisions of Minor Mineral Concession Rules, 1966 or any subsequent rules/amendments to be issued by Government or the orders, guidelines, clarifications issued by Government in this regard from time to time shall apply to any situation, which is not expressly stated herein."

(Encl: Annexures Form - S1 to Form - S5)

(BY ORDER IN THE NAME OF THE GOVERNOR OF ANDHRA PRADESH)

K. RAMGOPAL
SECRETARY TO GOVERNMENT (MINES)

To
All the District Collectors in the State of A.P.
The Director of Mines & Geology, A.P, Hyderabad.
The Vice Chairman & Managing Director, APMDC Ltd.
Copy to:
All the District Treasury Officers in the State of A.P.
The Director, Treasuries & Accounts, A.P., Vijayawada.
The Pay and Accounts Officer, Vijayawada.
The Accountant General of Andhra Pradesh, Vijayawada.
The P.S. to Hon'ble Deputy Chief Minister for Revenue
The P.S. to Hon'ble Minister for PR & RD and Mines & Geology
The P.S. to Hon'ble Minister for Water Resources (Irrigation)
The P.S. to Hon'ble Minister for Finance & Planning
The P.S. to Hon'ble Minister for Home
The P.S. to Hon'ble Minister for Housing
The P.S. to Secy. (Mines)
The Law (H) Department.
The Finance (FMU-REV-I&C) Department
Sf/Sc (File No: INC01-MG0POLI/18/2019.M.II) (Com. No. 910066)

//FORWARDED :: BY ORDER//

SECTION OFFICER

GOVERNMENT OF ANDHRA PRADESH

FORM – S1

Sand Trip sheet from Sand bearing area/ De-silted area/Patta land to Stockyard

[See Rule 9B(1)(c)(iii) &9B(2)(a)(v) of APMMC Rules, 1966]

Sand Reach code: _____

1. Trip No: __
2. Date and time of issue :
3. Vehicle No. :
4. Quantity under transportation : Cu.Mt.

5. Name of the Raising Contractor:

6. Description of specified sand bearing area/Desilted area/Patta land :

   a) Name of the area
   b) Village
   c) Mandal

7. Location ofspecified Stockyard :

   a. Survey No.
   b. Village
   c. Mandal

8. Date and time of receipt at Stockyard :

Signature of the Receiving authority at Stockyard

Signature of the Issuing Authority at Sand Reach

Note:

1. Overwriting in any form in the Trip sheet makes it invalid.
2. The Trip sheet shall be issued in duplicate
3. The driver shall carry the issued original Trip sheet and handover it to the authorized person of the allottee at the designated stockyard.
4. The tractor driver shall produce the Trip sheet to any authorized authority for checking purpose

GOVERNMENT OF ANDHRA PRADESH

FORM – S2

Sand Sale Booking Order Receipt

[See Rule 9B(1)(d)(i)& 9B (2)(a)(vii) of APMMC Rules, 1966]

| | | |
|---|---|---|
| | | GSTIN: |
| Order No. | Order date: | Valid upto: |
| | | |
| Customer name | | |
| Customer Mobile | | |
| Customer GSTIN | | |
| Delivery Address | | |
| Vehicle No: | | |
| Chasis No: | | |
| | | |
| Ordered Sand Quantity | / CBM | /TON |
| Sand Price: | | |
| CGST (2.50 %) | | |
| SGST (2.50 %) | | |
| Amount Paid (Rs) | | |
| | | |
| Stockyard Name | | |
| Stockyard Address | | |
| Stockyard Contact Details | | |
| Project Officer Contact Details | | |

AP Mineral Development Corporation charges (if any as approved by the Government)

| | | |
|---|---|---|
| | | GSTIN: |
| Service Charge (Rs.5/ CBM) | | |
| Road Damage charges | | |
| CGST (9%) | | |
| SGST (9%) | | |
| Amount paid (Rs.) | | |

GOVERNMENT OF ANDHRA PRADESH

FORM – S3

Sand Way bill from Stockyard to End user

[See Rules 9B(1)(d)(iii), 9B(2)(a)(vii)& 9B(16)(h)(iii) of APMMC Rules, 1966]

Way Bill No._____ District Code_____

1. Name of the Mineral: ORDINARY SAND
2. Customer name:
3. Customer contact number:
4. Delivery address:
5. Sand Booking Order ID & Date:
6. Order quantity: ___ cbm / __Tons
7. Order amount paid:
8. Stockyard address:
9. Stockyard person contact number
10. Loaded quantity: ___ cbm / __Tons
11. Vehicle Registration No:
12. Driver name:
13. Driver Contact No.:
14. Valid Till:
15. QR Code:

Signature of the ADMG Concerned Signature of the Issuing Authority

Note:

1. Overwriting in any form in the way bills makes it invalid.
2. The Way bill shall be issued in duplicate
3. The driver shall carry the issued original Way bill
4. The Vehicle driver shall produce the Way bill to any authorized authority for checking purpose

GOVERNMENT OF ANDHRA PRADESH

FORM – S4

Sand Way bill from De-Silted area to End user

[See Rule 9B(2)(a)(vii)of APMMC Rules, 1966]

Way Bill No._____ District Code_____

1. Name of the Mineral: ORDINARY SAND
2. Customer name:
3. Customer contact number:
4. Delivery address:
5. Sand Booking Order ID & Date:
6. Order quantity: ___ cbm / __Tons
7. Order amount paid:
8. De-silted area details:
   a) Name of the area
   b) Village
   c) Mandal
   d) Extent in Ha.
   e) Area code
9. Details of Custodian of De-silted area
   a) Name
   b) Contact number
   c) Address
10. Loaded quantity: ___ cbm / __Tons
11. Vehicle Registration No:
12. Driver name:
13. Driver Contact No.:
14. Valid Till:
15. QR Code:

Signature of the ADMG Concerned Signature of the Issuing Authority

Note:

1. Overwriting in any form in the way bills makes it invalid.
2. The Way bill shall be issued in duplicate
3. The driver shall carry the issued original Way bill
4. The Vehicle driver shall produce the Way bill to any authorized authority for checking purpose

GOVERNMENT OF ANDHRA PRADESH

FORM – S4

Monthly Statement of extraction and disposal of Sand

[See Rules 9B(1)(d)(v) of APMMC Rules, 1966]

*Form S7-A*

| S.No | Date | Production | Production Cumulative | Dispatch to Stockyard | Dispatch Cumulative | Balance |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |

*Form S7-B*

| S.No | Date | Production | Production Cumulative | Dispatch to Destination | Dispatch Cumulative | Balance |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |

Signature of the Authorized Signatory

GOVERNMENT OF ANDHRA PRADESH

FORM – S5

Yearly Statement of extraction and disposal of Sand
[See Rules9B (1)(d)(v) of APMMC Rules, 1966]

*Form S8-A*

| S.No | Month | Production | Production Cumulative | Dispatch to Stockyard | Dispatch Cumulative | Balance |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |

*Form S8-B*

| S.No | Month | Production | Production Cumulative | Dispatch to Destination | Dispatch Cumulative | Balance |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |

Signature of the Authorized Signatory

GOVERNMENT OF ANDHRA PRADESH
ABSTRACT

MINES & MINERALS - Regulation of Sand Mining in the State – Amendment to Andhra Pradesh Minor Mineral Concession Rules, 1966 – Fixing of Sand Sale Price - Orders – Issued

==========

INDUSTRIES, INFRASTRUCTURE, INVESTMENTS & COMMERCE (MINES-II) DEPARTMENT

G.O.MS.No. 72 Dated: 04-09-2019.
Read the following:

1. G.O.Ms.No.70, I.I.I & C (M.II) Dept., Dt:04.09.2019
2. G.O.Ms.No.71, I.I.I & C (M.II) Dept., Dt:04.09.2019

*****

ORDER

In the G.O. 1st read above, Government have introduced the New Sand Policy 2019.

2. In the G.O. 2nd read above, Government have issued orders amending the Rule 9-B of Andhra Pradesh Minor Mineral Concession Rules, 1966.

3. During the review meeting on New Sand Policy and with regard to fixation of sale price of sand with the Director of Mines & Geology, A.P., and the VC & MD, M/s APMDC Ltd., on 30.08.2019, the Government have discussed the details of expenditure involved in Sand excavation, loading and transportation from the reach to stock yard and loading into the vehicles from stockyard to the consumer destination, charges, taxes etc., and for dispatch of sand from the sand depots established near to the major consuming centres.

4. Government after careful examination of the matter, hereby order to fix the sale price of Sand ex-Stockyard as Rs.375/- per ton of sand (inclusive of applicable taxes and fees) across the State of Andhra Pradesh. The Districts having no source of sand and dependent on transport of sand from Stockyards of other locations, have to include the transportation cost so as to arrive at the ex-stockyard sale price.

5. The Director of Mines & Geology, Andhra Pradesh and the Vice Chairman & Managing Director, M/s. Andhra Pradesh Mineral Development Corporation Ltd., Vijayawada shall take necessary action accordingly.

(BY ORDER IN THE NAME OF THE GOVERNOR OF ANDHRA PRADESH)

K. RAMGOPAL
SECRETARY TO GOVERNMENT (MINES)

To
The Director of Mines & Geology, A.P, Ibrahimpatnam.
The VC & MD, APMDC Ltd., Kanuru, Vijayawada

P.T.O.

Copy to:
All the District Collectors in the State of A.P.
All the Superintendents of Police in the State.
The Revenue/Home/Water Resources/Finance/LAW Departments.
All the JD/DD and ADMG's through the DMG.
All the District Treasury Officers in the State of A.P.
The Director, Treasuries & Accounts, A.P., Vijayawada.
The Pay and Accounts Officer, Vijayawada.
The Accountant General of Andhra Pradesh, Vijayawada.
The P.S. to Secretary to CM/CS
The P.S. to Hon'ble Deputy Chief Minister for Revenue
The P.S. to Hon'ble Minister for PR & RD and Mines & Geology
The P.S. to Hon'ble Minister for Water Resources (Irrigation)
The P.S. to Hon'ble Minister for Finance & Planning
The P.S. to Hon'ble Minister for Home
The P.S.to Hon'ble Minister for Housing
The P.S. to Secy. (Mines)
The Finance (FMU-REV-I&C) Department
The Law (H) Department.
Sf/Sc (File No: INC01-MG0POLI/18/2019.M.II) (Com. No. 910066)

//FORWARDED :: BY ORDER//

SECTION OFFICER

GOVERNMENT OF ANDHRA PRADESH
ABSTRACT

MINES & MINERALS - Regulation of Sand Mining in the State–amendment to Andhra Pradesh Minor Mineral Concession Rules, 1966 – De-casting of sand from Patta Lands - Orders – Issued.

==========

INDUSTRIES, INFRASTRUCTURE, INVESTMENT & COMMERCE (MINES-II) DEPARTMENT

G.O.MS.No. 73 Dated: 04-09-2019.
Read the following:

1. G.O.Ms.No.70, I.I.I & C (M.II) Dept., Dt:04.09.2019.
2. G.O.Ms.No.71, I.I.I & C (M.II) Dept., Dt:04.09.2019.
3. G.O.Ms.No.72, I.I.I & C (M.II) Dept., Dt:04.09.2019.
4. From the Director of Mines & Geology, AP. e-file No. INC04-26024/13/2019-SAND SECTION-DMG under single file system.

*****

ORDER

In the G.O. 1st read above, Government have introduced the New Sand Policy 2019.

2. In the G.O. 2nd read above, Government have issued orders amending the Rule 9-B of Andhra Pradesh Minor Mineral Concession Rules, 1966. In the said orders, M/s APMDC Ltd., has to undertake de-casting of sand from the patta lands and a beneficiary amount as fixed by the Govt., has to be paid to the pattadars.

3. In the G.O.3rd read above, Government have issued orders fixing the sale price of Sand ex-Stockyard as Rs.375/- per ton (inclusive of all taxes / fees) of sand across the State of Andhra Pradesh.

4. In the reference 4th read above, the Director of Mines & Geology, A.P., has reported that due to recent heavy floods received to major rivers of Godavari, Krishna, Tungabhadra Nagavali & Vamsadhara, sand is casted in agriculture lands adjacent to the rivers and there is need to de-cast sand from the patta lands available within/outside the River bed to make the lands fit for agriculture purpose. He has, therefore, requested to issue orders for fixation of beneficiary amount to be paid to the pattadars.

5. Government after careful examination of the above proposal of the Director of Mines & Geology, A.P., hereby order to pay Rs.60/- (Sixty Rupees only) per CBM of sand de-casted from the pattalands.

6. The Director of Mines & Geology, A.P/Vice Chairman & Managing Director, M/s. Andhra Pradesh Mineral Development Corporation Ltd., Vijayawada shall take necessary action accordingly.

(BY ORDER IN THE NAME OF THE GOVERNOR OF ANDHRA PRADESH)

K. RAMGOPAL
SECRETARY TO GOVERNMENT (MINES)

To
The Director of Mines & Geology, A.P, Ibrahimpatnam.
The VC & MD, APMDC Ltd., Kanuru, Vijayawada
Copy to:
All the District Collectors in the State of A.P.

P.T.O.

All the Superintendents of Police in the State.
The Revenue/Home/Water Resources/Finance/LAW Departments.
All the JD/DD and ADMG's through the DMG.
All the District Treasury Officers in the State of A.P.
The Director, Treasuries & Accounts, A.P., Vijayawada.
The Pay and Accounts Officer, Vijayawada.
The Accountant General of Andhra Pradesh, Vijayawada.
The P.S. to Secretary to CM/CS
The P.S. to Hon'ble Deputy Chief Minister for Revenue
The P.S. to Hon'ble Minister for PR & RD and Mines & Geology
The P.S. to Hon'ble Minister for Water Resources (Irrigation)
The P.S. to Hon'ble Minister for Finance & Planning
The P.S. to Hon'ble Minister for Home
The P.S.to Hon'ble Minister for Housing
The P.S. to Secy. (Mines)
The Finance (FMU-REV-I&C) Department
The Law (H) Department.
Sf/Sc (File No: INC01-MG0POLI/18/2019.M.II) (Com. No. 910066)

//FORWARDED :: BY ORDER//

SECTION OFFICER

# ECOLOGICAL IMPACT ASSESSMENT STUDY ON FLORA AND FAUNA OF RIVER KRISHNA (UPSTREAM OF PRAKASAM BARRAGE, UP TO 13.5 KM) AND SOCIO-ECONOMIC EFFECTS DUE TO DESILTATION

## I BACKGROUND

Department of Mines, Govt. of Andhra Pradesh has approached the authorities of Acharya Nagarjuna University in the month of September, 2019 and besought to takeup an assessment study on the effect of desiltation in river Krishna upstream waters upto 13.5 kms from Prakasam barrage on flora and fauna as well as on Socio-economic condition of dependant people. Consequently, the University authorities has directed and assigned the work to four departments namely Dept. of Zoology & Aquaculture, Dept. of Botany & Microbiology, Dept. of Environmental Sciences and Dept. of Sociology & Social Work. In obdience to that, Prof. G. Rosaih and Dr. V. UmaMaheswara Rao of Dept. of Botany & Microbiology, Dr. G. Simhachalam of Dept. of Zoology & Aquaculture, Dr. P. Brahmaji Rao of Dept. of Environmental Sciences and Dr. M. Trimurthi of Dept. of Sociology & Social Work, along with the Research scholars as assistant personnel, have taken up the task of studying different aspects of the proposed work pertained to the areas of the departments.

## II. INTRODUCTION

The river Krishna is one of the major sources of irrigation and drinking water. An embankment across the river Prakasam Barrage (16°30'23.0"N, 80°36'17.2"E) at Vijayawada, near Amaravathi for conserving water. Bhavani Island situated in the midst of the Krishna River at the upstream of Prakasam barrage is a tourist spot and also small

Islandare unique to the river. The river water supporting to the native flora, fauna, and they form different communities.

Krishna river water quality criteria is one of the more prominent of rivers in India. The physico-chemical and biological parameters of Krishna river water represent more potability. Good water quality in the river favorably enrich the habitat for aquatic flora, fauna and benthic organisms. The optimum trophic levels in the riverine system enhance the primary productivity, consumers and decomposers, thereby ecological balance is maintained in the riverine ecosystem.

Phytoplankton are the microscopic organisms that live in fresh or salty water environments. The most common kinds of phytoplankton are Blue green algae, Green algae, Diatoms and Dinoflagellates. Several factors viz., temperature, salinity, depth, $CO_2$ and nutrients of water habitats, sunlight and grazing by predators influence the growth rate of phytoplankton. However, the life span of any individual phytoplankton species is rarely more than a few days. Phytoplankton contribute to about 90% of total primary production in aquatic habitats. Phytoplankton is a key food item for rotifers, molluscs etc., being the foundation of aquatic food web. Phytoplankton play a central role in nutrient cycling in aquatic habitats. They also serve as indicators of water quality as they respond quickly to environmental changes. However, dense blooms of phytoplankton blocks sunlight from reaching the bottom in shallow areas of estuaries and may cause massive decline in the submerged aquatic vegetation.

A riparian zone or area is the interface between land and a river or stream. Plant habitats and communities along the river margins and banks are called Riparian vegetation. Many kinds of plants including grasses, shrubs, herbs, vines, trees and hydrophilic plants grow in the riparian region. The healthy riparian vegetation helps to reduce stream bank erosion, to maintain stable stream, and to maintain high water quality in streams, rivers and lakes by functioning as a buffer, filtering out sediments and debris. Riparian vegetation slows down and dissipates flood waters and thereby prevents erosion that damage fish spawning areas and aquatic insect habitats.

Zooplankton are a type of heterotrophic plankton that range from microscopic organisms to large species, non motile perform weak swimming. Water currents help them for movement. Zooplankton lead partially plankton mode of life (larval forms of aquatic

organisms), remain as plankton for their entire lifecycle (Rotifera, Cladocera, Copepoda). Composition and distribution vary with the locations of the water body. Seasonal Changes in the abiotic factors, rainfall and nutrients could lead to zooplankton succession. Zooplankton is the major primary and secondary links in the food chain. Zooplankton community serves as basic indicators.

Benthos are organisms in the community that live in or on the river bottom. Benthic zone is the region at the bottom of the river including sediment surface and subsurface layers. Depth of water, temperature and type of substrate effect the distribution quality of benthos. Bivalves are dominant at hard substrates sand bottoms. Polychaetes populate at soft muddy bottoms. Algae serve as food for a variety small worms, insects, crustaceans and other benthic invertebrates.

The freshwater fishes are an integral component of aquatic ecosystem. In addition of being a desired resource for users of the aquatic habitat, they play important role in energy flow, cycling of nutrient and maintaining community balance in the river. It is an important element in the dependent community as well as economy of our nation and many people utilize as a diet. Freshwater fishes are direct indicators of the healthy river system.

Avian fauna is generally observed in riverine system and wetlands particularly for the feeding activity on molluscs, fishes and insects. Some avian species are resident to particular habitats for hatching and breeding. Birds are so important for the ecosystem, as their nutrient-valued faecal matter droppings leads to the improvement of ecosystem.

Social effects are evolved from the environmental, social and economic factors; however, it should be emphasized the quantifying socio-economic effects is a difficult task. An assessment and a study on socio-economic effects of desiltation in river Krishna would be helpful in wise decision making in river management. Though some sub-components of desiltation may improve the social conditions i.e. income generation, local revenue, livelihood, employment etc.

## III. ABOUT ACHARYA NAGARJUNA UNIVERSITY

Acharya Nagarjuna University, a state university established in 1976, has been constantly striving towards achieving progress and expansion during its existence for over four decades, in terms of introducing new courses in the University Colleges, affiliated colleges

and professional colleges. Spread over 300 acres of land on the National High Way (NH-5) between Vijayawada and Guntur of Andhra Pradesh, the University is one of the front ranking and fastest expanding Universities in the state of Andhra Pradesh. The University was inaugurated on 11th September, 1976 by the then President of India, Sri Fakruddin Ali Ahmed and celebrated its Silver Jubilee in 2001. The National Assessment and Accreditation Council (NAAC) awarded 'A' grade to Acharya Nagarjuna University in the year 2016.

It is named after Acharya Nagarjuna- one of the most brilliant preceptors and philosophers, whose depth of thought, clarity of perception and spiritual insight were such that even after centuries, he is a source of inspiration to a vast number of people in many countries. The University is fortunate to be situated on the very soil where he was born and lived, a soil made more sacred by the aspiration for light and a state of wholesomeness by generations of students.

With campus student strength of over 5000, the University offers instruction for higher learning in 50 PG programs and guidance for the award of M. Phil and PhD in 48 disciplines spread over six campus colleges and one PG Campus at Ongole. It also offers 153 UG programs in 412 affiliated colleges in the regions of Guntur and Prakasam Districts. It has a Centre for Distance Education offering 87 UG & PG programs. Characterized by its heterogeneous students and faculty hailing from different parts of the state and the country, the University provides most hospitable environment for pursuing Higher Learning and Research. Its aim is to remain connected academically at the forefront of all higher educational institutions.

The University provides an excellent infrastructure and on-Campus facilities such as University Library with over one lakh books & 350 journals; Smart Classrooms, Computer Centre; University Scientific Instrumentation Centre; Central Research Laboratory with Ultramodern Equipment; Well-equipped Departmental Laboratories; Career Guidance and Placement Cell; Health Centre; Sports facilities with Indoor & Outdoor Stadia and Multipurpose Gym; Sports Hostel; well facilitated separate hostels for Boys, Girls, Research Scholars and International Students; Pariksha Bhavan (Examinations Building); Computers to all faculty members; WiFi connectivity to all Departments; Canteen, Student Centre & Fast-food Centre; Faculty Club; Dr. H.H. Deichman & Dr. S.John David Auditorium cum Seminar Hall; Post Office; Telecom

Centre; State Bank of India; Andhra Bank; Energy Park; Silver Jubilee Park; Fish ponds; Water harvesting structures. The salient features of the university and technical capabilities of the professors is enclosed as Annexure-I.

## IV. OBJECTIVES OF THE STUDY

### IV.a. Study aspects

The present investigation (October to December 2019) was taken up by four departments; Botany and Microbiology, Zoology and Aquaculture, Environmental Sciences and Sociology and Social Work, ANU, to study the ecological impact of desiltationin River Krishna upstream from Prakasam barrage, Vijayawada, with the following objectives assigned by Dept. of Mines, Govt. of A.P.

1. Studies on suspended solids, turbidity in river Krishna
2. Studies on plankton (Phyto and Zoo plankton) in river Krishna
3. Diversity and community composition of fishes in river Krishna
4. Studies on Benthic fauna of river Krishna
5. Studies on riparian vegetation in river Krishna
6. Studies on Avian fauna in river Krishna
7. Ecological impact study due to desiltation activity
8. Socio-Economic condition of dependents / fisher men of river Krishna

   Accordingly,the study was distributed among four departments of the University concerned to their fields.

### IV.b. Study areas

The following sites of river Krishna upstream of Prakasm barrage both on Guntur and Krishna districts side of desiltation locations are taken into consideration for the present study:

1. **Undavalli** (reference site) is located (16° 30' 26.7" N, 80° 34' 23.0" E) in Tadepalli Municipality, Guntur District and south side of Prakasam Barrage from 2.0 km to 3.2 km of KRF Bank. Undavalli is the non-desiltation area which is taken as reference site for the study.There was no baseline data available, hence a site with similar geological characteristics where no dredging activity has taken place is chosen as reference site to compare the impacts.

2. **Penumaka** is located (16° 30' 41.5" N, 80° 33' 54.9" E)in Tadepalli Municipality, Guntur District nearby Undavalli from 3.2 km to 4.4 km of KRF Bank.
3. **Venkatapalem** is located (16° 31' 24.2" N, 80° 33' 38.7" E)in Mandadam Mandal, Guntur District, the desilting area is from 5.0 km to 6.4 km of KRF Bank.
4. **Uddandrayunipalem** is located (16°33'49.0" N, 80°31' 27.4"E) in Mandadam Mandal, Guntur District, the desilting area is from 9.0 km to 10.8 km of KRF Bank.
5. **Lingayapalem**is located (16° 33' 44.7" N, 80° 30' 15.2" E)in Thulluru Mandal, Guntur District, the desilting area is from 10.8 km to 12.0 km of KRF Bank.
6. **Rayapudi** is located (16° 34' 09.3" N, 80° 28' 27.9" E)in Thulluru Mandal, Guntur District, the desilting area is from 12.0 km to 13.5 km of KRF Bank.
7. **Surayapalem** is the (16° 32' 36.4" N, 80° 33' 14.4" E) Panchayat nearby Gollapudi, Krishna District the desilting area is from 6.0 km to 7.0 km of KLF Bank.
8. **Guntupalli**is the (16° 33' 00.3" N, 80° 32' 40.1" E)Panchayat nearby, Krishna District, the de-silting area is from 7.0 km to 9.0 km of KLF Bank.
9. **Ibrahimpatnam**is the (16° 34' 28.9" N, 80° 29' 44.9" E)Mandal in Krishna District, the distance from Prakasam Barrage is 10.0 km to 13.5 km of KLF Bank.

* The desiltation activity was stopped from 01.04.2019 onwards at the sites namely Penumaka, Venkatapalem, Uddandarayunipalem, Lingayapalem and Rayapudi of Guntur district side as per the Govt. Order dated 31.03.2019. On the Krishna district side, the desiltation was stopped at Surayapalem, Guntupally and Ibrahimpatnam from 05.04.2019 as per the Govt. Order dated 05.04.2019.

## V. METHODOLOGY

In the present study suitable methodology appropriate to the proposed studies was followed.

### V.a. Water quality analysis

The water samples were collected in plastic container of 2 liters capacity from nine different geographic locations along the river during sampling period. Water samples were collected from nine different study sites. From each site six samples from different depths at different times were collected. The total suspended solids (TSS) and turbidity were estimated using Gravimetric method and nephelometric (in termes Nephelo Turbidity

Units), respectively. The water quality in the riverine system was studied w.r.t TSS and turbidity since desilting is likely to increase the TSS and associated turbidity. Grab samples were collected from each location at varying depths of1.5 and 2.0 mts. for6rounds with a gap of 15days between samplings during the 3-month study period from October to December, 2019. Totally, 12samples were collected from each location.

**V.b. Plankton and Benthic fauna collection**

Plankton (Phyto and zoo plankton) sampling was done by towing the plankton net on the surface (phyto plankton), different depths (zooplankton) of waters until sufficient quantity was collected in the net. The collected samples were transferred to aseptic plastic sampling bottles and added 1% formaldehyde for preservation of Phyto plankton, 5% formaldehyde for preservation of zooplankton. The collected samples were brought to the laboratory for analysis. For screening of phytoplankton and zooplankton concentrated samples of water was placed on clean glass slide and the genera and species were identified through Lica Stereo Zoom Trinacular Microscopic observation and based on the reference slides to the genus level and a consolidated list was prepared.

The qualitative study on zooplankton was carried out by observing the prepared slides under Lica Stereo Zoom Trinacular Microscope. Zooplankton were identified to the genus and species level using previous literature.

For collection of benthic fauna, small core sub samples were taken from superficial sand layer and transferred into the plastic tubs and stirred thoroughly, sieved with different mesh size. Large forms associated with bottom surface collected by hand picking. For benthic fauna associated with vegetation scums and filamentous algae, small amounts of these materials washed into enamel tray containing salt solution and stirred thoroughly. The benthic organisms floated on to the surface were collected and preserved in 10% formaldehyde. Micro benthic fauna were observed under Stereo Zoom Trinocular Microscope and identified to the genus and species level.

**V.c. Riparian vegetation collection**

For the riparian vegetation study, the plants of riparian vegetation at the study sites were observed, collected, photographed and identified based on the standard books and the representative plant species are given as a consolidated list.

**V.d. Fish collection**

Fish fauna were collected with the help of artisanal fishermen using different types of gears (Cast nets, Gill nets, dragnets, scoop nets) and craft. Fishes were also collected from catches of local fisher folks at the sites, and from fish market of Polkampadu fishermen cooperative society at Sitanagaram, near Kondaveetivagu head regulatory, where fishes sold only catches of fish folks of river Krishna. As formalin decolorizes the colour of the fish on long preservation, photographs were taken at the collection spot itself and preserved specimens. Fishes were identified to the genus and species level.

**V.e. Avian fauna survey**

For avian fauna, extensive survey was conducted at 9 different sites of Krishna River basin from October to December, 2019. The observations of bird species were made from early morning to late evening. Point count method was used for observation and identification of bird species. The birds were sighted using an Olympus Binocular (10 x 40, field 7.8), and photographed, wherever it was possible. Birds were identified by using the field guides.

## VI. RESULTS OF QUALITATIVE ANALYSIS

### VI.a. Water quality

Table 1. Upstream of river Krishna (13.5 km) water quality in the selected stations

| S .No | Sampling Location | TSS (mg/l) | | Turbidity (NTU) | |
|---|---|---|---|---|---|
| | | Min | Max | Min | Max |
| 1 | Undavalli | 125 | 145 | 4.5 | 5.5 |
| 2 | Penumaka | 165 | 195 | 5.5 | 6.1 |
| 3 | Venkatapalem | 110 | 135 | 4.1 | 4.9 |
| 4 | Uddandrayunipalem | 135 | 165 | 4.8 | 5.2 |
| 5 | Lingayapalem | 120 | 145 | 4.4 | 5.4 |
| 6 | Rayapudi | 160 | 190 | 5.3 | 5.9 |
| 7 | Surayapalem | 130 | 155 | 4.8 | 5.1 |
| 8 | Guntupalli | 110 | 140 | 5.5 | 6.1 |
| 9 | Ibrahimpatnam | 95 | 125 | 4.5 | 5.6 |

The estimated TSS and turbidity values of water samples collected from Undavalli area, non-desilatation sampling site, found in the ranges of 125-145 mg/l and 4.5- 5.5 NTU, respectively. The minimum and maximum values of the estimated TSS in the water

samples collected from the desiltation sites were found to be in the range of 95 – 165 mg/L (minimum) and 125 – 195 mg/L (maximum). On the other hand, the range of turbidity values of the water samples of desiltation sites were observed to be in the minimum and maximum ranges of 4.1 – 5.5 NTU and 4.9 – 6.5 NTU, respectively.

As per BIS drinking water standards, the permissible TSS and turbidity are300 to 600 mg/L and 1.0 to 5.0 NTU, respectively.The TSS and turbidity in reference site and desilting locations are almost in the same range, which implies that the desiltation has not impacted thewater quality w.r.t TSS and turbidity, since desiltation is stopped since more than 6 months.

Figure showing collection of the water sample at Penumakasite

Figure showing collection of the water sample atLingayapalem site

**VI.b. Plankton, Benthos and Riparian vegetation**

*VI.b.i. Undavalli (Reference Site)*

Table 2. Consolidated list of flora and fauna of six samplings observed at Undavalli site (Non desilting and reference area) during the study period (Oct – Dec, 2019)

| S. No. | Particulars | Observed Species |
|---|---|---|
| 1 | Phytoplankton | Green algae: *Actinastrum* sps.,*Ankistrodesmus* sps., *Coelastrum* sps., *Pandorina* sps., *Pediastrum* sps., *Spirogyra* sps., *Ulothrix* sps.<br>Blue green algae: *Anabaena* sps., *Aphanizomenon* sps., *Arthrospira* sps., *Microcystis* sps., *Nostoc* sps., *Oscillatoria* sps., *Phormidium* sps., *Spirulina* sps.,<br>Diatoms: *Pinnularia sps.* |
| 2 | Zooplankton | Rotifera: *Brachionus angularis* (Brachionidae), *Brachionus bidentatus, Brachionus calyciflorus, Brachionus caudatus, Brachionus dichotomus, Brachionus diversicornis, Brachionus falcatus, Brachionus forficula, Brachionus quadridentatus, Brachionus rubens, Keratella trophica, Asplanchna sp.* (Asplanchnidae), *Cephalodella sp.* (Notommatidae), *Filinia longiseta* (Trochosphaeridae), *Hexthra sp.* (Hexarthridae), *Habrotrocha rosa* (Habrotrochidae), *Habrotrocha zanette, Macrothrix sp.*(Macrothricidae),*Lecane sp.* (Lecanidae)<br>Cladocerans: *Scapholeberis sp., Ceriodaphnia cornuta, Diaphanosoma excisum* (Sididae), *Moina micrura* (Moinidae), *Moina macrocopa, Macrothrix spinosa* (Macrothricidae), *Pleuroxus aduncus* (Chydoridae), *Pseudochydorus sp., Alona sp., Biapertura sp., Indialona sp., Chydorus sp., Bosmina sp.* (Bosminidae), *Bosminopsis deitersi*<br>Copepods: *Allodiaptomus raoi* (Diaptomidae), *Heliodiaptomus viduus, Phyllodiaptomus blanci, Sinodiaptomus (Rhinediaptomus) indicus, Halicyclops spinifer* (Cyclopidae), *Microcyclops varicans, Mesocyclops leuckarti, Mesocyclops sp., Thermocyclops sp., Cyclopoid nauplii, Eucyclops serrulatus, Paracyclops sp., Calanoid nauplii* (Cyclopidae),*Parastenocaris sp.* (Parastenocarididae)<br>Protozoa: *Vorticella sp.* (Vorticellidae) |
| 3 | Benthos | Crustaceans |

| | | |
|---|---|---|
| | | Ostracoda: *Cypris condona* (Cyprididae), *Cypris obensa, Cypris subglobosa, Cypris sp., Strandesia indica, Hemicypris falcatus, Cypretta sp., Herpetocypris sp., Parastenocypris major, Stenocypris sp., Parastenocypris biswasi, Parastenocypris sp., Physocypria minutus* (Cyclocyprididae), *Candona sp.* (Candonidae)<br><br>Clamp shrimp: *Cyclestheria hislopi* (Cyclestheriidae)<br><br>Aquatic insects<br><br>Bugs: *Lethocerus* sp. (Belostomatidae), *Lacotrephes* sp. (Nepidae), *Gerris* sp. (Gerridae), *Micronecta* sp. (Corixidae), *Enithares sp.* (Notonectidae)<br><br>Beetles: *Dineutus sp.* (Gyrinidae), *Noteridae sp.* (Noteridae), *Sandracottus sp.* (Dytiscidae), *Hydaticus sp., Laccophilus sp.*<br><br>Insect larvae: *Glossosoma sp.* (Glossosomatidae), *Stenopsyche sp.* (Stenopsychidae), *Hydropsyche sp.* (Hydropsychidae), *Chironomous* (Chironomidae), *Chaoborus* (Chaoboridae), *Thalerosphyrus* (Heptageniidae), *Manayunkia speciosa* (Fabriciidae)<br><br>Crab: *Paratelphusa jacquemontii* (Gelechiidae)<br><br>Prawns: *Macrobrachium malcolmsonii* (Palaemonidae), *Macrobrachium rosenbergii, Macrobrachium lamarrei*<br><br>Leech: *Hirudinea sp.* (Hirudinidae)<br><br>Molluscs: *Pila virens* (Ampullariidae), *Pila globosa, Pila sp., Bellamya bengalensis* (Viviparidae), *Bellamya dissimilis, Gabbia sp.* (Bithyniidae), *Digoniostoma sp., Thiara lineate* (Thiaridae), *Thiara scabra, Thiara tuberculata, Melania scabra, Melanoides tuberculatus, Lymnaea acuminate* (Lymnaeidae), *Lymnaea luteola, Indoplanorbis sp.* (Planorbidae), *Gyraulus convexiusculus, Cryprozona sp.* (Ariophantidae), *Lamellidens marginalis* (Unionidae), *Lamellidens sp., Parreysia sp., Parreysia sp., Corbicula straitella* (Cyrenidae), *Corbicula sp., Macrochlamys sp.* |
| 4 | Riparian vegetation plants | *Acacia nilotica, Alternanthera sessilis, Calotropis procera, Cyperus sps., Eichhornia crassipes, Ipomoea aquatica, Phyllanthus amarus, Pithecellobium dulce, Polygonum glabrum, Saccharum spontaneum, Sida longifolia, Ziziphus jujuba.* |

At Undavallireference site, a total of 16 different genera of phytoplankton belonging to three main groups viz., Green algae (7 genera), Blue-green algae (8 genera) and Diatoms (1 genus) were observed during the study period. Of the green algae group,

species of *Actinastrum*, *Pediastrum*, *Spirogyra* and *Ulothrix* were found more abundantly in the samples. Species of *Microcystis*, *Oscillatoria*, *Phormidium* and *Spirulina* were abundant among the blue-green algae group and only one genus of diatoms namely *Pinnularia* was observed at Undavalli site.

At Undavalli, the reference site without any desiltation activity in the present study, twelve plant species have been identified belonging to different plant categories. Mainly, *Acacia nilotica* and *Pithecellobium dulce* of tree category; *Calotropis procera*, *Polygonum glabrum* and *Ziziphus jujuba* of shrubs category; *Sida longifolia* and *Phyllanthus amarus* of herbs category, *Eichhornia crassipes* and *Ipomoea aquatica* of hydrophytes category, and *Saccharum spontaneum* of grass category were found predominant at the site area as riparian vegetation on the side of river bank.

Zooplankton of River Krishna at Undavalli reference site comprised three main groups (Table 2) viz; Rotifers, Cladocerans and Copepods. Rotifera were represented by 19 species of 9 genera and Cladocera by 14 species of 13 genera. The species abundance of genus *Brachionus* was higher than rotifers recorded from reference site. The species diversity was more in Cladocera. All the other genera of rotifer and cladocera recorded with single species, except the genus *Moina* represented by two species. Copepoda were represented by Calanoid and Cyclopoid copepods in a good number (11 species) belongs to 12 genera.

Benthos, mainly represented by *Lamellidens, a* bivalve molluscan, *Pila, Thiara, Gyraulus* of molluscs. The *Lamellidens* was observed at higher densities in sub-littoral limnitic region where water velocity is less. The other benthic organism, viz., Ostracods (14 species), clamp shrimp, five species of aquatic bugs and beetles, insect larvae (seven species) Annelida of one species and freshwater crab, *Pseudodiaptomus binghami* were recorded during the study period at reference site. The presence or absence of fauna mainly depend on quality and type of bottom. Since the bottom of the river Krishna upstream water covered / made with sand may reflects the absence of some bethic fauna. The diversity of zooplankton, benthos community of river Krishna at Undavalli /reference site was higher and it can be attributed to the physico-chemical conditions and available nutrients supporting for development, survival and distribution.

Figure showing riparian vegetation at Undavalli site

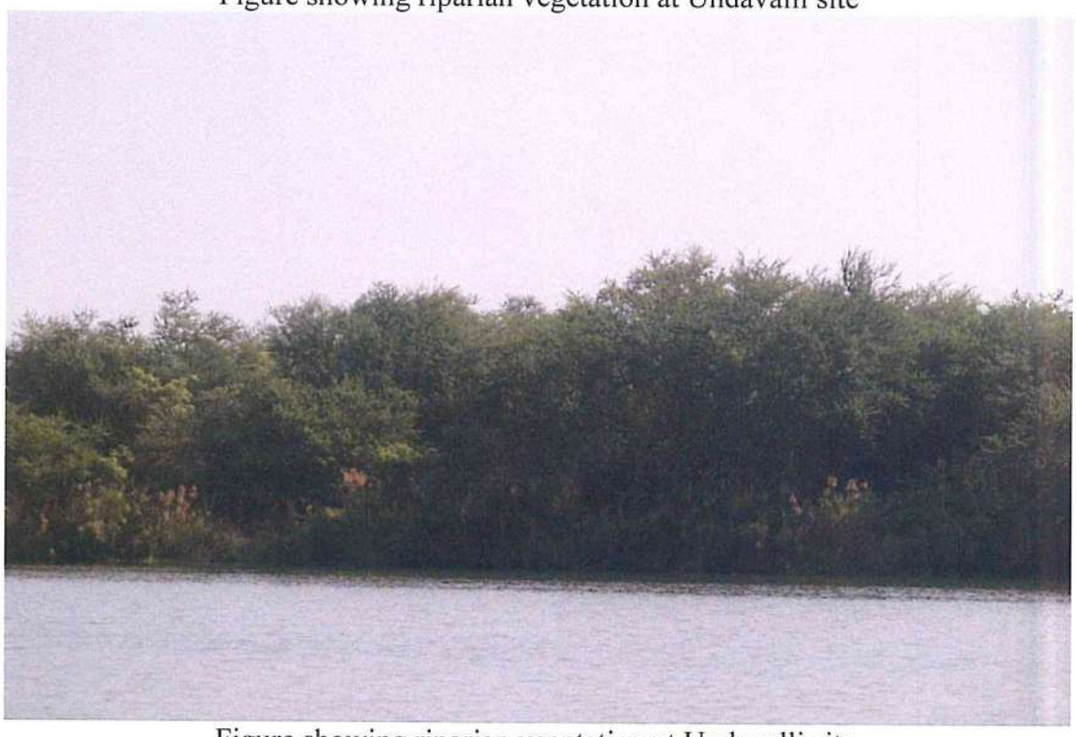

Figure showing riparian vegetation at Undavalli site

Figure showing collection of zooplankton samples at Undavalli site

*VI.b.2. Penumaka (Desiltation Area)*

Table 3. Consolidated list of flora and fauna of six samplings observed at Penumaka site (Desiltation area) during the study period (Oct – Dec, 2019).

| S. No. | Particulars | Observed Species |
|---|---|---|
| 1 | Phytoplankton | Green algae: *Coelastrum* sps., *Eudorina* sps., *Monoraphidium* sps., *Pandorina* sps., *Pediastrum* sps., *Spirogyra* sps., *Ulothrix* sps.<br>Blue green algae: *Microcystis* sps., *Nostoc* sps., *Oscillatoria* sps., *Phormidium* sps., *Spirulina* sps.,<br>Diatoms: *Asterionellopsis* sps., *Pinnularia* sps. |
| 2 | Zooplankton | Rotifera: *Brachionus angularis* (Brachionidae), *Brachionus bidentatus, Brachionus calyciflorus, Brachionus caudatus, Brachionus dichotomus, Brachionus diversicornis, Brachionus falcatus, Brachionus forficula, Brachionus rubens, Keratella trophica, Asplanchna sp.* (Asplanchnidae), *Cephalodella sp.* (Notommatidae), *Hexthra sp.* (Hexarthridae), *Habrotrocha rosa* (Habrotrochidae), *Macrothrix sp.* **(Macrothricidae).**<br>Cladocerans: *Scapholeberis sp., Ceriodaphnia cornuta, Diaphanosoma excisum* (Sididae), *Moina micrura* (Moinidae), *Moina macrocopa, Macrothrix spinosa* (Macrothricidae), *Pleuroxus aduncus* (Chydoridae), *Pseudochydorus sp., Alona sp., Biapertura sp., Indialona sp.,* |

| | | |
|---|---|---|
| | | *Chydorus sp., Bosmina sp.* (Bosminidae), *Bosminopsis deitersi*<br><br>Copepods: *Allodiaptomus raoi* (Diaptomidae), *Heliodiaptomus viduus, Phyllodiaptomus blanci, Sinodiaptomus (Rhinediaptomus) indicus, Halicyclops spinifer, Mesocyclops leuckarti, Mesocyclops sp., Thermocyclops sp., Cyclopoid nauplii, Eucyclops serrulatus, Paracyclops sp., Calanoid nauplii, Parastenocaris sp.* (Parastenocarididae)<br><br>Protozoa: *Vorticella sp.* (Vorticellidae) |
| 3 | Benthos | Crustaceans<br><br>Ostracoda: *Cypris condona* (Cypprididae), *Cypris obensa, Cypris subglobosa, Cypris sp., Strandesia indica, Hemicypris falcatus, Cypretta sp., Candonocypris dentatus, Herpetocypris sp., Parastenocypris major, Stenocypris sp., Parastenocypris biswasi, Parastenocypris sp., Physocypria minutus* (Cyclocyprididae), *Candona sp.* (Candonidae)<br><br>Clamp shrimp: *Cyclestheria hislopi* (Cyclestheriidae)<br><br>Aquatic Insects<br><br>Bugs: *Lethocerus* sp. (Belostomatidae), *Lacotrephes* sp. (Nepidae), *Ranatra sp., Gerris* sp. (Gerridae), *Micronecta* sp. (Corixidae), *Enithares sp.* (Notonectidae)<br><br>Beetles: *Dineutus sp.* (Gyrinidae), *Noteridae sp.* (Noteridae), *Sandracottus sp.* (Dytiscidae), *Hydaticus sp., Laccophilus sp.*<br><br>Insect larvae: *Glossosoma sp.* (Glossosomatidae), *Stenopsyche sp.* (Stenopsychidae), *Hydropsyche sp.* (Hydropsychidae) *Chironomous* (Chironomidae), *Chaoborus* (Chaoboridae), *Thalerosphyrus* (Heptageniidae), *Manayunkia speciosa* (Fabriciidae)<br><br>Crab: *Paratelphusa jacquemontii* (Gelechiidae)<br><br>Leech*: Hirudinea sp.* (Hirudinidae)<br><br>Prawns*: Macrobrachium malcolmsonii* (Palaemonidae), *Macrobrachium rosenbergii, Macrobrachium lamarrei*<br><br>Molluscs: *Pila virens* (Ampullariidae), *Pila globosa, Pila sp., Bellamya bengalensis* (Viviparidae), *Bellamya dissimilis, Gabbia sp.* (Bithyniidae), *Digoniostoma sp., Thiara lineate* (Thiaridae), *Thiara scabra, Thiara tuberculata, Melania scabra, Melanoides tuberculatus, Lymnaea acuminate* (Lymnaeidae), *Lymnaea luteola, Amnicola sp.* (Hydrobiidae), *Indoplanorbis sp.* (Planorbidae), *Gyraulus convexiusculus, Gyraulus sp.,Lamellidens marginalis* (Unionidae), *Lamellidens sp., Parreysia favidens, Parreysia sp., Corbicula straitella* (Cyrenidae), *Corbicula peninsularis, Corbicula sp.,* |

| | | |
|---|---|---|
| | | *Macrochlamys sp.* |
| 4 | Riparian vegetation plants | *Alternanthera sessilis, Borreria hispida, Chloris montana, Cleome viscosa, Corchorus aestevans, Crotalaria procera, Cyanodon dactylan, Cyperus sps., Dactyloctenium aegyptium, Echinochloa colona, Eclipta alba, Eichhornia crassipes, Fimbristylis miliacea, Ipomoea aquatica, Phyllanthus amarus, Pithecellobium dulce, Polygonum sps.,Prosopis juliflora,Saccharum spontaneum, Sida acuta, Sida cordifolia.* |

Figure showing riparian vegetation at Penumaka site

Figure showing riparian vegetation at Penumaka site

Figure showing plankton sample collection at Penumaka site

Figure showing collection of zooplankton samples at Penumaka site

Figure showing benthic fauna sample collection at Penumaka site

*VI.b.3. Venkatapalem*

Table 4. Consolidated list of flora and fauna observed at Venkatapalem site (Desiltation area) during six samplings during the study period (Oct – Dec, 2019).

| S. No. | Particulars | Observed Species |
|---|---|---|
| 1 | Phytoplankton | Green algae: *Actinastrum* sps., *Monoraphidium* sps., *Pediastrum* sps., *Spirogyra* sps.,<br>Blue green algae: *Anabaena sps., Aphanizomenon* sps., *Microcystis* sps., *Nostoc* sps., *Phormidium* sps., *Spirulina* sps.,<br>Diatoms: *Pinnularia* sps. |
| 2 | Zooplankton | Rotifera: *Brachionus angularis* (Brachionidae), *Brachionus bidentatus, Brachionus calyciflorus, Brachionus caudatus, Brachionus dichotomus, Brachionus diversicornis, Brachionus falcatus, Brachionus forficula, Brachionus quadridentatus, Brachionus rubens, Keratella trophica, Asplanchna sp.* (Asplanchnidae), *Cephalodella sp.* (Notommatidae), *Filinia sp.*, (Trochosphaeridae), *Hexthra sp.* (Hexarthridae), *Habrotrocha rosa* (Habrotrochidae), *Habrotrocha zanette, Macrothrix sp.*(Macrothricidae),*Lecane sp.* (Lecanidae), |

| | | |
|---|---|---|
| | | Cladocerans: *Daphnia carinata* (Daphniidae), *Scapholeberis sp., Ceriodaphnia cornuta, Diaphanosoma excisum* (Sididae), *Diaphanosoma Senegal, Moina micrura* (Moinidae), *Moina macrocopa, Macrothrix spinosa* (Macrothricidae), *Pleuroxus aduncus* (Chydoridae), *Pseudochydorus sp., Alona sp., Biapertura sp., Chydorus sp., Bosmina sp.* (Bosminidae), *Bosminopsis deitersi*<br><br>Copepods: *Allodiaptomus raoi* (Diaptomidae), *Heliodiaptomus viduus, Phyllodiaptomus blanci, Sinodiaptomus (Rhinediaptomus) indicus,Halicyclops spinifer* (Cyclopidae), *Microcyclops varicans, Mesocyclops leuckarti, Mesocyclops sp., Thermocyclops sp., Cyclopoid nauplii, Eucyclops serrulatus, Paracyclops sp., Calanoid nauplii* (Calanidae), *Parastenocaris sp.* (Parastenocarididae)<br><br>Protozoa: *Vorticella sp.* (Vorticellidae) |
| 3 | Benthos | Crustaceans<br><br>Ostracoda: *Cypris condona* (Cypridídae), *Cypris obensa, Cypris subglobosa, Cypris sp., Strandesia indica, Hemicypris falcatus, Cypretta sp., Candonocypris dentatus, Herpetocypris sp., Parastenocypris major, Stenocypris sp., Parastenocypris biswasi, Parastenocypris sp., Physocypria minutus* (Cyclocyprididae), *Candona sp.* (Candonidae)<br><br>Clamp shrimp: *Cyclestheria hislopi* (Cyclestheriidae)<br><br>Aquatic insects<br><br>Bugs: *Lethocerus* sp. (Belostomatidae), *Lacotrephes* sp. (Nepidae), *Ranatra sp., Gerris* sp. (Gerridae), *Micronecta* sp. (Corixidae), *Enithares sp.* (Notonectidae)<br><br>Beetles: *Dineutus sp.* (Gyrinidae), *Noteridae sp.* (Noteridae), *Sandracottus sp.* (Dytiscidae), *Hydaticus sp., Laccophilus sp.*<br><br>Insect larvae Aquatic larvae: *Glossosoma sp.* (Glossosomatidae), *Stenopsyche sp.* (Stenopsychidae), *Hydropsyche sp.* (Hydropsychidae), *Chironomous* (Chironomidae), *Chaoborus* (Chaoboridae), *Manayunkia speciosa* (Fabriciidae)<br><br>Prawns: *Macrobrachium malcolmsonii* (Palaemonidae), *Macrobrachium rosenbergii, Macrobrachium lamarrei*<br><br>Leech: *Hirudinea sp.* (Hirudinidae)<br><br>Molluscs: *Pila virens* (Ampullariidae), *Pila globosa, Pila sp., Bellamya bengalensis* (Viviparidae), *Bellamya dissimilis, Gabbia sp.* (Bithyniidae), *Digoniostoma sp., Thiara lineate* (Thiaridae), *Thiara scabra, Thiara tuberculata, Melania scabra, Melanoides tuberculatus, Lymnaea acuminate* (Lymnaeidae), *Lymnaea luteola, Amnicola sp.* (Hydrobiidae), |

| | | |
|---|---|---|
| | | *Indoplanorbis sp.* (Planorbidae), *Gyraulus convexiusculus, Gyraulus sp., Cryprozona sp.* (Ariophantidae), *Lamellidens marginalis* (Unionidae), *Lamellidens sp., Parreysia favidens, Corbicula straitella* (Cyrenidae), *Corbicula sp., Corbicula sp.* |
| 4 | Riparian vegetation plants | *Azadirachta indica, Borreria hispida, Calotropis procera, Cleome viscosa, Coccinia indica, Cyperus sps., Eichhornia crassipes, Hibiscus vitifolius, Ipomoea aquatica, Oldenlandia sps., Pergularia daemia, Pithecellobium dulce, Prosopis juliflora, Saccharum spontaneum, Sida acuta, Sida cordifolia.* |

Figure showing riparian vegetation at Venakatapalem site

Figure showing riparian vegetation at Venakatapalem site

Figure showing riparian vegetation collection at venkatapalem site

Figure showing riparian vegetation at Venakatapalem site

Figure showing zooplankton samples collection at Venkatapalem site

Figure showing benthic fauna collection at Venkatapalem site

*IV.b. 4.Uddandrayunipalem*

Table 5. Consolidated list of flora and fauna observed at Uddandrayunipalem site (Desiltation area) during six samplings during the study period (Oct – Dec, 2019).

| S. No | Particulars | Observed Species |
|---|---|---|
| 1 | Phytoplankton | Green algae: *Pediastrum* sps., *Spirogyra* sps., *Ulothrix* sps. |

| | | |
|---|---|---|
| | | Blue green algae: *Anabaena sps., Aphanizomenon* sps., *Microcystis* sps., *Oscillatoria* sps., *Phormidium* sps., *Spirulina* sps.<br>Diatoms: *Asterionellopsis* sps.,*Pinnularia sps.* |
| 2 | Zooplankton | Rotifera: *Brachionus angularis* (Brachionidae), *Brachionus bidentatus, Brachionus calyciflorus, Brachionus caudatus, Brachionus diversicornis, Brachionus falcatus, Brachionus forficula, Brachionus quadridentatus, Brachionus rubens, Keratella trophica, Cephalodella sp.* (Notommatidae), *Filinia longiseta* (Trochosphaeridae), *Hexthra sp.* (Hexarthridae), *Habrotrocha rosa* (Habrotrochidae), *Habrotrocha zanette, Macrothrix sp.***(Macrothricidae).**<br>Cladocerans: *Scapholeberis sp., Ceriodaphnia cornuta, Diaphanosoma excisum* (Sididae), *Diaphanosoma Senegal, Moina micrura* (Moinidae), *Moina macrocopa, Macrothrix spinosa* (Macrothricidae), *Pleuroxus aduncus* (Chydoridae), *Pseudochydorus sp., Alona sp., Biapertura sp., Chydorus sp., Bosmina sp.* (Bosminidae), *Bosminopsis deitersi*<br>Copepods: *Allodiaptomus raoi* (Diaptomidae), *Heliodiaptomus viduus, Phyllodiaptomus blanci, Sinodiaptomus (Rhinediaptomus) indicus, Microcyclops varicans* (Cyclopidae), *Mesocyclops leuckarti, Mesocyclops sp., Thermocyclops sp., Cyclopoid nauplii, Eucyclops serrulatus, Paracyclops sp., Calanoid nauplii* (Calanidae), *Parastenocaris sp.* (Parastenocarididae)<br>Protozoa: *Vorticella sp.* (Vorticellidae) |
| 3 | Benthos | Crustaceans<br>Ostracoda: *Cypris condona* (Cyprididae), *Cypris obensa, Cypris subglobosa, Cypris sp., Strandesia indica, Hemicypris falcatus, Cypretta sp., Candonocypris dentatus, Herpetocypris sp., Parastenocypris major, Stenocypris sp., Parastenocypris biswasi, Candona sp.* (Candonidae)<br>Clamp shrimp: *Cyclestheria hislopi* (Cyclestheriidae)<br>Aquatic Insects<br>Bugs: *Lethocerus* sp. (Belostomatidae), *Lacotrephes* sp. (Nepidae), *Ranatra sp., Gerris* sp. (Gerridae), *Enithares sp.* (Notonectidae)<br>Beetles: *Dineutus sp.* (Gyrinidae), *Noteridae sp.* (Noteridae), |

| | | |
|---|---|---|
| | | *Sandracottus sp.* (Dytiscidae), *Hydaticus sp., Laccophilus sp.*<br><br>Insect larvae: *Glossosoma sp.* (Glossosomatidae), *Stenopsyche sp.* (Stenopsychidae), *Hydropsyche sp.* (Hydropsychidae), *Chironomous* (Chironomidae), *Chaoborus* (Chaoboridae), *Thalerosphyrus* (Heptageniidae)<br><br>Crab: *Paratelphusa jacquemontii* (Gelechiidae)<br><br>Prawns: *Macrobrachium malcolmsonii* (Palaemonidae), *Macrobrachium rosenbergii, Macrobrachium lamarrei*<br><br>Leech: *Hirudinea sp.* (Hirudinidae)<br><br>Molluscs: *Pila virens* (Ampullariidae), *Pila globosa, Pila sp., Bellamya bengalensis* (Viviparidae), *Bellamya dissimilis, Gabbia sp.* (Bithyniidae), *Digoniostoma sp., Thiara lineate* (Thiaridae), *Thiara scabra, Thiara sp., Thiara tuberculata, Melania scabra, Melanoides tuberculatus, Lymnaea acuminate* (Lymnaeidae), *Lymnaea luteola, Amnicola sp.* (Hydrobiidae), *Indoplanorbis sp.* (Planorbidae), *Gyraulus convexiusculus, Gyraulus sp., Cryprozona sp.* (Ariophantidae), *Lamellidens marginalis* (Unionidae), *Lamellidens sp., Parreysia favidens, Parreysia caerulea, Parreysia sp., Corbicula straitella* (Cyrenidae), *Corbicula sp., Macrochlamys sp.* |
| 4 | Riparian vegetation plants | *Acacia nilotica, Achyranthus aspera, Aerva lanata, Alternanthera sessilis, Alysicarpus sps., Ammania baccifera, Blumea mollis, Cleome viscosa, Commelina benghalensis, Corchorus aestivans, Cyperus sps., Ergastris tenella, Hydrilla verticillata, Ipomoea aquatica, Ipomoea biloba, Ipomoea eriocarpa, Merrimia emarginata, Phyllanthus simplex, Pithecellobium dulce,Prosopis juliflora, Saccharum spontaneum, Ziziphus mauritiana, Vernonia cinera.* |

Figure showing riparian vegetation at Uddandrayunipalem site

Figure showing riparian vegetation at Uddandrayunipalem site

Figure showing riparian vegetation collection at Uddandrayunipalem site

Figure showing riparian vegetation at Uddandrayunipalem site

Figure showing benthic fauna collection at Uddandrayunipalem site

Figure showing benthic fauna collection at Uddandrayunipalem site

*VI.c.5. Lingayapalem*

Table 6. Consolidated list of flora and fauna observed at Lingayapalem site (Desiltation area) during six samplings during the study period (Oct – Dec, 2019).

| S. No. | Particulars | Observed Species |
|---|---|---|
| 1 | Phytoplankton | Green algae: *Actinastrum* sps., *Pediastrum* sps., *Spirogyra* sps., *Ulothrix* sps.<br>Blue green algae: *Aphanizomenon* sps., *Arthrospira* sps., *Microcystis* sps., *Nostoc* sps., *Oscillatoria* sps., *Phormidium* sps., *Spirulina* sps.<br>Diatoms: *Pinnularia sps.* |
| 2 | Zooplankton | Rotifera: *Brachionus angularis* (Brachionidae), *Brachionus bidentatus, Brachionus calyciflorus, Brachionus caudatus, Brachionus diversicornis, Brachionus falcatus, Brachionus forficula, Brachionus quadridentatus, Brachionus rubens, Keratella trophica, Asplanchna sp.* (Asplanchnidae), *Cephalodella sp.* (Notommatidae), *Hexthra sp.* (Hexarthridae), *Habrotrocha rosa* (Habrotrochidae), *Habrotrocha Sp., Macrothrix sp.***(Macrothricidae),***Lecane sp.* (Lecanidae)<br>Cladocerans: *Scapholeberis sp., Ceriodaphnia cornuta, Diaphanosoma excisum* (Sididae), *Diaphanosoma Senegal, Moina micrura* (Moinidae), *Moina macrocopa, Macrothrix spinosa* (Macrothricidae), *Pleuroxus aduncus* (Chydoridae), *Pseudochydorus sp., Indialona sp., Chydorus sp., Bosminopsis deitersi* (Bosminidae)<br>Copepods: *Allodiaptomus raoi* (Diaptomidae), *Heliodiaptomus viduus, Phyllodiaptomus blanci, Sinodiaptomus (Rhinediaptomus) indicus,Halicyclops spinifer* (Cyclopidae), *Microcyclops varicans, Mesocyclops hyalinus, Thermocyclops sp., Cyclopoid nauplii, Eucyclops serrulatus, Paracyclops sp., Calanoid nauplii* (Calanidae)<br>Protozoa: *Vorticella sp.* (Vorticellidae) |
| | Benthos | Crustaceans<br>Ostracoda: *Cypris condona* (Cypridídae), *Cypris obensa, Cypris subglobosa, Cypris sp., Cypretta sp., Candonocypris dentatus, Herpetocypris sp., Parastenocypris major, Stenocypris sp., Parastenocypris biswasi, Parastenocypris sp., Candona sp.* (Candonidae)<br>Clamp shrimp: *Cyclestheria hislopi* (Cyclestheriidae)<br>Aquatic Insects |

| | | |
|---|---|---|
| | | Bugs: *Lethocerus* sp. (Belostomatidae), *Lacotrephes* sp. (Nepidae), *Ranatra sp., Gerris* sp. (Gerridae), *Micronecta* sp. (Corixidae), *Enithares sp.* (Notonectidae)<br><br>Beetles: *Dineutus sp.* (Gyrinidae), *Noteridae sp.* (Noteridae), *Sandracottus sp.* (Dytiscidae), *Hydaticus sp., Laccophilus sp.*<br><br>Insect larvae: *Glossosoma sp.* (Glossosomatidae), *Stenopsyche sp.* (Stenopsychidae), *Hydropsyche sp.* (Hydropsychidae), *Chironomous* (Chironomidae), *Chaoborus* (Chaoboridae), *Thalerosphyrus* (Heptageniidae), *Manayunkia speciosa* (Fabriciidae)<br><br>Crab: *Paratelphusa jacquemontii* (Gelechiidae)<br><br>Prawns: *Macrobrachium malcolmsonii* (Palaemonidae), *Macrobrachium rosenbergii, Macrobrachium lamarrei*<br><br>Leech: *Hirudinea sp.* (Hirudinidae)<br><br>Molluscs: *Pila virens* (Ampullariidae), *Pila globosa, Pila sp., Bellamya bengalensis* (Viviparidae), *Bellamya dissimilis, Digoniostoma sp., Thiara lineate* (Thiaridae), *Thiara scabra, Thiara sp., Thiara tuberculata, Melania scabra, Melanoides tuberculatus, Lymnaea acuminate* (Lymnaeidae), *Lymnaea luteola, Amnicola sp.* (Hydrobiidae), *Indoplanorbis sp.* (Planorbidae), *Gyraulus convexiusculus, Gyraulus sp., Cryprozona sp.* (Ariophantidae), *Lamellidens marginalis* (Unionidae), *Lamellidens sp., Parreysia favidens, Parreysia caerulea, Parreysia sp., Corbicula sp.* (Cyrenidae) |
| 4 | Riparian vegetation plants | *Acacia leucophoea, Acacia nilotica, Ammania baccifera, Borassus flabellifer, Calotropis procera, Cyperus sps., Eclipta alba, Imperata cylindrica, Pithecellobium dulce, Polygonum glabrum, Polygonum sps.,Prosopis juliflora,Saccharum spontaneum.* |

Figure showing Lingayapalem site before sampling

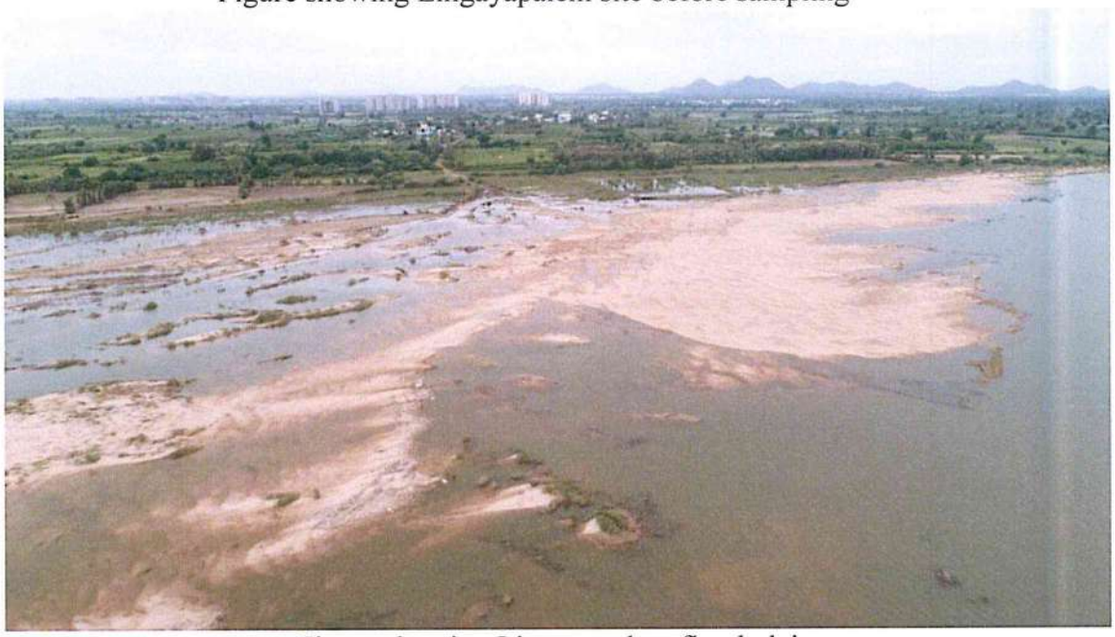

Figure showing Lingayapalem flood plain

Figure showing the team visit at Lingayapalem flood plain

Figure showing riparian vegetation at Lingayapalem site

Figure showing riparian vegetation at Lingayapalem site

Figure showing plankton collection at Lingayapalem site

Figure showing plankton collection at Lingayapalem site

***VI. b.6.*** *Rayapudi*

Table 7. Consolidated list of flora and fauna observed at Rayapudi site (Desiltation area) during six samplings during the study period (Oct – Dec, 2019).

| S. No | Particulars | Observed Species |
|---|---|---|
| 1 | Phytoplankton | Green algae: *Actinastrum* sps., *Coelastrum* sps., *Monoraphidium* sps., *Pediastrum* sps., *Spirogyra* sps., *Ulothrix* sps.,<br>Blue green algae: *Aphanizomenon* sps., *Lyngbya* sps., *Microcystis* sps., *Nostoc* sps., *Oscillatoria* sps., |
| 2 | Zooplankton | Rotifera: *Brachionus angularis* (Brachionidae), *Brachionus bidentatus, Brachionus calyciflorus, Brachionus caudatus, Brachionus dichotomus, Brachionus diversicornis, Brachionus falcatus, Brachionus forficula, Brachionus quadridentatus, Keratella trophica, Cephalodella sp.* (Notommatidae), *Habrotrocha rosa* (Habrotrochidae), *Habrotrocha zanette, Macrothrix sp.* **(Macrothricidae),** *Ptygura pilula* (Flosculariidae)<br>Cladocerans: *Daphnia carinata* (Daphniidae), *Scapholeberis sp., Ceriodaphnia cornuta, Diaphanosoma Senegal* (Sididae), *Moina micrura* (Moinidae), *Moina macrocopa, Macrothrix spinosa* (Macrothricidae), *Pleuroxus aduncus* (Chydoridae), *Pseudochydorus sp., Alona sp., Indialona sp., Chydorus sp., Bosminopsis deitersi* (Bosminidae) |

| | | |
|---|---|---|
| | | Copepods: *Allodiaptomus raoi* (Diaptomidae), *Heliodiaptomus viduus, Phyllodiaptomus blanci, Sinodiaptomus (Rhinediaptomus) indicus, Halicyclops spinifer* (Cyclopidae), *Microcyclops varicans, Mesocyclops Sp., Thermocyclops sp., Cyclopoid nauplii, Eucyclops serrulatus, Calanoid nauplii* (Calanidae),*Parastenocaris sp.* (Parastenocarididae) |
| 3 | Benthos | Crustacens<br>Ostracoda: *Cypris condona* (Cypprididae), *Cypris obensa, Cypris subglobosa, Cypris sp., Strandesia indica, Hemicypris falcatus, Cypretta sp., Candonocypris dentatus, Stenocypris sp., Parastenocypris biswasi, Parastenocypris sp., Physocypria minutus* (Cyclocyprididae), *Candona sp.* (Candonidae)<br>Clamp shrimp: *Cyclestheria hislopi* (Cyclestheriidae)<br>Aquatic insects<br>Bugs: *Lethocerus* sp. (Belostomatidae), *Lacotrephes* sp. (Nepidae), *Ranatra sp., Gerris* sp. (Gerridae), *Micronecta* sp. (Corixidae), *Enithares sp.* (Notonectidae)<br>Beetles: *Dineutus sp.* (Gyrinidae), *Noteridae sp.* (Noteridae), *Sandracottus sp.* (Dytiscidae), *Hydaticus sp., Laccophilus sp.*<br>Insect larvae: *Glossosoma sp.* (Glossosomatidae), *Stenopsyche sp.* (Stenopsychidae), *Hydropsyche sp.* (Hydropsychidae), *Chironomous* (Chironomidae), *Chaoborus* (Chaoboridae), *Thalerosphyrus* (Heptageniidae),<br>Crab: *Paratelphusa jacquemontii* (Gelechiidae)<br>Prawns: *Macrobrachium malcolmsonii* (Palaemonidae), *Macrobrachium rosenbergii, Macrobrachium lamarrei*<br>Molluscs: *Pila virens* (Ampullariidae), *Pila globosa, Pila sp., Bellamya bengalensis* (Viviparidae), *Bellamya dissimilis, Gabbia sp.* (Bithyniidae), *Digoniostoma sp., Thiara lineate* (Thiaridae), *Thiara scabra, Thiara sp., Thiara tuberculata, Melanoides tuberculatus, Lymnaea acuminate* (Lymnaeidae), *Lymnaea luteola, Amnicola sp.* (Hydrobiidae), *Indoplanorbis sp.* (Planorbidae), *Gyraulus convexiusculus, Cryprozona sp.* (Ariophantidae), *Lamellidens marginalis* (Unionidae), *Lamellidens sp., Parreysia favidens, Parreysia caerulea, Parreysia sp., Corbicula straitella* (Cyrenidae), *Corbicula peninsularis* |
| 4 | Riparian vegetation plants | *Acacia nilotica, Amaranthus viridis, Blumea mollis, Borassus flabellifer, Ceratophyllum sps., Cleome viscosa, Crotalaria retusa, Cyperus sps., Eclipta alba, Merremia emarginata, Phyllanthus maderaspatensis, Pithecellobium dulce,* |

| | | |
|---|---|---|
| | | *Portulaca quadrifida, Prosopis juliflora,Saccharum spontaneum, Ziziphus mauritiana, Ziziphus jujuba.* |

Figure showing Rayapudi site before sampling

Figure showing flood plain area of Rayapudi

Figure showing riparian vegetation at Rayapudi

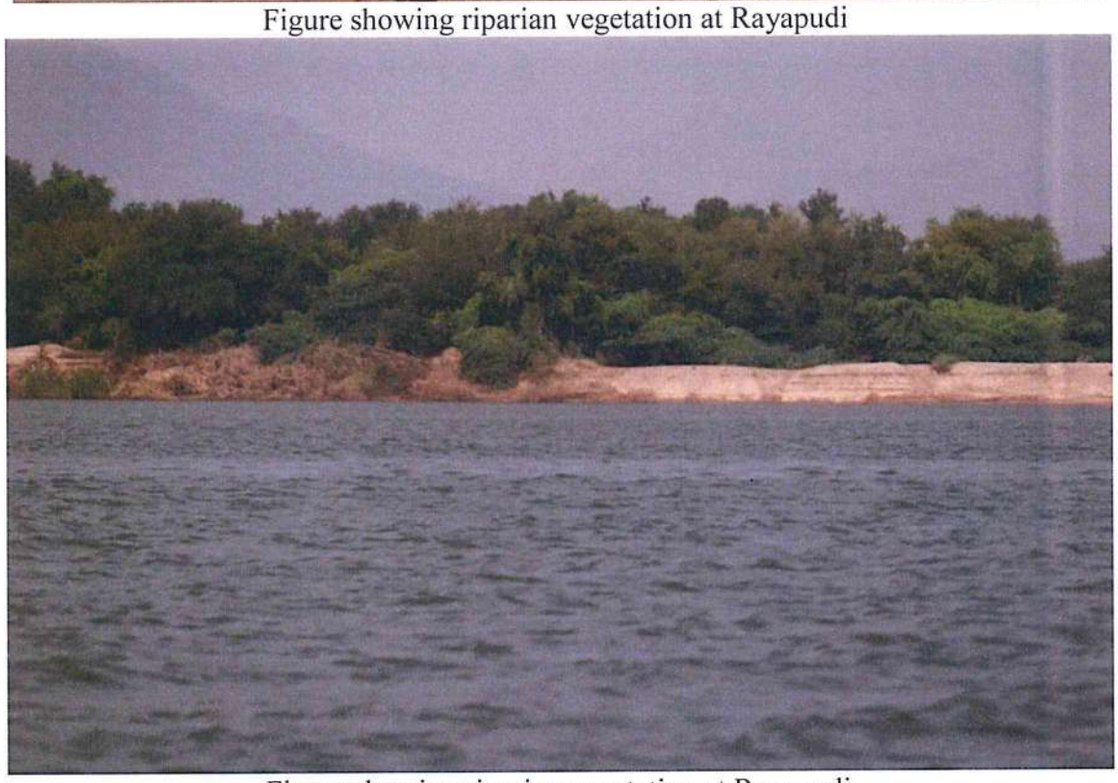

Figure showing riparian vegetation at Rayapudi

Figure showing benthic fauna collection at Lingayapalem site

Figure showing the team interaction with fishermen at Rayapudi

*VI. b. 7. SurayaPalem*

Table 8. Consolidated list of flora and fauna observed at Surayapalem site (Desiltation area) during six samplings during the study period (Oct – Dec, 2019).

| S.No. | Particulars | Observed Species |
|---|---|---|
| 1 | Phytoplankton | Green algae: *Monoraphidium* sps., *Pandorina* sps., *Pediastrum* sps., *Spirogyra* sps., *Ulothrix* sps.,<br>Blue green algae: *Aphanizomenon* sps., *Arthrospira* sps., *Lyngbya* sps., *Microcystis* sps., *Nostoc* sps., *Oscillatoria* sps., *Phormidium* sps., *Spirulina* sps.,<br>Diatoms: *Asterionellopsis* sps., *Pinnularia* sps. |
| 2 | Zooplankton | Rotifera: *Brachionus angularis* (Brachionidae), *Brachionus bidentatus, Brachionus calyciflorus, Brachionus caudatus, Brachionus dichotomus, Brachionus falcatus, Brachionus forficula, Brachionus quadridentatus, Brachionus rubens, Keratella trophica, Asplanchna sp.* (Asplanchnidae), *Cephalodella sp.* (Notommatidae), *Filinia longiseta* (Trochosphaeridae), *Hexthra sp.* (Hexarthridae), *Habrotrocha rosa* (Habrotrochidae), *Macrothrix sp.* **(Macrothricidae),** *Ptygura pilula* (Flosculariidae)<br>Cladocerans: *Daphnia carinata* (Daphniidae), *Scapholeberis sp., Ceriodaphnia cornuta, Diaphanosoma excisum* (Sididae), *Diaphanosoma Senegal, Moina micrura* (Moinidae), *Macrothrix spinosa* (Macrothricidae), *Pleuroxus aduncus* (Chydoridae), *Pseudochydorus sp., Alona sp., Biapertura sp., Indialona sp., Bosmina sp.* (Bosminidae)<br>Copepods: *Allodiaptomus raoi* (Diaptomidae), *Heliodiaptomus viduus, Phyllodiaptomus blanci, Sinodiaptomus (Rhinediaptomus) indicus, Halicyclops spinifer* (Cyclopidae), *Microcyclops varicans, Mesocyclops leuckarti, Mesocyclops hyalinus, Thermocyclops sp., Cyclopoid nauplii, Eucyclops serrulatus, Paracyclops sp., Calanoid nauplii* (Calanidae), *Pseudodiaptomus binghami* (Pseudodiaptomidae)<br>Protozoa: *Vorticella sp.* (Vorticellidae) |
| 3 | Benthos | Crustacens<br>Ostracoda: *Cypris condona* (Cyprididae), *Cypris obensa, Cypris subglobosa, Cypris sp., Strandesia indica, Hemicypris falcatus, Cypretta sp., Candonocypris dentatus, Herpetocypris sp., Parastenocypris major, Stenocypris sp., Parastenocypris biswasi, Parastenocypris sp.,*<br>Clamp shrimp: *Cyclestheria hislopi* (Cyclestheriidae)<br>Aquatic Insects |

| | | |
|---|---|---|
| | | Bugs: *Lethocerus* sp. (Belostomatidae), *Lacotrephes* sp. (Nepidae), *Ranatra sp., Gerris* sp. (Gerridae), *Micronecta* sp. (Corixidae), *Enithares sp.* (Notonectidae)<br><br>Beetles: *Dineutus sp.* (Gyrinidae), *Noteridae sp.* (Noteridae), *Sandracottus sp.* (Dytiscidae), *Laccophilus sp.*<br><br>Insect larvae: *Glossosoma sp.* (Glossosomatidae), *Stenopsyche sp.* (Stenopsychidae), *Chironomous* (Chironomidae), *Chaoborus* (Chaoboridae), *Thalerosphyrus* (Heptageniidae), *Manayunkia speciosa* (Fabriciidae)<br><br>Crab: *Paratelphusa jacquemontii* (Gelechiidae)<br><br>Prawns: *Macrobrachium malcolmsonii* (Palaemonidae), *Macrobrachium rosenbergii, Macrobrachium lamarrei*<br><br>Molluscs: *Pila virens* (Ampullariidae), *Pila globosa, Pila sp., Bellamya bengalensis* (Viviparidae), *Bellamya dissimilis, Gabbia sp.* (Bithyniidae), *Thiara lineate* (Thiaridae), *Thiara scabra, Thiara sp., Thiara tuberculata, Melania scabra, Melanoides tuberculatus, Lymnaea acuminate* (Lymnaeidae), *Lymnaea luteola, Indoplanorbis sp.* (Planorbidae), *Gyraulus convexiusculus, Gyraulus sp., Lamellidens marginalis* (Unionidae), *Lamellidens sp., Parreysia favidens, Parreysia caerulea, Parreysia sp., Corbicula straitella* (Cyrenidae), *Corbicula peninsularis.* |
| 4 | Riparian vegetation plants | *Acacia leucophoea, Acacia nilotica, Coccinia indica, corchorus capsularis, Cyanatis axillaris, Cyperus sps.,Dactyloctenium aegyptium, Ipomoea aquatica, Ipomoea sps., Oxystelma chinensis, Phyllanthus maderaspatensis, Pithecellobium dulce, Prosopis juliflora,Saccharum spontaneum, Ziziphus jujuba.* |

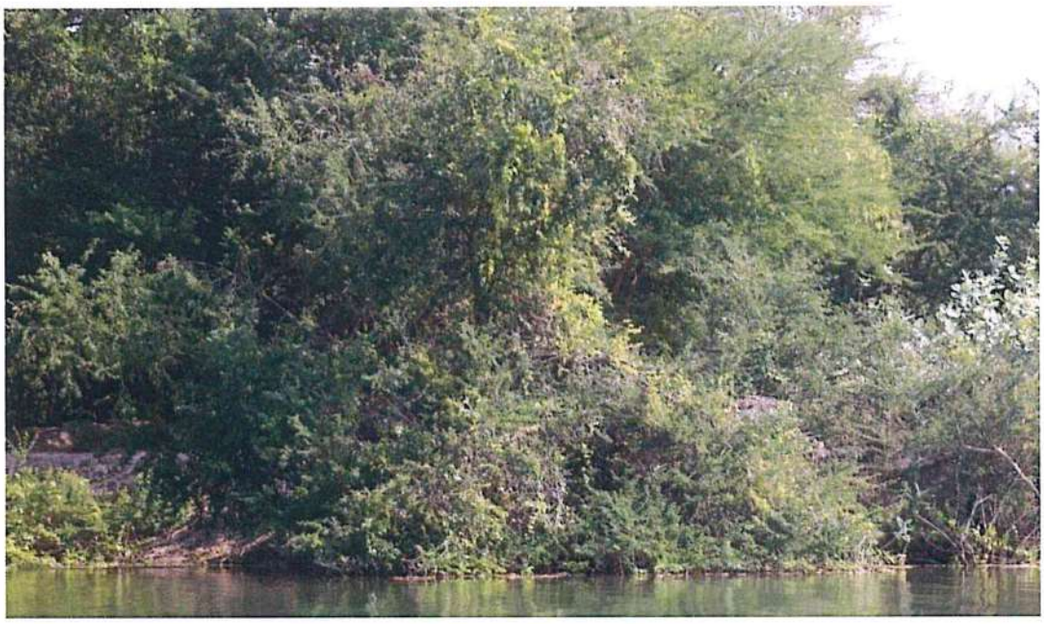

Figure showing riparian vegetation at Surayapalemsite

Figureshowing riparian plants, plankton and benthic fauna collection at riverbank side of Lingayapalem site

*VI. b.8. Guntupalli*

Table 9. Consolidated list of flora and fauna observed at Guntupalli site (Desiltation area) during six samplings during the study period (Oct – Dec, 2019).

| S. No. | Particulars | Observed Species |
|---|---|---|

| | | |
|---|---|---|
| 1 | Phytoplankton | Green algae: *Monoraphidium* sps., *Pediastrum* sps., *Spirogyra* sps., *Ulothrix* sps.<br>Blue green algae: *Arthrospira* sps., *Lyngbya* sps., *Microcystis* sps., *Nostoc* sps., *Phormidium* sps., *Spirulina* sps.,<br>Diatoms: *Pinnularia* sps. |
| 2 | Zooplankton | Rotifera: *Brachionus angularis* (Brachionidae), *Brachionus bidentatus, Brachionus calyciflorus, Brachionus caudatus, Brachionus diversicornis, Brachionus falcatus, Brachionus forficula, Brachionus quadridentatus, Brachionus rubens, Keratella trophica, Asplanchna sp.* (Asplanchnidae), *Filinia longiseta* (Trochosphaeridae), *Hexthra sp.* (Hexarthridae), , *Habrotrocha zanette* (Habrotrochidae), *Macrothrix sp.* **(Macrothricidae)**<br>Cladocerans: *Daphnia carinata* (Daphniidae), *Scapholeberis sp., Ceriodaphnia cornuta, Diaphanosoma excisum* (Sididae), *Diaphanosoma Senegal, Moina micrura* (Moinidae), *Moina macrocopa, Macrothrix spinosa* (Macrothricidae), *Pleuroxus aduncus* (Chydoridae), *Pseudochydorus sp., Alona sp., Biapertura sp., Indialona sp., Bosmina sp.* (Bosminidae)<br>Copepods: *Allodiaptomus raoi* (Diaptomidae), *Heliodiaptomus viduus, Phyllodiaptomus blanci, Eucyclops semidenticulatus* (Cyclopidae), *Microcyclops varicans, Mesocyclops leuckarti, Mesocyclops hyalinus, Thermocyclops sp., Cyclopoid nauplii, Eucyclops serrulatus, Paracyclops sp., Calanoid nauplii* (Calanidae),*Parastenocaris sp.* (Parastenocarididae)<br>Protozoa: *Vorticella sp.* (Vorticellidae) |
| 3 | Benthos | Crustacens<br>Ostracoda: *Cypris condona* (Cypridídae), *Cypris obensa, Cypris subglobosa, Cypris sp., Hemicypris falcatus, Cypretta sp., Candonocypris dentatus, Herpetocypris sp., Parastenocypris major, Parastenocypris biswasi, Parastenocypris sp., Candona sp.* (Candonidae)<br>Clamp shrimp: *Cyclestheria hislopi* (Cyclestheriidae)<br>Aquatic Insects<br>Bugs: *Lethocerus* sp. (Belostomatidae),(Nepidae), *Ranatra sp., Gerris* sp. (Gerridae), *Enithares sp.* (Notonectidae)<br>Beetles: *Dineutus sp.* (Gyrinidae), *Noteridae sp.* (Noteridae), *Hydaticus sp., Laccophilus sp.*<br>Insect larvae: *Glossosoma sp.* (Glossosomatidae), *Hydropsyche sp.* (Hydropsychidae), *Chironomous* |

| | | |
|---|---|---|
| | | (Chironomidae), *Chaoborus* (Chaoboridae), *Thalerosphyrus* (Heptageniidae), *Manayunkia speciosa* (Fabriciidae)<br><br>Prawns: *Macrobrachium malcolmsonii* (Palaemonidae), *Macrobrachium rosenbergii, Macrobrachium lamarrei*<br><br>Molluscs: *Pila virens* (Ampullariidae), *Pila globosa, Pila sp., Bellamya bengalensis* (Viviparidae), *Bellamya dissimilis, Gabbia sp.* (Bithyniidae), *Digoniostoma sp., Thiara lineate* (Thiaridae), *Thiara scabra, Thiara sp., Thiara tuberculata, Melania scabra, Melanoides tuberculatus, Lymnaea luteola* (Lymnaeidae), *Indoplanorbis sp.* (Planorbidae), *Gyraulus convexiusculus, Gyraulus sp., Cryprozona sp.* (Ariophantidae), *Lamellidens marginalis* (Unionidae), *Lamellidens sp., Parreysia favidens, Parreysia caerulea, Parreysia sp.* |
| 4 | Riparian vegetation plants | *Acacia nilotica, Alternanthera sessilis, Boerhavia diffusa, Calotropis procera, Cleome viscosa, Corchorus aestivans, Cyanodon dactylan, Cyperus flavidus, Cyperus sps., Eclipta alba, Eichhornia crassipes, Hydrilla verticillata, Ipomoea aquatica, Ipomoea repans, Pithecellobium dulce, Polygonum glabrum, Prosopis juliflora,Ricinus communis, Saccharum spontaneum.* |

Figure showing riparian vegetation at Guntupalli site

Figure showing Molluscs in river Krishna at Guntupalli

Figure showing collection of plankton sample at Guntupalli site

*VI.b. 9. Ibrahimpatnam*

Table 10. Consolidated list of flora and fauna observed at Ibrahimpatnam site (Desiltation area) during six samplings during the study period (Oct – Dec, 2019).

| S. No. | Particulars | Observed Species |
|---|---|---|
| 1 | Phytoplankton | Green algae: *Actinastrum* sps., *Monoraphidium* sps., *Pediastrum* sps., *Spirogyra* sps., *Ulothrix* sps.<br>Blue green algae: *Anabaena sps., Aphanizomenon* sps., *Arthrospira* sps., *Lyngbya* sps., *Microcystis* sps., *Nostoc* sps., *Oscillatoria* sps., *Phormidium* sps., *Spirulina* sps.,<br>Diatoms: *Asterionellopsis* sps., *Pinnularia* sps. |
| 2 | Zooplankton | Rotifera: *Brachionus angularis* (Brachionidae), *Brachionus bidentatus, Brachionus calyciflorus, Brachionus caudatus, Brachionus dichotomus, Brachionus diversicornis, Brachionus quadridentatus, Brachionus rubens, Asplanchna sp.* (Asplanchnidae), *Cephalodella sp.* (Notommatidae), *Habrotrocha rosa* (Habrotrochidae), *Habrotrocha zanette*<br>Cladocerans: *Daphnia carinata* (Daphniidae), *Scapholeberis sp., Ceriodaphnia cornuta, Diaphanosoma excisum* (Sididae), *Diaphanosoma Senegal, Moina micrura* (Moinidae), *Macrothrix spinosa* (Macrothricidae), *Pleuroxus aduncus* (Chydoridae), *Alona sp., Biapertura sp., Chydorus sp., Bosmina sp.* (Bosminidae), *Bosminopsis deitersi*<br>Copepods: *Allodiaptomus raoi* (Diaptomidae), *Heliodiaptomus viduus, Phyllodiaptomus blanci, Sinodiaptomus (Rhinediaptomus) indicus, Eucyclops semidenticulatus* (Cyclopidae), *Halicyclops spinifer, Mesocyclops hyalinus, Mesocyclops sp., Thermocyclops sp., Cyclopoid nauplii, Eucyclops serrulatus, Calanoid nauplii* (Calanidae) |
| 3 | Benthos | Crustacens<br>Ostracoda: *Cypris condona* (Cypridídae), *Cypris obensa, Cypris subglobosa, Cypris sp., Strandesia indica, Hemicypris falcatus, Cypretta sp., Candonocypris dentatus, Stenocypris sp., Parastenocypris biswasi, Parastenocypris sp., Candona sp.* (Candonidae)<br>Clamp shrimp: *Cyclestheria hislopi* (Cyclestheriidae)<br>Aquatic Insects<br>Bugs: *Lethocerus* sp. (Belostomatidae), *Lacotrephes* sp. (Nepidae), *Ranatra sp., Gerris* sp. (Gerridae), *Enithares sp.* (Notonectidae)<br>Beetles: *Noteridae sp.* (Noteridae), *Sandracottus sp.* |

| | | |
|---|---|---|
| | | (Dytiscidae), *Hydaticus sp., Laccophilus sp.*<br><br>Insect larvae: *Glossosoma sp.* (Glossosomatidae), *Hydropsyche sp.* (Hydropsychidae), *Chironomous* (Chironomidae), *Chaoborus* (Chaoboridae), *Manayunkia speciosa* (Fabriciidae)<br><br>Crab: *Paratelphusa jacquemontii* (Gelechiidae)<br><br>Prawns: *Macrobrachium malcolmsonii* (Palaemonidae), *Macrobrachium rosenbergii, Macrobrachium lamarrei*<br><br>Leech: *Hirudinea sp.* (Hirudinidae)<br><br>Molluscs: *Pila virens* (Ampullariidae), *Pila globosa, Pila sp., Bellamya bengalensis* (Viviparidae), *Bellamya dissimilis, Gabbia sp.* (Bithyniidae), *Digoniostoma sp., Thiara lineate* (Thiaridae), *Thiara scabra, Thiara sp., Thiara tuberculata, Melanoides tuberculatus, Lymnaea acuminate* (Lymnaeidae), *Lymnaea luteola, Amnicola sp.* (Hydrobiidae), *Indoplanorbis sp.* (Planorbidae), *Gyraulus convexiusculus, Cryprozona sp.* (Ariophantidae), *Lamellidens marginalis* (Unionidae), *Lamellidens sp., Parreysia favidens, Parreysia caerulea, Corbicula straitella* (Cyrenidae) |
| 4 | Riparian vegetation plants | *Acacia nilotica, Calotropis procera, Commelina benghalensis, Corchorus aestevans, Cordiospermum helicacabum, Cyanatis cristata, Cyanotis axillaris, Eclipta alba, Eucalyptus sps., Ficus hispida, Ipomoea repans, Mimosa pudica, Pithecellobium dulce, Portulaca quadrifida, Prosopis juliflora,Tinospora cardifolia, Ziziphus jujuba, Ziziphus mauritiana.* |

Figure showing riparian vegetation at Ibrahimpatnam site

Figure showing riparian vegetation at Ibrahimpatnam site

In comparison with the Undavalli site, the phytoplankton observed at other different desiltation sites viz., Penumaka, Venkatayapalem, Uddandarayunipalem, Lingayapalem and Rayapudi on Guntur district side, and Surayapalem, Guntupalli and Ibrahimpatnam on Krishna district side was more or less similar with a deviation of presence or absence of one or two genera of phytoplankton at one site or the other. In that

context, few genera (3 or 4) of total phytoplankton identified were positively present at one or the other desiltation sites which were not found at non desiltation site namely Undavalli. At the reference site, only *Pinnularia* sps. of diatoms group was found, whereas a second genus namely *Asterionellopsis* of diatoms was also recorded at Penumaka, Uddandarayunipalem, Surayapalem and Ibrahimpatnam sites in addition to *Pinnularia* sps.

The phytoplankton study results showing good presence and distribution of most common and different freshwater phytoplankton members in river Krishna waters at different study sites during the study period. The distribution of phytoplankton was found without much qualitative variation among the sampling sites. In general among all the study sites including the Undavalli (reference site), *Actinastrum*sps., *Pediastrum* sps., *Spirogyra* sps., and *Ulothrix* sps., of green algae group, and *Microcystis* sps., *Oscillatoria*sps., *Phormidium* sps., *Spirulina* sps., and *Nostoc* sps., of blue-green algae group were found in more richness over the other members of their groups. In the diatoms group, only *Pinnularia* sps., of the two genera recorded in the study was present uniformly in all the samples.

In general, the riparian vegetation at the study sites of river Krishna upstream from Prakasam barrage at Vijayawada consists of trees, shrubs, herbs and submerged to floating hydrophytes both on islands in the middle of the river and along the riverbank sides. During the study, about 30-40 plants species belonging to different families were observed as a part of riparian vegetation. The list of the plant species of riparian vegetation observed and identified was given in a consolidated table 2-10.

From the qualitative analysis, it is observed that riparian vegetation in reference site and desiltation areas are similar which implies that the desiltation and dredging is not having serious impact on vegetation. Of the tree species observed at the sites, *Acacia nilotica*, *Acacia leucophoea*, *Pithecellobium dulce*, *Prosopis juliflora* were found commonly and abundantly in almost all sites giving dense vegetation appearance. Shrubs like *Calotropis procera*, *Polygonum glabrum*, *Ziziphus jujuba*, *Ziziphus mauritiana* and *Corchorus aestivans,* and herbaceous plants namely *Sida acuta*, *Achyranthus aspera*, *Cleome viscosa* and *Aerva lanata* were found in abundance. Of the hydrophytic plants, *Ipomoea aquatica* and *Eichornia crassipes* were abundant and *Hydrilla verticillata* plant was also seen at some sites. Differentgrass species belonging to genera viz., *Cyperus*,

*Cyanodon*, *Dactyloctenium* and *Saccharum* were observed so commonly and in abundance at all sites. However, some of the plant species mentioned in the list were moderate to low in abundance due to their presence or absence at one or the other sites of the study.

Zooplankton of river Krishna, upstream water was represented by three groups viz., Rotifera, Cladocera and Copepoda. The species diversity was more in Rotifer and Cladocera in all desiltation sites as well as non-desiltation area (Tables 2-10), and abundance of *Brachionus* species seems to be reasoned to physico-chemical conditions of riverine ecosystem that supporting the growth and distribution. The Copepoda was found as the second largest group observed in the non- desiltation /reference site. The same trend was observed in the desiltation areas of river Krishna.

Benthos are the organisms which are living in or on the bottom materials, mainly represented by ostrocodes, clamshrimp, aquatic bugs, beetles, insects and molluscs (Table 2-10). When compared the benthic community of desiltation and non-desiltation areas, molluscs were found as a dominant constituent followed by ostrocodes and crustaceans. In the present investigation, the other freshwater macro and micro benthic fauna were observed to be at moderate level in river Krishna, upstream waters of desiltation areas. The good distribution and abundance of benthic fauna recorded in river Krihna upstream waters indicating that desiltation activity hs no affect n the benthic community.

**Fish fauna of river Krishna**

Table 10. List of fish fauna recorded from Krishna River upstream of Prakasam barrage 13.5 km

| S. No. | Orders | Family | Genus | Species | Local Name |
|---|---|---|---|---|---|
| 1 | Osteoglossiformes | Notopteridae | *Notopterus* | *Notopterus notopterus* | Ullinkaya |
| 2 | Elopiformes | Megalopidae | *Megalops* | *Megalops cyprinoides* | Kondinga |
| 3 | Anguilliformes | Anguillidae | *Anguilla* | *Anguilla bengalensis* | Baimuchhu |
| 4 | Cypriniformes | Cyprinidae | *Catla* | *Catla catla* | Bochhe |
| 5 | | | *Cirrhinus* | *Cirrhinus mrigala* | Jadumosu |
| 6 | | | | *Cirrhinus reba* | Teegamosu |
| 7 | | | *Ctenopharyngodon* | *Ctenopharyngodon idella* | Gaddi chepa |
| 8 | | | *Labeo* | *Labeo bata* | Chamarai |

| | | | | | |
|---|---|---|---|---|---|
| 9 | | | | *Labeo boga* | Boga labeo |
| 10 | | | | *Labeo calbasu* | Nalla Chamarai |
| 11 | | | | *Labeo rohita* | Rohu |
| 12 | | | *Osteobrama* | *Osteobrama cotio* | Chedu parige |
| 13 | | | *Puntius* | *Puntius chola* | Chedu bethe |
| 14 | | | | *Puntius conchonius* | Chukka bethe |
| 15 | | | | *Puntius gelius* | Bethe |
| 16 | | | | *Puntius guganio* | Bethe |
| 17 | | | | *Puntius filamentosa* | Bethe |
| 18 | | | | *Puntius sophore* | Bethe |
| 19 | | | | *Puntius terio* | Bethe |
| 20 | | | | *Puntius ticto* | Bethe |
| 21 | | | *Chela* | *Chela cachius* | Jobidai |
| 22 | | | *Salmostoma* | *Salmostoma phulo* | Nettallu |
| 23 | | | *Amblypharyngodon* | *Amblypharyngodon mola* | Ilambrai |
| 24 | | | *Rasbora* | *Rasbora daniconius* | Chedu parige |
| 25 | | | *Danio* | *Danio devario* | Aata Parigi |
| 26 | Siluriformes | Bagridae | *Mystus* | *Mystus armatus* | Gaddi jella |
| 27 | | | | *Mystus bleekeri* | Nara jella |
| 28 | | | | *Mystus cavasius* | Aaku jella |
| 29 | | | | *Mystus gulio* | Yeti jella |
| 30 | | | | *Mystus vittatus* | Aata jella |
| 31 | | | *Aorichthys* | *Aorichthys seenghala* | Mutte jella |
| 32 | | Siluridae | *Ompok* | *Ompok bimaculatus* | Guggidama |
| 33 | | | *Wallago* | *Wallago attu* | Waluga |
| 34 | | Schilbeidae | *Pseudeutropius* | *Pseudeutropius atherinoides* | Sunku jella |
| 35 | | Clariidae | *Clarias* | *Clarias batrachus* | Marpu |
| 36 | | Heteropneustidae | *Heteropneustes* | *Heteropneustes fossilis* | Ingilayee |
| 37 | | Loricariidae | *Pterygoplichthys* | *Pterygoplichthys pardalis* | Deyyapu chepa |
| 38 | Cyprinodontiformes | Hemiramphidae | *Hyporhamphus* | *Hyporhamphus limbatus* | Kovasi |
| 39 | | Belonidae | *Xenentodon* | *Xenentodon cancila* | Yeti kovasi |
| 40 | Perciformes | Centropomidae | *Lates* | *Lates calcarifer* | Pandugappa |
| 41 | | Ambassidae | *Chanda* | *Chanda nama* | Chedu bethhe |
| 42 | | Lutjanidae | *Lutjanus* | *Lutjanus johni* | Keesani guraka |
| 43 | | Nandidae | *Nandus* | *Nandus nandus* | Keesu guraka |
| 44 | | Cichlidae | | *Etroplus canarensis* | Duvvena guraka |

| | | | | | |
|---|---|---|---|---|---|
| 45 | | | *Etroplus* | *Etroplus maculatus* | Duvvena chepa |
| 46 | | | *Oreochromis* | *Oreochromis mossambica* | China guraka |
| 47 | | | | *Oreochromis niloticus* | Guraka |
| 48 | Mugiliformes | Mugilidae | *Mugil* | *Mugil cephalus* | Katti parige |
| 49 | | Gobiidae | *Glossogobius* | *Glossogobius guiris* | Isakadontu |
| 50 | | Anabantidae | *Anabas* | *Anabas testudineus* | Natu goraka |
| 51 | | Channidae | *Channa* | *Channa punctatus* | Bonta mattagidisa |
| 52 | | | | *Channa marulius* | pumeenu |
| 53 | | | | *Channa striatus* | Korameenu |
| 54 | Mastacembeliformes | Mastacembelidae | *Macrognathus* | *Macrognathus aral* | Bommidai |
| 55 | | | | *Macrognathus pancalus* | Chinna bommidai |

Fish catching and selling is the main income source for fisher folks in and around the river Krishna at Vijayawada. They used traditional methods for fish catching which increases the sustainability of fishes in river. They are selling fishes through their fishermen cooperative society. The desiltation and non-desiltation areas of river Krishna, upstream water has represented with the maximum number (55 fishes) of fish species belonging to different groups (Photogrps enclosed Annexures- 2).

The abundance of species like *Catla,* Rohu, Mrigala, *Labeo bata* and L. *boga, Mystus* and *Channa* was higher than other species available in river Krishna. The highest distribution and abundance of Cyprinidae members (55 species) observed in the present study showing that fish community in river Krishna has not been disturbed by disilatation activity.

**Avian fauna of river Krishna**

Table 12. List of avian fauna recorded in Krishna River upstream of Parkasam Barrage 13.5

| S. No. | Orders | Family | Scientific name | Common name | Category |
|---|---|---|---|---|---|
| 1 | Podicipediformes | Podicipedidae | *Tachybaptus ruficollis* (Pallas) | Little Grebe | R |
| 2 | Suliformes | Phalacrocoracidae | *Phalacrocorax fuscicollis* (Stephens) | Indian cormorant | R |
| 3 | | | *Phalacrocorax niger* | Little cormorant | R |

| | | | | | |
|---|---|---|---|---|---|
| | | | (Vieillot) | | |
| 4 | Pelecaniformes | Ardeidae | *Ardea cinerea* (Linnaeus) | Grey Heron | R/M |
| 5 | | | *Ardea purpurea* (Linnaeus) | Purple Heron | R |
| 6 | | | *Butorides striata* (Linnaeus) | Little Green Heron | R |
| 7 | | | *Ardeola grayii* (Sykes) | Indian Pond Heron | R |
| 8 | | | *Bubulcus ibis* (Linnaeus) | Cattle Egret | R |
| 9 | | | *Casmerodius albus* (Linnaeus) | Large Egret | R/LM |
| 10 | | | *Egretta garzetta* (Linnaeus) | Little Egret | R/M |
| 11 | | Threskiornithidae | *Threskiornis melanocephalus* (Latham) | Oriental white Ibis | M |
| 12 | | | *Platalea leucorodia* (Linnaeus) | Eurasian spoonbill | M |
| 13 | Ciconiiformes | Ciconiidae | *Mycteria leucocephala* (Pennant) | Painted Stork | R/LM |
| 14 | | | *Anastomus oscitans (Boddaert)* | Asian Open bill stork | R/LM |
| 15 | Accipitriformes | Accipitridae | *Pernis ptilorhyncus* (Temminck) | Oriental Honey Buzzard | R/M |
| 16 | Gruiformes | Rallidae | *Amauronis phoenicurus* (Pennant) | White- breasted Waterhen | R |
| 17 | | | *Gallinula chloropus* (Linnaeus) | Common Moorhen | R |
| 18 | | | *Fulica atra* (Linnaeus) | Common Coot | R |
| 19 | Charadriiformes | Charadriidae | *Vanellus indicus* (Boddaert) | Red- Wattled Lapwing | R |
| 20 | | | *Charadrius dubius* (Scopoli) | Little Ringed Plover | R |
| 21 | Columbiformes | Columbidae | *Streptopelia traquebarica* (Hermann) | Red Collared Dove | R |
| 22 | | | *Streptopelia chinensis* (Scopoli) | Spotted Dove | R |
| 23 | Coraciiformes | Alcedinidae | *Ceryle rudis* (Linnaeus) | Lesser Pied Kingfisher | R |
| 24 | | | *Alcedo atthis* (Linnaeus) | Small Blue Kingfisher | R |
| 25 | Cuculiformes | Cuculidae | *Eudynamys scolopacea* (Linnaeus) | Asian Koel | R |
| 26 | | | *Centropus sinensis* (Stephens) | Greater Coucal | R |

| | | | | | |
|---|---|---|---|---|---|
| 27 | Passeriformes | Nectariniidae | *Nectarinia minima* (Sykes) | Small sunbird | R |
| 28 | | | *Nectarinia asiatica* (Latham) | Purple Sunbird | R |

R. Resident Lm- local migratory m- migratory

Birds are recognized as one of the most important indicators of the state of environment, as they are sensitive to habitat change. The present study on avian faunal diversity carried for three months period at river Krishna upstream from Prakasam barrage. The observed and indentified 28 avian species were found belonging to 12 families of 11 orders (table 12). Seven of the 28 avian species identified were of Ardeidae family belongs to Pelecaniformes order. The identified avian species were classified into Resident, Local & migratory and Migratory categories. Lake Kolleru and Uppalapdu which are situated nearer to river Krishna are the home-grounds for different birds and there from these birds frequently visit river Krishna for feeding. The resident birds at the sites were found to be adapted for habitat, feeding and breeding & hatching purposes, whereas the other species depend only for feeding activity. Krishna upstream having good vegetation and algae at riverbank sides and islands seems to be most favourable feeding grounds for avian fauna.

Figure showing avian fauna of river Krishna

Figure showing avian fauna of river Krishna

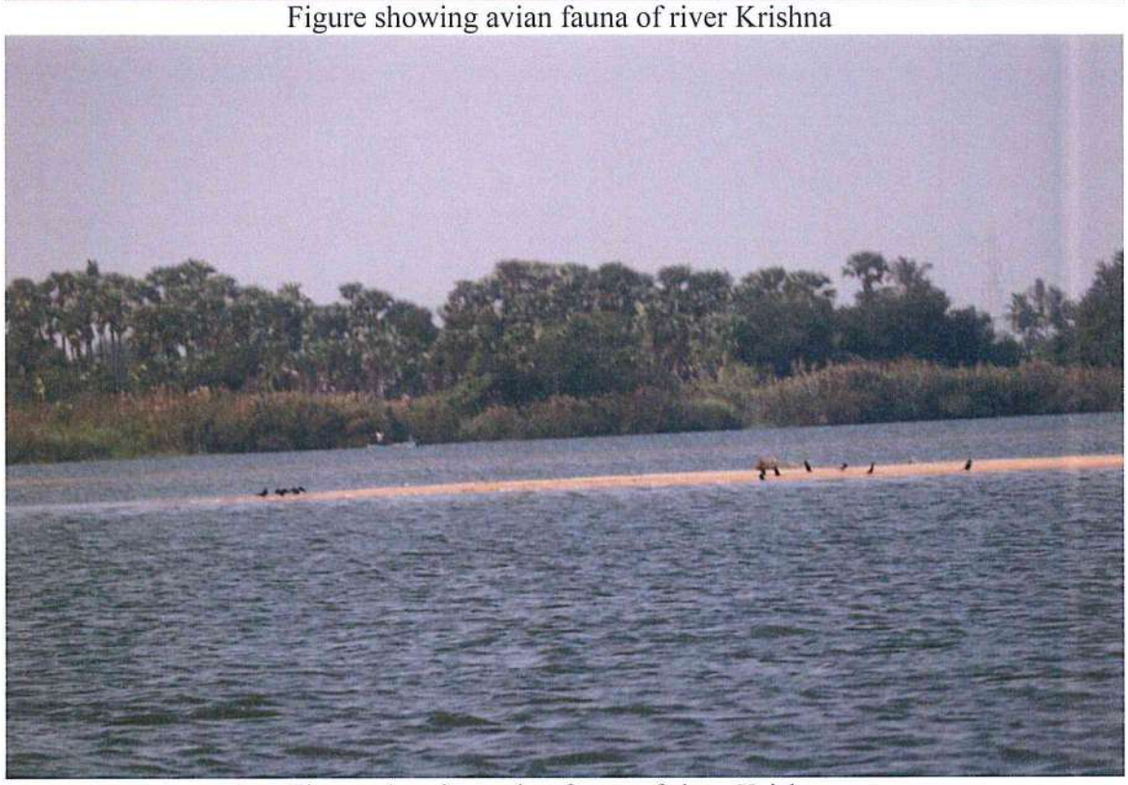

Figure showing avian fauna of river Krishna

## VII. SOCIO-ECONOMIC EFFECTS OF DESILTATION IN RIVER KRISHNA (UPSTREAM OF PRAKASAM BARRAGE), VIJAYAWADA

Social effects are evolved from the environmental, social and economic factors; however, it should be emphasized the quantifying socio-economic effects is a difficult task. An assessment and a study on socio-economic effects of desiltation in river Krishna would be helpful in wise decision making in river management. Though some sub-components of desiltation may improve the social conditions i.e., income generation, local revenue, livelihood, employment etc.

The investigator and research assistant have gone through the sand reach points and desiltation places i.e., Undavalli, Venkatayapalem, Lingayapalem, Rayapudi Surayapalem and Ibrahimpatnam villages. The study on Socio-Economic Impacts was conducted at above said places to know the socio-economic effects of people due to desiltation in river Krishna with respect by following methods:

### *VII. a. Research Methodology*

The research methodology used to carry out the study and evaluate the research objectives. It is clearly emphasizesthe research design, nature of the sample, methods of sample selection, size of the sample, data collection tools and techniques and the statistical tools used to analyze the collected data in order to draw inferences and conclude accordingly.

### *VII.b. Research Design*

Research design is the conceived plan and structure of investigation to obtain answers to the research objectives. The problem under the research is to describe certain characteristics such as applications, dependency, acceptability and advantages of the subject matter under consideration. Hence, the research design has adopted for the study is 'analytical research'.

### *VII.c. Objectives of the Study*

The study is conducted with the following objectives:

1) To understand the problems of people effected due to the desiltation at river Krishna, upstream of Prakasam Barrage (13.5 Km), Vijayawada.
2) To study the Socio-economic effects during desiltation stage at different places of river Krishna, upstream of Prakasam Barrage (13.5 Km), Vijayawada.
3) To find out the livelihood conditions of the fishermen community in the selected villages of desiltation in river Krishna, upstream of Prakasam Barrage, Vijayawada.

*VII.d. Study Area and Sample Method*

The research is designed to conduct the socio-economic effects of fishermen community in the selected upstream villages of river Krishna having the sand reach points and desiltation places i.e. Undavalli, Venkatayapalem, Lingayapalem, Rayapudi, Surayapalem and Ibrahimpatnam villages. The study on Socio-Economic effects were conducted at above said places to study the impact of desiltation and affected families/people depended on river Krishna.

*VII.e. Sample Size*

The researcher has followed the 'purposive sampling method' to select the sample respondents. The fishermen community from the villages of Undavalli, Venkatayapalem, Lingayapalem, Rayapudi, Surayapalem and Ibrahimpatnam were selected for the study. Twenty-five fishermen families, as respondents, were selected from each village i.e., from six villages, total 150 respondent families were selected to conduct the study.

*VII.f. Data Collection Tools*

A structured interview schedule was prepared by the investigator and interviews were conducted to the respondent families and desiltation workers for collection of first- hand information as primary data and the data was used for the study.

*VII.g. Socio-Economic Study*

The objective of the study is to identify Socio-Economic effects and to prepare complete inventory of affected fishermen community/families and dependant persons at desiltation places of river Krishna, upstream (13.5 Km) of Prakasam Barrage, Vijayawada, and to identify the social impacts. In order to capture the primary data for present exercise, an interview schedule was carried out. As a part of the study, socio-economic survey has been conducted by the researcher to identify the effects on livelihood of fishermen families/dependent persons and list out the effects.

The socio-economic effects due to the desiltation in river Krishna, upstream of Prakasam Barrage, Vijayawada have been classified as:

1) Socio-economic effects at beginning of the desiltation stage of river Krishna, upstream of Prakasam Barrage (13.5 Km), Vijayawada.
2) Socio-economic effects during desiltation stage of different places of river Krishna, upstream of Prakasam Barrage (13.5 Km), Vijayawada.

3) Socio-economic effects after desiltation stage of river Krishna, upstream of Prakasam Barrage, Vijayawada.

*VII.h. Socio-Economic Household Survey for effected Families/Persons*

The study of the families/persons effected with desiltation was conducted in and around of river Krishna. The survey, inter alia, has assessed the effects of the desiltation, the socio-demographic aspects, economical aspects, and living standards of effected persons/families particularly the fishermen communities in Undavalli, Venkatayapalem, Lingayapalem, Rayapudi, Surayapalem and Ibrahimpatnam due to the desiltation in river Krishna. The data was collected on the following aspects during the study:

- Socio-economic conditions of the fishermen communities and the dependent persons;
- Family structure and number of family members of the respondents;
- Literacy levels of the respondents;
- Occupation type and income levels of the respondents;
- Inventory of household assets;
- Indebtedness of the respondents;
- Loss of immovable assets due to the desiltation and degree of loss;
- Accessibility to the community facilities;
- Perceptions on the resettlement and rehabilitation measures;
- Perceived income restoration measures;
- Willingness to participate in the desiltation; and
- Present livelihood status.

*VII.i. Data Analysis and Interpretation*

The collected data is tabulated and interpreted to understand the results of the study.

*VII.i.1. Age wise Distribution of the Respondents*

Table 13. Age Group of the Respondents

| S. No. | Age Group | No. of Respondents | Percent |
|---|---|---|---|
| 1 | 21 to 30 | 18 | 12.00 |
| 2 | 31 to 40 | 45 | 39.00 |
| 3 | 41 to 50 | 59 | 39.33 |
| 4 | Above 51 | 28 | 18.67 |

| | | |
|---|---|---|
| **Total** | **150** | **100.00** |

Age group of the respondents in the study gives good idea about area and its people because if the number of aged people working in specific area then there can be different problems and attitudes of that respective study area. If the number of younger people is high then social problems, attitudes can be different like unemployment. So, the understanding of the age pattern is very important and age data of all the effected persons of desiltation is given in table 13.

*VII.i.2. Family Structure of the Respondents*

Table 14. Family System of the Respondents

| S. No. | Family System | No. of Respondents | Percent |
|---|---|---|---|
| 1 | Joint Family | 27 | 18.00 |
| 2 | Nuclear Family | 123 | 82.00 |
| **Total** | | **150** | **100.00** |

Table 14 shows that the nuclear families are dominating in the study area of fishermen communities with an incidence of 82 percent, while the remaining 18 percent were observed living in joint family system.

*VII.i.3. Religion of the Respondents*

The social division of the households in the study area of fishermen community, the figure show that (113 families out of 150) 75.33 percent of the total households are belongs to Hindu religion and it is followed by 22.67 percent (34 families out of 150) of the respondents are Christians and only 2 percent are Muslims were settled in the study area. Majority of the fishermen community belongs to the backward classes in the social system their basic profession is fishing catching and netting for fishes.

Table 15. Religion of the Respondents

| S. No. | Religion | No. of Respondents | Percent |
|---|---|---|---|
| 1 | Hindu | 113 | 75.33 |
| 2 | Christian | 34 | 22.67 |
| 3 | Muslim | 3 | 2.00 |
| 4 | Others | -- | -- |
| **Total** | | **150** | **100.00** |

*VII.i.4. Marital Status of Desiltation effected persons*

The analysis on marital status of the desiltation effected fishermen community persons indicates that 85.33 percent of respondents are married, while 12 percent are unmarried and 2 percent are living alone, whereas 0.67 percent is divorced are living in the study area. The marital status of the respondents is depicted in the following Table.

Table 16. Marital Status of the Respondents

| S. No. | Marital Status | No. of Respondents | Percent |
|---|---|---|---|
| 1 | Married | 128 | 85.33 |
| 2 | Unmarried | 18 | 12.00 |
| 3 | Single | 3 | 2.00 |
| 4 | Separated | 1 | 0.67 |
| **Total** | | **150** | **100.00** |

*VII.i.5. Educational Status of the Respondents*

Table 17. Educational Status of the Respondents

| S. No. | Education | No. of Respondents | Percent |
|---|---|---|---|
| 1 | Illiterate | 79 | 52.67 |
| 2 | Up to 5$^{th}$ Class | 35 | 23.33 |
| 3 | Up to 7$^{th}$ Class | 14 | 9.34 |
| 4 | Up to 10$^{th}$ Class | 11 | 7.33 |
| 5 | ITI/Intermediate | 8 | 5.33 |
| 6 | Diploma/Graduation | 3 | 2.00 |
| **Total** | | **150** | **100.00** |

Among the total 150 respondents more than half (52.67%) of the respondents are illiterates, since they have no facility for education, and they attained more than 40 years of age. From among the total respondents, 23.33 percent of the respondents had education up to 5$^{th}$ standard they can put their signature only, whereas 9.34 percent of the respondents having education up to 7$^{th}$ class and 7.33 percent had studied up to 10$^{th}$ class. The small group (5.33%) of the respondents studied ITI/Intermediate and only 2 percent have studied diploma/graduation. The educational status of the fishermen community is very low the data is enumerated in the above table.

*VII.i.6. Occupation of the Respondents*

Table 18. Occupation of the Respondents

| S. No. | Occupation | No. of Respondents | Percent |
|---|---|---|---|
| 1 | Fishing | 28 | 18.67 |
| 2 | Netting | 5 | 3.33 |
| 3 | Desiltation | 111 | 74.00 |
| 4 | Labour Work | 4 | 2.67 |
| 5 | Others | 2 | 1.33 |
| **Total** | | **150** | **100.00** |

The above table 6 revealed that the occupation of the respondents. The investigator has enquired that out of total 150 respondents, majority (74%) of them are settled in desiltation work from several years, because they are getting the regular and more income than fishing and compare with other professions. Only 18.67 percent of the respondents felt that their profession is fishing and few respondents (3.33%) are settled in fish netting in the river Krishna, but they are not getting the regular income, where as 2.67 percent attending labour work and only 1.33 percent are doing self-employment in their locality.

Traditionally, the community was into fishing activity. During 2015, when the de-siltation works started, in addition to fishing the people native to the region have taken debt and invested in dredging machinery like boats etc. It was informed by the public that before the debts taken for dredging machinery is cleared the desiltation activity is stopped due to which the economic condition of the people has deteriorated.

*VII.i.7. Daily Income level of the Respondents*

Table 19. Daily Income Level of the Respondents

| S. No. | Daily Income in Rupees | No. of Respondents | Percent |
|---|---|---|---|
| 1 | Below 500/- | 6 | 4.00 |
| 2 | 501/- to 800/- | 25 | 16.67 |
| 3 | 801/- to 1200/- | 67 | 44.67 |
| 4 | 1201/- to 1500/- | 38 | 25.33 |
| 5 | Above 1501/- | 14 | 9.33 |
| **Total** | | **150** | **100.00** |

Income of the respondents is presented in the table 19, out of the total 150 respondents, 4 percent are getting Rs.500/- per day, 16.67 percent are getting daily income between Rs.501/- to Rs.800/- per day. Majority (44.67%) of the respondents expressed that their daily income is between Rs.801/- to 1200/- per day, whereas 25.33 percent of the respondents expressed that their daily income is between Rs.1201/- to 1500/- and only 9.33 percent are getting the income per day is above 1500 rupees per day. Since the investigator has thoroughly interacted with all the respondents that they are attending the desiltation work in the river Krishna that is only source of regular income to them, and expressed that they have purchased the desiltation machine boats and have settled in the sand collection and desiltation work in the river Krishna.

*VII.i.8. Type of Housing assets owned by the Respondents*

Table 20. Type of House of the Respondents

| S. No. | Type of House owned | No. of Respondents | Percent |
|---|---|---|---|
| 1 | Owned Pukka | 105 | 70.00 |
| 2 | Owned Kacha | 20 | 13.34 |
| 3 | Rented Pukka | 17 | 11.33 |
| 4 | Rented Kacha | 8 | 5.33 |
| Total | | 150 | 100.00 |

The above table 20 depicts that the type of housing assets having by the respondents, among the total 150 respondents, majority (70%) of the them have owned permanent/pukka houses in their communities, it is followed by 13.34 percent have owned kacha houses since the government has provided the housing colony is developed to their communities. The remaining 16.66 percent of the respondents felt that they are recently migrated to these localities for getting of desiltation work in river Krishna, that's why they are staying in the rented houses. On the overwhelm, we can understand most of the respondents having owned houses in the colony or own constructed houses.

*VII.i.9. Indebtedness of the Respondents*

Table 21. Indebtedness of the Respondents

| **S. No.** | **Indebtedness in Rupees** | **No. of Respondents** | **Percent** |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1 | Below 1Lakh | 24 | 21.24 |
| 2 | 1to 3Lakhs | 35 | 30.97 |
| 3 | 3 to 5Lkhs | 31 | 27.43 |
| 4 | 5 to 7Lakhs | 18 | 15.93 |
| 5 | Above 7Lakhs | 5 | 4.43 |
| **Total** | | **113** | **100.00** |

Table 21 revealed that the indebtedness of the respondents, among the total 113 respondents more than 75 percent have the indebts. Out of 113 respondents, 30.97 percent have below 3 lakhs indebtedness and 27.43 percent have below 5 lakhs indebted, whereas 21.24 percent have below one lakh and 15.93 percent of the respondents were indebted with more than 7 lakhs. All the respondents felt that they have indebts because of they purchased the desiltation machine boats on finance based and received the loans from local financiers on interest basis. The loan amount being remitted daily or weekly basis to the loan lenders. The respondents expressed that if the government provides the loans, the indebts will be reduced and they may be tension free with the indebtedness.

*VII.i.10 Accessibility to the Community Facilities*

Table 22. Accessibility to the Community Facilities

| S. No. | Opinion | No. of Respondents | Percent |
|---|---|---|---|
| 1 | Good | 27 | 18.00 |
| 2 | Satisfactory | 85 | 56.67 |
| 3 | Bad | 38 | 25.33 |
| **Total** | | **150** | **100.00** |

Table 22 explains the accessibility with the community facilities to the respondents, more than half (56.67%) of the respondents felt that they are satisfying with the available facilities in the community and it is followed by 18 percent expressed that the present facilities in the community is good. On the other hand, one fourth (25.33%) of the respondents opined that existing facilities in the community is bad. The government and NGOs shall take initiation to provide the education, health and infrastructural facilities to develop their communities.

*VII.i.11. Perception on Resettlement and Rehabilitation Measures*

Table 23. Perception on Resettlement and Rehabilitation Measures

| S. No. | Opinion | No. of Respondents | Percent |
|---|---|---|---|
| 1 | Immediate | 42 | 28.00 |
| 2 | Some what | 65 | 43.33 |
| 3 | In future | 43 | 28.67 |
| Total | | 150 | 100.00 |

The present legal policy and government policy of the desiltation is stopped in the upstream of river Krishna, all the people who worked in desiltation they have no work since more than 9 months and they are not interested to attend other works since they habitat with the same work. Table 23 describes about the respondents' perception on resettlement and rehabilitation measures, out of 150 respondents, 28 percent expressed that the facilities shall provide immediately and 43.33 percent felt that some what measures shall be initiated on resettlement and rehabilitation. On the other hand, 28.67 percent of the respondents opined that in future the measures can be initiated for their settlement.

*VII.i.12. Perceived income for restoration measures*

Table 24. Income for Restoration Measures

| **S. No.** | **Opinion** | **No. of Respondents** | **Percent** |
|---|---|---|---|
| 1 | Yes | 127 | 84.67 |
| 2 | No | 23 | 15.33 |
| **Total** | | **150** | **100.00** |

The above table explains the opinion on measures for restoration of income, among the total 150 respondents most (84.67%) of the respondents expressed that present they have no work in the river Krishna so that they wanted to restore the present income generation measures to maintain their livelihoods. Whereas 15.33 percent opined that there is no need of measures to restoration of income.

*VII.i.13. Present Livelihood Status*

Table 25. Present Livelihood Status

| **S. No.** | **Opinion** | **No. of** | **Percent** |
|---|---|---|---|

| | | Respondents | |
|---|---|---|---|
| 1 | Good | 6 | 4.00 |
| 2 | Satisfactory | 23 | 15.33 |
| 3 | Bad | 94 | 62.67 |
| 4 | Very difficult | 27 | 18.00 |
| **Total** | | **150** | **100.00** |

Table 25 narrates that the present livelihood status of the respondents in the study area, out of total 150 respondents majority (62.67%) expressed that the present condition of livelihood status is bad due to at present they have no work and almost have the indebts for purchase of machine boats for desiltation, and it is followed by 18 percent of the respondents expressed that their present livelihood is very difficult to meet the food and groceries. Whereas only 4 percent are in good condition. The government and NGOs have to take initiation to meet their daily needs and to improve the livelihood conditions of the fishermen community and other dependants in the study area.

*VII.i.14. Findings of the Study*

Interviews and observations were carried out with fishermen community/families, individuals and other dependents. Village level consultations were held during socio-economic study and important issues were discussed with the fishermen community. The issues are related to occupation, income, loss of livelihood, and provision of livelihood opportunities during and after desiltation in river Krishna 13.5km upstream of Prakasam Barrage were asked.

The following findings are presented based on the study:

1) Regarding the age group, 80 percent of the respondents attained the age between 31 to 50 years. Regarding the family system the nuclear families are dominating in the study area of fishermen communities with an incidence of 82 percent. Majority (75.33%) of the respondents of the total households are belong to Hindu religion. Majority of the fishermen community persons in the study area indicates (85.33%) that are married.

2) The aspect of education of the respondents, more than half (52.67%) of the respondents are illiterates and remaining are low literate, since they have no facility for education and now they have attained more than 50 years of age.
3) Regarding the occupation, majority (74%) of the respondents were settled in desiltation work since several years, because they are getting regular and more income compare with fishing other local professions.
4) The aspect of daily income of the respondents, majority (44.67%) of them expressed that their daily income is between Rs.801/- to Rs.1200/- per day, whereas 25.33 percent of the respondents getting daily income is between Rs.1201/- to Rs.1500/- but they have to pay the instalments for indebtedness.
5) The aspect regarding the own house, majority (70%) of the respondents have owned houses in their communities/villages.
6) Regarding indebtedness, out of 113 respondents, 30.97 percent have below 3 lakhs indebtedness and 27.43 percent have below 5 lakhs indebted, and 15.93 percent of the respondents were indebted with more than 7 lakhs. All the respondents felt that they have indebts because they purchased the desiltation machine boats on finance based and barrowed the loans from local financiers on payment of interest and instalment basis.
7) The facilities available in the community, more than half (56.67%) of the respondents are satisfied with the available facilities in the community, but there is a need to improve the community facilities.
8) Perception on resettlement and rehabilitation measures, 28 percent expressed that the facilities shall provide immediately, and 43.33 percent felt that some what measures shall initiated on resettlement and rehabilitation.
9) The issue of present income generation, most (84.67%) of the respondents expressed that they have no work in the river Krishna, so they wanted to restore the present income generation measures to maintain their livelihoods.
10) Most (86%) of the respondents willing to participate in the desiltation since there is no way to get the income and work in other areas, because they know the present work from several years.

11) Majority (62.67%) of the respondents expressed that the present condition of livelihood is bad, because of not having any work and almost all the people are indebted for acquiring of the sand mine boats.

*VII.i.15. Socio-Economic Effects*

The investigators gone through the study findings, discussions with the community, the details of socio-economic study conducted in the villages of Undavalli, Lingayapalem, Venktayapalem, Surayapalem, Rayapudi, and Ibrahimpatnam villages in the upstream (13.5km) of Prakasam Barrage, river Krishna. The researchers have visited the villages and sand reach points in the river at different places.

*VII.i.16. Economic Activity and Livelihood Pattern*

The fishermen community in the study area include families, dependants and all the respondents i.e., those who have been engaged desiltation for some economic activity during the last few years.

Therefore, there is an immense need to address the human costs and the measures to be taken should create trust and hope preferably with immediate monetory gains to establish confidence in the functioning of the system. Concrete plan to avoid impoverishment risks and restore/upgrade the income and livelihood of the effected families shall be made immediately. Food security measures shall be taken for the loss of work in the study area. Therefore, there is a need to create employment to earn their bread but with immediate payment of no work/unemployment gratuity especially based on individuals' minimum needs rather than based on a family because all the members in the study villages are mostly daily wage earners.

*VII.i.17. Ameliorative Measures Recommended*

In addition to giving suitable positive consideration to the people effected as discussed earlier, the study recommends the following measures:

1) The livelihoods are to be converted into non desiltation livelihoods and take immediate measures for upgradation of skills of the fishermen cum dependents of river Krishna.
2) Provision of ample access to interest free credit to encourage self-employment.
3) All fishermen families and people of the communities in the study villages should provide with healthcare, free quality education and creation of various opportunities.

4) Every family should earn at least Rs.15000/- per month. Further, those affected families may be consider for more entitlements under the regular public distribution system.
5) Establishment of homes for the homeless people, who are poor and loss of livelihood due to the stoppage of desiltation.

Figure showing team interaction with fisher folks at Rayapudi village

Figure showing team interaction with fisher folks at Rayapudi village

Figure showing team interaction with fisher folks at Ibrahimpatnam village

Figure showing interaction with fisher folks at Ibrahimpatnam village

## VIII PERSONAL INTERACTION WITH FISHER FOLKS ABOUT THE PRESENCE DEAD MOLLUSCANS AT RAYAPUDI

During the personal interaction with the fisher folks of Rayapudi area about the presence of dead molluscan shells on flood plain areas at Rayapudi, the fishermen clearly expressed that the dead molluscan shells (Death mainly due to predators and age factor) get struck to fishing nets during fish catching, which will be separated from the nets and left at a common shore place itself leading to their accumulation.

Figure showing personal interaction with fisher folks about the presence dead molluscan

Figure showing dead molluscans struck in the nets

Figure showing dead molluscans separation from the net

*Various other photographs taken at the sampling sites during the study period w.r.t. collection of samples and interaction with fishermen are given in Annexture-3.

## IX CONCLUSIONS OF THE STUDY

- During the study period (October – December, 2019), there was no desiltation activity at all the study sites of river Krishna upstream to Parkasam barrage upto 13.5 Kms.
- The present estimated TSS and Turbidity parameters of river Krishna upstream waters are within the permissible limits of fresh waters. These findings are found to be supportive and favourable for flora and fauna towards the sustainability of ecological balance.
- As the observed phytoplankton, during the study period, of the water samples collected from reference and desiltation sites of river Krishna was normal and abundant, it seems that there is no ecological impact on the phytoplankton and thereby primary producers even at the desilting areas.
- The riparian vegetation at all the study sites, both of non-desilted reference site and desiltation sites, was found normal and dense comprising trees, shrubs, herbs etc., except at the point of place where the approach road was laid for the transportation of sand to land.
- The available biotic components of the river Krishna upstream water to show that the water quality of the river. Invertebrates as molluscs and vertebrates as fishes

have been used as indicators. In the present investigation in the river Krishna we have recorded good number of Zooplankton, Benthic crustaceans, molluscs, fishes and avian fauna. Among faunal populations *Brachionus, Keritella* of Rotifera; *Ceriodaphnia, Moina, Macrothrix* of Cladocera, different species of Cyclopoid, Calonoid copepods and occurrence of molluscs as *Bellamiya, Thiara, Lamellidens* and the presence of Mayfly nymph, *Gerris* and also fishes like *Catla catla, Labeo bata, L.boga Mystus, Clarias, Puntius* species indicate that the community composition of the ecosystem. These can be used as faunal bio-indicators and water quality of river through biological assessment. Qualitatively the number of genera and species of different taxa found in desiltation area of river Krishna, upstream water to show that the species diversity is more and uniform. This clearly indicates that ecosystem is more or less homogenous. This is corollary to the river characteristics and ecological conditions.

- The types and occurance of avian fauna including the migratory category noticed at the upstream of river Krishna indicating that the habitat environment of river Krishna is favourable to the livelihood for birds in all aspects.
- The Socio-Ecominic study recommends duly taking into consideration of the measures recommended to safeguard livelihoods of the fishermen community and other effected families in the study villages, which are different from the other villages in and around the river Krishna. Certainly, the fishermen community people of these villages feel more loss as ofnow, but they should be made future beneficiaries.

## OVERALL CONCLUSION OF THE STUDY

Basing on the above conclusions drawn from different studies, the members opined that there was no notable negative impact on water quality regarding TSS & Turbidity, Phytoplankton, Riparian vegetation, Zooplankton, Benthos, Fishes and Avian fauna at desiltation sites in river Krishna during the study period. However, the members came to understand from the discussions with fishermen, that due to stopping of desiltation activity, there was some impact on the livelihood of dependant fishermen-cum-desiltation workers of the villages.

## SUGGESTIONS

1. Though not found any noticeable disturbance in flora, fauna and riparian vegetation during the study period (October to December,2019) at reference and desiltation sites in river Krishna upstream of Prakasam Barrage (13.5 Km), the frequency and level of desiltation may be optimized to
   - to retain the better water quality of river Krishna
   - to upkeep the storage capacity of Prakasam Barrage to its full capacity, as river Krishna at Vijayawada is the source for irrigation and drinking water.
   - to sustain the primary producers, flora and fauna of river Krishna
   - to have good riparian vegetation at riverbank sides and on islands of river Krishna
2. To create favourable environment in the river for proper fish breeding activity during summer season (15th April to 15th June), desiltation activity may be given interval during summer as that of National policy on fishing holiday.
3. Encourage the usage of good number of manually operated boats, which will improve the livelihood conditions of the local fishermen-cum-desiltation workers as well as to maintain the sustainability of ecological environment in the river Krishna.

## SIGNATURES OF THE MEMBERS

1 Mahima T.
Scientist 'D'
Central Pollution Control Board
(Ministry of Environment, Forest & CC, Govt. Of India)
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2 Prof. G. Rosaiah
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3 Dr.G. Simhachalam
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5 Dr. P. Brahmaji Rao
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6 Dr. M. Trimurthi Rao
Department of Sociology & Social Work
Acharya Nagarjuna University
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## ANNEXURE-1

### CREDENTIALS OF ACHARYA NAGARJUNA UNIVERSITY

Acharya Nagarjuna University, a state university established in 1976, has been constantly striving towards achieving progress and expansion during its existence for over four decades, in terms of introducing new courses in the University Colleges, affiliated colleges and Professional colleges. Spread over 300 acres of land on the National Highway (NH-5) between Vijayawada and Guntur of Andhra Pradesh, the University is one of the front ranking and fastest expanding Universities in the state of Andhra Pradesh. The University was inaugurated on 11th September, 1976 by the then President of India, Sri Fakruddin Ali Ahmed and celebrated its Silver Jubilee in 2001. The National Assessment and Accreditation Council (NAAC) awarded 'A' grade to Acharya Nagarjuna University in the year 2016.

With campus student strength of over 5000, the University offers instruction for higher learning in 50 PG programs and guidance for the award of M. Phil and PhD in 48 disciplines spread over six campus colleges and one PG Campus at Ongole. The University had an excellent infrastructure and on-Campus facilities such as University Library, Computer Centre, Central Research Laboratory, Career Guidance and Placement Cell, Health Centre, Indoor & Outdoor Stadia and Multipurpose Gym, Student Centre & Fast-food Centre; Faculty Club; Dr. H.H. Deichman & Dr. S.John David Auditorium cum Seminar Hall etc.

### PROFILE OF THE MEMBERS INVOLVED IN THE STUDY

### PROF. G. ROSAIAH

Prof. G. Rosaiah is a senior faculty in the Department of Botany & Microbiology, Acharya Nagarjuna University with 28 years of teaching and research experience. He is specialized in Plant Physiology and his academic account consists publication of 45 National and International research papers and he has attended more than 50 conferences and workshops. Seven Ph.Ds. and 2 M.Phils. were awarded under his guidance, Sofar, he has

completed three Major Research Projects funded by UGC, DBT & ICAR. He is a very good administrator and held different positions like Registrar of Acharya Nagarjuna University, Coordinator - UG Exams, Coordinator - CDE Exams, Director - Directorate of Admissions etc.

**G. SIMHACHALAM**

Dr. G. Simhachalam is a senior faculty and alumni of Acharya Nagarjuna University, currently he is the Head and Associate Professor of the Department of Zoology & Aquaculture. He is specialized in Taxonomy, Biodiversity and Aquaculture. He gained experience of 25 years in Teaching and Research in ANU. Dr. Chalam has successfully completed the UGC funded Minor Research Project in 2010 and he discovered three new species. Dr. Chalam has published 25 research articles in peer reviewed and refereed International and National Journals and presented more than 55 papers in National/International Seminar/Conferences. Dr. Simhachalam served as Member, Institutional Ethics Committee, Govt. Medical College, Guntur and Advisory Member, Ministry of Fisheries, Govt. of Andhra Pradesh. Under his guidance, research scholars were awarded M.Phil. & Ph.D., degrees in the areas of diversity and distributional aspects of fishes, Ostracods, clam shrimps.

**Dr. V. UMAMAHAESWARA RAO**

Dr. V. Umamaheswara Rao is a senior faculty and alumni of Acharya Nagarjuna University. Currently he is working as Associate Professor in Department of Botany & Microbiology (UGC-SAP Phase II & DST-FIST Level I funded Department). His specialized areas are plant-microbe interactions and isolation of bioactive principles from different sources. He has put up 28 years of Teaching and 34 years of Research experience in ANU. He worked in one UGC Project and one APSEB Project. He has successfully completed an individual Major Research Project funded by UGC, New Delhi 2014. Life Member in Indian Science Congress and Associate fellow of Andhra Pradesh Akademi of Sciences. Dr. Rao has published 60 research articles in peer reviewed and refereed International and national Journals and presented more than 45 papers in National/International Seminars/Conferences. Under his guidance, sofar, six Ph.D. degrees and five M.Phil. degrees were awarded. Dr. Umamaheswara Rao serving as Referee to several reputed International and National Journals.

**Dr. P. BRAHMAJI RAO**

Dr. P. Brahmaji Rao is a senior faculty and alumni of Acharya Nagarjuna University, currently he is the Head and Associate Professor of the Department of Environmental Sciences. His specialized areas are Ecology, Biodiversity and Aquaculture in Andhra Pradesh. He has gained 25 years of Teaching and Research experience in ANU. Dr. Brahmaji has published 69 research articles in peer reviewed and refereed in International and national Journals and presented more than 60 papers in National/International Seminars/ Conferences. Under his guidance, 10 Ph.D. and 3 M.Phil. degrees were awarded to students in the areas of Environmental Sciences. Dr. Brahmajirao served as Member Pollution Control Board, Govt. of Andhra Pradesh and he has been involving in Environmental consaltancy.

**Dr. MARRAPU TRIMURTHI RAO**

Dr. Marrapu Trimurthi Rao is working as faculty in Acharya Nagarjuna University since 23 years with the specialized areas of Community Development, Human Resource Management and Medical& Psychiatric Social Work, received his M.A Social Work from Acharya Nagarjuna University and M.HRM, B.L and Ph. D from Andhra University and received honorary D.Litt from University of South America in 2017. He is currently an Associate Professor in the Department of Sociology and Social Work, Acharya Nagarjuna University, Guntur, Andhra Pradesh. Life Member for Indian Society of Labour Economics, National Institute of Personnel Management, Dr. S. Radhakrishnan Teachers Welfare Association, Mumbai and other professional bodies. Published 43 research articles in National & International Journals and presented more than 65 papers in National/International Seminars/Conferences.

Dr. Trimurthi Rao is Member, Expert Committee, Social Impact Assessment (SIA), Andhra Pradesh Capital Region Development Authority (APCRDA), Govt. of Andhra Pradesh; Member, Institutional Ethics Committee, Govt. Medical College, Guntur and Member, Regional Advisory Committee, Central Board for Workers Education, Vijayawada Region, Govt. of India. Eight Ph.D., degrees and five M. Phil., degrees were awarded under his guidance.

**DETAILS OF THE TECHNICAL MANPOWER AND FIELD PERSONAL INVOLVED**

1. Mr. K. Govinda Rao, Research Scholar, Department of Zoology and Aquaculture, University College of Sciences, ANU is working on Murrel fish diversity and biology with reference to *Channa striata* and he published seven papers in peer reviewed journals.

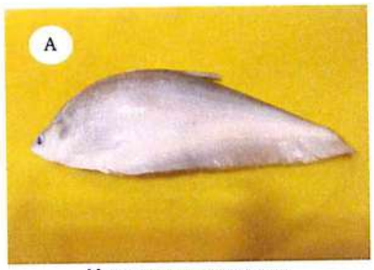
2. Mr. K. Samuel John, Research Scholar, Department of Botany and Microbiology, University College of sciences, ANU is working under supervision of Dr. V. Umamaheswara Rao on Isolation and Characterization of bioactive principles and communicated 2 research papers for publication.

3. Dr. K. Sasidhar, Research Scholar in the Department of Environmental Sciences. Extending research and Environmental Consultancy works carried out in the department. He published 21 peer reviewed research papers in International and National journals. He is having NABET Accreditation in the fields of Ecology and biodiversity.

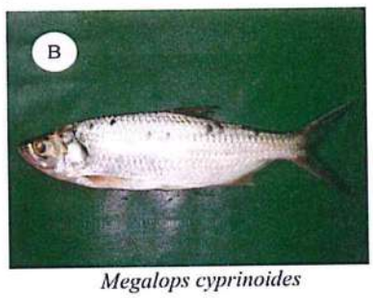
4. Dr. V. Ganga Raju, Research Scholar, did his research work on handloom weavers of Guntur and Krishna Districts of Andhra Pradesh under the Guidance of Dr. M. Trimurthi Rao, Department of Sociology and Social Work, ANU and published 9 research papers.

## ANNEXURE-2

### List of fish fauna recorded from Krishna River upstream of Prakasam barrage 13.5 km

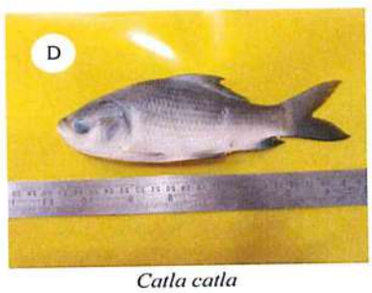



*Notopterus notopterus*

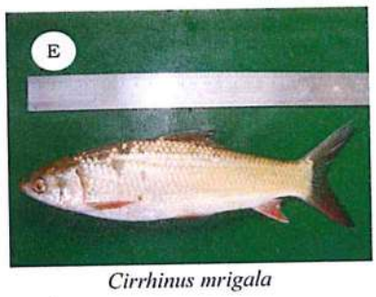



*Megalops cyprinoides*


*Anguilla bengalensis*




*Catla catla*

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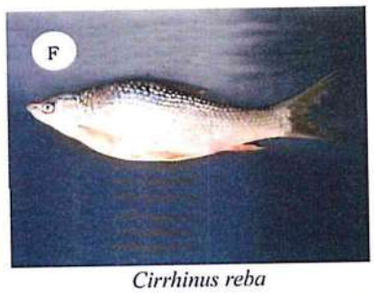


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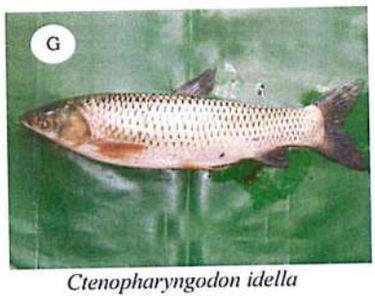


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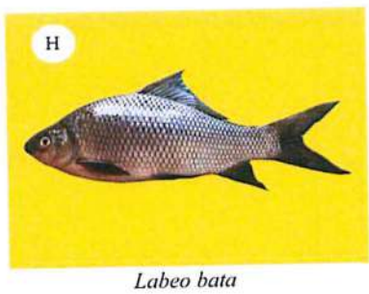


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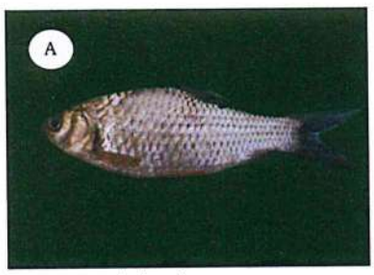


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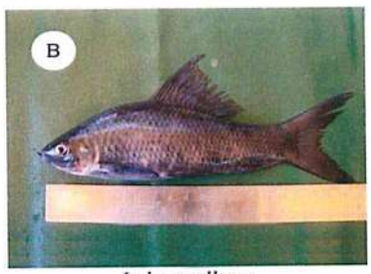


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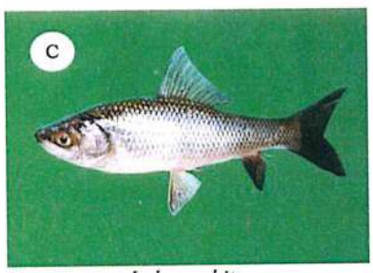


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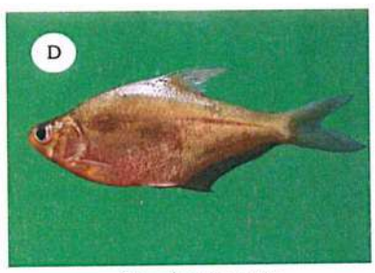


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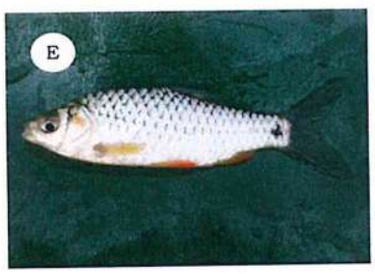
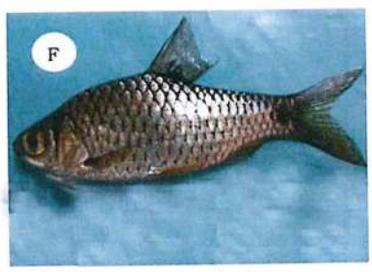
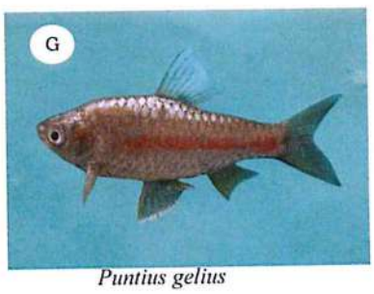



*Puntius chola*

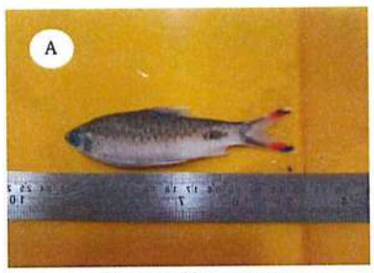



*Puntius conchonius*




*Puntius gelius*


*Puntius guganio*

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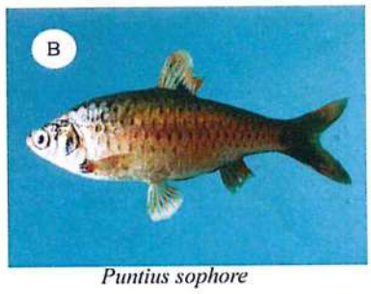
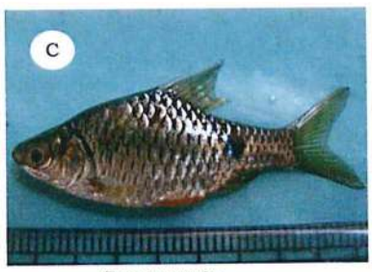



*Puntius sophore*

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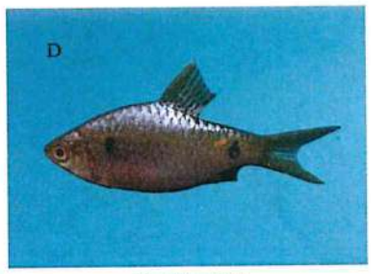
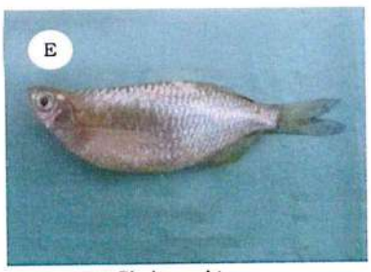
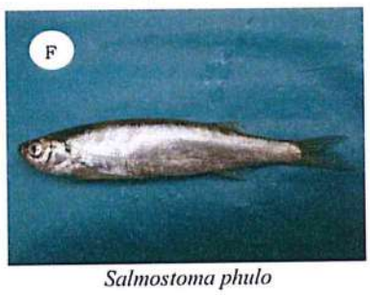


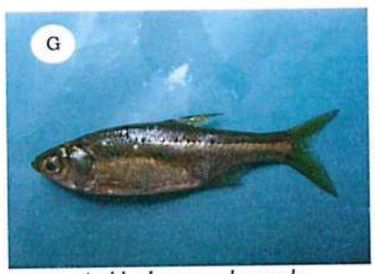

*Puntius ticto*



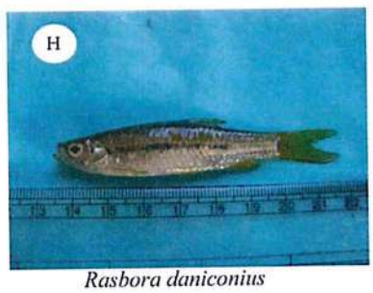

*Chela cachius*



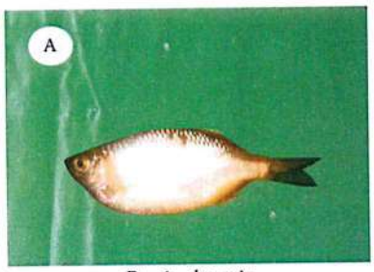

*Salmostoma phulo*



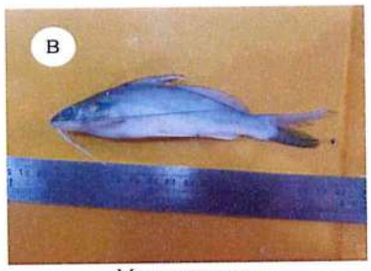

*Amblypharyngodon mola*



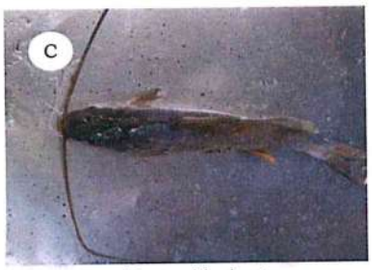

*Rasbora daniconius*




*Danio devario*




*Mystus armatus*

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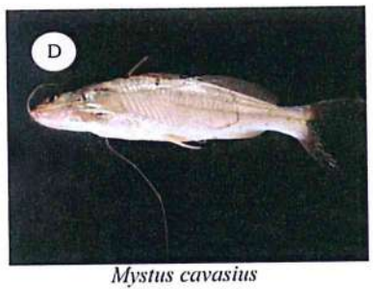


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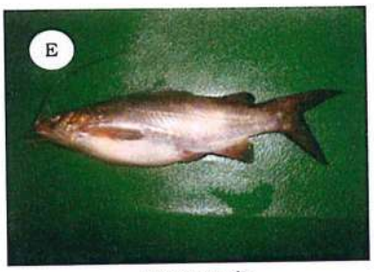
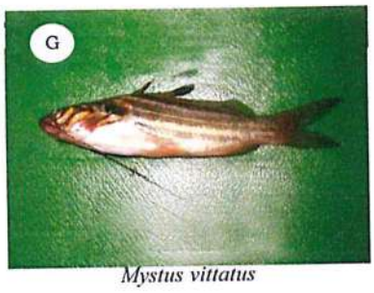
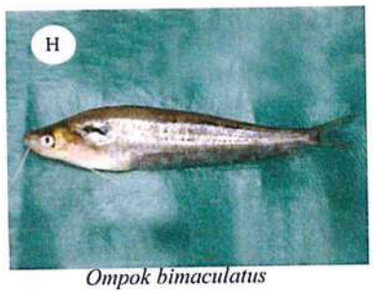



*Mystus gulio*

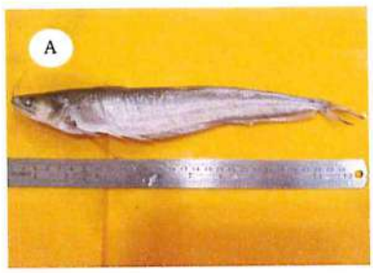

*Aorichthys seenghala*



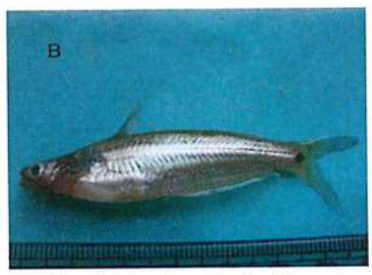

*Mystus vittatus*



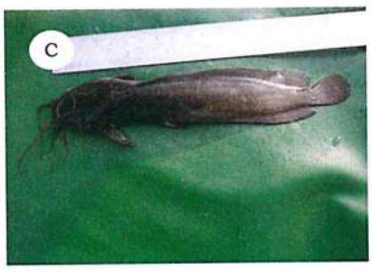

*Ompok bimaculatus*




*Wallago attu*




*Pseudeutropius atherinoides*

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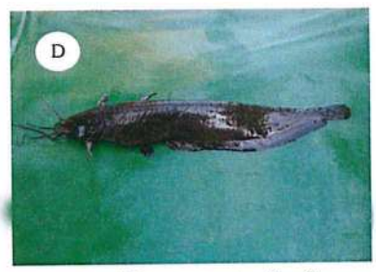
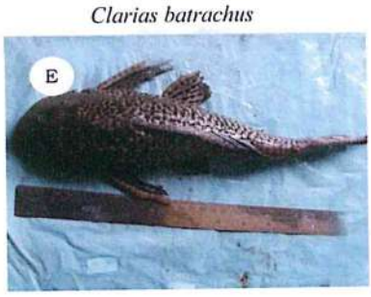
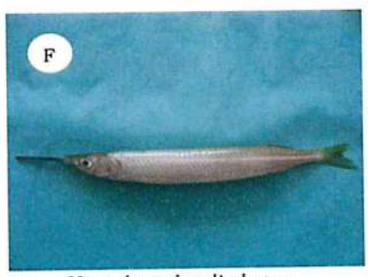


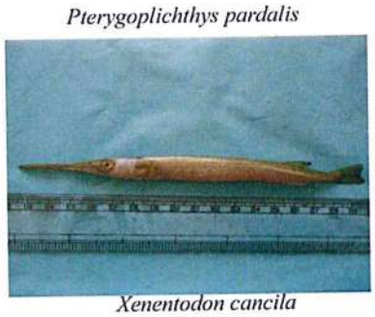

*Heteropneustes fossilis*




*Pterygoplichthys pardalis*




*Hyporhamphus limbatus*



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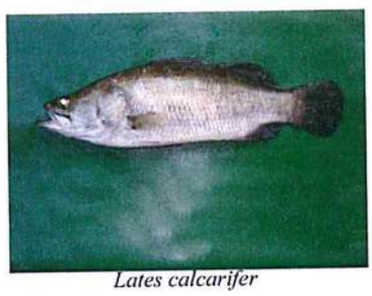

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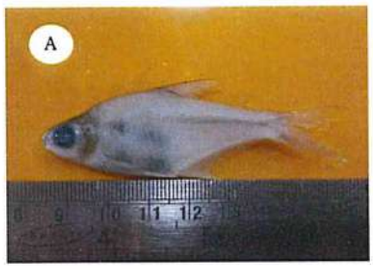
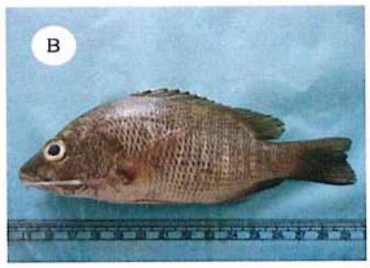
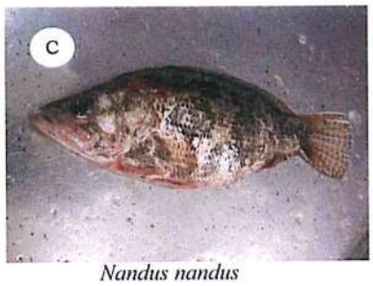


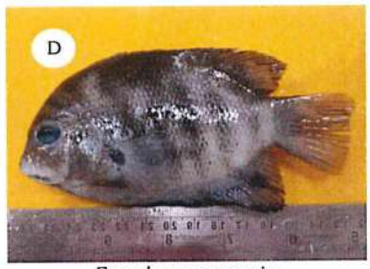

*Chanda nama*



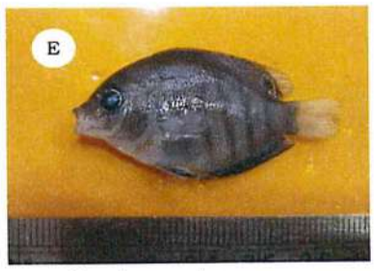

*Lutjanus johni*




*Nandus nandus*

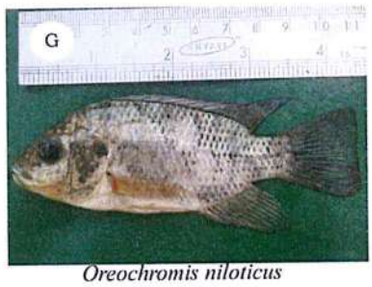



*Etroplus canarensis*

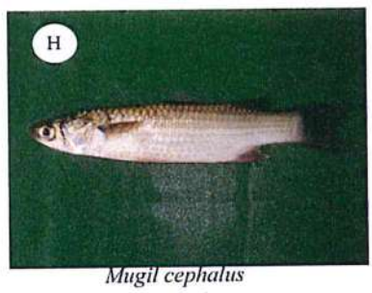



*Etroplus maculatus*

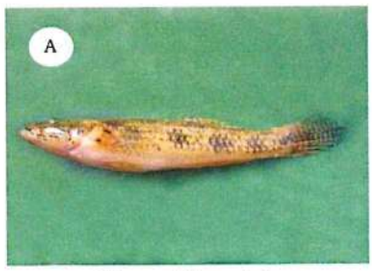

*Oreochromis mossambica*



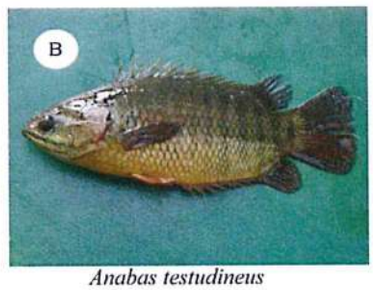

*Oreochromis niloticus*



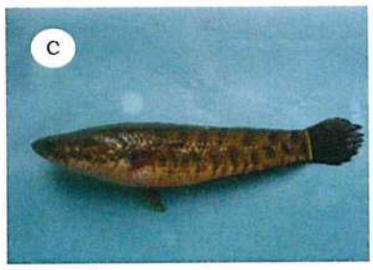

*Mugil cephalus*



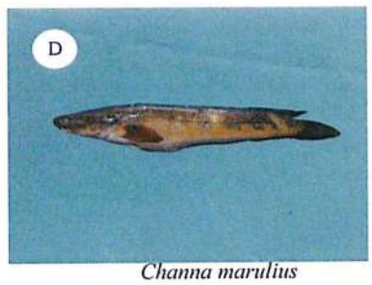

*Glossogobius guiris*



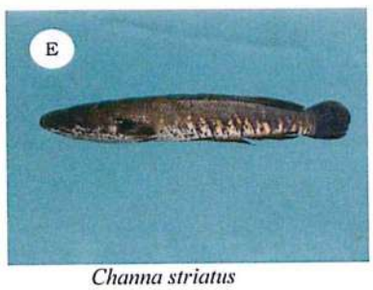

*Anabas testudineus*



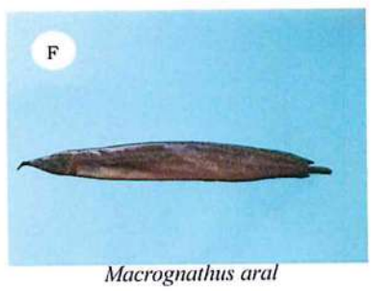

*Channa punctatus*



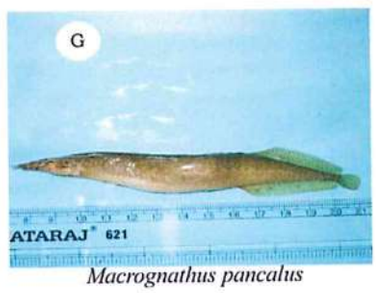

*Channa marulius*




*Channa striatus*




*Macrognathus aral*




*Macrognathus pancalus*

## ANNEXURE-3

Figure showing team members visit to Venkatapalemon 14.10.2019

Figure showing team members interaction with fisher folks at Rayapudi on 14.10.2019

Figure showing team members interaction with fisher folks at Rayapudi on 14.10.2019

Figure showing collection of water sample, flora and fauna
near islandat Guntupallion 15.11.2019

Figure showing collection of water sample, flora and fauna
at riverbank of Penumaka on 15.11.2019

Figure showing water and plankton sample collection at middle of the river Krishna
at venkatapalem on 23.12.2019

Figure showing water and plankton, benthos sample collection at Uddandarayunipalem on 15.11.2019

Figure showing water sample collection at Surayapalem on 15.11.2019

Figure showing water and plankton sample collection at Uddandrarayunipalemon 15.11.2019

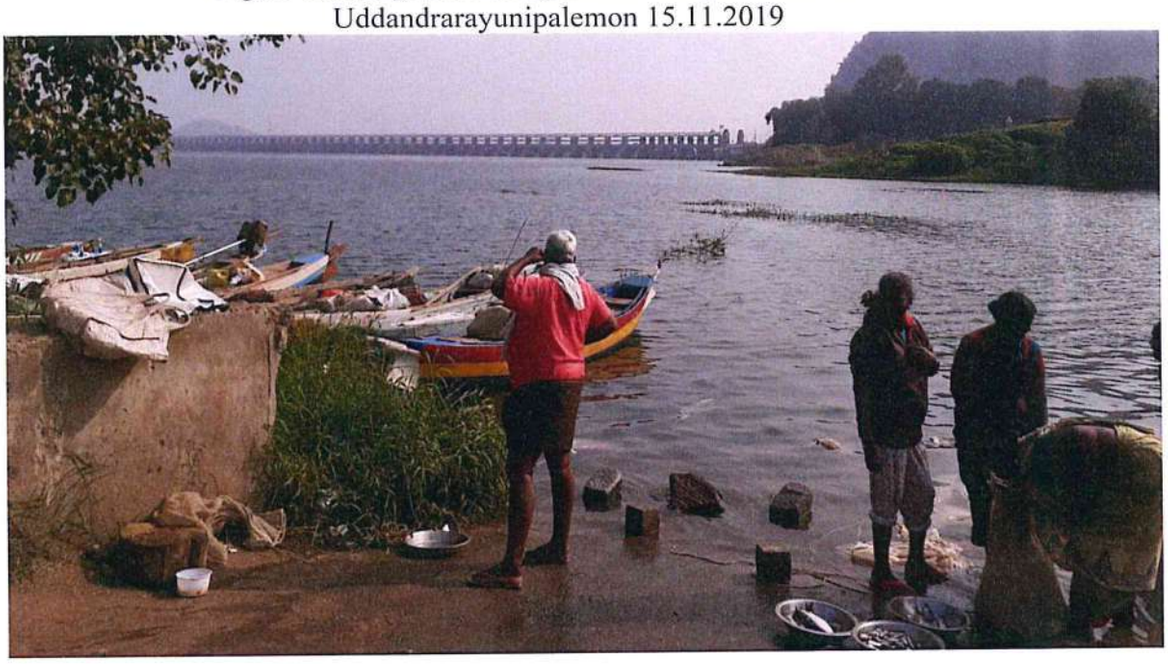


Figure showing Polakampadu fishermen cooperative society fish market at Sitanagaram on 23.12.2019

Figure showing Polakampadu fishermen cooperative society fish market at Sitanagaram on 23.12.2019

Figure showing fish collection on 23.11.2019 at Sitanagaram

Figure showing benthos collection at Gollapudi on 23.11.2019

Figure showing riparian vegetation near island at Guntupalli on 23.11.2019

Figure showing plankton and benthos collection at island area of Penumaka on 23.11.2019

Figure showing riparian vegetationat Surayapalem on 23.11.2019

Figure showing riparian vegetation collection near island at Surayapalemon 23.11.2019

Figure showing fishes collection by fishermen with the help of bamboo trap at Undavalli site on 23.11.2019

Figure showing fishes collection by fishermen with the help of cast net at Undavalli site on 23.11.2019

Figure showing flora and fauna sample collection at Venkatapalem shore region on 23.11.2019

Figure showing Molluscan fauna at Guntupalli sampling site on 07.12.2019

Figure showing local birds of River Krishna at Lingayapalem on 07.12.2019

Figure showing birds of River Krishna at Rayapudi on 07.12.2019

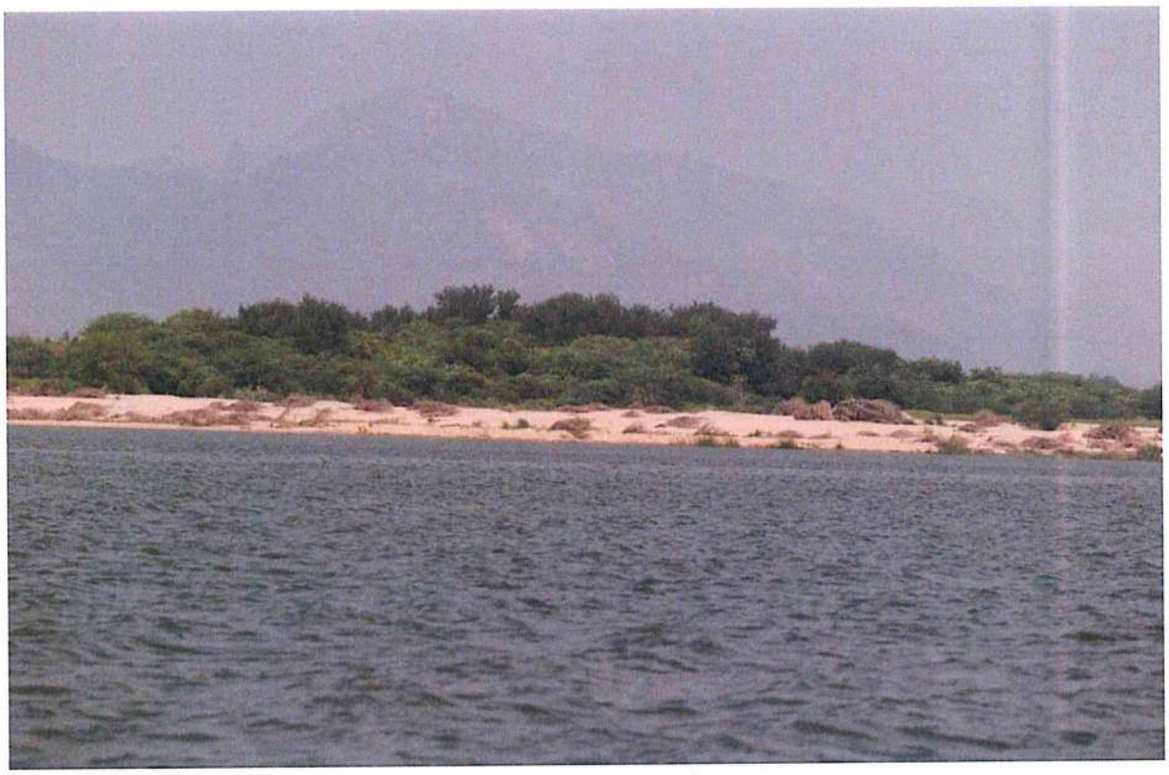


Figure showing sample collection spot at Rayapudi on 07.12.2019

Figure showing newly formed flood plains at Lingayapalam on 07.12.2019

Figure showing team members interaction with fishermen at Rayapudi on 07.12.2019

Figure showing team members interaction with fishermen at Rayapudi on 07.12.2019

Figure showing riparian vegetationat Rayapudi on 07.12.2019

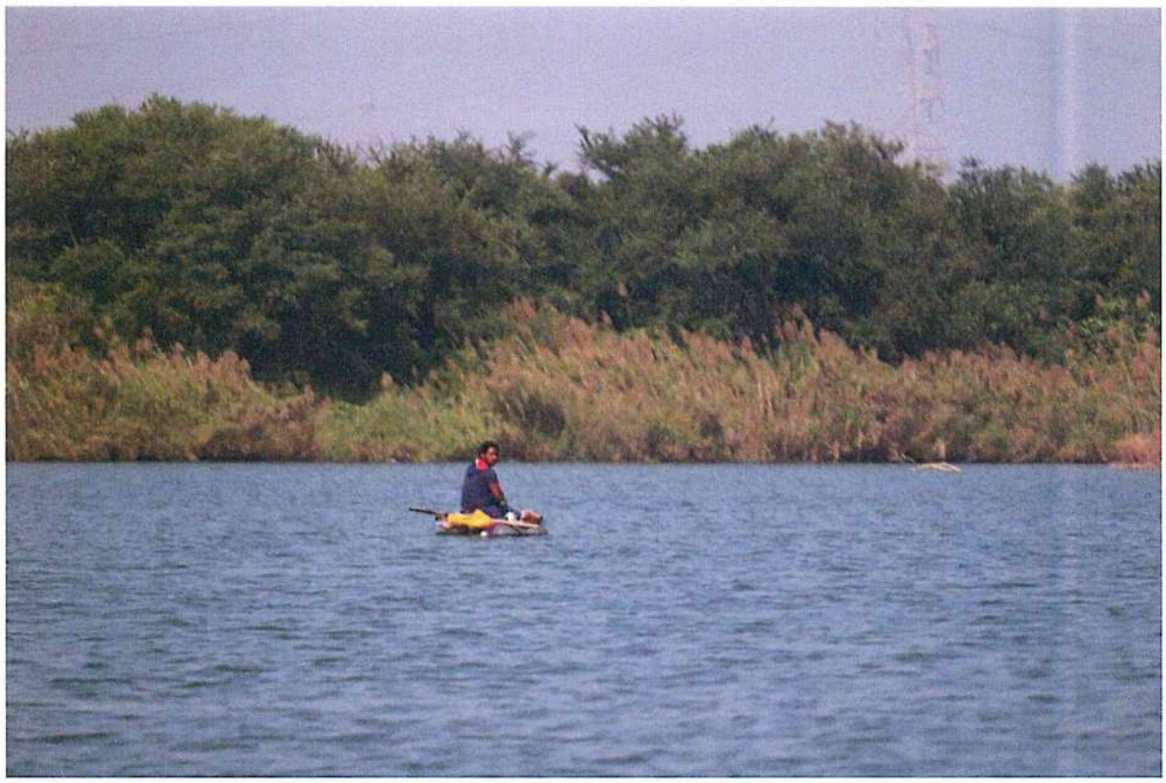


Figure showing fish collection by fisher men using type of craft at Surayapalem on 07.12.2019

Figure showing flora and fauna collection site at Uddandrayunipalemon 07.12.2019

Figure showing flora and fauna collection site at Undavalli site on 07.12.2019

Figure showing team members interaction with fishermenat Ibrahimpatnam on 23.12.2019

Figure showing team members interaction with fishermen at Ibrahimpatnam on 23.12.2019

Figure showing plankton and benthos sample collection near island area at Uddandrayunipalem on 23.12.2019

Figure showing Riparian vegetation at Venkatapalemon 23.12.2019

Figure showing team members visit to Rayapudi village on 30.12.2019