BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL
(SOUTHERN ZONE BENCH, CHENNAI)
IN
ORIGINAL APPLICATION NO. 117 OF 2021 (SZ)

JOINT COMMITTEE REPORT FILED BY THE DISTRICT COLLECATOR, KOTTAYAM

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Dated at Chennai on this the 9th day of September 2021.

M/s. E.K.KUMARESAN

Standing Counsel for State Government of Kerala - NGT(SZ) Chennai Bench

BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL

(SOUTHERN ZONE), CHENNAI

Original Application No. 117 of 2021 (SZ)

IN THE MATTER OF

Kottayam Nature Society,

Reg. No. K-1/2001, Srinilayam,

Near Union Club, Kottayam,

Represented by its Secretary Dr. N.Unnikrishnan

... Applicant(s)

Versus

State of Kerala and Ors.

...Respondents

JOINT COMMITTEE REPORT FILED BY THE DISTRICT COLLECTOR, KOTTAYAM

1. It is submitted that this Hon'ble Tribunal vide its order dated 25.05.2021 in OA No.117/2021 has appointed a Joint Committee to ascertain the genuineness of the allegations made in the above application.

2. It is submitted that a joint committee constituted as per the directions of this Hon'ble Tribunal inspected several project sites along the banks of the Meenachil River and all the members of the joint committee were present during the field inspection.

Therefore it is most humbly prayed that this Hon'ble Tribunal may be pleased to take the said joint committee Report filed by the District Collector, Kottayam on Record and thus render justice.

Dated at Chennai on this the 9th day of September, 2021

(E.K.Kumaresan)

Counsel for R1, R3, R4 and R6

Standing Counsel for State Government of Kerala

NGT(SZ), Chennai Bench

BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL
(SOUTHERN ZONE BENCH, CHENNAI)
Original Application No. 117 of 2021

BETWEEN

Kottayam Nature Society,
Rep. by its Secretary
Dr.N.Unnikrishnan

...Applicant(s)

AND

State of Kerala & others

...Respondents

JOINT COMMITTEE REPORT FILED BY THE DISTRICT COLLECTOR, KOTTAYAM

M/s. E.K.KUMARESAN

Standing counsel for Kerala (SZ)
Counsel for R1 to R4

REPORT OF THE JOINT COMMITTEE IN THE MATTER OF

O.A.NO.117 OF 2021 (SZ)

(KOTTAYAM NATURE SOCIETY VS STATE OF KERALA)

IN COMPLIANCE OF ORDER OF

HON'BLE NATIONAL GREEN TRIBUNAL (SOUTHERN BENCH, CHENNAI)

DATED 25/05/2021

SUBMITTED TO

HON'BLE NATIONAL GREEN TRIBUNAL (SOUTHERN BENCH, CHENNAI)

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REPORT FILED BY THE COMMITTEE CONSTITUTED IN THE MATTER OF O.A.NO.117/2021 (SZ) IN ACCORDANCE WITH THE THE ORDER DATE 25/05/2021 OF HON'BLE NATIONAL GREEN TRIBUNAL (SOUTHERN BENCH, CHENNAI)

PREAMBLE

Hon'ble National Green Tribunal (SZ, Chennai) vide its order dated 25/05/2021 in OA. No. 117/2021 (SZ) directed constitution of a Joint Committee with the following representatives:

(i) Senior Officer from MoEFCC Regional Office (Bangalore).
(ii) Scientist having expertise botanical study from Kerala State Bio Diversity Board, Thiruvananthapuram, Kerala.
(iii) Assistant Conservator of Forest, Kerala Forest & Wildlife Department, Kottayam.
(iv) Executive Engineer, Major Irrigation Department, Kottayam.
(v) District Collector, Kottayam District.

The Hon'ble NGT directed the Joint Committee to examine the following:

1) To ascertain as to whether there was any damage caused to the environment on account of removal of riparian plants such as Attuvanchi, Bamboo etc. which act as a natural barrier for protecting flood and also preserving the retaining capacity of the water of the river throughout the year as Meenachil River is a main water body catering needs of the people for drinking water as well as for irrigation purpose in Kottayam District.

2) To ascertain as to whether any study has been conducted or any plan has been evolved as contemplated under the Disaster Management Act, 2005 considering the nature of impact of flood in those areas in previous years and what are all the steps taken by them in previous years to prevent such anticipating such recurrence the coming years and whether those steps are effective or not and what is the need for going into the deepening activity/widening activity or removing the riparian plants/ vegetation

3) Whether any scientific impact study has been conducted by the authorities and to what extent that can be done to avoid damage to the riverine ecology and environment

4) If any activities are being done in unscientific manner affecting the biological diversity and also the riverine ecology and what is the nature of damage caused to the environment and to assess environmental compensation which is required for restoring the damage caused to the environment

5) Whether if the activities will have to be continued, to what extent it can be permitted to continue without affecting the riverine environment and riparian vegetation in order to avoid flood in certain areas which are likely to be affected during the monsoon.

6) The Forest Department has been made as the nodal agency for co-ordination and also for providing necessary logistics and for submission of report to Hon'ble NGT on behalf of the Joint Committee.

COMPOSITION OF THE JOINT COMMITTEE

As per the directions of the Hon'ble NGT, a Joint Committee has been constituted after seeking nominations from all the concerned agencies with the following Members.

S. No	Name	Representative Department/ Agency
1	Dr. P. K. Jayasree, IAS	District Collector, Kottayam
2	Dr. Murali Krishna	Scientist-D, Ministry of Environment, Forest and Climate Change, Integrated Regional Office, Bangalore
3.	Dr. Pradeep C.G	Senior Research Officer Kerala State Bio- diversity Board Trivandrum.
4	Dr. Prasad G	Assistant Conservator of Forests Social Forestry Division, Kottayam District.
5	Smt. Mollykutty Immaneul	Executive Engineer, Irrigation Division Kottayam.

Copy of the Order dated 23.06.2021 constitution of the Joint Committee is enclosed as **Annexure-I.**

MANDATE OF THE JOINT COMMITTEE

1. To ascertain as to whether there was any damage caused to the environment on account of removal of riparian plants such as Attuvanchi, Bamboo etc. which act as a natural barrier for protecting flood and also preserving the retaining capacity of the water of the river throughout the year as Meenachil River is a main water body catering needs of the people for drinking water as well as for irrigation purpose in Kottayam District.
2. To ascertain as to whether any study has been conducted or any plan has been evolved as contemplated under the Disaster Management Act, 2005 considering the nature of impact of flood in those areas in previous years and what are all the steps taken by them in previous years to prevent such anticipating such recurrence the coming years and whether those steps are effective or not and what is the need for going into the deepening activity/widening activity or removing the riparian plants/ vegetation
3. Whether any scientific impact study has been conducted by the authorities and to what extent that can be done to avoid damage to the riverine ecology and environment
4. If any activities are being done in unscientific manner affecting the biological diversity and also the riverine ecology and what is the nature of damage caused to the environment and to assess environmental compensation which is required for restoring the damage caused to the environment
5. Whether if the activities will have to be continued, to what extent it can be permitted to continue without affecting the riverine environment and riparian vegetation in order to avoid flood in certain areas which are likely to be affected during the monsoon.
6. The Forest Department has been made as the nodal agency for co-ordination and also for providing necessary logistics and for submission of report to Hon'ble NGT on behalf of the Joint Committee.

KEY ISSUES RAISED IN THE PETITION

This instant petition filed by Secretary, Kottayam Nature Society primarily alleges regarding the removal of riparian plants such as Attuvanchi, Bamboo etc. which act as a natural barrier of protecting flood and also preserving the retaining capacity of the water of the river throughout the year and this had to be evaluated after a detailed scientific study by a competent agency having expertise in riparian ecology, botany, and geology.

Further, the petitioner also alleged that cutting and removal of these riparian vegetations will have a great impact on riverine environment which also has lot of biological diversity resources.

APPROACH ADOPTED BY THE JOINT COMMITTEE

- In order to ascertain the factual situation on the ground, the Joint Committee constituted as per the directions of the Hon'ble NGT inspected several project sites along the banks of the Meenachil River over a stretch of about 15-20 Kms. Due to scheduling of the site visit on a very short notice, one Member representative from MoEFCC Regional Office, Bangalore could not join for physical inspection but was available through video conferencing mode and all the other members attended the physical inspection. The Joint Committee inspected sites at Pichakassery Mali, Poovathum moodu hanging bridge, Neelimangalam areas, Cherunarakom bridge, Illickal areas, Cheepunkal (Delta), Kavanaar and Arthootti.
- Pursuant to physical inspection, all the relevant agencies were requested to offer their specific observations and comments and the same was discussed during the videoconference held on 27.06.2021.

Fig 1. Site Inspection by Joint Committee

Fig 2. Site Inspection by Joint Committee

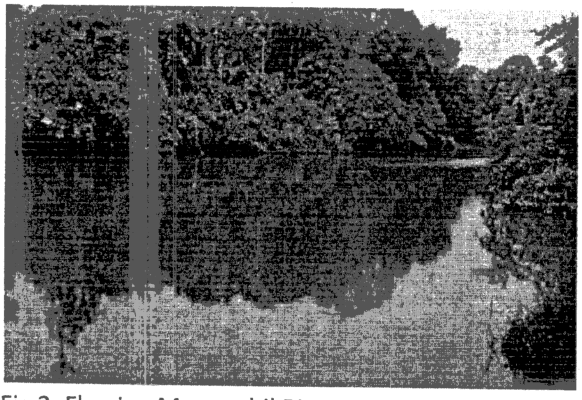


Fig 3. Flowing Meenachil River

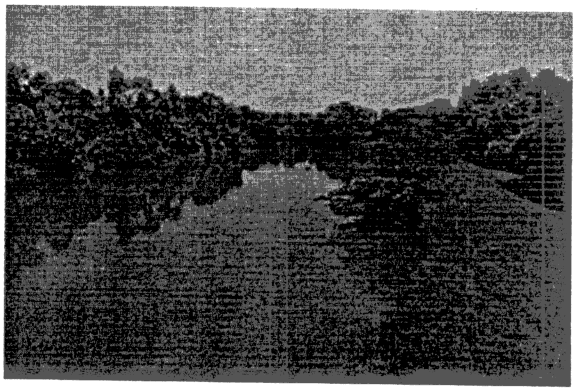


Fig 4. Delta formation on side of river with plants

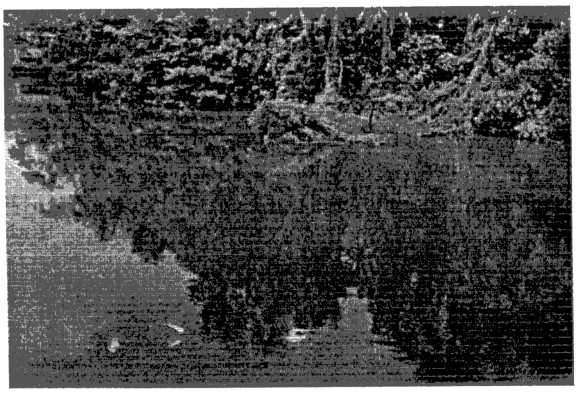


Fig 5. Fallen tree in Meenachil River

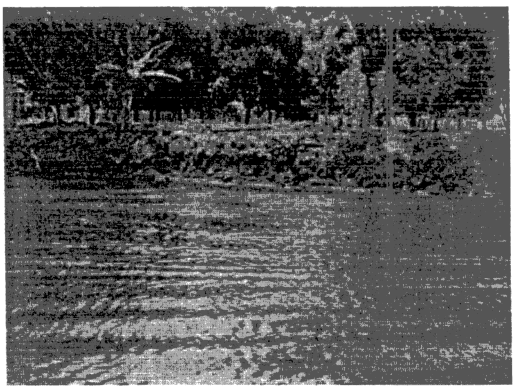


Fig 6. Stopped works on river side

OBSERVATIONS OF THE JOINT COMMITTEE TO THE ALLEGATIONS MADE IN THE PETITION

S. No	Allegation Raised in the Petition	Remarks of the Joint Committee
1	To ascertain as to whether there was any damage caused to the environment on account of removal of riparian plants such as Attuvanchi, Bamboo etc. which act as a natural barrier for protecting flood and also preserving the retaining capacity of the water of the Meenachil River	▪ The Joint Committee noted that 3 works have been initiated by Major Irrigation Department in Meenachil River which inter-alia include the following: 1) CSIND- cleaning obstruction desilting in Meenachil river (Neelimangalam feeder canal) and repair of Kumarakom boat route canal. 2) CSIND- De silting of Meenachil river from Chungam to Kanjiram. 3) Rejuvenation work for Meenachil river from Ettumanoor to Kottayam municipal area. The Joint Committee noted that out of the above three works, the second work only had been started, but the same was also stopped owing to the order of Hon. NGT. Copy of the Contracts executed are enclosed as **—Annexurell** ▪ During the visit, it was noted that at certain parts tree felling was noticed at large, but it was ascertained through other department officials that those trees were cut prior to the initiation of any work by the Irrigation Department. **COMMENTS OF IRRIGATION DEPARTMENT** ▪ As per the information provided by Irrigation Department, it was informed that no damages have been caused to environment on account of these works and there is no construction activities on the Banks, and there is no sand mining going on. ▪ The instant works proposed by Irrigation Department relates to maintenance of the width and depth of Meenachil River by

		removing the deltas formed at identified reaches for easy flow of flood water. The desilted spoil is to be used for forming eroded banks of the river as well as for filling the deep trenches formed in the river bed identified as per investigation works carried out recently for several feeder canals, which includes various stretches of the river also as part of the development of Inland Navigation under IWT scheme. ▪ The Joint Committee noted that the width of the Meenachil river has been reduced at some places to due to delta formation at specific reaches due to the natural phenomena and thereby reducing the water conveyance capacity which in turn results in flooding of banks during the Monsoon. Also due to meandering of the river, which is a natural process, opposite banks is eroded causing threat to people living on the banks. Flood control activities are a must. ▪ At the same time desilting of lower reaches like Pazhukkanilam and Chheppunkal are to be sought for. ▪ Further, the irrigation Department ascertained that no trees were cut or removed from the site instead only hanging branches of small trees and hanging portions of bamboo bunches obstructing the flow of water are cut and deposited on the banks itself and assured that while undertaking desilting activities especially on the deltas formed prior permission from District Tree Committee and Social Forestry wing would be obtained for cutting of trees and adequate provisions for planting of Bamboo, Ramacham ,Attuvanchi etc. for protection of eroded banks have already been included in the estimate. Enclosed as **Annexure—III** ▪ As per the directions in the Orange Book of Disaster Management 2021, and in the light of upcoming monsoon seasons and the previous floods of 2018 and 2019, it is the responsibility of the Irrigation department to ensure the free flow of flood water by removing the obstructions in all the canals, streams and rivers under the jurisdiction (Pg 140 -145 of Orange Book of Disaster Management 2021) **Annexure-**

		-IV and accordingly as per the directions in the Pre-monsoon Preparedness meeting convened by Hon'ble Minister Sri V.N Vasavan and District Collector on 23.05.2021 along with MLA's of the District the above listed works have been initiated. **COMMENTS OF KERALA STATE BIODIVERSITY BOARD** ▪ Pursuant to on spot verification, a rare and endangered species of plant, locally named as 'Attuvanchi' (*Ochreinauclea missionis*) is found along the banks of Meenachil and tributary rivers. They are endangered due to habitat loss and are listed on the IUCN Red List II. ▪ In addition to that, there are about 12 rare and endangered plants on the IUCN red lists were also reported from the banks of Meenachil River. These plants play an important role in protecting the river bank from landslides and maintaining the stability of river. ▪ The flow of the river can be facilitated /enhanced in such a way that, by cutting down the branches of fallen trees and plants including bamboo as they obstruct the natural flow of water and this will lower the intensity and threat of flood. But, if these plants are uprooted or cutting down will be subject to landslides on the river banks, which will cause in change in the natural habitat of river and also leads to the extinction of rare plants. ▪ Islands formed by the deposition of silt in various parts of the river can be removed in a manner that does not cause much harm to the river habitat, thereby facilitating the flow of the river and avoiding the threat of flood. ▪ The excavated sediments should be deposited in suitable places/banks of the river and native species of plants should be planted here for river bank protection. ▪ Revenue land along the banks of the river can be surveyed and a bio-fence can be constructed here to protect the river banks. Plants like 'Kaitha' (Pandanus sp.) 'Ramacham' (Vetiver) (Chrysopogon zizanoides) can be grown here and also in excavated sediment deposited places. ▪ A large number of endangered species of plants 'Attuvanchi' (*Ochreinauclea missionis*) were

found in the area formed by silt deposition near the suspension bridge in Peroor village. As per the Biodiversity Act 2002, section 37 (Conservation of endangered flora & fauna and unique ecosystem), Ettumanoor Municipality Biodiversity Management Committee (BMC) proposed this area to declare as a Local Biodiversity Heritage Site (LBHS) to conserve this endangered plants and unique ecosystem. **Annexure--V**

- An ecological and biodiversity study related to the present river projects should be done accordingly.

COMMENTS OF SOCIAL FORESTRY DIVISION OF KERALA FOREST DEPARTMENT

River is a self flowing entity with its own sediments and meandering nature. The quantity of silt and sand which had been deposited previously and which can be deposited in the near coming future along with the running water has to be ascertained and a radical solution for scientific removal of the silt, debri and sand from the place of deposition had to be sought for, to mitigate floods. The deposited silt and soil, if removed; should be done on a onetime basis and not for a recurrent nature. The debri should be moved out from river or its banks.

The naturally grown plants which acts as barriers for protecting the water body has to be protected by the Government, even when they are doing desilting or other Disaster Management Activity to prevent the flood in future. This is not seen executed in areas where the works were started (Chungam- Illikkal river side and Arthootty River side). If any tree is to be cut or lopped, from public land, procedures as per G.O (Rt) No. 68/2010 F&WLD dated 10/02/2010 will have to be followed. **Annexure--VI**

Details of amphibian, fish and other aquatic fauna and flora in the river and riparian habitat can be made out only after a competent scientific study. Altogether, an approximate length of 15 to 20 kilometres of live river tract with its entire natural vegetation will be affected by these three works of Major irrigation department. In future years also some similar works are supposed to come up. Moreover, the livelihoods of many river dependent people who fetch fish and similar resources from the said river have to be taken care of by the

		Government. The repeated floods along the riverside of Meenachil have affected the lives of many people as well. The Irrigation departments may go ahead with flood mitigating activities and salvage the life and property of people after conducting a detailed scientific study for removal of sand, silt and trees on the river banks. Moreover, the reasons for the recurring floods may be due to accumulation of debri like human dumped waste and plastic, construction materials which were carried away by the floods, non degradable organic matter like timber, poles etc which have occupied the river basin, thereby reducing the volume of the river. These removable things should be ascertained scientifically at the earliest, and shifted out to increase the volume of the river to occupy the surplus water during the floods. The removal should be executed in such a way that they will not spill out into same river again. For this, permanent removal of the debri has to be worked out for increasing the volume and carrying capacity of the river. In order to accommodate the flood water, it is necessary to increase the water retention of the lower areas like Pazhukkanilam and Cheepunkal Delta by removing the huge amount of debri accumulated there. The excavated sediments (debri) and silt if dumped in same bank will again seep back into the same river. Hence it can be used for reinforcing the bunds in agricultural lands, so that it never spills back to reduce carrying capacity of the river. A continuous population of, approximately 2km long, huge trees of Ochreinauclea missionis ('Attuvanchi') is documented from Peroor region of Ettumanoor Municipality. It is listed in the IUCN Red List II—**Annexure--VII** Ettumanoor Municipality Biodiversity Management Committee (BMC) had already proposed this area to be declared as a Local Biodiversity Heritage Site (LBHS), vide Section (37) {Conservation of endangered flora & fauna and unique ecosystems}, of The Biodiversity Act; 2002, to conserve this endangered plants and unique ecosystem. A similar population is protected as a notified "Reserved Forest" Area by Kerala Forest and Wildlife Department at Kattachira, Kidangoor.

		The riparian Ecosystem as such is an entity formed over a period of time and has carved its niche which needs to be protected. The role of the trees standing on the delta, which are proposed to be removed in by the Irrigation department (Rejuvenation work for Meenachil river from Ettumanoor to Kottayam municipal area) has to be studied systematically. As a known fact, plants play an important role in protecting the river bank (where they grow) from landslides and maintaining the stability of the river. Kerala Forest Research Institute Peechi has published a book "Manual for Biorestoration of River Banks in Kerala" (ISBN: 81-85041-97-0) which can be a good guideline for undertaking the work. **COMMENTS OF MOEF&C, REGIONAL OFFICE** Based on the findings of the physical inspection and also after evaluation of key inputs received from other Members of the Joint Committee, it was noted that because of desilting works undertaken by the Irrigation Department, no major damage has been caused to caused to the environment as out of proposed 3 works only 1 work has just begun and that too have been stopped immediately after the direction of Hon'ble NGT. Considering the fact that floods have caused a damage to the lives of the population along the banks of the Meenachil River during the floods of 2018 and 2019, it is important that desilting and cutting of branches falling on the river or causing obstruction to the flow of water has to be initiated as per the Mandate of the Irrigation Department and Revenue Department. At the same time it is also very important that pristine environment especially which harbours the endangered plant species needs to be protected and accordingly it is opined that activities related to free flow of water to avoid flooding situation for protection of human and animal life needs to be undertaken by the concerned Government agencies without causing any damage to endangered plant species found along the banks of the Meenachil River have to be done and in case any tree has to be cut, it should be done after seeking requisite permission from Social Forest Department. And in case of any unavoidable

		situation if any tree has to be uprooted or cut appropriate number of relevant plant species which can act as natural barriers have to be planted. **COMMENTS OF DISTRICT COLLECTOR, KOTTAYAM** As per Gazette Notification SO 1224 (E) dated 28.03.2020 issued by the Ministry of Environment, Forest and Climate Change, dredging and desilting of dams reservoirs, weirs, barrages, rivers and canals for the purpose of their maintenance, upkeep and disaster management does not need any prior Environmental Clearance. Copy of the Notification is enclosed as **Annexure-VIII** Further, Government of Kerala vide GO (Ms) No. 316/16/RD dated 24.05.2016 directed District Collector, Kottayam not to accord sanction for sand mining in Meenachil River for coming three years from the date of Order. Copy of the Notification is enclosed as —**Annexure IX** Also in GO (Rt) No. 3880/2019/RD dated 24.12.2019 Government accorded sanction to all District Collectors to remove silt and debris in flood affected rivers as an immediate measure to accommodate flood waters and to increase the capacity of river channels. Copy of the Notification is enclosed as —**Annexure-X** As per Disaster Management Act 2005 it is not a statutory requirement for Disaster Management Authorities to conduct any studies for removal of debris and Amicus Curiae report furnished in the High Court of Kerala in WP (C) No. 2651 of 2019 related to floods have also highlighted the need for desiliting. Based on the perusal of views of various agencies, the Joint Committee concludes that no major environmental damage has been caused due to the activities undertaken by the Irrigation Department for desiliting of Meenachil River and accordingly, no environmental compensation needs to be recovered from any agency. The pictures of further site inspections done are appended as Annexure XV
2	To ascertain as to whether any study has been conducted or any plan has been evolved as contemplated under the Disaster Management Act, 2005 considering the nature of impact of flood in those areas in previous years and what are	As per the information provided by District Collector, it is noted that as per Disaster Management Act 2005 it is not a statutory requirement for Disaster Management Authorities to conduct any studies for removal of debris and Amicus Curiae report furnished in the High Court of

	all the steps taken by them in previous years to prevent such anticipating such recurrence the coming years and whether those steps are effective or not and what is the need for going into the deepening activity/widening activity or removing the riparian plants/ vegetation	Kerala in WP (C) No. 2651 of 2019 related to floods have also highlighted the need for desiliting. As per the information provided by the Irrigation Department, Recommendations of Flood Report by Central Water Commission (CWC)—**Annexure XI** Kerala Integrated Water Resource Management (IWRM) Action Plan for Kuttanad Basin—**Annexure XII**, Investigation and development studies conducted in feeder canals by the Department under IWT Scheme and previous years flood hazards and field observation were taken in to consideration as a base for proposing these works. Copy of Flood Hazard Zonation Maps are enclosed as —**Annexure XIII** Kerala Forest Research Institute Peechi has published a book "Manual for Biorestoration of River Banks in Kerala" (ISBN: 81-85041-97-0) which can be a good guideline for undertaking the work. **Anexure XIV**
3	Whether any scientific impact study has been conducted by the authorities and to what extent that can be done to avoid damage to the riverine ecology and environment	As per the information provided to the Joint Committee, it was noted that no specific scientific study has been conducted by the concerned authorities for this specific work and these works have been initiated as part of Disaster Management Mitigation measures and as a routine work of Irrigation department to avoid floods in the Meenachil River and was taken up based on the Internal / Departmental study reports. Recommendations of Flood Report by Central Water Commission (CWC)—**Annexure XI** Kerala Integrated Water Resource Management (IWRM) Action Plan for Kuttanad Basin—**Annexure XII**, Investigation and development studies conducted in feeder canals by the Department under IWT Scheme and previous years flood hazards and field observation were taken in to consideration as a base for proposing these works. "Manual for Bio restoration of River Banks in Kerala" (ISBN: 81-85041-97-0) by Kerala Forest Research Institute, Peechi can serve as a backbone for the work and be a good guideline **Anexure –XIV**
4	If any activities are being done in unscientific manner affecting the biological diversity and also the riverine ecology and what is the nature of damage caused to the	Based on the perusal of views of various agencies, the Joint Committee concludes that no major environmental damage has been caused till now, due to the activities undertaken by the Irrigation

	environment and to assess environmental compensation which is required for restoring the damage caused to the environment	Department for desiliting of Meenachil River and accordingly, no environmental compensation needs to be recovered from any agency.
5	Whether if the activities will have to be continued, to what extent it can be permitted to continue without affecting the riverine environment and riparian vegetation in order to avoid flood in certain areas which are likely to be affected during the monsoon.	Considering the fact that floods have caused a damage to the lives of the population along the banks of the Meenachil River during the floods of 2018 and 2019, it is important that the flow of the river has to be facilitated or enhanced by removing the accumulated man made /settled cadaver in the river and cutting down the branches of fallen trees and plants including bamboo as they obstruct the natural flow of water and this will lower the intensity and threat of floods. No uprooting or felling of trees shall be done from deltas as it will make the river bank unstable and boost up the diversion of river in future. Deltas or Islands formed by silt and sand deposition in various parts of the river can be removed in a manner that does not cause harm to the river floral habitat, thereby facilitating the flow of the river and avoiding the threat of flood. At the same time it is also very important that endangered plant species existing in the region needs to be protected and in case any tree has to be cut or uprooted, it should be done after seeking requisite permission from District Tree Committee and Social Forestry wing as per procedures vide G.O (Rt) No. 68/2010 F&WLD dated 10/02/2010 of Kerala state. And in case of any unavoidable situation if any tree has to be uprooted or cut appropriate numbers of relevant plant species which can act as natural barriers have to be planted. A similar project has been successfully executed in Varattar River in Pathanamthitta District by Haritha Kerala Mission along tributary of River Pampa without destroying the Flora and enhancing the water flow. It may be adopted here also. The Joint Committee opines that these flood control and mitigation measures to be undertaken in Meenachil River without affecting the endangered plant biodiversity and accordingly, a Monitoring Committee consisting of Kerala State Biodiversity Board Officials, Kerala Forest Research Institute Officials and Officials of Haritha Kerala Mission may be constituted for overseeing the activities along the Meenachil River.

Fig 7. Google meeting of the Joint Commitee members on 16-08-2021 for finalaising the report

CONCLUSION AND FINAL REMARKS

- The Joint Committee noted that the Kottayam District especially the regions along the banks of Meenachil River are prone to floods and the same have been already evidenced during the years 2018 and 2019 wherein considerable amount of loss have been incurred. In order to avoid recurrence of such situation again, it is important that desilting activities in the River Meenachil may be taken up on a priority basis, in a scientific manner.

- The joint committee on inspection observed, that there had been change in original course of Meenachil river near chainages 810m(near Irumpupalam portion) ,1590m(Koottupallikkadavu Portion) 5550m (Cherickal Portion) and several other portions also, which is evidenced by the fact that ,the left bank of the river at this area has curved (bend on its own) and deviated more towards the left ,causing severe eroding of the left bank, creating disastrous whirlpools up to about 6m depth near the left bank where as the extension and spread of right bank in to the river (aggradations)due to the deposition of *debris*, clay and soil mud in the rootmat of vegetation like Attuvanchi and bamboo is causing obstruction to the normal course of Meenachil River. The trees being water loving trees ,if not removed will interfere with the flow of river along its normal course and in turn result in more deviation of the river flow towards the left bank. This will again result in severe erosion of left bank and loss of property /Land of the people residing on the left bank.

- The Joint Committee noted that since this region harbours a lot of endangered plant biodiversity, especially in the upper reaches; due care has to be taken to avoid any unnecessary damage to such plant species which are not only endangered but also which can also act as natural barriers for prevention of floods and in case of any unavoidable situation if any tree has to be uprooted or cut, appropriate number of relevant plant species which can act as natural barriers have to be planted for flood protection of banks ,in concurrence with the Forest department.

- Since the present works are of urgent nature for mitigating the ill effects of the impending monsoon

, exemptions may be given as per Gazette Notification SO 1224 (E) dated 28.03.2020 issued by the Ministry of Environment, Forest and Climate Change which states that for dredging and desilting of dams reservoirs, weirs, barrages, rivers and canals for the purpose of their maintenance, upkeep and disaster management does not need any prior Environmental Clearance.

- As no major damage has been caused to the environment due to initiation of desiliting and dredging activities in the Meenachil River by Irrigation department, no environmental compensation or damages are to be recovered from any Department. Only the obstructions to the flow of water in the river were seen removed and whatever spoil obtained were deposited on the banks for formation of eroded banks .The works were stopped on getting the NGT order. On the day of joint inspection no work was going on, awaiting further directions from Honourable National Green Tribunal.
- The Joint Committee recommends Undertaking of flood control and mitigation measures in Meenachil River , by clearing the obstructions in the water way, whether it be the hanging branches of trees and bamboo bushes ,obstructing the flow of water or the depositions in the waterway, as these are efforts to reinstate the river to its original condition ,there by increasing the flow area and flood discharge capacity .These measures reduce the intensity of flooding.
- The Joint Committee felt the need for , long term measures for future flood control and mitigation in entire Meenachil River basin considering ecological aspects as well, which the department may give due consideration ,for preventing the recurrence of floods, after conducting a detailed Scientific study.
- As the area is now facing the threat of flood due to Monsoon 2021 and the Government have already given orange alerts in the months of June ,July, August and September prompt action without delay, as regarding the mitigating steps warranted to avoid flood and related calamities must be taken. Hence the Honurable Tribunal may issue appropriate orders, so as to enable the District Administration /District Disaster Management Authority, to carry out flood hazard mitigation activities.

SIGNATURES OF THE MEMBERS OF THE JOINT COMMITTEE

S. No	Representative Department/ Agency	Signature
1	District Collector, Kottayam	
2	Scientist-D, Ministry of Environment, Forest and Climate Change, Integrated Regional Office, Bangalore	
3.	Senior Research Officer, Kerala State Bio- diversity Board, Trivandrum.	
4	Assistant Conservator of Forests, Social Forestry Division, Kottayam District.	
5	Executive Engineer, Irrigation Division, Kottayam.	

Annexure I

Proceedings of the Assistant Conservator of Forests, Social Forestry Division Kottayam

Present: Dr. G Prasad

Sub – Order of Hon. National Green Tribunal (Southern Zone) Chennai dated 25-05-2021 regarding works taken up by Major Irrigation Department of Kottayam Division , Kerala State in Meenachil river - Constitution of Joint committee –Orders issued

Ref – 1) OA Number 117 of 2021 (SZ) filed by Kottayam Nature Society represented by Dr N Unnikrishnan before the National Green Tribunal Southern Zone, Chennai
2) Letter No F.No. EP/12.07/NGT/43/KER of Regional Officer, MOEFF& CC Bangalore, dated 17/06/2021
3) Letter No A 13/ 21/ KSBB. of Member Secretary. KSBB Trivandrum, dated 12/06/2021

Order No SF3-1089/2021 dated. 17/06/2021

In accordance with the communication received vide Reference (2&3) a Joint Committee for examining the facts pertaining to the allegation in OA No. 117/2021 filed before the Hon'ble National Green Tribunal, Chennai with the following members are constituted:

1 Dr. Muralikrishna. C, Scientist-D, Ministry of Environment &Forests and Climate Change, Regional Office, Southern Zone, Bangalore- 34.

2 Dr. Pradeep C. G, Senior Research Officer, Kerala State Biodiversity Board, Thiruvananthapuram

3 District Collector, Kottayam.

4 Assistant Conservator of Forests, Social Forestry Division, Kottayam.

5 Executive Engineer, Irrigation Division, Kottayam.

Assistant Conservator of Forests,
Social Forestry, Kottayam.

Copy to District Collector, Kottayam;

Dr. Muralikrishna. C, Scientist-D, MOEF&CC, Regional Office, S. Zone, Bangalore-34.

Dr. Pradeep C. G, Senior Research Officer, Kerala State Biodiversity Board, Thiruvananthapuram

Executive Engineer, Irrigation Division, Kottayam.

Anx. II

കേരളം केरल KERALA

K 198518

AGREEMENT No. 7/EE/ 2021-22 DATED: 14/06/2021 FOR WORKS

CONTRACT AGREEMENT entered to this the 14th day of June 2021 (Two thousand and Twenty one) between **Sri. ANOOP THOMAS, Chathurathundyil House, Kurichy P.O, Kottayam** of the one part (hereinafter called the contractor) and the Executive Engineer, Irrigation Division, Kottayam for and on behalf of the Governor of the State of Kerala (hereinafter called the Government) on the other part for the execution of the work **"Rejuvenation works of Meenachil river from Ettumanoor to Kottayam municipal area in Kottayam district "** by the former for the use of the Irrigation Department of the said Government of the State of Kerala as per the accompanying agreement, plan, specification and conditions of contract approved by the Executive Engineer, Irrigation Division , Kottayam.

Signed and delivered by the above mentioned, **Sri. ANOOP THOMAS,** Contractor.

In the presence of:

1. Smt. Sonia Thomas.
   2nd Grade Draftsman

2. Smt. Daicy Mathew
   1st Grade Draftsman

CONTRACTOR : **EXECUTIVE ENGINEER**

SUB TREASURY
10 JUN 2021

കേരളം केरल KERALA -2- K 198519

Rejuvenation works of Meenachil river from Ettumanoor to Kottayam municipal area in Kottayam district

CONTRACTOR

EXECUTIVE ENGINEER

SUB TREASURY
10 JUN 2021

भारतीय गैर न्यायिक

भारत INDIA

रु. 500

FIVE HUNDRED RUPEES

पाँच सौ रुपये

Rs. 500

सत्यमेव जयते

INDIA NON JUDICIAL

കേരളം केरल KERALA K 198520

-3-

Rejuvenation works of Meenachil river from Ettumanoor to Kottayam municipal area in Kottayam district

CONTRACTOR

EXECUTIVE ENGINEER

SUB TREASURY

10 JUN 2021

भारतीय गैर न्यायिक

भारत INDIA

रु. 500 FIVE HUNDRED RUPEES

पाँच सौ रुपये Rs. 500

INDIA NON JUDICIAL

केरल KERALA K 198521

-4-

Rejuvenation works of Meenachil river from Ettumanoor to Kottayam municipal area in Kottayam district

CONTRACTOR

EXECUTIVE ENGINEER

SUB TREASURY
10 JUN 2021

കേരള KERALA

K 198522

-5-

Rejuvenation works of Meenachil river from Ettumanoor to Kottayam municipal area in Kottayam district

CONTRACTOR

EXECUTIVE ENGINEER

SUB TREASURY

കേരള KERALA

K 198523

-6-

Rejuvenation works of Meenachil river from Ettumanoor to Kottayam municipal area in Kottayam district

CONTRACTOR

EXECUTIVE ENGINEER

SUB TREASURY

भारतीय गैर न्यायिक

एक सौ रुपये

Rs. 100

ONE HUNDRED RUPEES

रु. 100

सत्यमेव जयते

भारत INDIA

INDIA NON JUDICIAL

കേരള केरल KERALA

CX 075061

-7-

Rejuvenation works of Meenachil river from Ettumanoor to Kottayam municipal area in Kottayam district

CONTRACTOR

EXECUTIVE ENGINEER

SUB TREASURY

भारतीय गैर न्यायिक

एक सौ रुपये

Rs. 100

रु. 100

ONE HUNDRED RUPEES

सत्यमेव जयते

भारत INDIA

INDIA NON JUDICIAL

കേരളം केरल KERALA

CX 075062

-8-

Rejuvenation works of Meenachil river from Ettumanoor to Kottayam municipal area in Kottayam district

CONTRACTOR

EXECUTIVE ENGINEER

SUB TREASURY

കേരളം केरल KERALA CX 075063

-9-

Rejuvenation works of Meenachil river from Ettumanoor to Kottayam municipal area in Kottayam district

CONTRACTOR

EXECUTIVE ENGINEER

SUB TREASURY
09 FEB 2021

भारतीय गैर न्यायिक

एक सौ रुपये

Rs. 100

रु. 100

ONE HUNDRED RUPEES

सत्यमेव जयते

भारत INDIA

INDIA NON JUDICIAL

കേരള KERALA

CX 075064

-10-

Rejuvenation works of Meenachil river from Ettumanoor to Kottayam municipal area in Kottayam district

CONTRACTOR

EXECUTIVE ENGINEER

SUB TREASURY

केरल KERALA

CD 641114

Rejuvenation works of Meenachil river from Ettumanoor to Kottayam municipal area in Kottayam district

Signed and delivered by **Smt. Mollykutty Emmanuel**, Executive Engineer, Irrigation Division, Kottayam for and on behalf of the Governor of the State of Kerala.

EXECUTIVE ENGINEER
IRRIGATION DIVISION KOTTAYAM
(For and on behalf of the Governor of the State of Kerala)

In the presence of:

1. Smt. Jincy Chandy
   Personal Assistant to Executive Engineer
2. Sri. G. Manoj
   Divisional Accounts Officer

CONTRACTOR

EXECUTIVE ENGINEER

SUB TREASURY

PRICE

EST NO:2021/122/IA

TS Register No: 77/2021-2022
AS Register No:155/2020-2021

Detailed Estimate

Rejuvenation works of Meenachil river from Ettumanoor to Kottayam Municipal area in Kottayam district.

(Cost Index Applied for this estimate is 37.93%)

Sl No	Description	No	L	B	D	CF	Quantity	Remark
	1 clearing obstructions							
1	od39347/2020_2021/IA od62800/2019_2020/IA :Cutting and removing Bamboo bunch of trees fallen down to the river course and obstructing the flow of water, and any other submerged materials under water and other floating materials from the river as directed by the departmental officers at site 							
	Along the river	16	30.000	5.000			2400.000	
		24	40.000	6.000			5760.000	
						Total Quantity	8160.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	8160.000 sqm	
						Say 8160.000 sqm @ Rs 20.78 / sqm	**Rs 169564.80**	
2	2.33.1 Felling trees of the girth (measured at a height of 1 m above ground level) including cutting of trunks and branches, removing the roots and stacking of serviceable material and disposal of unserviceable material.Beyound 30 cm girth up to and including 60 cm girth							
		30					30.000	
						Total Quantity	30.000 each	
						Total Deducted Quantity	0.000 each	
						Net Total Quantity	30.000 each	
						Say 30.000 each @ Rs 302.34 / each	**Rs 9070.20**	
3	50.2.33.5 Cutting branches of trees overhanging above any structures of girth between 40cm to 60cm including stacking of serviceable materials and disposal of unserviceable material, cost of labour, hire charges of rope and pully etc without making any damages to nearby structures etc complete.							
		1100					1100.000	
						Total Quantity	1100.000 each	
						Total Deducted Quantity	0.000 each	
						Net Total Quantity	1100.000 each	
						Say 1100.000 each @ Rs 208.00 / each	**Rs 228800.00**	

കേരളം केरल KERALA

K 198512

AGREEMENT No. 8/EE/ 2021-22 DATED: 14/06/2021 FOR WORKS

CONTRACT AGREEMENT entered to this the 14th day of June 2021 (Two thousand and Twenty one) between **Sri. ANOOP THOMAS, Chathurathundyil House, Kurichy P.O, Kottayam** of the one part (hereinafter called the contractor) and the Executive Engineer, Irrigation Division, Kottayam for and on behalf of the Governor of the State of Kerala (hereinafter called the Government) on the other part for the execution of the work of **" CSIND –Clearing obstruction and desilting in Meenachil river (Neelimangalam feeder canal) and repair of Kumarakom boat route canal in Kottayam district "** by the former for the use of the Irrigation Department of the said Government of the State of Kerala as per the accompanying agreement, plan, specification and conditions of contract approved by the Executive Engineer, Irrigation Division , Kottayam

Signed and delivered by the above mentioned, **Sri. Anoop Thomas , Contractor**

In the presence of:

1. Smt. Sonia Thomas .
   2nd Grade Draftsman .
2. Smt. Daicy Mathew,
   1st Grade Draftman.

CONTRACTOR

EXECUTIVE ENGINEER

SUB TREASURY

भारतीय गैर न्यायिक

भारत INDIA

रु. 500 FIVE HUNDRED RUPEES

पाँच सौ रुपये Rs. 500

INDIA NON JUDICIAL

കേരള केरल KERALA K 198513

-2-

CSIND –Clearing obstruction and desilting in Meenachil river (Neelimangalam feeder canal) and repair of Kumarakom boat route canal in Kottayam district.

CONTRACTOR

EXECUTIVE ENGINEER

SUB TREASURY

കേരളം केरल KERALA K 198514

-3-

CSIND –Clearing obstruction and desilting in Meenachil river (Neelimangalam feeder canal) and repair of Kumarakom boat route canal in Kottayam district.

CONTRACTOR

EXECUTIVE ENGINEER

SUB TREASURY

भारतीय गैर न्यायिक

भारत INDIA

रु. 500 FIVE HUNDRED RUPEES

पाँच सौ रुपये Rs. 500

सत्यमेव जयते

INDIA NON JUDICIAL

केरल KERALA

K 198515

-4-

CSIND –Clearing obstruction and desilting in Meenachil river (Neelimangalam feeder canal) and repair of Kumarakom boat route canal in Kottayam district.

CONTRACTOR

EXECUTIVE ENGINEER

SUB TREASURY

केरल KERALA K 198516

-5-

CSIND –Clearing obstruction and desilting in Meenachil river (Neelimangalam feeder canal) and repair of Kumarakom boat route canal in Kottayam district.

CONTRACTOR

EXECUTIVE ENGINEER

SUB TREASURY
TREASURY

भारतीय गैर न्यायिक

भारत INDIA

रु. 500 FIVE HUNDRED RUPEES

सत्यमेव जयते

पाँच सौ रुपये Rs. 500

INDIA NON JUDICIAL

ഇന്ത്യ केरल KERALA K 198517

-6-

CSIND –Clearing obstruction and desilting in Meenachil river (Neelimangalam feeder canal) and repair of Kumarakom boat route canal in Kottayam district.

Signed and delivered by **Smt. Mollykutty Emmanuel , Executive Engineer,** Irrigation Division, Kottayam for and on behalf of the Governor of the State of Kerala.

EXECUTIVE ENGINEER

IRRIGATION DIVISION KOTTAYAM
(For and on behalf of the Governor of the State of Kerala)

In the presence of:

1. Smt. Jincy Chandy,
   Personal Assistant to Executive Engineer. .
2. Sri.G. Manoj.
   Divisional Accounts Officer.

CONTRACTOR

EXECUTIVE ENGINEER

SUB TREASUR

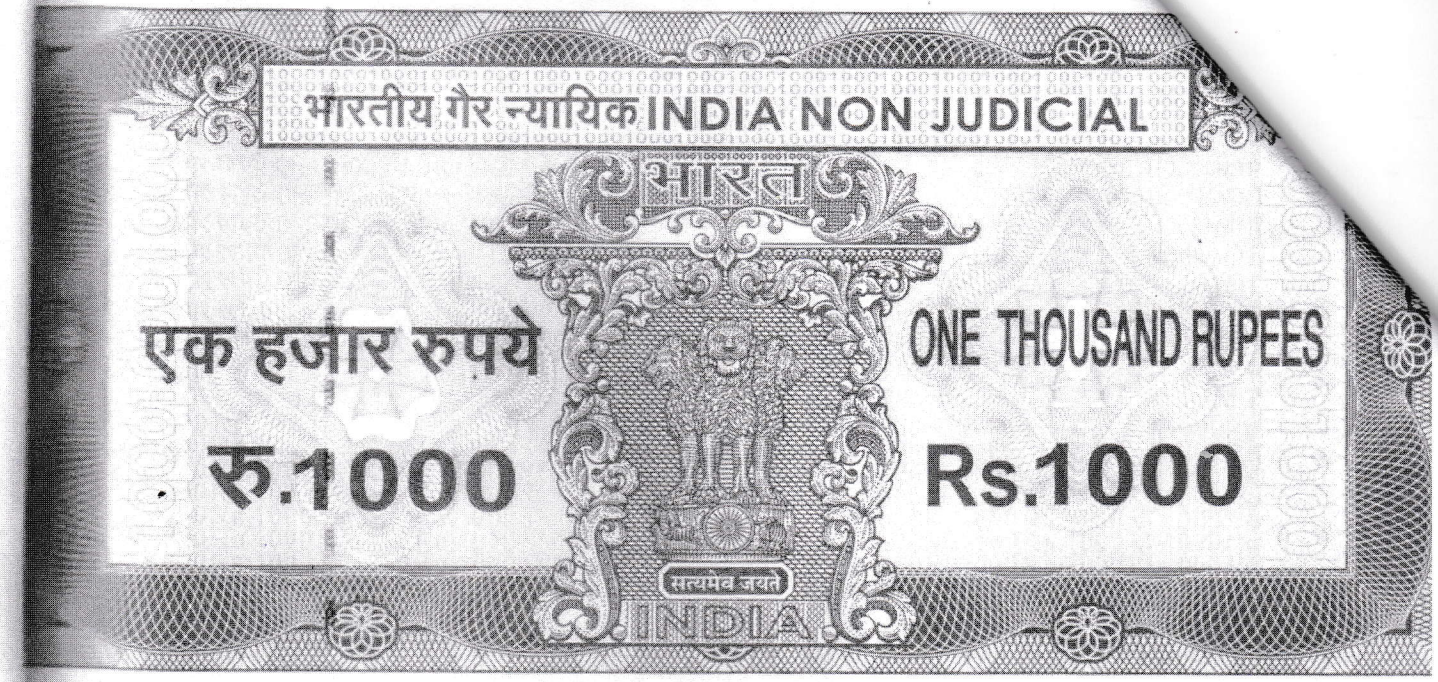
കേരള KERALA N 163441

AGREEMENT NO. 60/EE/2019-20 DATED:16-03-2020 FOR WORKS

CONTRACT AGREEMENT entered to this the 16th day of March 2020 (Two thousand and Twenty) between Sri.Saji A Kuruvilla, Ambazhachalil House, Arpookkara West P.O, Kottayam of the one part (hereinafter called the contractor) and the Executive Engineer, Irrigation Division, Kottayam for and on behalf of the Governor of the State of Kerala (hereinafter called the Government) on the other part for the execution of the work "CSIND- Desilting of Meenachil river from Chungam to Kanjiram in Kottayam Municipality and Thiruvarppu panchayath in Kottayam District" by the former

Contractor

EXECUTIVE ENGINEER



കേരള KERALA

N 163440

Name of Work: CSIND- Desilting of Meenachil river from Chungam to Kanjiram in Kottayam Municipality and Thiruvarppu panchayath in Kottayam District

for the use of the **Irrigation Department** of the said **Government of the State of Kerala** as per the accompanying agreement, plan, specification and conditions of contract approved by the **Executive Engineer, Irrigation Division , Kottayam.**

Signed and delivered by the above mentioned Contractor, Sri. Saji A Kuruvilla

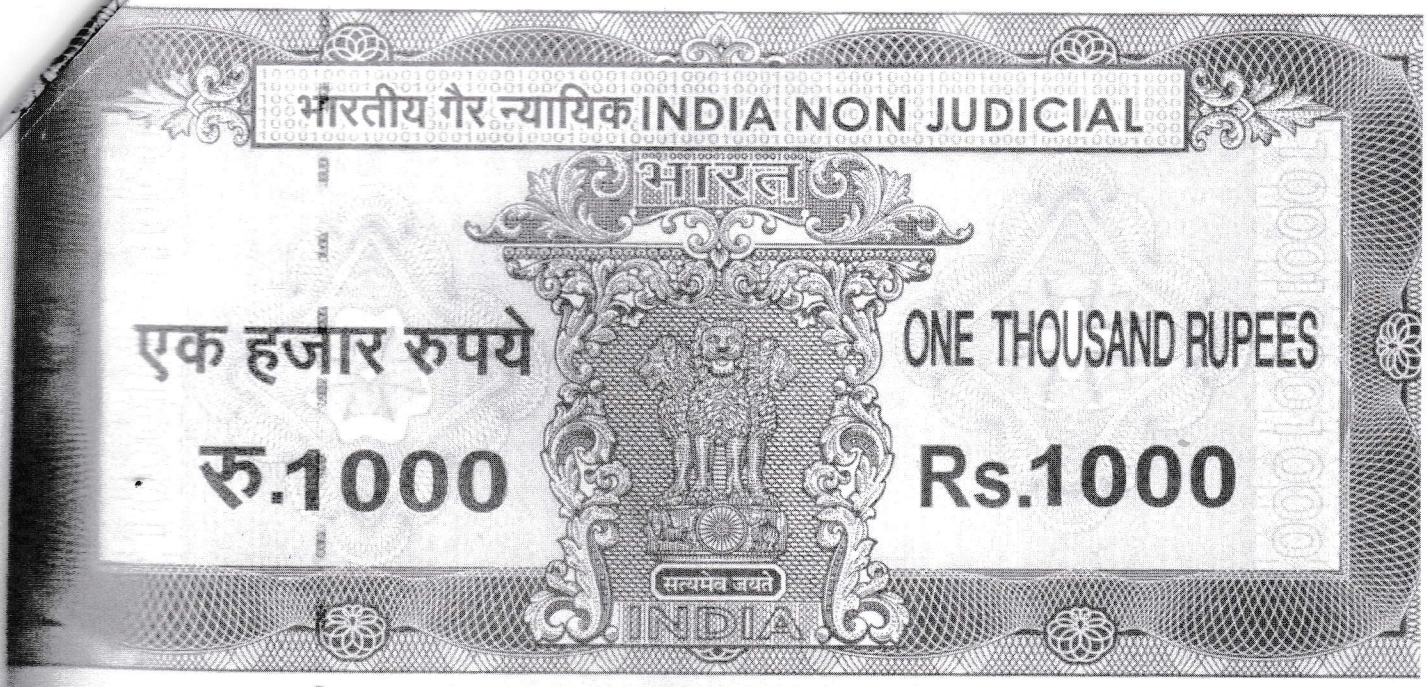
In the presence of:

1. Smt.Daicy Mathew
   1st Grade Drafts man

2. Smt.Sonia Thomas
   2nd Grade Drafts man

Contractor

EXECUTIVE ENGINEER



केरल KERALA

N 163439

Name of Work: CSIND- Desilting of Meenachil river from Chungam to Kanjiram in Kottayam Municipality and Thiruvarppu panchayath in Kottayam District

Contractor

EXECUTIVE ENGINEER

भारतीय गैर न्यायिक

भारत INDIA

रु. 500 FIVE HUNDRED RUPEES

पाँच सौ रुपये Rs. 500

सत्यमेव जयते

INDIA NON JUDICIAL

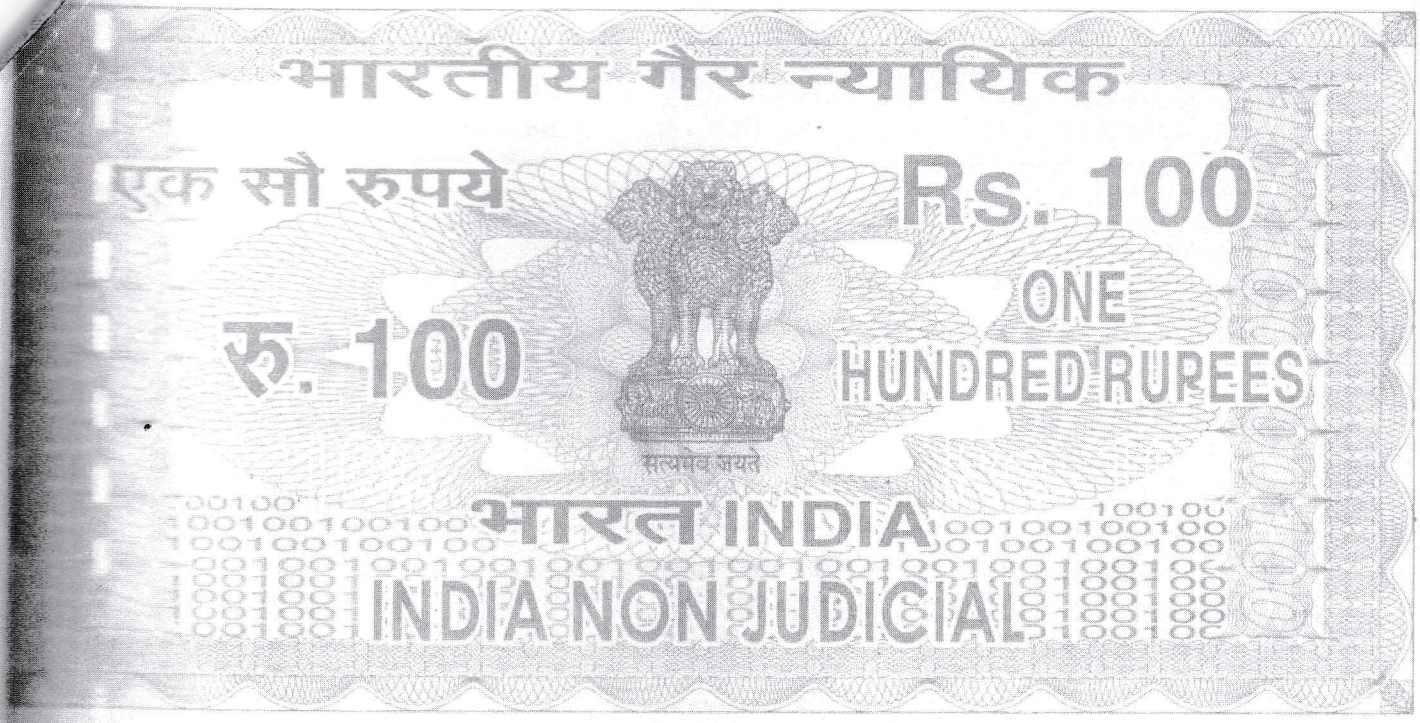
केरल KERALA G 844727

Name of Work: CSIND- Desilting of Meenachil river from Chungam to Kanjiram in Kottayam Municipality and Thiruvarppu panchayath in Kottayam District

Contractor

EXECUTIVE ENGINEER

SIVASANKARAN NA[illegible]



കേരള KERALA CL 285144

Name of Work: CSIND- Desilting of Meenachil river from Chungam to Kanjiram in Kottayam Municipality and Thiruvarppu panchayath in Kottayam District

Signed and delivered by Sri.Rajesh K.. Executive Engineer, Irrigation Division, Kottayam for and on behalf of the Governor of the State of Kerala.

EXECUTIVE ENGINEER
IRRIGATION DIVISION KOTTAYAM
(For and on behalf of the Governor of the State of Kerala)

In the presence of:

1. Smt.Suseela R
   Personal Assistant to Executive Engineer

2. Sri. G.Manoj
   Divisional Accountant

Contractor

EXECUTIVE ENGINEER

STAMP DEPOT

Anx. III

PRICE

EST NO:2020/5559/IA

TS Register No: 108/2021-2022
AS Register No:348/2020-2021

Detailed Estimate

CSIND-Clearing obstructions and desilting in Meenachil river(Neelimangalam feeder canal) & repair of Kumarakom boat route canal in Kottayam District

(Cost Index Applied for this estimate is 37.93%)

Sl No	Description	No	L	B	D	CF	Quantity	Remark
	1 clearing Jungles							
1	2.31 Clearing jungle including uprooting of rank vegetation, grass, brush wood, trees and saplings of girth up to 30 cm measured at a height of 1 m above ground level and removal of rubbish up to a distance of 50 m outside the periphery of the area cleared							
	neelimangalam to Kudamaloor	2	6500.000	3.000			39000.000	
						Total Quantity	39000.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	39000.000 sqm	
						Say 39000.000 sqm @ Rs 9.93 / sqm	**Rs 387270.00**	
2	2.33.1 Felling trees of the girth (measured at a height of 1 m above ground level) including cutting of trunks and branches, removing the roots and stacking of serviceable material and disposal of unserviceable material.Beyound 30 cm girth up to and including 60 cm girth							
		100					100.000	
						Total Quantity	100.000 each	
						Total Deducted Quantity	0.000 each	
						Net Total Quantity	100.000 each	
						Say 100.000 each @ Rs 302.34 / each	**Rs 30234.00**	
3	od34855/2020_2021/IA Earth work excavation by mechanical means(Hydraulic excavator) over areas exceeding 30cm in depth ,1.5m in width as well as 10 sqm on plan including disposal of earth,disposed earth to be levelled and neatly dressed,All kinds of soil							
	From Kumarakom boat jetty	1	550.000	5.000	0.500		1375.000	
	Neelimangalam feeder canal	1	500.000	5.000	2.000		5000.000	
		1	450.000	4.000	1.500		2700.000	
		1	600.000	5.000	1.200		3600.000	

PRICE EST NO:2020/5559/

		1	750.000	15.000	0.600		6750.000	
		1	500.000	15.000	0.800		6000.000	
		1	650.000	15.000	0.700		6825.000	
						Total Quantity	32250.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	32250.000 cum	
						Say 32250.000 cum @ Rs 124.64 / cum	**Rs 4019640.00**	
4	od8236/2021_2022/IA Providing bioshielding to river bank using bamboo/vettiver as per direction of department officers at site							
		250					250.000	
						Total Quantity	250.000 each	
						Total Deducted Quantity	0.000 each	
						Net Total Quantity	250.000 each	
						Say 250.000 each @ Rs 52.48 / each	**Rs 13120.00**	
Sl No	Description	No	L	B	D	CF	Quantity	Remark
	2 Side protection							
1	15.9.2 Demolishing stone rubble masonry manually / by mechanical means including stacking of serviceable material and disposal of unserviceable material within 50 metres lead as per direction of Engineer -in-Charges:In cement mortar							
	Existing retaining wall	1	10.000	(0.50+0.30)/2	(0.50+2.00)/2		5.000	
						Total Quantity	5.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	5.000 cum	
						Say 5.000 cum @ Rs 1387.16 / cum	**Rs 6935.80**	
2	2.6.1 Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil							
	Side cutting river side	1	15.000	0.500	1.000		7.500	
						Total Quantity	7.500 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	7.500 cum	
						Say 7.500 cum @ Rs 173.72 / cum	**Rs 1302.90**	

PRICE

EST NO:2020/5559/IA

3	5.33.1 Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying but excluding the cost of centering, shuttering, finishing and reinforcement, including admixtures in recommended proportions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer - in-charge. Note:- Cement content considered in this item is @ 330 kg/ cum. Excess or less cement used as per design mix is payable or recoverable separately.All work upto plinth level							
	For piles -Lower pointing pyramid shape(Volume=1/3(Area*Vertical length)	8	0.300	0.250	0.400	0.333	0.080	
	Haunch for resting of slabs on piles, sectional area=(0.40+0.2)/2*0.15=0.045	8		0.300		0.045	0.108	
	Capping beam (width=Pile width + higher slab thickness)	1	15.000	(.25+.06)	0.150		0.698	
	For Anchor	8	1.000	0.100	0.100		0.080	
						Total Quantity	0.966 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	0.966 cum	
						Say 0.966 cum @ Rs 8891.66 / cum	**Rs 8589.34**	
4	od43602/2020_2021/IA Providing and conveying Pre-cast reinforced cement concrete piles of specified size in M-25 cement concrete to carry safe working load not less than specified,including centering,shuttering,etc.complete but excluding the cost of steel reinforcement.(Length of pile for payment shall be measured from top of the shoe to the bottom of the pile cap). 300 mm x250 mm piles. Details of cost for 20m length of pile.(Based on DSR 20.5.1) MATERIAL:Concrete - 0.30 x 0.25 x 20 = 1.50 cum							
	Side protection pile(0.30x0.25)@2.10 m c/c for 15 m left bank	8	6.300				50.400	
	additional pile for anchor	3	2.000				6.000	
						Total Quantity	56.400 metre	
						Total Deducted Quantity	0.000 metre	
						Net Total Quantity	56.400 metre	

PRICE

EST NO:2020/55

				Say 56.400 metre @ Rs 1117.26 / metre			**Rs 63013.46**	
5	od43603/2020_2021/IA Driving and installing Pre-cast reinforced cement concrete piles of any size and length in M-25 cement concrete, etc.complete (Based on DSR 20.5.1)							
	Piles	8	3.500				28.000	
		3	1.500				4.500	
						Total Quantity	32.500 metre	
						Total Deducted Quantity	0.000 metre	
						Net Total Quantity	32.500 metre	
						Say 32.500 metre @ Rs 1203.18 / metre	**Rs 39103.35**	
6	od43604/2020_2021/IA Providing,conveying,hoisting and fixing up to floor five level, precast reinforced cement concrete in slabs including setting in cement mortar 1:3(1 cement : 3 coarse sand), cost of required centering, shuttering and finishing with neat cement punning on exposed surfaces but excluding the cost of reinforcement, with machine batched and machine mixed design mix M-25 grade cement concrete (based on DSR 5.16) For precast slab(Lower) size -- 2.00 x 1.00 x0.08 m Quantity of concrete(1: 1.5:3) = 2.00 x 1.00 x 0.08 =0.16 cum Area of form work: sides 2 x 2.00 x 0.08 =0.32 sides 2 x 1.00 x 0.08 =0.16 Total area =0.48sq.m							
	Side protection pre cast slab (lower)	7	2.000	1.000	0.080		1.120	
						Total Quantity	1.120 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	1.120 cum	
						Say 1.120 cum @ Rs 13553.90 / cum	**Rs 15180.37**	
7	od43605/2020_2021/IA Providing,conveying,hoisting and fixing up to floor five level, precast reinforced cement concrete in slabs including setting in cement mortar 1:3(1 cement : 3 coarse sand), cost of required centering, shuttering and finishing with neat cement punning on exposed surfaces but excluding the cost of reinforcement, with machine batched and machine mixed design mix M-25 grade cement concrete (based on DSR 5.16)For precast slab(Higher) -- 2.00 x 1.80 x0.06 m Details of cost for one precast slab -- 2.00 x 1.80 x0.06 m Quantity of concrete(1: 1.5:3) = 2.00 x 1.80 x 0.06 =0.216 cum Area of form work: sides 2 x 2.00 x 0.06=0.24 sides 2 x 1.80 x 0.06 =0.216 Total area =0.456 sq.m							
	Side protection pre cast slab (higher)	7	2.000	1.800	0.060		1.512	
						Total Quantity	1.512 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	1.512 cum	
						Say 1.512 cum @ Rs 13316.06 / cum	**Rs 20133.88**	

RICE

EST NO:2020/5559/IA

8	2.25 Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundation etc. in layers not exceeding 20 cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift up to 1.5 m.							
	For deadman and Anchor	1	15.000	(1+1.5)/2	1.300		24.375	
	Working space for placing slab(below anchor)	1	15.000	(.3+.5)/2	1.500		9.000	
	Deadman Qty	1	15.000	0.500	0.600		-4.500	
		8	1.000	0.100	0.100		-0.080	
						Total Quantity	33.375 cum	
						Total Deducted Quantity	-4.580 cum	
						Net Total Quantity	28.795 cum	
						Say 28.795 cum @ Rs 173.45 / cum	**Rs 4994.49**	
9	4.1.5 Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level:1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size)							
	Deadman	1	15.000	0.500	0.600		4.500	
						Total Quantity	4.500 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	4.500 cum	
						Say 4.500 cum @ Rs 6795.81 / cum	**Rs 30581.15**	
10	5.9.5 Centering and shuttering including strutting, etc. and removal of form for:Lintels, beams, plinth beams, girders bressumers and cantilevers							
	Haunch, sectional area=(0.40+0.2)/2*0.15=0.045	8	2*.045				0.720	
	Haunch	8	1*.3		0.400		0.960	
	For piles - End Pyramid Shoe (4*(.125*.4)/2)	8	0.025		0.400		0.080	
	Anchor (2 sides)	8*2	1.000		0.100		1.600	
	For deadman	2	15.000		0.600		18.000	
	End	2	0.500		0.600		0.600	

PRICE

EST NO:2020/555

	Anchor rod area	8				0.0314	-0.251	
							Total Quantity	21.960 sqm
							Total Deducted Quantity	-0.251 sqm
							Net Total Quantity	21.709 sqm
							Say 21.709 sqm @ Rs 472.96 / sqm	**Rs 10267.49**
11	5.22.6 Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete upto plinth levelThermo - Mechanically Treated bars of grade Fe-500D or more							
	Pile Qty =((8*6.3*.3*.25)+(3*2*.3*.25)=4.23 @ 125kg/m3	4.23				125.0	528.750	
	Lower pointing pyramid for piles and haunch	0.188				125.0	23.500	
	slab quantity=1.12+1.512=2.632@90kg/m3	2.632				90.0	236.880	
	capping beam quantity	5.58				90.0	502.200	
	anchor rod 20mm dia	8	1.500			2.47	29.640	
							Total Quantity	1320.970 kilogram
							Total Deducted Quantity	0.000 kilogram
							Net Total Quantity	1320.970 kilogram
							Say 1320.970 kilogram @ Rs 78.07 / kilogram	**Rs 103128.13**
							Total Amount	4753494.00
							Provision for GST payments (in %) @	**5.0%**
							Amount reserved for GST payments	**237674.70**
							Total	**4991168.70**
							Lumpsum for round off	**8831.30**
							TOTAL Rs	**5000000.00**
							Rounded Total Rs	**50,00,000**
								Rupees Fifty Lakh Only

(Cost Index Applied for this estimate is 37.93%)

ND-Desiltingof Meenachilriver fromChungamtoKanjiraminKottayamMunicipalityand

RICEEST.No:2018/4894/IA Agt.No.60/EE/2019-20dt.16.03.2020.

Nameofconractor :Saji .A.Kuruvila ContactorsAgreed PAC:Rs.3557441.25/-

REVISED ESTIMATE

1. (cost index 37.93%)	od32705/2019_2020/IA:Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding30 cm in depth,1.5m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 mand lift up to 1.5 m,disposed earth to be levelled and neatly dressed. All kindsof soil.											
	Atvariousreaches											
	L/B		1	1390		6		1.2		10065.60		
	L/B		1	600		5		1		3000.00		
	R/B		1	1470		6		1.2		10584.00		
	R/B		1	570		5		1		2850.00		
	L/B								TOTAL	26499.60		
			Say	26500.00	m3		@ Rs	124.64	/m3			3302960.00
	EXTRAITEMS											
E1.	od62800/2019_2020/IA: Cutting and removing Bamboo bunches fallen down to the river course as obstructing the flow of water, and any other submerged materials under water andother floating materials from the river as directed by the departmental officers at site.											
	Removing Bamboo trees:											
	L/B		22	30.00		12.00				7920.00		
	L/B		20	30.00		10.00				6000.00		
	L/B		22	15.00		5.00				1650.00		
	R/B		22	30.00		12.00				7920.00		
	R/B		24	30.00		10.00				7200.00		
	R/B		25	15.00		5.00				1875.00		
									TOTAL	32565.00		
0			Say	32565.00	m2	@	Rs	20.78	/m2			676700.70
E2. 50.2.33.5	Cutting branches of trees overhanging above any structures of girth between 40 cmto 60 cm including stacking of serviceable materials and disposal of unserviceable material, cost of labour, hire charges of rope and pully etcwithout making any damages to nearby structures Etc complete.											
	L/B		220							220.00		
	R/B		205							205.00		
									TOTAL	425.00		
			Say	425.00	E	@	Rs	208.00	/E			88400.00
E3. 2.33.1.	Felling trees of the girth (measured at a height of 1 m above ground level) including cutting of trunks and branches, removing the roots and stacking of serviceable material and disposal of unserviceable material.Beyound 30 cm girth up to and including 60 cm girth											
	L/B		5							5.00		
	R/B		8							8.00		
									TOTAL	13.00		
0			Say	13.00	E	@	Rs	302.34	/E			3930.42
E4	Providing bioshielding to river bank using bamboo /vettiver /mmacham etc as per direction of departmenal officers at site											
			50							50		

23. 40,74,615.12

GST 5%. ₹ 2,03,730.75

42,78,345.87.

എക്സിക്യൂട്ടീവ് എഞ്ചിനീയർ
ഇറിഗേഷൻ ഡിവിഷൻ
കോട്ടയം

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EST NO:2021/122/IA

TS Register No:77/2021-2022
AS Register No:155/2020-2021

Detailed Estimate

Rejuvenation works of Meenachil river from Ettumanoor to Kottayam Municipal area in Kottayam district.

(Cost Index Applied for this estimate is 37.93%)

Sl No	Description	No	L	B	D	CF	Quantity	Remark
	1 clearing obstructions							
1	od39347/2020_2021/IA od62800/2019_2020/IA :Cutting and removing Bamboo bunch of trees fallen down to the river course and obstructing the flow of water, and any other submerged materials under water and other floating materials from the river as directed by the departmental officers at site 							
	Along the river	16	30.000	5.000			2400.000	
		24	40.000	6.000			5760.000	
						Total Quantity	8160.000 sqm	
						Total Deducted Quantity	0.000 sqm	
						Net Total Quantity	8160.000 sqm	
						Say 8160.000 sqm @ Rs 20.78 / sqm	**Rs 169564.80**	
2	2.33.1 Felling trees of the girth (measured at a height of 1 m above ground level) including cutting of trunks and branches, removing the roots and stacking of serviceable material and disposal of unserviceable material.Beyound 30 cm girth up to and including 60 cm girth							
		30					30.000	
						Total Quantity	30.000 each	
						Total Deducted Quantity	0.000 each	
						Net Total Quantity	30.000 each	
						Say 30.000 each @ Rs 302.34 / each	**Rs 9070.20**	
3	50.2.33.5 Cutting branches of trees overhanging above any structures of girth between 40cm to 60cm including stacking of serviceable materials and disposal of unserviceable material, cost of labour, hire charges of rope and pully etc without making any damages to nearby structures etc complete.							
		1100					1100.000	
						Total Quantity	1100.000 each	
						Total Deducted Quantity	0.000 each	
						Net Total Quantity	1100.000 each	
						Say 1100.000 each @ Rs 208.00 / each	**Rs 228800.00**	

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4	od44076/2020_2021/IA Earth work excavation in for all kinds of soil, in or under water using dredger of capacity 100 m3 per hour (Departmental dredger having hire charge of Rs 53500) up to a depth so as to get sufficient draft over areas including disposal of earth, disposed earth to be levelled and neatly dressed Including hire charge of dredger and cost of lubricant oil etc complete							
	At various reaches	1	810.000	5.000	2.000		8100.000	
		1	625.000	6.000	1.800		6750.000	
		1	725.000	4.000	2.100		6090.000	
		1	850.000	4.000	2.400		8160.000	
		1	130.000	4.000	2.200		1144.000	
		1	470.000	10.000	1.000		4700.000	
						Total Quantity	34944.000 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	34944.000 cum	
						Say 34944.000 cum @ Rs 124.69 / cum	**Rs 4357167.36**	
5	2.6.1 Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil							
	For kadavu	3	3.200	3.400	2.300		75.072	
						Total Quantity	75.072 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	75.072 cum	
						Say 75.072 cum @ Rs 173.72 / cum	**Rs 13041.51**	
6	60.7.2 DR PACKING Under foundation - Dry stone packing under foundation with good quality blasted rubble including conveyance of material and labour charges etc. complete as per direction of departmental officers at site.							
	For kadavu foundation	3	3.200	3.400	0.500		16.320	
						Total Quantity	16.320 cum	
						Total Deducted Quantity	0.000 cum	
						Net Total Quantity	16.320 cum	
						Say 16.320 cum @ Rs 2038.88 / cum	**Rs 33274.52**	
7	60.7.1 DRY RUBBLE MASONRY _ Dry rubble without concrete levelling course masonry with good quality blasted rubble including packing to compactness to lines and levels cost and conveyance of all materials							

	labour charges etc. complete as per direction of Departmental officers at site							
	Side wall	3*2	2.700	0.500	2.000		16.200	
	back wall	3*1	3.000	0.500	2.000		9.000	
	Step	3*1	2.000	2.700	0.200		3.240	
		3*1	2.000	2.400	0.200		2.880	
		3*1	2.000	2.100	0.200		2.520	
		3*1	2.000	1.800	0.200		2.160	
		3*1	2.000	1.500	0.200		1.800	
		3*1	2.000	1.200	0.200		1.440	
		3*1	2.000	0.900	0.200		1.080	
		3*1	2.000	0.600	0.200		0.720	
		3*1	2.000	0.300	0.200		0.360	
	Total Quantity						41.400 cum	
	Total Deducted Quantity						0.000 cum	
	Net Total Quantity						41.400 cum	
	Say 41.400 cum @ Rs 2647.29 / cum						**Rs 109597.81**	
8	4.1.5 Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level:1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size)							
	Side wall	3*2	2.700	0.500	0.075		0.608	
	back wall	3*1	3.000	0.500	0.075		0.338	
	Step	3*1	2.000	0.300	0.075		0.135	
		3*1	2.000	0.300	0.075		0.135	
		3*1	2.000	0.300	0.075		0.135	
		3*1	2.000	0.300	0.075		0.135	
		3*1	2.000	0.300	0.075		0.135	
		3*1	2.000	0.300	0.075		0.135	
		3*1	2.000	0.300	0.075		0.135	
		3*1	2.000	0.300	0.075		0.135	
		3*1	2.000	0.300	0.075		0.135	
	Total Quantity						2.161 cum	
	Total Deducted Quantity						0.000 cum	
	Net Total Quantity						2.161 cum	

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EST NO:2021/122/IA

	Say 2.161 cum @ Rs 6795.81 / cum							Rs 14685.75
9	od7719/2021_2022/IA Providing bioshielding to river bank using bamboo/vettiver as per direction of Dept.officers at site							
	Planting trees	250					250.000	
	Total Quantity							250.000 each
	Total Deducted Quantity							0.000 each
	Net Total Quantity							250.000 each
	Say 250.000 each @ Rs 52.48 / each							Rs 13120.00
Total Amount								4948322.00
Provision for GST payments (in %) @								5.0%
Amount reserved for GST payments								247416.10
Total								5195738.10
Lumpsum for round off								4261.90
TOTAL Rs								5200000.00
Rounded Total Rs								52,00,000
Rupees Fifty Two Lakh Only								

(Cost Index Applied for this estimate is 37.93%)

Anx. IV

ORANGE BOOK 2021 - Relevant Pages (140-145

ഇതിനാവശ്യമായ ഫോർമാറ്റ് Handbook on Disaster Management – Volume 1 – Emergency Operations Centres & Emergency Support Functions Plan, Keralaൽ നൽകിയിട്ടുണ്ട്. മുൻകൂർ റേറ്റ് കോൺട്രാക്റ്റ് ക്ഷണിച്ച് അംഗീകരിക്കാത്ത ഒരു വസ്തുവകകളുടെയും വാടകയോ, ചെലവ് തുകയോ സംസ്ഥാന ദുരന്ത പ്രതികരണ നിധിയിൽ നിന്നും ചെലവഴിക്കുവാൻ പാടുള്ളതല്ല. ഇത്തരം റേറ്റ് കോൺട്രാക്റ്റ് തഹസിൽദാർ വേണം അന്തിമമായി അഗീകരിക്കുവാൻ.

5. വകുപ്പിന്റെ നിയന്ത്രണത്തിൽ ഉള്ള എല്ലാ അണക്കെട്ടുകളുടെയും ചുവപ്പ് അലേർട്ട് (തുറന്നു വിടുന്നതിന് മുൻപുള്ള മുന്നറിയിപ്പ്), ഓറഞ്ച് അലേർട്ട്, നീല അലേർട്ട് എന്നീ ജലനിരപ്പുകളും, റൂൾ കെർവ് അനുസരിച്ച് ഏതു സാഹചര്യങ്ങളിൽ അണക്കെട്ടുകൾ തുറന്നുവിടും എന്നും അണക്കെട്ടുകൾ നിലനിൽക്കുന്നതും, അണക്കെട്ടിലെ ജലം ഒഴുകി പോകുന്നതുമായ ജില്ലകളിലെ ജില്ലാ ദുരന്ത നിവാരണ അതോറിറ്റിക്ക് ജൂൺ 1ന് മുൻപ് നൽകി മുൻകൂർ അനുമതി വാങ്ങണം. ഈ അംഗീകൃത പദ്ധതി അനുസരിച്ച് മാത്രമേ അണക്കെട്ടുകളിൽ നിന്നും ജലം തുറന്ന് വിടുവാൻ പാടുള്ളൂ.

6. വകുപ്പിന്റെ നിയന്ത്രണത്തിൽ ഉള്ള എല്ലാ കാനാലുകളും, പുഴകളും, നീർച്ചാലുകളും തടസരഹിതമാക്കി എന്ന് മെയ് മാസത്തിൽ തന്നെ ഉറപ്പ് വരുത്തുക. പ്രധാന നീർചാലുകളും, ഓടകളും, പരിശോധിച്ച്, അവയിൽ തടസങ്ങൾ ഇല്ല എന്ന് മണ്ണ് സംരക്ഷണ വകുപ്പ്, തദ്ദേശസ്വയംഭരണ വകുപ്പ് എന്നിവരുമായി ചേർന്ന് ഉറപ്പ് വരുത്തുക. മഴവെള്ളത്തിന്റെ ഒഴുക്ക് തടസ്സപ്പെടുത്തുന്ന എല്ലാ വസ്തുക്കളും ഓടകളിൽനിന്നും, നീർച്ചാലുകളിൽ നിന്നും മാറ്റുക.

7. അണക്കെട്ടുകളിൽ നിന്നും ജലം തുറന്നു വിടേണ്ടുന്ന സാഹചര്യം ഉണ്ട് എന്ന അനുമാനത്തിൽ എത്തുകയാണെങ്കിൽ നീല അലേർട്ട് പുറപ്പെടുവിക്കുന്ന അവസരത്തിൽ തുറന്നുവിടുവാൻ സാധ്യതയുള്ള അണക്കെട്ടിന്റെ ജല ബഹിർഗമന പാതയിലുള്ള എല്ലാ ജില്ലകളിലെയും അടിയന്തിരഘട്ട കാര്യനിർവ്വഹണ കേന്ദ്രങ്ങളിൽ (BSNL 1077ൽ) നിർബന്ധമായും അറിയിപ്പ് നൽകേണ്ടതാണ്; 36 മണിക്കൂർ

സ്വീകരിക്കണം. ഇതിനായി ആശുപത്രികളിൽ ഉടനടി ജനറേറ്ററുകൾ സ്ഥാപിക്കണം.

19. വൈദ്യുത ബന്ധത്തിൽ തകരാറുകൾ വരുന്ന മുറക്ക് യുദ്ധകാലാടിസ്ഥാനത്തിൽ പരിഹാരം കണ്ടെത്താനുള്ള തയ്യാറെടുപ്പുകൾ, ആവശ്യമായ ടാസ്ക് ഫോഴ്സുകൾ തുടങ്ങിയവ മുൻകൂട്ടി സജ്ജമാക്കി നിർത്തണം.

20. സംസ്ഥാനത്തെ ആശുപത്രികളിൽ വൈദ്യുതി മുടങ്ങുന്നില്ലെന്ന് ജില്ലാ ദുരന്ത നിവാരണ അതോറിറ്റിയും, വൈദ്യുതി ബോർഡുമായി ചേർന്ന് ഉറപ്പാക്കണം.

ജലസേചന വകുപ്പ്

1. തീരശോഷണ ആഘാതം ലഘൂകരിക്കുവാൻ ആവശ്യമായ രീതിയിൽ ജലസേചന വകുപ്പ് കടൽ ഭിത്തികൾക്കുള്ള കേടുപാടുകൾ അടിയന്തിരമായി പരിശോധിച്ച്, പരിഹരിക്കുക. കടൽ ഭിത്തിയുടെ നിർമ്മാണം, പരിപാലനം, പുനർനിർമ്മാണം എന്നിവയ്ക്ക് ദുരന്ത പ്രതികരണ നിധി വിനിയോഗിക്കുവാൻ പാടുള്ളതല്ല.

2. തീരശോഷണം നേരിടുവാൻ സാധ്യതയുള്ള എല്ലാ പ്രദേശങ്ങൾ കണ്ടെത്തി മെയ് 30ന് മുൻപ് പ്രസ്തുത വിവരം ജില്ലാ ദുരന്ത നിവാരണ അതോറിറ്റിയെ അറിയിക്കുക.

3. അടിയന്തിരഘട്ടങ്ങളിൽ തീരത്തെയും, വയൽ ബണ്ടുകളിലെയും, പുഴയോരത്തെയും വീടുകൾക്ക് സംരക്ഷണം നൽകുവാൻ ആവശ്യമായ രീതിയിൽ മണൽനിറച്ച കയർ ചാക്കുകളോ, ജിയോ ട്യൂബുകളോ കരുതുവാൻ വേണ്ടുന്ന നടപടികൾ ജലസേചന വകുപ്പ് തദ്ദേശ സർക്കാരുമായി ചേർന്ന് നടത്തണം

4. തീരശോഷണം, ശക്തമായ കാറ്റ്, സുനാമി, ചുഴലിക്കാറ്റ് എന്നിവയോടനുബന്ധിച്ചുള്ള അടിയന്തിരഘട്ടത്തിൽ മണൽനിറച്ച കയർ ചാക്കുകളോ, ജിയോ ട്യൂബുകളോ ഉപയോഗിക്കുന്നതിന് ദുരന്ത പ്രതികരണ നിധിയിൽ നിന്നും തുക ചെലവഴിക്കാവുന്നതാണ്. ആവശ്യമാണെങ്കിൽ മാത്രം ഇവ ഉപയോഗപ്പെടുത്തുക.

മുൻപെങ്കിലും ഇത്തരം ഒരു പ്രാഥമിക അറിയിപ്പ് ജില്ലകൾക്ക് നല്കുവാൻ വകുപ്പ് പരിശ്രമിക്കണം. ജല ബഹിർഗമന പാതയിലുള്ള എല്ലാ ജില്ലാ കളക്ടർമാരുടെയും അനുമതിയോടെ മാത്രമേ അണക്കെട്ടുകളിൽ നിന്നും ജലം തുറന്നു വിടാൻ പാടുള്ളൂ.

8. നീല അലേർട്ട് നൽകുന്ന സമയം മുതൽ ചുവപ്പ് അലേർട്ട് വരെ ചുരുങ്ങിയത് 24 മണിക്കൂർ സമയം എങ്കിലും ജില്ലാ ദുരന്ത നിവാരണ അതോറിറ്റികൾക്ക് ലഭിക്കുന്നു എന്ന് ഉറപ്പ് വരുത്തുക.

9. ഓറഞ്ച് ആലേർട്ടും, ചുവപ്പ് ആലേർട്ടും മാത്രമുള്ള അണക്കെട്ടുകളിൽ ഓറഞ്ച് അലേർട്ട് നൽകുന്ന സമയം മുതൽ ചുവപ്പ് അലേർട്ട് വരെ ചുരുങ്ങിയത് 24 മണിക്കൂർ സമയം എങ്കിലും ജില്ലാ ദുരന്ത നിവാരണ അതോറിറ്റികൾക്ക് ലഭിക്കുന്നു എന്ന് ഉറപ്പ് വരുത്തുക.

10. എല്ലാ അണക്കെട്ടുകൾക്കും ചുവപ്പ്, ഓറഞ്ച്, നീല എന്നീ മൂന്നു തരം മുന്നറിയിപ്പുകൾ ഇല്ല. ഏതെല്ലാം അണക്കെട്ടുകൾക്കാണ് ഇവ ബാധകം എന്നത് പ്രത്യേകമായി ജല ബഹിർഗമന പാതയിലുള്ള എല്ലാ ജില്ലാ ദുരന്ത നിവാരണ അതോറിറ്റികളെ അറിയിക്കണം.

11. ഒരു കാരണവശാലും വൈകിട്ട് 6 മണിക്ക് ശേഷം, പകൽ 6 മണിവരെ, പകൽ തുറക്കാതെ ഇരുന്ന അണക്കെട്ടുകളുടെ ഷട്ടറുകൾ തുറന്ന് പുതുതായി ജലം ഒഴുക്കരുത്.

12. വേലിയേറ്റ സമയത്തെ സമുദ്ര സ്ഥിതി കൂടി INCOISന്റെ വെബ്സൈറ്റിൽ (https://incois.gov.in/portal/osf/tide.jsp) നിന്നും പരിശോധിച്ചിട്ട് വേണം അണക്കെട്ടുകളിൽ നിന്നും ജലം തുറന്നു വിടുവാൻ അനുവാദം നല്കുവാൻ. ജില്ല ഇ.ഓ.സി യിൽ നിയോഗിച്ചിടുള്ള ജലസേചന വകുപ്പ് എഞ്ചിനീയർ മേൽ അനുമാനം നടത്തി അണക്കെട്ടിന്റെ ചുമതലയുള്ള ഉദ്യോഗസ്ഥനുമായി ചർച്ച ചെയ്ത് ശുപാർശ നൽകേണ്ടതാണ്.

13. അപ്രതീക്ഷിത മഴയിൽ രാത്രിയും തുറന്ന് വിടേണ്ടി വരുന്ന അണക്കെട്ടുകളുടെ പേരുകൾ അനുബന്ധം 4 ആയി ഉൾപ്പെടുത്തിയിട്ടുണ്ട്. ഇത്തരം അണക്കെട്ടുകളിൽ നിന്നും ജലം തുറന്ന്

വിടുന്നതിന് മുൻപ് ജില്ല ദുരന്ത നിവാരണ അതോറിറ്റിയെ അറിയിക്കുക, അനുമതി വാങ്ങുക.

14. ജലസേചന വകുപ്പുകളിലെ അസിസ്റ്റന്റ് എക്സിക്യൂട്ടീവ് എഞ്ചിനീയറിൽ കുറയാത്ത ഉദ്യോഗസ്ഥനെ ഷിഫ്റ്റ് അടിസ്ഥാനത്തിൽ ജീല്ലാ അടിയന്തിരഘട്ട കാര്യനിർവ്വഹണ കേന്ദ്രങ്ങളിലേക്ക് 24 x 7 നിയോഗിക്കുക.

15. ജില്ല ഇ.ഓ.സിയിൽ നിയോഗിച്ചിട്ടുള്ള ജലസേചന വകുപ്പ് എഞ്ചിനീയർ അതാത് അണകെട്ടിൽ നിന്നും പുറത്തേക്ക് ഒഴുക്കുവാൻ ഉദ്ദേശിക്കുന്ന ജലത്തിന് അനുസരിച്ച് ഓരോ പ്രദേശത്തും എത്ര കണ്ട് ജലം ഉയരും എന്നത് വകുപ്പിലെ മറ്റ് ഉദ്യോഗസ്ഥരുമായി ചർച്ച ചെയ്ത് ജില്ലാ ഇ.ഒ.സിയ്ക്ക് അനുമാനിച്ച് നൽകേണ്ടതാണ്. ജലം നദിയുടെ കരകവിഞ്ഞ് ഒഴുകുമോ എന്ന് കൂട്ടായി പരിശോധിക്കുകയും ചെയ്യുക.

16. നദീ ജലം മറ്റ് ജില്ലകളിൽ ചെന്ന് എത്തും എങ്കിൽ പ്രസ്തുത ജില്ലയിലെ ജില്ലാ ഇ.ഒ.സിയെ അറിയിക്കുക

17. കേന്ദ്ര ജല കമ്മിഷൻ (CWC) നൽകുന്ന പ്രളയ മുന്നറിയിപ്പ് (ഇവ ഇവിടെ നിരീക്ഷിക്കാം http://india-water.gov.in/) നിരീക്ഷിച്ച് ജില്ലയിലെ ഏതെല്ലാം ഭാഗത്ത് പ്രളയ സാധ്യതയുണ്ട് എന്ന് സംസ്ഥാന, ജില്ലാ ഇ.ഒ.സികൾ, തദ്ദേശ സ്ഥാപനങ്ങൾ എന്നിവരെ അറിയിക്കുന്നതിന് ജില്ലയിലെ എല്ലാ ജല സേചന ഉദ്യോഗസ്ഥരും, കെ.എസ്.ഇ.ബി ഉദ്യോഗസ്ഥരുമായി നിരന്തരം ബന്ധപ്പെട്ട് പ്രവർത്തിക്കുവാനുള്ള ചുമതലയും മേൽ ഉദ്യോഗസ്ഥന് ആയിരിക്കും.

18. പൊതുജനങ്ങൾക്ക് അണക്കെട്ട് തുറക്കുന്നതിന് മുൻപ് ഇ.എ.പി അനുസരിച്ചുള്ള സൈറൺ മുഴക്കി അറിയിപ്പ് നൽകുക

19. വകുപ്പ് തയ്യാറാക്കിയ അടിയന്തിരഘട്ട പ്രവർത്തന പദ്ധതി (ഇ.എ.പി) പ്രകാരം പൊതുജനങ്ങളും തദ്ദേശ സർക്കാരുകളും അറിഞ്ഞിരിക്കേണ്ട വിഷയങ്ങൾ ഉൾപ്പെടുത്തി മലയാളത്തിൽ ഒരു ലഘുലേഖയിൽ ഓരോ അണകെട്ടും സംബന്ധിച്ച് പ്രസിദ്ധീകരിക്കുക. ഈ ലഘുലേഖയിൽ ജനങ്ങൾക്ക് എങ്ങനെയാണ് മുന്നറിയിപ്പ് നൽകേണ്ടത്, ആരാണ് മുന്നറിയിപ്പ് നൽകേണ്ടത്, എങ്ങനെയാണ് അവരെ അടിയന്തരഘട്ടത്തിൽ

മാറ്റേണ്ടത് എന്നിങ്ങനെയുള്ള കാര്യങ്ങൾ പ്രതിപാതിക്കണം. താഴ്ന്ന പ്രദേശങ്ങളിൽ ജീവിക്കുന്ന ആളുകളുടെ വിവരങ്ങൾ, അവർക്കുള്ള സുരക്ഷിത സ്ഥലങ്ങൾ, സുഗമമായ മാർഗങ്ങൾ, ഒഴിപ്പിക്കൽ വഴികൾ തുടങ്ങിയവയുടെ വിശദാംശങ്ങളും പ്രസ്തുത പദ്ധതിയിൽ ഉൾപ്പെടുത്തണം.

Sl. No	ജില്ല	അണക്കെട്ട്	ഇ.എ.പി ലിങ്ക്	റൂൾ കെർവ്
1	തിരുവനന്തപുരം	നെയ്യാർ	Neyyar	Neyyar
2	കോഴിക്കോട്	കുറ്റിയാടി (പെരുവണ്ണാമൂഴി)	Kuttiyadi	Kuttiyadi
3	പാലക്കാട്	മലമ്പുഴ	Malampuzha	Malampuzha
4	പാലക്കാട്	ചുള്ളിയാർ	Chulliyar	
5	പാലക്കാട്	മംഗലം		Mangalam
6	പാലക്കാട്	വാളയാർ	Walayar	
7	പാലക്കാട്	കാഞ്ഞിരപ്പുഴ	Kanjirappuzha	Kanjirappuzha
8	പാലക്കാട്	മീൻകര	Meenkara	
9	പാലക്കാട്	കുളൂർ ബറാജ് (പഴശ്ശി)	Pazhasshi	
10	പാലക്കാട്	പോത്തുണ്ടി	Pothundy	Pothundy
11	തൃശ്ശൂർ	ചീമോനി	Chimony	Chimony
12	തൃശ്ശൂർ	വാഴാനി	Vazhani	Vazhani
13	തൃശ്ശൂർ	പീച്ചി	Peechi	Peechi
14	ഇടുക്കി	മലങ്കര	Malankara	
15	കൊല്ലം	കല്ലട (പരപ്പാർ)	Kallada	Kallada

20. ആലപ്പുഴ ജില്ലയിൽ ജലസേചന വകുപ്പിന്റെ നിയന്ത്രണത്തിൽ സൂക്ഷിച്ചിരിക്കുന്ന അതിശക്തമായ പമ്പുകൾ പരിശോധിച്ച് അവ പ്രവർത്തന ക്ഷമമം ആണ് എന്ന് 10-6-2021ന് മുൻപ് ഉറപ്പ് വരുത്തുകയും, ഇവ അടിയന്തിരമായി വിവിധ സ്ഥലങ്ങളിൽ വിന്യസിക്കുവാൻ ആവശ്യമായ ക്രെയിൻ, വാഹനങ്ങൾ എന്നിവയ്ക്ക് മെയ് മാസത്തിൽ തന്നെ കേന്ദ്ര സർക്കാർ Ltr. No. 33-2/2015-NDM-I dated 17th April 2015 from Ministry of Home Affairs, Govt. of India പ്രകാരം നിഷ്കർഷിച്ചിരിക്കുന്നത് പോലെ റേറ്റ് കോൺട്രാക്റ്റ് ക്ഷണിച്ച് തീരുമാനമാക്കി സൂക്ഷിക്കുക. ആവശ്യമാണെങ്കിൽ മാത്രം

ഉപയോഗപ്പെടുത്തുക. ഇതിനാവശ്യമായ ഫോർമാറ്റ് Handbook on Disaster Management – Volume 1 – Emergency Operations Centres & Emergency Support Functions Plan, Keralaൽ നൽകിയിട്ടുണ്ട്. ഈ പ്രവർത്തികൾക്ക് ചെലവാകുന്ന തുക GO (Ms) No. 194/2015/DMD dated 20-05-2015, Item 4 – Clearance of Affected Areas പ്രകാരം 2245-02-101-94-Flood-Other Itemsൽ നിന്നും വഹിക്കാവുന്നതാണ്. ഇവ വിനിയോഗിക്കുന്നതിനും, മറ്റ് ജില്ലകളിലേക്ക് മാറ്റുന്നതിനും ജില്ലാ ദുരന്ത നിവാരണ അതോറിറ്റിയുടെ അനുമതി വാങ്ങണം.

21. തണ്ണീർമുക്കം ബണ്ടിലൂടെയുള്ള ജല ബഹിർഗമനം സുഗമമാണ് എന്ന് ഉറപ്പുവരുത്തുക
22. തദ്ദേശ സ്ഥാപന തലത്തിൽ വെള്ളപ്പൊക്ക നിവാരണ പദ്ധതികൾ (Flood Management Plan) തയ്യാറാക്കുന്നതിന് തദ്ദേശ സ്ഥാപനങ്ങളെ സഹായിക്കുക. വകുപ്പിന്റെ പദ്ധതികൾ തദ്ദേശ സ്ഥാപനങ്ങളുടെ ദുരന്ത ലഘൂകരണ പദ്ധതിയുമായി ചേർന്ന് പോകുന്നതാണ് എന്ന് ഉറപ്പ് വരുത്തുക
23. പൊഴി മുഖങ്ങളിൽ അടിഞ്ഞിട്ടുള്ള മണ്ണ് ജൂൺ 15ന് മുൻപായി മാറ്റുക. ജല ബഹിർഗമനം സുഗമമാക്കുവാനായി നിരന്തരം ആവശ്യമായ നടപടികൾ സ്വീകരിക്കുക.
24. സ്പിൽവേകൾ, അണക്കെട്ടുകൾ, ബരാജ്കൾ എന്നിവയുടെ ഷട്ടറുകൾ പ്രവർത്തനക്ഷമം ആണ് എന്ന് ഉറപ്പ് വരുത്തി ജില്ലാ ദുരന്ത നിവർണ അതോറിറ്റിയ്ക്ക് റിപോർട്ട് ജൂൺ 15ന് മുൻപായി നൽകുക

കെ.എസ്.ഇ.ബി

1. കെ.എസ്.ഇ.ബിയുടെ നിയന്ത്രണത്തിൽ ഉള്ള എല്ലാ പ്രധാന അണക്കെട്ടുകളുടെയും ചുവപ്പ്, ഓറഞ്ച്, നീല എന്നീ അലേർട്ട് ജലനിരപ്പുകളും, റൂൾ കെർവ് അനുസരിച്ച് ഏതു സാഹചര്യങ്ങളിൽ അണക്കെട്ടുകൾ തുറന്നുവിടും എന്നും അണക്കെട്ടുകൾ നിലനിൽക്കുന്നതും, അണക്കെട്ടിലെ ജലം ഒഴുകി പോകുന്നതുമായ ജില്ലകളിലെ ജില്ലാ ദുരന്ത നിവാരണ അതോറിറ്റിക്ക് ജൂൺ 1ന് മുൻപ് നൽകി മുൻകൂർ അനുമതി വാങ്ങണം.

ANX (5)

Anx. V

A ANNEXURE A6

ഭരണഭാഷ മാതൃഭാഷ

കേരള സംസ്ഥാന ജൈവവൈവിധ്യ ബോർഡ്
KERALA STATE BIODIVERSITY BOARD

A statutory and autonomous body, Government of Kerala

Kailasam, T.C.4/1679 (1), No. 43, Belhaven Gardens, Kowdiar P.O.,
Thiruvananthapuram – 695 003
E-mail: keralabiodiversity@gmail.com, Web: www.keralabiodiversity.org
Toll free No: 1800 425 5383

നം. 4075/എ8/2019/കെ.എസ്.ബി.ബി. 01.03.2021

ജില്ലാ കോർഡിനേറ്റർ, കെ.എസ്.ബി.ബി.

കോട്ടയം ജില്ല

മാഡം,

വിഷയം:- ഏറ്റുമാനൂർ മുനിസിപ്പാലിറ്റിയിലെ പേരൂർ എന്ന സ്ഥലത്തെ ആറ്റുവഞ്ചി ഉൾപ്പെടെ അപൂർവ്വ സസ്യങ്ങൾ കാണപ്പെടുന്ന പ്രദേശം പ്രാദേശിക ജൈവവൈവിധ്യ പൈതൃക കേന്ദ്രമായി സംരക്ഷിക്കുന്നത് സംബന്ധിച്ച്.

സൂചന:- 1) താങ്കളുടെ 08.02.2021 ലെ ഇ-മെയിൽ.
2) 03.03.2020 ലെ സ.ഉ.(കൈ)നം.5/2020/പരി. നമ്പർ സർക്കാർ ഉത്തരവ്.

മേൽ വിഷയത്തിലേക്കും സൂചനകളിലേക്കും ശ്രദ്ധ ക്ഷണിക്കുന്നു. സൂചന മെയിലിൽ നിർദ്ദേശിച്ചിട്ടുള്ള ഏറ്റുമാനൂർ മുനിസിപ്പാലിറ്റിയിലെ പേരൂർ എന്ന സ്ഥലത്തെ ആറ്റുവഞ്ചി ഉൾപ്പെടെ അപൂർവ്വ സസ്യങ്ങൾ കാണപ്പെടുന്ന പ്രദേശം പ്രാദേശിക ജൈവവൈവിധ്യ പൈതൃക കേന്ദ്രമായി സംരക്ഷിക്കുന്നതിന് മുനിസിപ്പാലിറ്റിയിലെ ബി.എം.സി. യുമായി കൂടിയാലോചിച്ച് തീരുമാനമെടുക്കേണ്ടതാണ്. ബി.എം.സി. തീരുമാനപ്രകാരവും, ബോർഡിന്റെ മാർഗ്ഗനിർദ്ദേശങ്ങൾക്കും, സൂചന 2 ഉത്തരവിന്റെയും അടിസ്ഥാനത്തിലും, പ്രസ്തുത പ്രദേശത്തിന്റെ ജൈവവൈവിധ്യ പ്രാധാന്യത്തെക്കുറിച്ച് പഠനം നടത്തിയ ശേഷം റിപ്പോർട്ട് ബി.എം.സി. മുഖേന സമർപ്പിക്കേണ്ടതാണ്. പ്രസ്തുത സ്ഥലം ആറ്റുപുറമ്പോക്കാണെന്ന് സൂചിപ്പിച്ചിട്ടുള്ളതിനാൽ (സൂചന 1), സംരക്ഷിക്കപ്പെടേണ്ട സ്ഥലത്തിന്റെ അതിർത്തി കൃത്യമായും നിർണ്ണയിക്കേണ്ടതും, പ്രസ്തുത പ്രദേശം പ്രാദേശിക ജൈവവൈവിധ്യ പൈതൃക കേന്ദ്രമാക്കുന്നതിന്മേൽ പൊതുജനാഭിപ്രായം സ്വരൂപിക്കേണ്ടതും അനിവാര്യമാണ്. പ്രസ്തുത വിവരങ്ങൾ കൂടി ഉൾപ്പെടുത്തിക്കൊണ്ടാവണം പഠന റിപ്പോർട്ട് ബോർഡിൽ സമർപ്പിക്കേണ്ടതെന്നും അറിയിക്കുന്നു.

വിശ്വസ്തതയോടെ,

റെനി ആർ. പിള്ള
മെമ്പർ സെക്രട്ടറി

പകർപ്പ്: ചെയർപേഴ്സൺ/ സെക്രട്ടറി, ഏറ്റുമാനൂർ നഗരസഭ

This is the true copy of the document referred to and marked as Annexure.A.6 in the original application.

Advocate

Translation to ANNEXURE A6

KERALA STATE BIO-DIVERSITY BOARD
A statutory and autonomus body, Government of Kerala
Kailasam, T.C. 4/1679(1), No.43 Belheaven gardens,Kowdiyar P.O..
Thiruvananthapuram- 695003.
Email: keralabiodiversity@gmail.com,Web:www.keralabiodiversity.org
Toll free No.1800 425 5363

No. 4075/A8/2019/KSBB 01.03.2021

District Co-ordinator,KSBB
Kottayam District

Madam,

Sub: Declaring the area where an endangered flora including rare species of Attuvanchi are present in Peroor in Ettumanoor Municipality as Local Bio-diversity Heritage Site regarding

Ref: 1. Your are e-mail dated 8 .2. 2021
2. Government Order (K) No.5/2020/ dated 03.03.2020

Let me call your kind attention to the subject and the references given above. As proposed in the e-mail cited here, the said site with rich flora at Peroor in Ettumanoor Municipality may be protected as Local Bio-diversity Heritage Site in consultation with BMC of the Municipality. As per the decision of the BMC and in accordance with the Government Order, a detailed study of the biodiversity of the region shall be conducted and the report submitted through BMC. As given in the Reference 1. the area is identified as river purampokku and hence its boundaries has to be surveyed and demarcated. Also measures shall be initiated to educate the public in favour of declaring the identified area as Local Bio-diversity Heritage Site. This too should be taken into consideration while submitting the study report to the Board.

Yours faithfully

Reni R Pillai
Member Secretary

Copy to: Chairperson /Secretary Ettumanoor municipality

Secretary
Kottayam Nature Society
No: K.1/2001

This is the true English translation of Annexure.A.6 document

Advocate

6

Anx. VI

GOVERNMENT OF KERALA
Abstract

Forest & Wildlife Department – Trees grown on lands at the disposal of Government – Regulation on felling and destruction-Sanctioned-Orders issued.

Forest & Wildlife (E) Department

G.O(Rt)No. 68/2010/F&WLD. Dated, Thiruvananthapuram, 10/02/2010

Read:- 1) G.O.(P)85/86/FE&WLD dtd. 02.09.1986
2) Lr. No. Pro.(11)-5016/2009 dtd. 30.01.2010 from Principal Chief Conservator of Forests, Thiruvananthapuram.

ORDER

There are large number of trees growing on lands at the disposal of the Government, such as lands owned or occupied by public institutions under Government including government offices, educational institutions, medical institutions, research institutions, local self government institutions, public sector undertakings, quasi Government institutions, statutory bodies and the like. The trees growing on such lands are being felled for and in the name of various developmental activities such as construction/widening of roads, construction of buildings etc. Large number of petitions are being received by the Government and the Forest Department alleging indiscriminate felling of trees growing on lands at the disposal of Government.

At present, Government orders issued vide G.O. read above to the effect that trees growing on public lands shall not be felled without permission from the Assistant Conservator of Forests (Social Forestry) having jurisdiction over the area are being followed as a measure against indiscriminate cutting of trees grown on public lands.

Principal Chief Conservator of Forests in his letter read and

public lands are taken more transparently by committees constituted for Panchayat/Corporation/Municipal areas, after field inspection.

The Constitution of such committees can be as follows:

- The president of the District Panchayat or the Mayor of the Municipal Corporation or the Chairperson of the Municipality, within whose jurisdiction, the public land is situated, shall be the Chairpersons of the respective committees at Panchayat, Corporation and Municipality areas.
- The Assistant Conservator of Forests Social Forestry of the concerned District shall be the Convener of the committees.
- The president of the Grama Panchayat or the member of the Division of the Corporation or the member of the Ward of the Municipality where the public land is situated, the town planner of the concerned corporation or Municipality, and one or more representatives of reputed non-governmental organizations nominated by the government for each District shall be the members of the committee.

He has also proposed that the following procedure may be prescribed for the purpose of taking a decision on felling of trees grown on the lands at the disposal of government.

- The authority in charge of the land at the disposal of Government where any tree is required to be felled shall submit a written application to the Assistant Conservator of Forests (Social Forestry) having jurisdiction over the concerned district giving full particulars of the land and the trees proposed to be felled therefrom.
- The location sketch and survey sketch of the area shall be submitted along with the application.
- The Assistant Conservator of Forests (Social Forestry) on receipt of the application shall, within seven days from the date of receipt

- Three members will constitute the quorum.
- The Committee after inspection of the area and the trees proposed for felling shall prepare a report and take decision on the application submitted by the authority in charge of the land at the disposal of Government. The committee shall record the reasons based on which the decision is taken.
- The decision of the committee shall as far as possible be taken unanimously and it shall be communicated to all members irrespective of whether or not they were present during the inspection.
- The Assistant Conservator of Forests (Social Forestry) shall communicate the decision of the committee to the party concerned within a week from the date of inspection.
- The committee shall insist that the indenting authority shall plant and nurture at least equal number of saplings of local tree species in the same or nearby locality.
- The timber and firewood obtained from the felling of such trees shall be disposed of by the authority in charge of the land at the disposal of the Government after having got a valuation prepared by the Assistant Conservator of Forests (Social Forestry).
- In cases where sandal wood or Rose wood trees are involved, the sandal wood or rose wood timber and firewood shall be extracted/ converted and disposed by KFD as per rules in force. The sale proceeds shall be given to the authority in charge of the lands at the disposal of Government after deducting working charges and service charges of Kerala Forest Department.

Government have examined the matter in detail and are pleased to constitute the committee as proposed by Principal Chief Conservator of Forests to protect the trees growing on

Growth in Non Forest Areas) Act is passed and the rules notified thereunder.

(By Order of the Governor)

P. VIJAYAKUMAR
Deputy Secretary to Govt.

To

- Principal Chief Conservator of Forests, Thiruvananthapuram.
- The Accountant General (Audit/A&E), Kerala, Thiruvananthapuram.
- Director of Public Relations (for publicity)
- Forest & Wildlife (B) Department
- Sock file /Office copy

Forwarded/By Order;

Section Officer

The IUCN Red List of Threatened Species™
ISSN 2307-8235 (online)
IUCN 2020: T33650A115932864
Scope(s): Global
Language: English

Anx. VII

Ochreinauclea missionis, Attuvanchi

Assessment by: Barstow, M. & Dhyani, A.

View on www.iucnredlist.org

Citation: Barstow, M. & Dhyani, A. 2020. *Ochreinauclea missionis*. *The IUCN Red List of Threatened Species* 2020: e.T33650A115932864. https://dx.doi.org/10.2305/IUCN.UK.2020-1.RLTS.T33650A115932864.en

Taxonomy

Kingdom	Phylum	Class	Order	Family
Plantae	Tracheophyta	Magnoliopsida	Gentianales	Rubiaceae

Scientific Name: *Ochreinauclea missionis* (Wall. ex G.Don) Ridsd.

Synonym(s):

- *Bancalus missionis* (Wall. ex G.Don) Kuntze
- *Nauclea missionis* Wall. ex G.Don
- *Nauclea oblongata* Miq. ex Hook.f.
- *Sacocephalus missionis* (Wall. ex G.Don) Havil.

Common Name(s):

- Malayalam: Attuvanchi, Niryanchi
- Kannada: Ahnao, Anavu, Holehalasu
- Marathi: Phuga
- Tamil: Attu-vanji

Taxonomic Notes:

The genus is monotypic.

Assessment Information

Red List Category & Criteria: Vulnerable A2d ver 3.1

Year Published: 2020

Date Assessed: April 25, 2019

Justification:

Ochreinauclea missionis is a large tree species endemic to the Western Ghats in India. The species has a small geographic range. Although it is not able to be calculated as there is no point data available. It experiences threat from habitat loss, caused by agricultural expansion. There is also the loss of trees which are over-exploited for their medicinal value. The species is present in multiple *ex situ* collections. Due to threats to the species, it is suspected that there is a decline of 30% over three generations. The species is assessed as Vulnerable.

Previously Published Red List Assessments

1998 – Vulnerable (VU)
https://dx.doi.org/10.2305/IUCN.UK.1998.RLTS.T33650A9800624.en

1998 – Vulnerable (V)

Geographic Range

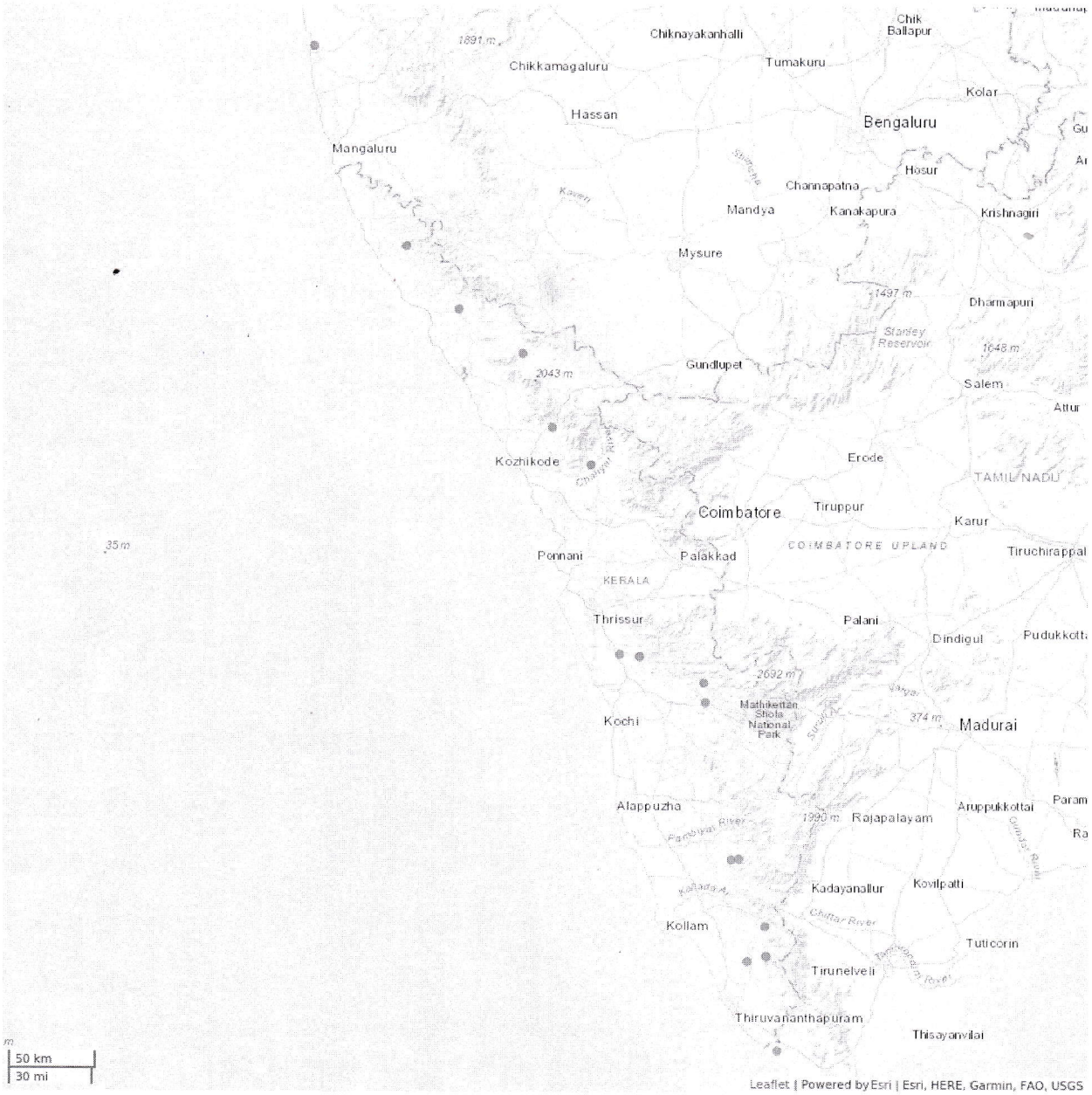
Range Description:

This species is endemic to India, to the Western Ghats in Maharashtra, Goa, Kerala, Tamil Nadu and Karnataka.

Country Occurrence:

Native, Extant (resident): India (Goa, Karnataka, Kerala, Maharashtra, Tamil Nadu)

Distribution Map

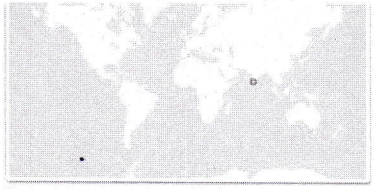


Legend

EXTANT (RESIDENT)

Compiled by:

Deepu, S. 2020 2020



Anx. VIII

MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE

NOTIFICATION

New Delhi, the 28th March, 2020

S.O. 1224(E).—WHEREAS, *vide* the Mineral Laws (Amendment) Act, 2020 (2 of 2020), the Mines and Minerals (Development and Regulation) Act, 1957 (67 of 1957) (hereinafter referred to as MMDR Act) has been amended with effect from the 10th day of January, 2020 and, *inter alia*, new section 8B relating to the provisions for transfer of statutory clearances has been inserted;

AND WHEREAS, sub-section (2) of section 8B of the MMDR Act provides that notwithstanding anything contained in this Act or any other law for the time being in force, the successful bidder of mining leases expiring under the provisions of sub-sections (5) and (6) of section 8A and selected through auction as per the procedure provided under this Act and the rules made thereunder, shall be deemed to have acquired all valid rights, approvals, clearances, licences and the like vested with the previous lessee for a period of two years;

AND WHEREAS, sub-section (3) of section 8B of the MMDR Act provides that notwithstanding anything contained in any other law for the time being in force, it shall be lawful for the new lessee to continue mining operations on the land, in which mining operations were being carried out by the previous lessee, for a period of two years from the date of commencement of the new lease;

AND WHEREAS, in pursuance of the aforesaid amendment to the MMDR Act, the Central Government deems it necessary to align the relevant provisions of the notification of the Government of India in the erstwhile Ministry of Environment and Forests number S.O. 1533 (E), dated the 14th September, 2006 (hereinafter referred to as the EIA Notification, 2006);

AND WHEREAS, the Ministry of Environment, Forest and Climate Change is in the receipt of representations for waiver of requirement of prior environmental clearance for borrowing of ordinary earth for roads; and manual extraction of lime shells (dead shell), shrines, etc., within inter tidal zone by the traditional community;

Now, therefore, in exercise of the powers conferred by sub-section (1) and clause (v) of sub-section (2) of section 3 of the Environment (Protection) Act, 1986 (29 of 1986), read with sub-rule (4) of rule 5 of the Environment (Protection) Rules, 1986, the Central Government, after having dispensed with the requirement of notice under clause (a) of sub-rule (3) of the rule 5 of the said rules, in public interest, and in supersession of the notification number S.O. 4307(E), dated the 29th November, 2019, hereby makes the following further amendments in the EIA Notification, 2006, namely:-

In the said notification,-

(i) in paragraph 11, after sub-paragraph (2), the following sub-paragraph shall be inserted, namely:-

"(3) The successful bidder of the mining leases, expiring under the provisions of sub-sections (5) and (6) of section 8A of the Mines and Minerals (Development and Regulation) Act, 1957 (67 of 1957) and selected through auction as per the procedure provided under that Act and the rules made thereunder, shall be deemed to have acquired valid prior environmental clearance vested with the previous lessee for a period of two years, from the date of commencement of new lease and it shall be lawful for the new lessee to continue mining operations as per the same terms and conditions of environmental clearance granted to the previous lessee on the said lease area for a period of two years from the date of commencement of new lease or till the new lessee obtains a fresh environmental clearance with the terms and conditions mentioned therein, whichever is earlier:

Provided that the successful bidder shall apply and obtain prior environmental clearance from the regulatory authority within a period of two years from the date of grant of new lease.";

(ii) in the Schedule, against the item 1(a), in the column (5), after clause (2) of the Note, the following clause shall be inserted, namely:-

"(3) The evacuation or removal and transportation of already mined out material lying within the mining leases expiring under the provisions of the Mines and Minerals (Development and Regulation) Act, 1957 (67 of 1957), by the previous lessee, after the expiry of the said lease, shall not form the part of the mining capacity so permitted to the successful bidder, selected through auction as per the procedure provided under that Act and the rules made thereunder.";

(iii) for Appendix-IX, the following Appendix shall be substituted, namely:-

"APPENDIX-IX

EXEMPTION OF CERTAIN CASES FROM REQUIREMENT OF ENVIRONMENTAL CLEARANCE

The following cases shall not require Prior Environmental Clearance, namely:-

1. Extraction of ordinary clay or sand by manual mining, by the Kumhars (Potter) to prepare earthen pots, lamp, toys, etc. as per their customs.
2. Extraction of ordinary clay or sand by manual mining, by earthen tile makers who prepare earthen tiles.
3. Removal of sand deposits on agricultural field after flood by farmers.
4. Customary extraction of sand and ordinary earth from sources situated in Gram Panchayat for personal use or community work in village.
5. Community works, like, de-silting of village ponds or tanks, construction of village roads, ponds or bunds undertaken in Mahatma Gandhi National Rural Employment and Guarantee Schemes, other Government sponsored schemes and community efforts.
6. Extraction or sourcing or borrowing of ordinary earth for the linear projects such as roads, pipelines, etc.
7. Dredging and de-silting of dams, reservoirs, weirs, barrages, river and canals for the purpose of their maintenance, upkeep and disaster management.
8. Traditional occupational work of sand by Vanjara and Oads in Gujarat vide notification number GU/90(16)/MCR-2189(68)/5-CHH, dated the 14th February, 1990 of the Government of Gujarat.
9. Manual extraction of lime shells (dead shell), shrines, etc., within inter tidal zone by the traditional community.
10. Digging of wells for irrigation or drinking water purpose.
11. Digging of foundation for buildings, not requiring prior environmental clearance, as the case may be.
12. Excavation of ordinary earth or clay for plugging of any breach caused in canal, nallah, drain, water body, etc., to deal with any disaster or flood like situation upon orders of the District Collector or District Magistrate or any other Competent Authority.
13. Activities declared by the State Government under legislations or rules as non-mining activity."

[F. No. Z-11013/47/2018-IA.II (M)]

GEETA MENON, Jt. Secy.

Note: The principal notification was published in the Gazette of India, Extraordinary, Part II, Section 3, Sub-section (ii) *vide* number S.O. 1533 (E), dated the 14th September, 2006 and subsequently amended *vide* the following numbers:-

1. S.O. 1949 (E), dated the 13th November, 2006;
2. S.O. 1737 (E), dated the 11th October, 2007;
3. S.O. 3067 (E), dated the 1st December, 2009;
4. S.O. 695 (E), dated the 4th April, 2011;
5. S.O. 156 (E), dated the 25th January, 2012;
6. S.O. 2896 (E), dated the 13th December, 2012;
7. S.O. 674 (E), dated the 13th March, 2013;
8. S.O. 2204 (E), dated the 19th July, 2013;
9. S.O. 2555 (E), dated the 21st August, 2013;
10. S.O. 2559 (E), dated the 22nd August, 2013;
11. S.O. 2731 (E), dated the 9th September, 2013;
12. S.O. 562 (E), dated the 26th February, 2014;
13. S.O. 637 (E), dated the 28th February, 2014;

14. S.O. 1599 (E), dated the 25th June, 2014;
15. S.O. 2601 (E), dated the 7th October, 2014;
16. S.O. 2600 (E), dated the 9th October, 2014;
17. S.O. 3252 (E), dated the 22nd December, 2014;
18. S.O. 382 (E), dated the 3rd February, 2015;
19. S.O. 811 (E), dated the 23rd March, 2015;
20. S.O. 996 (E), dated the 10th April, 2015;
21. S.O. 1142 (E), dated the 17th April, 2015;
22. S.O. 1141 (E), dated the 29th April, 2015;
23. S.O. 1834 (E), dated the 6th July, 2015;
24. S.O. 2571 (E), dated the 31st August, 2015;
25. S.O. 2572 (E), dated the 14th September, 2015;
26. S.O. 141 (E), dated the 15th January, 2016;
27. S.O. 648 (E), dated the 3rd March, 2016;
28. S.O. 2269(E), dated the 1st July, 2016;
29. S.O. 2944(E), dated the 14th September, 2016;
30. S.O. 3518 (E), dated 23rd November 2016;
31. S.O. 3999 (E), dated the 9th December, 2016;
32. S.O. 4241(E), dated the 30th December, 2016;
33. S.O. 3611(E), dated the 25th July, 2018;
34. S.O. 3977 (E), dated the 14th August, 2018;
35. S.O. 5733 (E), dated the 14th November, 2018;
36. S.O. 5736 (E), dated the 15th November, 2018;
37. S.O. 5845(E), dated the 26th November, 2018;
38. S.O. 345(E), dated the 17th January, 2019;
39. S.O. 1960(E), dated the 13th June, 2019;
40. S.O. 236(E), dated the 16th January, 2020;
41. S.O. 751(E), dated the 17th February, 2020; and
42. S.O. 1223(E), dated the 27th March, 2020.

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Anx. IX

GOVERNMENT OF KERALA

Abstract

Revenue Department – Sand Auditing of Rivers in Kerala- Sand Mining in Meenachil River- Sanction Accorded - Orders issued.

REVENUE (P) DEPARTMENT

G.O (Ms) No. 316/16/RD Dated, Thiruvananthapuram, 24..05..2016

Read: 1 GO(Ms) No 161/11/RD,dated 02/04/2011.
2 GO(Rt) No.3001/2011/RD, dated 13/07/2011.
3 GO(Ms) No.161/12/RD, dated 21/04/2012.
4 GO(Ms) No.188/12/RD, dated 05/05/2012.
5 GO(MS) No.338/12/RD, dated 12/09/12.
6 Letter no LR(K1) 46214/2014, dated 16/11/15.

ORDER

Government, vide orders read as first,second,third and fourth papers above, have accorded sanction for conducting River Bank Mapping and Sand Auditing of 20 rivers of the State. Kerala River Bank Protection and Regulation of Removal of Sand Rules, Clause 19(2) necessitates the determination of quantity of sand to be extracted from each kadavu on the basis of Sand Auditing report. Accordingly the task of conducting Sand Auditing was entrusted to different agencies. Section 9 of the Kerala Protection of River Banks and Regulation of Removal of Sand Act (Act18 of 2001) as amended by Amendment Act 15 of 2013 provides for entrusting other agencies in the sector other than Centre for Earth Science Studies (CESS) and Centre for Water Resources Development and Management (CWRD) for conducting Sand Auditing in rivers.

Earlier, the sand auditing reports of 14 rivers viz; Kabani, Vamanapuram, Neyyar, Ithikkara, Periyar, Pampa, Kallada, Chaliyar, Kadalundi, Chandragiri, Kuttiyadi, Muvattupuzha, Karuvannur and Anjarakkandy have been received in Government and Government Orders pertaining to those rivers have already been issued.

Now, the Land Revenue Commissioner vide letter read as 7th paper above has forwarded the sand auditing reports pertaining to Meenachil River. The Sand auditing of the rest of the rivers is in progress.

As enumerated above, Government is in receipt of the Sand Audit Report pertaining to Meenachil. The Sand Audit Report of the said river has been compiled by CRM (Centre for rural Management) Kottayam under the technical guidance of River Management Cell and has been scrutinised and verified by National Centre for Earth Science Studies (NCESS).

According to the report the total quantity of sand above summer water level in the river is estimated as 'nil'.

The description with regard to this in respective Panchayaths is as shown below:

Sl No	Name of Panchayath	Quantity of sand (Cu.M) above Summer Water Level (Mineable sand for 3 years)	Mineable sand per year In Cu.M
1	Meenachil Grama panchatat (Left Bank)	Nil	Nil
2	Pala Municipality (Left & Right Bank)	Nil	Nil
3	Mutholy Grama panchatat (Left & Right Bank)	Nil	Nil
4	Kidangoor Grama Panchayath(Left & Right Bank)	Nil	Nil
5	Ayarkunnam Grama Panchayath (Left Bank)	Nil	Nil
6	Vijayapuram Grama Panchayath (Left Bank)	Nil	Nil
7	Kottayam Municipality (Left & Right Bank)	Nil	Nil
8	Bharananganam Grama Panchayath(Right Bank)	Nil	Nil
9	Ettumanoor Grama Panchayat (Right Bank)	Nil	Nil
10	Ayamanam Grama Panchayat (Right Bank)	Nil	Nil

11	Thiruvarppu Grama Panchayat (Right Bank)	Nil	Nil
	Total	Nil	Nil

Government have examined the sand audit report of Meenachil river and approved as above.

Chapter III, Section 12 of the Kerala Protection of River Banks and Regulation of Removal of Sand Act, 2001 and Section 29 of the Kerala Protection of River Banks and Regulation of Removal of Sand Rules stipulates conditions for the sand removal operations for protection of river banks and bio-physical environment systems of the river.

Accordingly, the District Collector, Kottayam, is directed not to accord sanction for sand mining in Meenachil river for the coming three years with effect from the date of this order.

The responsibility of implementing this order flawlessly rests with the District Collector, Kottayam, who shall meticulously take action to see that all instructions of the Government in this regard are implemented strictly and no unauthorised mining of sand or environmental degradation is allowed to happen.

The District Collector, shall, in turn, furnish the action taken report with regard to this to Government Periodically.

By Order of the Governor,
Dr. VISHWAS MEHTA
Additional Chief Secretary to Government

To

The Commissioner, Land Revenue, Thiruvananthapuram.
The District Collector, Kottayam
The Co Ordinator ,River Management Cell.
CRM (Centre for Rural Management), Kottayam
The Principal Accountant General (Audit), Kerala,
Thiruvananthapuram.

The Accountant General (A & E), Kerala, Thiruvananthapuram
I& PRD(Web and New Media) / Press Release
SF / O.C.

Forwarded / By order

Section Officer

Copy to:- PS / Additional PS to Hon'ble Minister (Revenue)
P.A to Principal Secretary (Revenue)
CA to Additional Secretary
Under Secretary.

File No.REV-P3/172/2019-REV

Anx. X

28807
30/12/19

GOVERNMENT OF KERALA

Abstract

Revenue Department – Desilting and removal of debris in Flood affected rivers – Sanction Accorded cancelling G.O(Rt)No. 3852/2019/RD dated 21.12.2019 - Orders issued.

REVENUE (P) DEPARTMENT

G.O.(Rt)No.3880/2019/RD Dated,Thiruvananthapuram, 24/12/2019

Read 1 G.O (Rt) No.2882/2019/RD dated 16.10.2019.

2 Minutes of the Meeting held on 7.11.2019, under the presidentship of Chief Secretary.

3 Letter No. ILDM/492/2017/E1 dated 14.11.19 from the Director, ILDM.

4 GO(Rt)No. 3852/2019/RD dated 21.12.2019.

ORDER

As per GO read as 1st Paper above, a Committee has been constituted with Chief Secretary as Chairperson, Additional Chief Secretary (Water Resources), Additional Chief Secretary (Local Self Government Department), Additional Chief Secretary (Forest and Wildlife), Principal Secretary (Revenue), Principal Secretary (Environment) and Director (Mining and Geology) as members in order to look into matters relating to dredging in rivers.

A Meeting of the above Committee was held on 7.11.19 and it was decided to entrust respective District Collectors to conduct desilting and removal of debris in flood affected rivers in the context of the massive floods happened in 2018 and 2019.

File No.REV-P3/172/2019-REV

As per section 24, 34 of the Disaster Management Act 2005, State Disaster Management Executive Committee, District Disaster Management Authority can take necessary steps to 'remove debris, conduct search and carry out operations'. With regard to the authority of Section 33 of Disaster Management Act, 2005, the Hon'ble High Court of Uttarakhand in WP(C) No.93/2015 has ordered that "if the dredging is undertaken for the purpose of maintaining water bodies no clearance of Ministry of Environment and Forest is required." As per Section 72 of the Disaster Management Act, this Act overrides the other Acts.

Government have examined the matter in detail and are pleased to accord Sanction to all District Collectors for removing silt and debris in flood affected rivers, as an immediate measure to accommodate flood waters and to increase the capacity of river channels.

District Collectors should ensure the stability of river banks and protection of river bed while removing the silt and debris. District Collectors have liberty to dispose off the silt and debris in the appropriate manner. District Collectors can seek necessary help from local technical personnels of Water Resources and Geology Departments, to identify areas for urgent intervention.

As such G.O (Rt) No. 3852/2019/RD dated 21.12.2019 read as 4th Paper above, stands cancelled.

(By order of the Governor)
BENCY J
ADDITIONAL SECRETARY

The Land Revenue Commissioner, Thiruvananthapuram.

District Collector's-

Malappuram/Kannur/Pathanamthitta/Kasargod/Ernakulam/Idukki.

The Principal Accountant General (Audit), Kerala, Thiruvananthapuram.

File No.REV-P3/172/2019-REV

The Accountant General (A & E), Kerala, Thiruvananthapuram

I & PRD (Web and New Media)

SF / O.C.

Forwarded /By order

Nizamu

Section Officer

Copy to : Additional Chief Secretary (Water Resources).

Additional Chief Secretary (Local Self Governement Department.

Additional Chief Secretary (Forest and Wildlife).

The Principal Secretary (Environment).

The Director, Mining & Geology.

The Director, Institute of Land and Disaster Management, PTP Nagar, PTP Nagar PO, Thiruvananthapuram – 38.

PS to Hon'ble Chief Minister.

PS to Hon'ble Minister(Revenue).

PS to Chief Secretary.

PA to Principal Secretary (Rev).

CA to Additional Secretary (Rev).

KUTTANAD FLOOD REPORT BY CWC (RELEVANT PAGES ONLY) 18 to 21, 34 Anx. XI

4.2.2 Combined runoff of Pamba, Manimala, Meenachil and Achenkovil rivers

Four major west flowing rivers namely Achenkovil, Pamba, Manimala and Meenachil drain directly into the southern part of Vembanad Lake while a southern branch of Periyar (further north of Muvattupuzha) drains into Cochin Kayal and finally into the Arabian sea through Kochi outlet. The Vembanad Lake is bordered by Alappuzha (Alleppey), Kottayam and Ernakulam districts of Kerala covering an area of about 200 sq km and extending 80 km in a NW-SE direction from Munambam in the north to Alleppey in the south. The width of the lake varies from 500 m to 4 km and the depth from 1m to 12m. An index map of Vembanad lake is given in Fig.10.

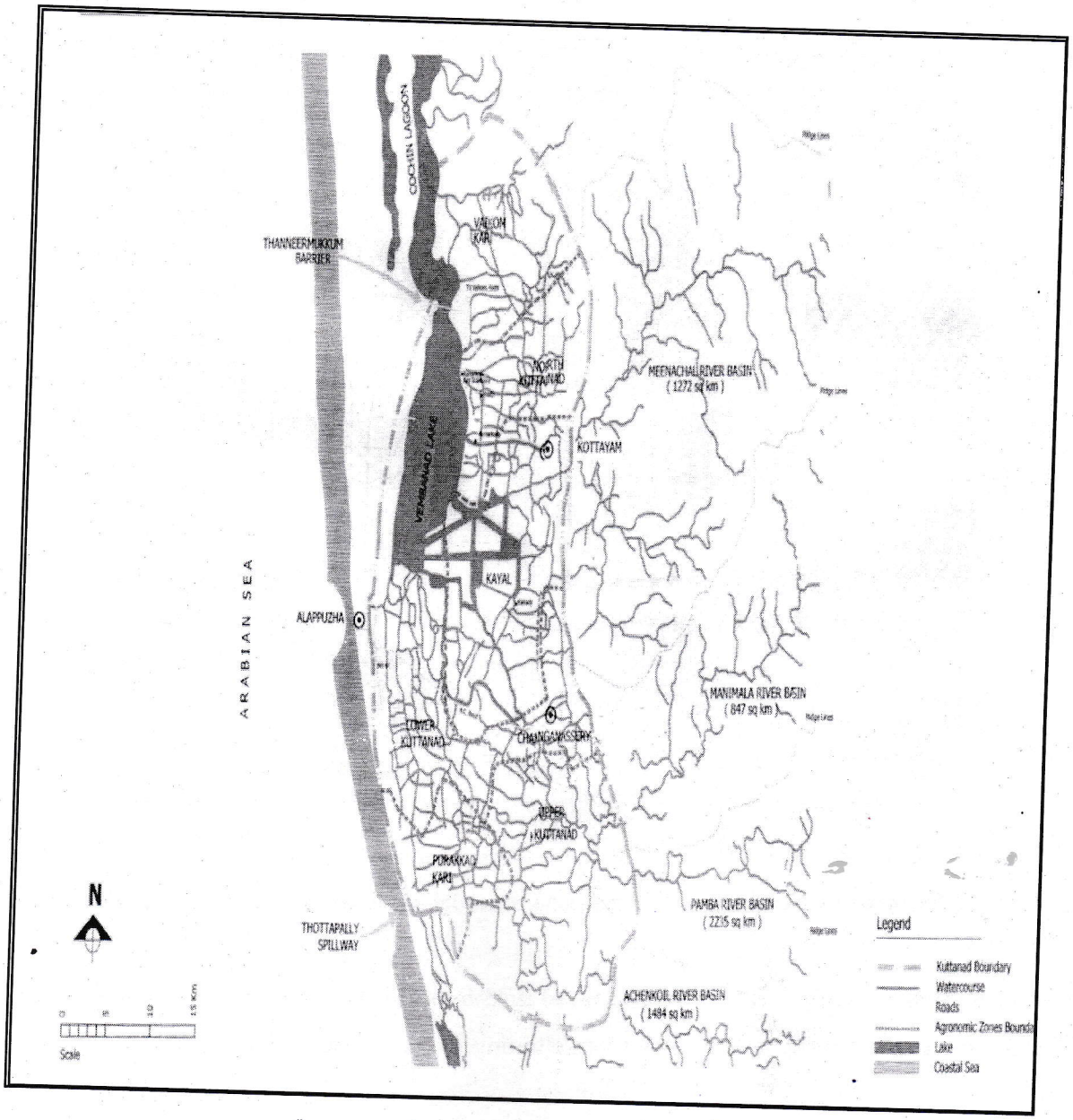


Fig.10: Index map of Vembanad Lake

Manimala, Meenachil, Pamba and Achenkovil flow into the lake south of Thanneermukkom. While Muvattupuzha river flows into the Cochin backwaters north of Thanneermukkom barrage. Kuttanadu is a marshy delta in the southern part of the lake, formed by four river network namely, Pamba, Manimala, Achankoil and Meenachi together with the backwaters in and around the Vembanad lake. Large parts of the vast estuary lie below the sea level up to a depth of about 2.5 m, waterlogged for most part of the year subject to flood and inundation during the monsoons and saline water intrusion during the summer months. The Vembanad lake was declared as a Ramsar Site in November 2002. A catchment area map of Pamba, Manimala, Achankoil and Meenachi river systems up to Vembanad lake is given in Fig.11.

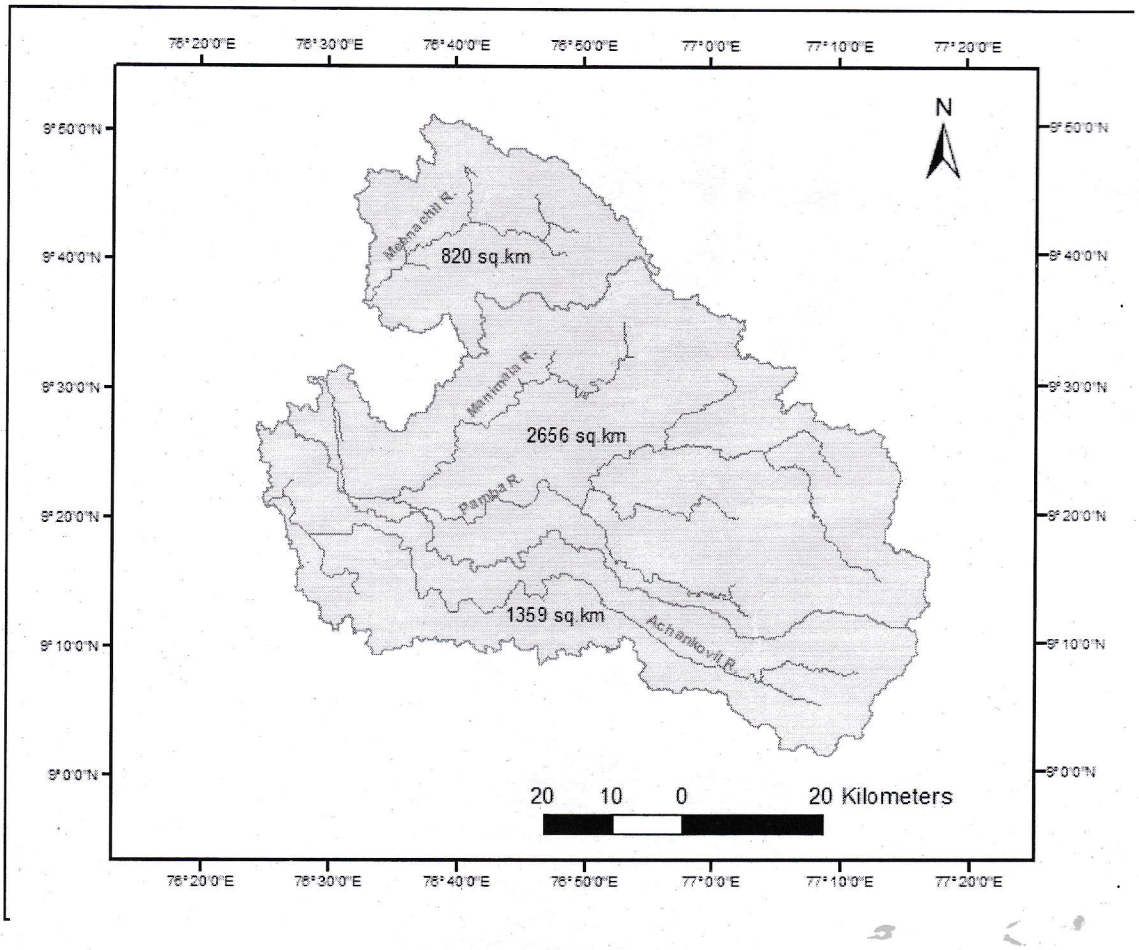


Fig.11: catchment area map of Pamba, Manimala, Achenkoil and Meenachi river systems

The estimated runoff for a runoff coefficient of 0.75 from Pampa, Manimala, Achankoil and Meenachi river systems up to vemabanad lake during 15-17, August 2018 is given in Table-10.

Table-10: Rainfall and runoff in Pamba, Manimala, Achankoil and Meenachi river systems up to Vembanad lake

River	Catchment Area	Rainfall depth 15 Aug 2018 (1 day)	Rainfall depth 15-16, Aug 2018 (2day)	Rainfall depth 15-17, Aug 2018 (3 day)	Runoff 15Aug 2018 (1 day)	Runoff 15-16, Aug 2018 (2 day)	Runoff 15-17, Aug 2018 (3 day)
	(sq.km)	(mm)	(mm)	(mm)	(MCM)	(MCM)	(MCM)
Achankovil	1359	122	231	329	124	235	336
Pamba and Manimala	2656	173	382	517	346	762	1030
Meenachil	820	146	327	437	90	201	268
Total	**4835**	**441**	**940**	**1283**	**560**	**1198**	**1634**

As per July 2008 report of Planning Commission, the water carrying capacity of the system is reported to have reduced to an abysmal 0.6 BCM from 2.4 BCM as a result of land reclamation. The Pamba reservoir (31 MCM) and Kakki reservoir (447 MCM), in the Pamba sub basin can hardly regulate 10.5% of the average annual flow in the Pamba River. All other storages in Pamba river are very small ones having no appreciable storage capacity. The other three rivers Manimala, Meenachil and Achenkovil have no storages on them. The Thottappally spillway Constructed in 1954, as part of Kuttanadu development scheme for relieving flood condition in Kuttanadu, by diverting flood waters of Pamba, Manimala, Achenkovil and Meenachil directly to the sea. The Thottappally spillway consists of a leading channel 1310 m long 365 m wide with a bridge cum regulator across the spillway channel. The bridge cum regulator is 365 m along with 40 vents, each having 7.6 m clear span. Though the original discharge capacity of the spillway was about 1812 cumec, it is reported that at present the average maximum discharge passing through the spillway is limited to 630 cumec, which is almost 1/3rd of the design capacity of the spillway.

The runoff generated from Pamba, Manimala, Achenkovil and Meenachil rivers during 15-17 August rainfall was about 1.63 BCM (1630 MCM) against the 0.6 BCM (600 MCM) carrying capacity of Vembanad lake. Further, the discharging capacity of 630 cumec of Thottappally spillway was other major constraint for the disposal of runoff. Considering the lake carrying capacity of about 600 MCM and discharging capacity of 630 cumec of Thottappally spillway and about 1706 cumec present discharging capacity of Thaneermukkom barrage, it can be concluded that out of 1.63 BCM the runoff generated during the 15 to 17 August 2018 rainfall, only about 0.605 BCM runoff was possible to drain out of the Vembanad lake. The remaining runoff volume of about 1 BCM created the rise of the water level in the lake and

nearby areas. This continuous rising of lake water may be one of the reason of overall change in the river hydrodynamics of Pamba, Manimala, Meenachil and Achenkovil river systems resulting higher water level for a particular discharge in these rivers. Considering the high rainfall during 15-17, August 2018, the absence of appreciable storage reservoirs in the upstream on the above rivers, shrinkage of carrying capacity of Vembanad Lake and reduction of the capacity of Thottappally spillway may have worsened the flooding in the Kuttanad region and the backwater flows to the low-lying areas in the upper reaches of the lake. This may be the reason of the heavy flooding experienced in the low-lying areas closer to the Vembanad lake in the Pathnamthitta, Kottayam and Alapuzha districts.

4.3 Runoff computations for Chalakudy sub-basin

Chalakudy River is the fifth longest river in Kerala. The Chalakudy river is formed by the confluence of five streams, Parambikulam, Kuriarkutty, Sholayar, Karappara and Anakkayam, all of them originating in the Anamalai Hills of the Western Ghats. Out of these, Parambikulam and Sholayar rivers originate from the Coimbatore district of Tamil Nadu. Karappara and Kuriarkutty rivers originate from the Palakkad district in Kerala. At about 470m above M.S.L. the Parambikulam joins the Kuriarkutty river. Further 9 km down, the river is joined by the Sholayar. The Karappara joins the main river at about 455m above M.S.L. The Anakkayam joins the main river 8 km further down at 365m above M.S.L. In the initial course, the river passes through thick forests and its flow is broken by many falls till it reaches the plains at Athirapally.

The Chalakudi river basin is bounded by the Karuvannur sub-basin on the north and the Periyar sub-basin on the south. The basin consists of about 30,000 ha of wet lands. The basin receives and average rainfall of about 3000 mm. The total drainage area of the river is 1704 sq.km and out of this 1404 sq.km lies in Kerala and the rest 300 sq.km in Tamil Nadu. The length of the river is about 130 km.

The famous waterfalls, Athirappilly falls and Vazhachal falls, are situated on this river. The hydro electric projects on Chalakudy River are Sholayar and Peringalkutthu Hydro Electric Projects. For irrigation purposes Thumboormoozhy weir is constructed across this river. It merges with the Periyar River near Elenthikara, adjacent to Manjali North Paravur in Ernakulam district and finally joins Kodungallur backwaters and Arabian Sea at Azhekode. The Parambikulam Dam has been built on the Parambikulam river, one of its four tributaries. The river finally empties into the right arm of the Periyarat Elanthikkara in

from Idukki and Idamalayar were 1500 cumec (inflow 1610 cumec) and 1272 cumec (inflow 1007 cumec). On analysis of data it has been found that the releases from these dams were the controlled releases, as the discharging capacity of these dams are 5013 cumec (Idukki) and 3012 cumec (Idamalyar).

ix. The maximum discharge in Pamba river at CWC, G&D site (Malakkara) was 2900 cumec on 16 August 2018 with corresponding water level at EL 9.58 m. The earlier recorded HFL was 8.2 m. The major reservoir in Pamba sub-basin is Kakki and release from this reservoir was 488 cumec (15th of August), 899 cumec (16th of August), 443 cumec (17th of August), 356 cumec (18th of August), 309 cumec (19th of August) against the spillway capacity of 1788 cumec. The reservoir was at EL 980.91 m on 14 August 2018, against the FRL at EL 981.46 m. The maximum reservoir level attained on 19 August 2018 was 981.4 m.

x. From the analysis it has been found that the dams in Kerala neither added to the flood nor helped in reduction of flood, as most of the dams were already at FRL or very close to FRL on 14 August 2018, due to more than normal rainfall in the months of June to July 2018. It may be noted that, had the reservoir been a few feet below FRL, the flooding conditions would have not changed much, as the severe storm continued for 3 days and even for 4 days at majority of the places, and in any case it would have been necessary to release from the reservoirs after 1st day of the extreme rainfall.

xi. Nevertheless, it is essential to review the rule curves of all the reservoirs in Kerala. The rule curves need to be meticulously drawn particularly for the reservoirs having the live storage capacity, of more than 200 MCM in order to create some dynamic flood cushion for moderating the floods of lower return periods particularly in the early period of monsoon.

xii. The runoff generated from Pamba, Manimala Achenkovil and Meenachil rivers during 15-17, August 2018 rainfall was about 1.63 BCM against the 0.6 BCM carrying capacity of Vembanad lake. Further, the discharging capacity of 630 cumec of Thottappally spillway was the other major constraint for the disposal of runoff. Considering the lake carrying capacity of about 600 MCM and discharging capacity of 630 cumec of Thottappally spillway and about 1706 cumec present discharging

Anx. XII

IRRIGATION SUB DIVISION KADUTHURUTHY

IWT-Development of State Water ways and Feeder Canals – Conducting study classification of State waterway and deriving development standards and preparation of master plan for state water ways – For Meenachil River from Chungam to Kanjiram in Kottayam District.

IWT-Development of State Water ways and Feeder Canals – Conducting study classification of State waterway and deriving development standards and preparation of master plan for state water ways – For Meenachil River from Chungam to Kanjiram Canal in Kottayam District

Introduction

Inland Water Transport (IWT) is a fuel efficient and environment friendly mode of transportation. IWT for passenger and freight movement involves lower operating costs and environmental pollution than road, rail or air.

There are 41 rivers in Kerala that flows towards west clubbed with numerous backwaters. All these are part of the inland water transport system having a length of approx.. 1895 km. Important places which are commercially important are situated on the banks of these rivers. Of this, the Kollam-Kottappuram stretch (168 km) is already declared as National Waterway-3 with effect from 1993. (NW-3) along with Champakkara (14 km) and Udyogamandal canals (23 km) is almost made fully functional. Recently Central Government has declared the extension of NW-3 between Kottappuram and Kozhikode (160 km) as national waterway. Besides, four canals viz. Alappuzha-Changanassery (28 km), Alappuzha –Kottayam – Athirampuzha (38 km) and Kottayam – Vaikom (42 km) have also been declared as national waterway by Central Government in April, 2016.

The State Water Transport Department caters to the traffic needs of the inhabitants of the waterlogged areas of the Districts of Alappuzha, Kottayam, Kollam, Ernakulam, Kannur and Kasaragod.

Location and History

Inland Water Transport is one of the most environmental friendly modes of transport because of low fuel usage and ability to carry in bulk thereby reducing pollution and congestion. The main constraint in the development of water transport is the conflict of interest between tranditional fisher folks and navigation operation, friction between Road-IWT operators, insufficient navigation lock/bridge clearances, lack of maintenance of navigation system and bank protection, lack of modern inland craft terminals and cargo handling system, lack of end user incentivisation, delay in project execution and poor fund utilization. Keeping in mind the constraints facing IWT, and recognizing its potential for growth, there is a need for reduction in cost and time of transportation and enhancement of the safety and reliability of cargo. To achieve this, the thrust should be on the creation of infrastructure in the form of fairways, with adequate depth and width, besides the setting up of terminals. Private investment should be attracted for the development of this mode through suitable incentives. In short in order to make the sector more effective, there is a need to create adequate infrastructure facilities, simplify customs procedures and provide necessary fiscal incentives for the development of the sector.

IWT-Development of State Water ways and Feeder Canals – Conducting study classification of State waterway and deriving development standards and preparation of master plan for state water ways – For Meenachil River from Chungam to Kanjiram Canal in Kottayam District

Most of the Check dams were affected by silt deposits. The silt deposits reduced their storage capacity and obstructed the free flow of the river. Maintenance of the check dams and the silt removal are urgent in nature and provisions for the same are to be included for the preparation of master plan.

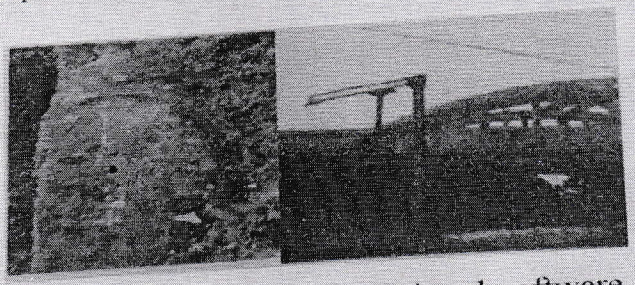
At many portions, the river banks were totally damaged. Several residential buildings along the banks are in the dangerous position and many roads passing along the banks eroded. These spots were selected based on their proximity to residential buildings and public roads and should be protected properly. The people in the region are economically weak and they not have the financial capability to execute the work on their own.

Field Investigation

The flield survey inwstigation work is conducted for the entire canal width of 40 M and about 5M on both sides of bank. For this three separate survey teams with GPS RTK system has carried the topographic suvey specifying the obstructions along the canal for the entire stretch of about 7.500 kms.

Topographic Survey

Topographic survey is conducted using both total station and GS 14 GPS RTK system. The MSL Datum 4.925 is shifted from the nearest Nagampadm Bridge as shown by Irrigation department (fig a)



Total station and GPS data is processed using Liscad software and presented in Autocad format at the required scale. Necessary Topogmph1c Map is also prepared and submitted in Scale 1 : 500 (A1 size) both digital and Hard copy format. Volume-2

Longitudinal and cross sections were prepared and submitted in hard and digital copies and presented in appendix (A)

IWT-Development of State Water ways and Feeder Canals – Conducting study classification of State waterway and deriving development standards and preparation of master plan for state water ways – For Meenachil River from Chungam to Kanjiram Canal in Kottayam District

Physiography

The Meenachilriver is formed by several streams organizing from the Western Ghats. The river flows through the Poonjar, Teekoy, Erattupetts, Pala, Ettumanoor and Kottayam. A few miles upstream of Kottayam Town the river bifurcates in Neelimangalam branch and Nagampadam branch and both the branches finaly into vembanad lake.

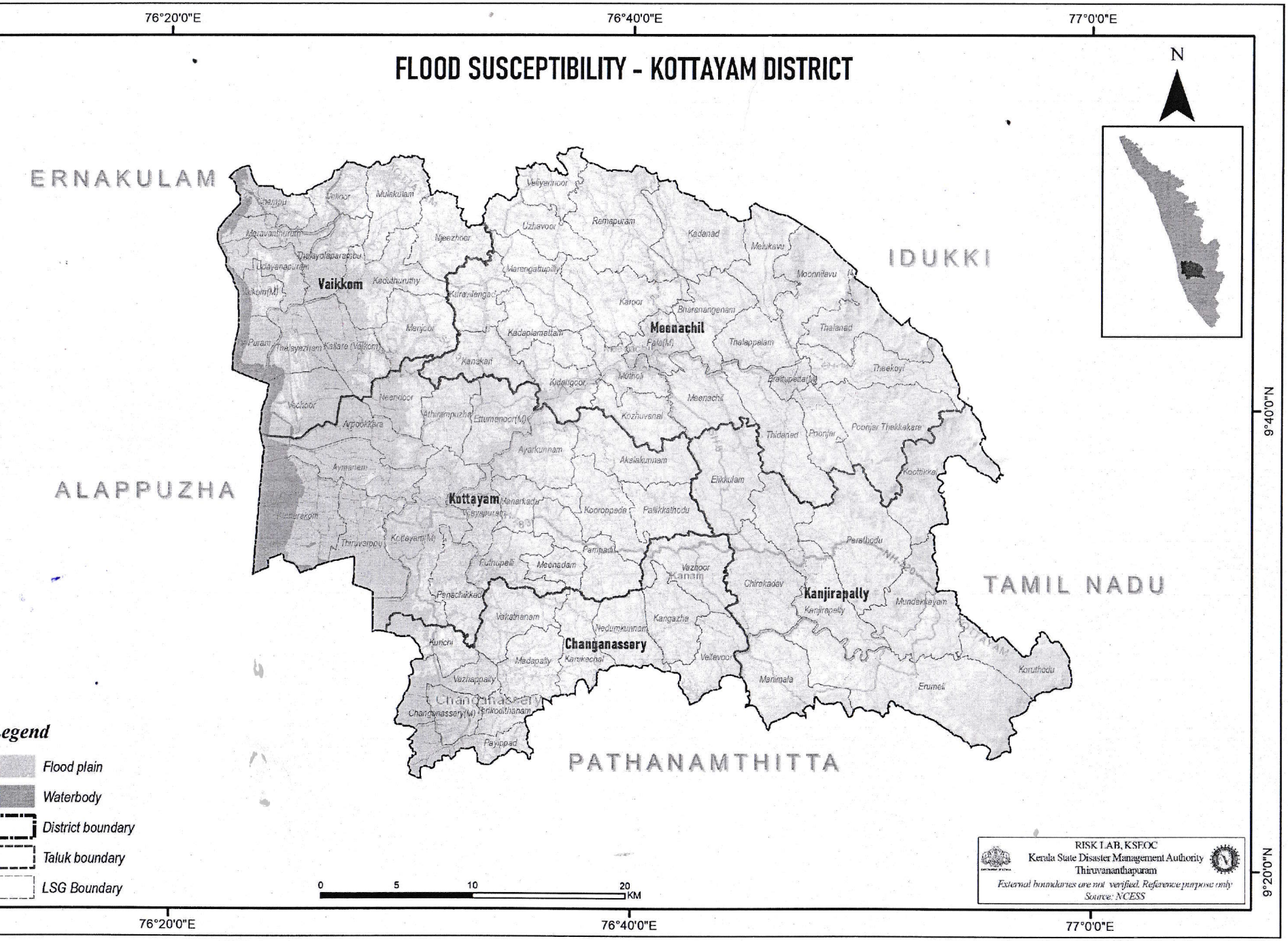
The length of the river, including the tributaries under the jurisdiction of the irrigation Sub Division, Kadithuruthy is 118.2 kms and total drainage is 1272 sq. km. Meenachil river does not have any major dams. The important check dams in Meenachil river are Erattupetta, Kalariamackal, Kadappattu and Kidangoor . The detailed break up of the river and tributaries is listed below:-

1) Meenachil river - 64.00 km
2) Meenanthara river (branch of Meenachil river) - 5.50 km
3) Neelimangalam river (branch of Meenachil river) - 16.00 km
4) Thiruvattakavanattinkara river (branch of Meenachil river)- 15.00 km
5) Thiruvarppu kumarakom canal (branch of Meenachil river) – 8.00 km
6) Chengalam kumarakom canal (branch of Meenachil river) – 8.5 km
7) Prapuzha Pulikuttiseet thodu (branch of Meenachil river)- 1.2 km

Total 118.2 km

The unprecedented floods, which hit Kerala in the month of August 2018, created huge have to the banks of Meenachil river. Erosion along the river banks damaged several residential buildings and infrastructure located near the river banks. Upper reaches of the Meenachil river such as Teekoy, Thidanad Poonjar Panchayath and Erattupetta municipality where affected by heavy rain landslides whereas kidangoor, Arpookara, Thiruvarppu, Kumarakom, Neendor, thirampuzha, Vijayapuram Panchayat and Kottaym/Ettumanoor municipalities were badly affected by the floods.

Anx. XIII


FLOOD SUSCEPTIBILITY - KOTTAYAM DISTRICT
76°20'0"E
76°40'0"E
77°0'0"E
9°40'0"N
9°20'0"N
N
ERNAKULAM
IDUKKI
ALAPPUZHA
TAMIL NADU
PATHANAMTHITTA
Vaikkom
Meenachil
Kottayam
Kanjirapally
Changanassery
Legend
Flood plain
Waterbody
District boundary
Taluk boundary
LSG Boundary
0 5 10 20 KM
RISK LAB, KSEOC
Kerala State Disaster Management Authority
Thiruvananthapuram
External boundaries are not verified. Reference purpose only
Source: NCESS

MANUAL FOR BIORESTORATION OF RIVER BANKS IN KERALA

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Adv. K Rajan
GOVERNMENT CHIEF WHIP & OLLUR MLA
Govt. of Kerala

Foreword

The extreme weather events that had devastated the river banks of Kerala in recent years have generated lots of interest for their biorestoration. Several field level activities have been initiated in several parts of Kerala for protection of river banks both by Govt. agencies and private organizations. The enthusiasm among the general public for such initiatives should not be gone unseen. However, there exists a knowledge gap on the strategies and techniques to be adopted for such biorestoration initiatives. Dr. Syam Viswanath and his colleagues have devoted considerable time and energy to develop a manual on the biorestoration of stream banks which I consider as a very much useful and important guide for the ongoing and future initiatives on stream bank stabilization.

I appreciate the present good work of Dr. Syam Viswanath, Dr. S Sandeep, Dr. V. B. Sreekumar, Mr. R Vishnu and Mr. M.S. Sanil on developing a manual for bio restoration of river banks in Kerala, and believe that the document, will be of immense use for those concerned with river bank stabilization.

P.K. Kesavan IFS
Principal Chief Conservator of Forests
(Head of Forest Force, Kerala)
Forest Headquarters, Vazhuthacaud
Thiruvananthapuram- 695014

Preface

The State of Kerala is bestowed with 44 rivers and their innumerable number of tributaries. The peculiar habitat provided by the banks of these streams nourishes a specialised set of aquatic, herbaceous and arborescent plant community. In addition to protecting banks of the river, they provide multi faceted services like conservation of biodiversity, protection of environment and supporting of livelihood.

The huge contribution that is being made by the riparian vegetation has recently been gaining appreciation, especially after the state experienced repeated exposure to extreme rainfall events during 2018 and 2019. This has given rise to a realisation that mechanical or engineering structures are costly but not as effective as the protection offered by the vegetation.

Though in the past there had been efforts by government agencies, private organisations and even private individuals to harness the potential of plants to protect the river banks and at the same time avail their innumerable ecosystem services, several research gaps impeded their widespread adoption. This felt-need for consolidation of the available scientific knowledge and development of standard set of protocols for the bio restoration of river banks is expected to be addressed by this manual put together by the team of researchers consisting of Drs, Syam Viswanath, S. Sandeep, V.B. Sreekumar, R. Vishnu and M.S. Sanil. Though it has a focus on Kerala, it will prove to be of significant help in other parts of the country as well.

I congratulate KFRI and the team of scientists for this timely and valuable contribution.

15/12/2020

Acknowledgements

We express our sincere thanks to Executive Vice President, KSCSTE, Thiruvananthapuram for constant support and encouragement for this work. We express sincere thanks to persons for contributing photographs. Financial support provided by UNDP is duly acknowledged.

Authors

Contents

CHAPTER 1

GUIDELINES FOR RIVERBANK BIORESTORATION

1.1. INTRODUCTION

There are 44 rivers in Kerala. Of these, 41 originate from the eastern side of Western Ghats region of the state and flow westward to join the Arabiansea; The remaining three rivers also originating from the Western Ghats (Kabini, Bhavani and Pambar) flow eastwards to join the Bay of Bengal, after flowing through the neighbouring states. The rivers, with their tributaries and distributaries form a mesh of streams interspersed with land systems in the regional landscape of Kerala. The high density of these water systems makes river banks a major landform in Kerala (Figure 1).

Riverbanks are ecologically fragile ecosystems which continuously face serious threat from various natural and anthropogenic activities. Protection of the river/ stream bank will lead to the stabilization of the water courses, and making the area productive along the river or stream. Because of the wide variety of land uses, restoration objectives, and riparian species present in different regions, a set of different riparian restoration techniques have been developed to restore them.

Many engineering structures and techniques, both at local and global level, have been developed by researchers/engineers for stabilization of riverbanks.

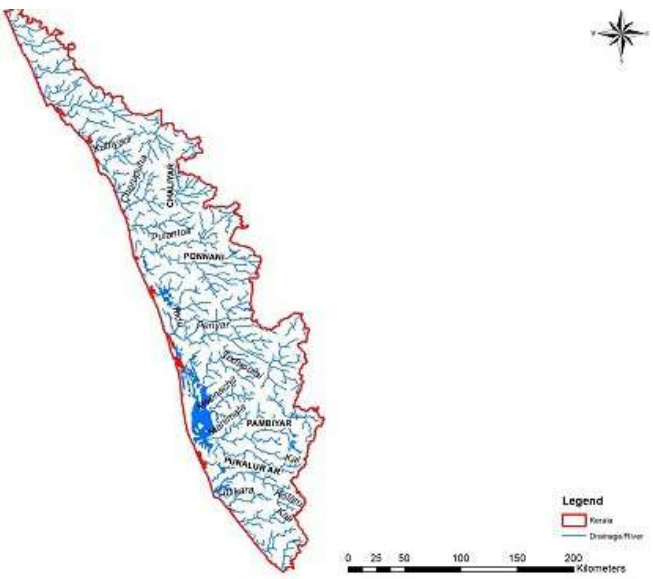


Figure 1. Profile of rivers in Kerala

But these river-engineering structures and associated disturbances to a large extend are unable to support vegetation which adversely affect natural river ecosystem. Traditional engineering methods for stream bank stabilization that were once thought successful in the past are being re-evaluated in context of impacts resulting from excessive and rapid urbanization, and from the public awareness of new environmental issues. Further, these restoration strategies are very costly, may require perpetual effort, and often fail. The recognition of this negative impact of river-engineering disturbances has stimulated numerous bio-restoration activities and the development of environment-friendly methods of river management. Stabilization of riverbank through vegetation and soil treatment measures may be particularly appropriate in situations where an abundance of vegetative material is present, and where manual labour, rather than machinery for installation, can be easily found.

Planting of trees, shrubs, herbs or grasses along the riverbank is a vegetative method of stabilization referred to as riverbank bio-stabilization whereby the root system hold the soil in place and reduce the impact of water flow. There are several methods available in different names in which biological components like grasses, shrubs, herbs and trees are used for riverbank stabilization. Stream bank soil bioengineering, soil bioengineering, eco-engineering, biotechnical soil stabilization, and water bioengineering are few methods. There are distinctions made between these different names and these distinctions may always not be consistent. However, they all basically refer to the use of live and dead herbaceous and woody plant materials in combination with natural and synthetic support materials for slope stabilization, erosion reduction, and vegetative establishment. In simple terms, riverbank bio-stabilization uses plants and sometimes inert material to increase the strength and structure of the riverbank. Vegetation appears more complex to work with but also offers unique benefits. Vegetation as a live material can be self-sustaining under suitable conditions, it can adapt to temporal changes in topography, it provides habitat for other species, provides food sources for other species, and can prevent the warming of river flow temperature by overbank shading.

1.2. PURPOSE OF THIS MANUAL

This manual will provide general guidelines of bio stabilization to control the river flow, stabilise channel alignment, protect stream banks and rebuild habitat. This also aims to provide technical advice that will assist local government, community groups and landholders to restore, protect and manage river bank. The guidelines are developed from the theoretical knowledge gained from books, reports and other sources and practical knowledge gained from the Manalipuzha River Bank Stabilization Program. This incorporates a general discussion on site preparation, plant materials selection criteria, zonation of river bank, planting, its monitoring and maintenance and other river bank stabilization treatments including installation guidelines and materials requirements. Successful appli-

cation of these guidelines is dependent upon many site specific conditions such as stream velocity, soil conditions, soil nutrients, rainfall, debris load, flooding, drought, plant availability, and climate. So the practitioner is advised to collect all available local knowledge of the area for successful implementation of these guidelines.

1.3. NEED FOR RIVERBANK BIORESTORATION

When stream banks are not stable, it may lead to erosion which ultimately result in loss of valuable land, associated agriculture and biodiversity. Critical infrastructure adjacent to river such as bridges, roads, and underground utilities may be damaged. Eroding streambanks are often a safety concern for humans, livestock and wildlife. Sometimes heavy rainfall results in flooding which negatively impacts water quality largely by increasing the amount of suspended sediment in the stream water.

1.4. WHERE IS IT APPLICABLE ?

Any waterway can benefit from a riverbank stabilization process. A riverbank, otherwise called riparian zone is simply described as the area between land and water. Riparian areas are where water saturates the soil more than adjacent areas and where water-loving vegetation is concentrated. Riparian zones are very important because they provide erosion control by regulating sediment transport and distribution, enhance water quality, produce organic matter for aquatic habitats, and provide fish and wildlife habitat. Being an ecologically fragile area, long linear areas along rivers and streams are occasionally flooded by those bodies of water. Soil bioengineering systems use woody vegetation installed in specific configurations that offer immediate erosion protection, reinforcement of the soils, and a woody vegetative surface cover and root network. The vegetation is adaptive and can withstand high flows if it is established in the correct planting zone.

1.5. PROJECT GOALS AND OBJECTIVES

One of the most important steps in a river restoration project is the determination of project goals and objectives. The perceived success or failure of a project is dependent upon thoughtful and consensus-based development of goals and objectives by the stakeholders and technical specialists. Goals are general and are highly dependent upon context, while objectives are measurable and in support of the stated goals.

The goals of a river restoration programme can be broadly classified as ecological and socioeconomic goals.

- **To stabilize and restore the riverine ecosystem.**
- **To obtain livelihood security and sustainable development of the society**

To develop the ecological goals, ecological factors for the project site such as river form, vegetation, hydraulics, water quality, temperature, substrate types and

sizes, and sediment transport has to be determined. Then the components which are valuable at the project site has to be defined and the characteristics or features to be protected or enhanced as part of the project design has to be identified. The social context of the restoration, which simply means the acceptance by the society who live with the stream and its floodplain, should be accounted for the successful implementation of project. Factors such as employment generation, food security, industrial supply of timber and other raw materials etc. has to be considered for defining socioeconomic goals. The ecological and socioeconomic goals can be defined as

Objectives need to be specific, realistic, achievable and measurable. Exploring project objectives at the beginning of the project helps for planning and designing of activities, which will limit the changes and costs that can surface later in the design. When possible, objectives should be quantifiable in nature. If the number of objectives are more, it would be better to rank the objectives based on the weightage and importance of the parameters considered.

1.6. POTENTIAL IMPACTS/ BENEFITS

The objectives of establishing a riparian vegetation zone in the riverbank may ultimately aim to achieve the following benefits;

- To reduce erosion and stabilize stream banks
- To restore riparian forests
- To increase biodiversity
- To increase input of organic matter (e.g. large wood, leaf litter)
- To improve water quality through filtration of fine sediment, nutrients, or pollutants from agriculture, roads, or urbanized landscapes
- To increase shade and reduce stream temperatures
- To generate employment to the local people
- Food security
- To supply timber, NTFP and other resources to the society

The following potential impacts can be achieved from a successful river restoration programme

- Flood control
- Ecological restoration and biodiversity conservation
- Maintenance of catchment
- Restoration of water quality and quantity
- Retrieval of flood plain and stabilization of river banks
- Coping with climate change
- Enhancement of tourism and recreational potentials
- Food and livelihood security of local people

- Promotion of historical and cultural values and
- Creation of multipurpose space like parks for local residents and promotion of river oriented community development

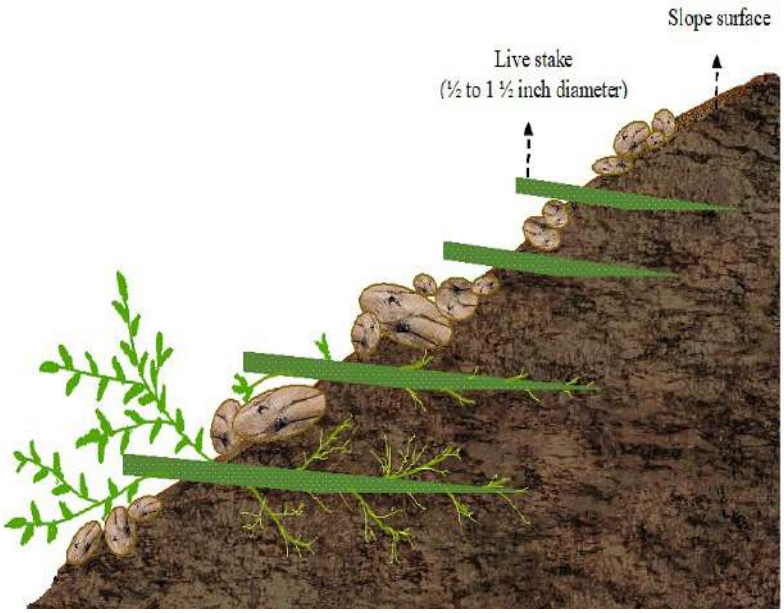
1.7. DIFFERENT BIO-RESTORATION METHODS

The different bioengineering methods available for bio-restoration are

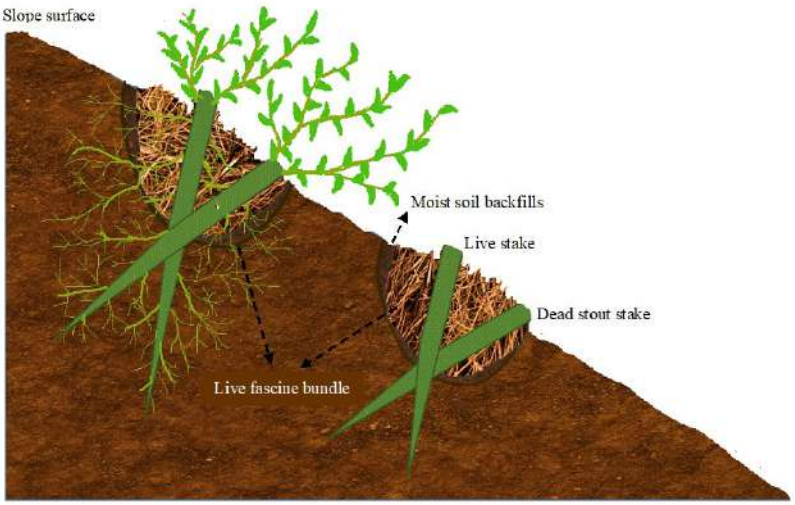
Name	Type of protection and where to apply									Problems addressed					
	Decrease Force	Increase Resistance	Immediate Resistance	Protection at waterline	Streambank	Shoreline	Flatbanks	Steepbanks	Holes/ Local slumps	Toe erosion, undercutting	Wildlife habitat	Aquatic habitat	Water quality	Bare bank	Overbank erosion
Soil bioengineering															
Live stakes		1			1	1	1		1		1		1	1	1
Live Fascines		1			1	1	1				1		1	1	1
Branch packing	1	1	1		1	1	1		1		1	1	1	1	
Vegetated geogrids		1	1	1	1	1	1	1	1	1	1	1	1	1	1
Live cribwall		1	1	1	1	1		1	1	1	1	1	1	1	1
Brush mattress		1	1		1	1					1		1	1	1
Reed clumps		1				1					1		1	1	1
Coconut fiber rolls		1	1	1	1	1					1	1	1	1	

SCHEMATIC DIAGRAM OF BIOENGINEERING METHODS

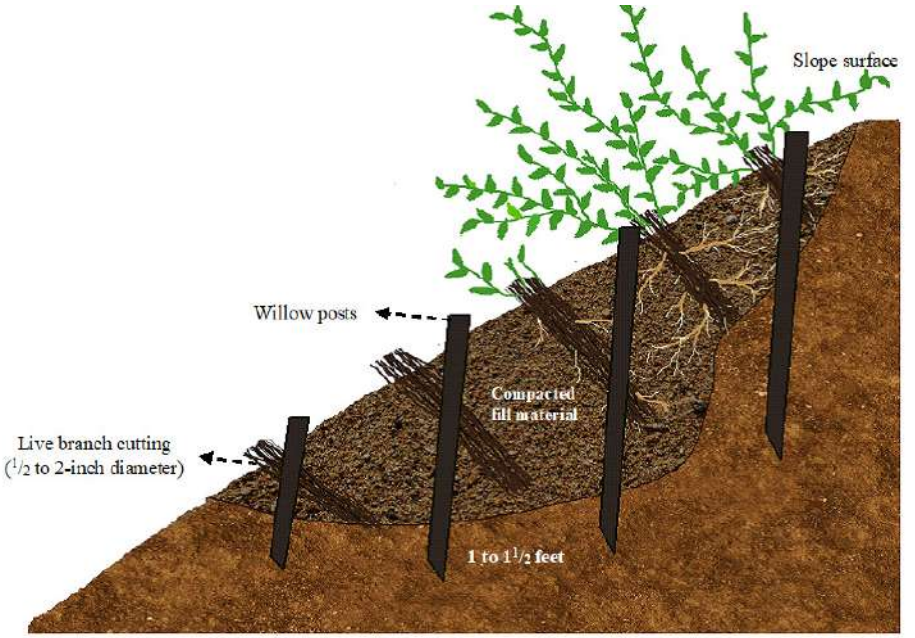
Live stakes



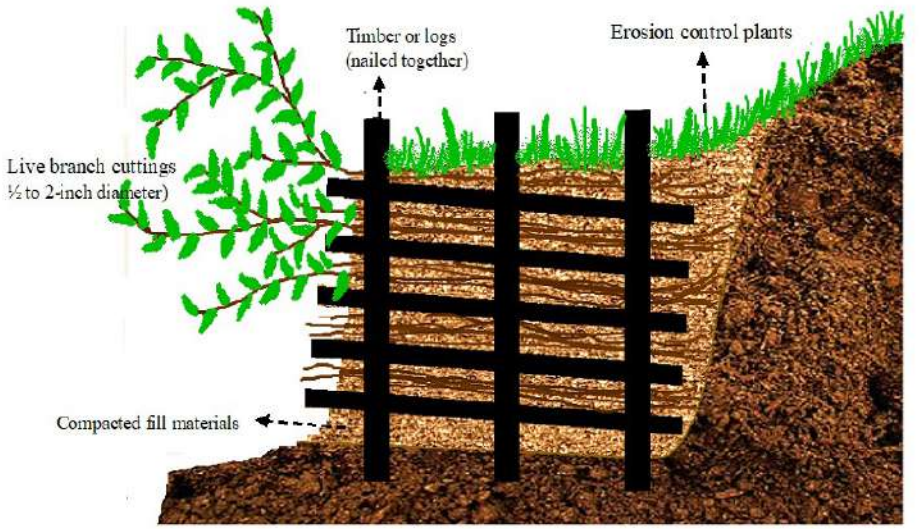
Live Fascines



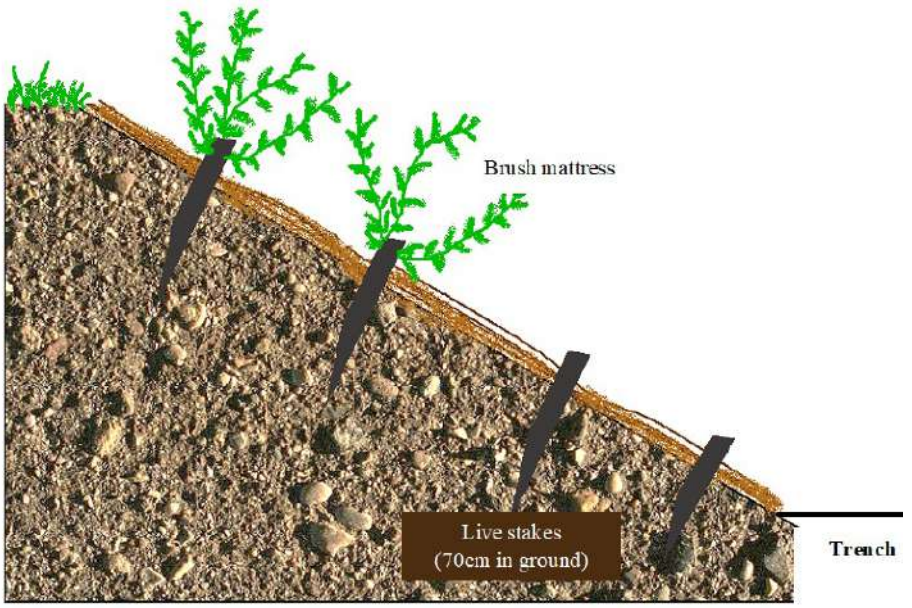
Branch packing



Live cribwall



Brush mattress



1.8. FRAMEWORK OF BIORESTORATION

The proposed river bio-restoration frame work may consist of the following steps:

i. Define goals and objectives

ii. Setting up infrastructure, fund and multidisciplinary team

iii. Scoping to set the boundary conditions

iv. Preparation of restoration plan

v. Plan implementation and execution of restoration measures

vi. Monitoring to review timely progress, effectiveness of the projects and maintenance

vii. Community involvement and people's participation

CHAPTER 2

FIELD ACTIVITIES

2.1. PRELIMINARY SURVEY FOR PRIMARY AND SECONDARY DATA COLLECTION

This includes data collection of demographic, socioeconomic and ecological aspects. Demographic information (population, density etc.) will help to analyse the number of people directly or indirectly depending upon a particular river ecosystem. Socio economic aspects include economic benefits to society in the form of various resources like timber, fuel wood, food, NTFPs, employment for the local people and aesthetic benefits. Ecological factors such as soil type, elevation, flood, low-flow, groundwater levels, invasive species, wildlife, and disease or insects will also affect the success of establishing a successful bio-restoration programme.

2.2. ZONATION OF RIVER BANK

The success of river bank stabilization is dependent upon the establishment of riparian plant species. The success of the plants is, in turn, dependent upon the species used, their procurement, planting and handling techniques, and their location relative to the stream. Therefore, it is important to observe the location and types of existing vegetation in and adjacent to the project area. Any river stabilization work should also be assessed and designed in terms of the relative location of the plants to the stream and water table. The elevation and lateral relationships can be visualized and described in terms of riparian planting zones. A figure illustrating an idealized depiction of these zones, as well as a brief description of each, is provided below (Figure 2). Not all streams will exhibit all of these zones. Topographic and edaphic conditions will change along and across the riverbank. For designing and planning of riverbank stabilization process we had divided the riverbank into three zones based on the width of riverbank, water level and vegetation characteristics.

1. **Lower Zone** is adjacent to river having low to medium water level. This zone is usually water saturated throughout the year. The species seen in this zone have the ability to survive prolonged inundation and are flexible enough to withstand high velocity water current. Grasses and shrubs tolerant to continuous inundation can survive in this zone.

2. **Middle zone** is having medium to high water level. This zone is usually saturated 3-4 months in a year. This zone includes small trees and reed species along with grasses and shrubs tolerant to occasional water inundation.

3. **Upper zone**- In the zone above the high water level and rarely to nil water saturation. Trees, palms or bamboos are seen with or without shrubs.

Riparian zones are best established in reaches where there will be periodic inundation to maintain healthy coverage

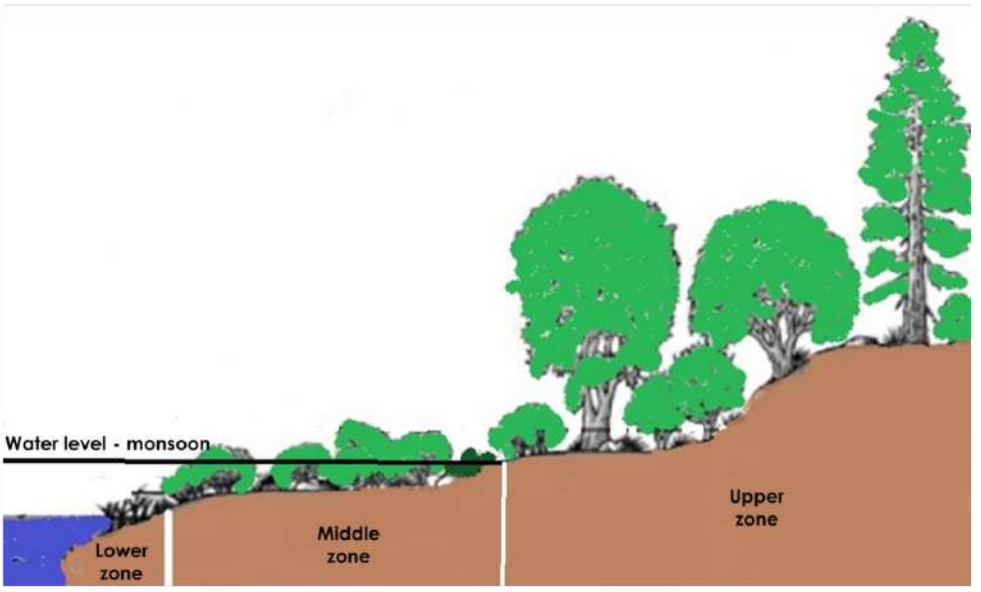


Figure 2. Zonation of riverbank

but not continual inundation. The lower and middle zone is normally devoid of riparian vegetation and marks the lowest elevation for planting plans. In these zones, vegetation only provides bank stabilization through mature roots for a short depth of 1 to 3 ft. An upland plant zone borders the highest elevation of riparian plants. Plants that do not rely on the groundwater table for moisture can provide sufficient erosion resistance in the highest terrace of the floodplain. Erosive forces in the zones can be further reduced to a level through grading the slopes to a flatter slope. The large benefit is future sustainable erosion protection, but the disadvantage is the loss of existing mature plants during slope grading.

Vegetation in these zones helps to prevent erosion on slopes by:

- **Interception**: The vegetation canopy intercepts raindrops and reduces their size and mechanical strength, thus protecting the soil from erosion caused by rain splash

- **Restraint:** The dense network of coarse and fine roots physically binds and restrains soil particles in the ground, while the above ground portions filter sediment out of runoff

- **Absorption:** Roots absorb surface water and underground water thus reducing the saturation level of soil and the concomitant risk of slope failure

- **Infiltration:** Plants and their residues help to maintain soil porosity and permeability, thereby increasing retention and delaying the onset of runoff

- **Evapotranspiration:** Vegetation transpires water absorbed through the roots and allows it to evaporate into the air at the plant surface

- Surface runoff reduction: Stems and roots can reduce the velocity of surface runoff by increasing surface roughness

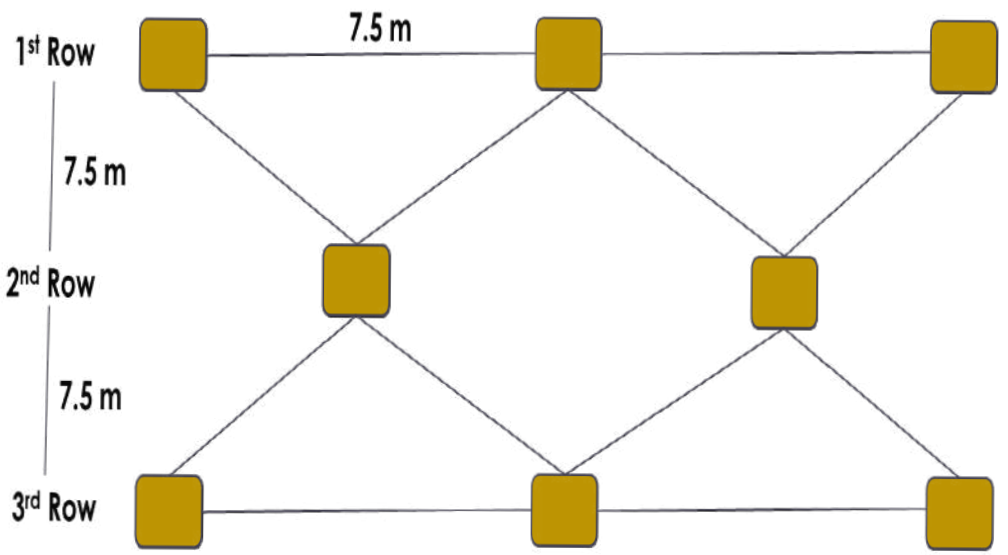
2.3. SITE PREPARATION

The level of site preparation needed will depend on the specific goals and objectives of the project, riparian species to be used, zonation of river bank and condition of the site. Site preparation is critical for plant survival and growth and may include removal of invasive species or other vegetation, grading, exposing soil, draining, irrigating, or adding fertilizer and other soil amendments. Mapping the area and fixing the boundary of the river bank using GIS is critical to initiate the site preparation activities. This will help to calculate the total time and manpower required for site preparation activities.

The site preparation activities include

1. **Selective area cleaning:** - The field should be cleared for planting. Since riverbanks are fragile and unstable, instead of uprooting or cutting of weeds, invasive plants and other unwanted plants it is advisable to clearing the site only at specific points where planting or other bioengineering treatment is planned. Well rooted trees, grasses, bamboos, aquatic plants and other plants already present in river banks can be retained.

2. **No slash and burn:** - Slash and burn of cleared material is not advisable in river bank. This activity may result in some adverse effects like changes in soil structure, loss of soil nutrient and destruction of soil fauna and flora. Instead of slash and burn, these cleared materials can be stored *in-situ* in pits



(50 X 50 X 50 cm^3) for composting. Care should be taken to avoid dispersion of weeds and invasive plants through composts. The spacing of the pits can be at 5 - 7.5 m in a triangular pattern and the activity should be done at least 45 - 60 days in advance so that the composts are ready by the time of planting. The ideal time for such activity is February – March.

3. **Pitting:** - The next step is to dig pits of specified size for planting. Based on the species used pit size may differ. Spacing between pits will depend upon the species used and zone of work. Trees require more space as compared to grasses, bamboos and shrubs. Pits of size 50 X 50 X 50 cm can be used for planting trees, shrubs and bamboos, whereas small digs with crow bars is advisable for herbs and grasses so as to minimize soil disturbances. Pits dug at a spacing of 7.5 m in a triangular pattern is advised for most trees, 5.0 m in a triangular pattern for most shrubs and 2.0 m in a triangular pattern is recommended for herbs and grasses. Pits for insitu composts can be used for trees, shrubs and bamboos. Money, time and available manpower considerations should also be taken into account while finalizing the size and number of pits.

The selection of suitable plant species and species combinations for bio stabilization measures must be based on careful vegetation surveys. Many species grow quickest in the open although others prefer shade, so one must carefully assess site conditions to understand which are most appropriate before deciding which species and types are to be used for the bio-restoration activities. An ideal situation would be to use a nearby healthy riparian area with similar physical characteristics of the project site as a template or reference to help guide restoration efforts. The use of appropriately sized plant stock is also a key consideration.

Plant selection should be done based on following characteristics

- Select indigenous species
- Suitable for climatic and edaphic conditions of the site
- Good root anchoring capacity
- High tolerance to adverse conditions like salinity, drought, waterlogging etc.
- High growth rate
- Multiple uses (food, timber, fodder, NTFPs etc.)
- High regeneration and coppicing power

The list of species suitable for each zone based on above characteristics is as

I. Large Trees

Sl. No.	Scientific name	Vernacular Name	Family	Zone – Lower/ Middle/ Upper
1.	*Adenanthera pavonina* L.	Manchadai Maniadi Manjati	Fabaceae	Upper Zone
2.	*Artocarpus heterophyllus* Lam.	Chakka maram Plavu Chakka	Moraceae	Upper Zone
3.	*Bhesa indica* (Bedd.) Ding Hou	Penali	Celastraceae	Upper Zone
4.	*Calophyllum inophyllum* L.	Pinna Punna Surampunna	Clusiaceae	Upper Zone
5.	*Caryota urens* L.	Aanapana Choondappana	Arecaceae	Upper Zone
6.	*Chukrasia tabularis* A. Juss.	Chandanaveppu Chuvannakil Karadi	Meliaceae	Upper Zone
7.	*Corypha umbraculifera* L.	Kodappana Sitalam Talippana	Arecaceae	Upper Zone
8.	*Drypetes confertiflora* (Hook.f.) Pax & Hoffm.	Kaduvapidukkan	Putranjivaceae	Upper Zone
9.	*Dysoxylum malabaricum* Bedd. ex Hiern	Akil Vellakil	Meliaceae	Upper Zone
10.	*Elaeocarpus tuberculatus* Roxb.	Adraksham Rudraksham Thodayam	Elaeocarpaceae	Upper Zone
11.	*Ficus racemosa* L.	Atthi	Moraceae	Upper Zone
12.	*Holigarna arnottiana* Hook. f.	Cheru Kattuchera Karincheru	Anacardiaceae	Upper Zone

13.	*Holoptelea integrifolia* (Roxb.) Planch.	Aavel Aavil Avelkurunnu	Ulmaceae	Upper Zone
14.	*Hopea parviflora* Bedd.	Irumbagam Thambagam	Dipterocarpaceae	Upper Zone
15.	*Hydnocarpus pentandrus* (Buch.-Ham.) Oken	Marotti Maravetti	Achariaceae	Upper Zone
16.	*Kingiodendron pinnatum* (Roxb. ex DC.) Harms	Chukennappayin Kulavu	Fabaceae	Upper Zone
17.	*Knema attenuata* (Hook. f. & Thoms.) Warb.	Chorapali Chorappathiri Chorappayin	Myristicaceae	Upper Zone
18.	*Lophopetalum wightianum* Arn.	Vembala Venkadavam Venkkotta	Celastraceae	Upper Zone
19.	*Neolamarckia cadamba* (Roxb.) Bosser	Aattuthekku Kadambu Kadhamba-vriksham	Rubiaceae	Upper Zone
20.	*Persea macrantha* (Nees) Kosterm.	Kulamavu Kulirmavu Malamavu	Lauraceae	Upper Zone
21.	*Poeciloneuron indicum* Bedd.	Poothamkolli	Calophyllaceae	Upper Zone
22.	*Pterocarpus marsupium* Roxb.	Karavenga Venna Venga	Fabaceae	Upper Zone
23.	*Reinwardtiodendron anamalaiense* (Bedd.) Mabb.	Cheeralam	Meliaceae	Upper Zone
24.	*Sterculia guttata* Roxb. ex DC.	Aanathondi-maram Kavalam Kithondi	Malvaceae	Upper Zone

25.	*Terminalia paniculata* Roth	Maruthu	Combretaceae	Upper Zone
26.	*Trewia nudiflora* L.	Malamkumbil Naikumbil Pambarakumbil Thavalamaram	Euphorbiaceae	Upper Zone
27.	*Vateria indica* L.	Painimaram Perumpiney Vellappayin	Dipterocarpaceae	Upper Zone

II. Medium Trees

Sl. No.	Scientific name	Vernacular Name	Family	Zone – Lower/ Middle/ Upper
1.	*Acronychia pedunculata* (L.) Miq.	Chakkimaram Mavaranchi Verukutheeni	Rutaceae	Upper Zone
2.	*Aegle marmelos* (L.) Correa	Koolakam Koovalam Mavilavu	Rutaceae	Upper Zone
3.	*Aporosa acuminata* Thw.	Neervetti Swarnavetti	Phyllanthaceae	Middle Zone
4.	*Aporosa cardiosperma* (Gaertn.) Merr.	Ponvetti Vetti	Phyllanthaceae	Middle Zone
5.	*Baccaurea courtallensis* (Wight)Muell.-Arg.	Mootilpazham Mootippuli Mootilthoori	Phyllanthaceae	Upper Zone
6.	*Barringtonia acutangula* (L.) Gaertn.	Iluppa	Lecythidiaceae	Middle Zone
7.	*Briedelia retusa* (L.) A. Juss.	Mullankkayini-Mulluvenga	Phyllanthaceae	Upper Zone
8.	*Butea monosperma* (Lam.) Taub.	Brahmavriksham Chamatha Mukkappuyam Plasu Palasinsamatha	Fabaceae	Upper Zone

9.	*Callicarpa tomentosa* (L.) L.	Cheruthekku Kattuthekku	Lamiaceae	Upper Zone
10.	*Cinnamomum malabatrum* (Burm. f.) Blume	Vayana Patta	Lauraceae	Upper Zone
11.	*Cinnamomum riparium* Gamble	Aattuvayana	Lauraceae	Middle Zone
12.	*Cinnamomum verum* Presl	Elavangam Erikkolam Karuva Vayana	Lauraceae	Upper Zone
13.	*Cleistanthus collinus* (Roxb.) Benth. ex Hook.f.	Odugu Odaku	Phyllanthaceae	Upper Zone
14.	*Crataeva magna* (Lour.) DC.	Neermathalam Neerval Mavulangam	Capparaceae	Upper Zone
15.	*Dimocarpus longan* Lour.	Chempoovam Chempunna Malampoovathi	Sapindaceae	Upper Zone
16.	*Elaeocarpus variabilis* Zmarzty	Kara Kattakara Malamkara	Elaeocarpaceae	Upper Zone
17.	*Garcinia gummi-gutta* (L.) Robs.	Kodampuli Meenpuli	Clusiaceae	Middle Zone
18.	*Humboldtia vahliana* Wight	Aattuvanchi Karappongu Kurappunna	Fabaceae	Middle Zone
19.	*Madhuca neriifolia* (Moon) H. J. Lam	Attu-ilippa Iluppa	Sapotaceae	Middle Zone
20.	*Mallotus aureopunctatus* (Dalz.) Muell.-Arg.	-	Euphorbiaceae	Upper Zone

21.	*Ochreinauclea missionis* (Wall. ex G. Don) Ridsd.	Aattuvanchi Neervanchi	Rubiaceae	Middle Zone
22.	*Oroxylum indicum* (L.) Benth. ex Kurz	Palakapayyani Vellapathiri	Bignoniaceae	Upper Zone
23.	*Otonephelium stipulaceum* (Bedd.) Radlk.	Poripoovam Pavirimulei	Sapindaceae	Middle Zone
24.	*Pongamia pinnata* (L.) Pierre	Minnari Ungu	Fabaceae	Middle Zone
25.	*Salix tetrasperma* Roxb.	Attupala Puzhappanji Vanchi	Salicaceae	Upper Zone
26.	*Sapindus trifoliatus* L.	Soapinkaimaram Urulungi Uruvangi	Sapindaceae	Middle Zone
27.	*Syzygium cumini* (L.) Skeels	Njara Njaval Perinnaral Valiyanjaval	Myrtaceae	Upper Zone
28.	*Syzygium lanceolatum* (Lam.) Wight & Arn.	Njaval	Myrtaceae	Upper Zone
29.	*Tabernaemontana alternifolia* L.	Kundalappala Kunninpala Kuruttupala	Apocyanaceae	Middle Zone
30.	*Trema orientalis* (L.) Blume	Amarathi Omamaram Pottamaram	Cannabaceae	Middle Zone
31.	*Wrightia tinctoria* (Roxb.) R. Br.	Dhanthappala Thondappala	Apocyanaceae	Upper Zone
32.	*Xanthophyllum arnottianum* Wight	Madukka Madakka Mottal	Polygalaceae	Upper Zone

III. Shrubs

Sl. No.	Scientific name	Vernacular Name	Family	Zone – Lower/ Middle/ Upper
1.	*Agrostistachys indica* Dalz.	-	Euphorbiaceae	Middle Zone
2.	*Bambusa balcooa* Roxb.	Baruwa Bhaluka	Poaceae	Upper Zone
3.	*Bambusa bambos* (L.) Voss	Mula Mullumula Pattil	Poaceae	Upper Zone
4.	*Clerodendrum infortunatum* L.	Perivelam Perukilam Vattapparuvalam	Lamiaceae	Middle Zone
5.	*Dendrocalamus asper* (Schult.f.) Backer	-	Poaceae	Upper Zone
6.	*Dendrocalamus brandisii* (Munro) Kurz	-	Poaceae	Upper Zone
7.	*Dendrocalamus longispathus* (Kurz) Kurz	-	Poaceae	Upper Zone
8.	*Dendrocalamus sikkimensis* Gamble ex Oliv.	-	Poaceae	Upper Zone
9.	*Dendrocalamus strictus* (Roxb.) Nees	Kalmula Illi Kallanmula	Poaceae	Upper Zone
10.	*Desmodium gangeticum* (L.) DC.	Orila	Fabaceae	Middle Zone
11.	*Homonoia retusa* (Graham ex Wight) Muell.-Arg.	-	Euphorbiaceae	Middle Zone
12.	*Homonoia riparia* Lour.	Aattuvanchi Kadallari Neervanchi	Euphorbiaceae	Middle Zone

13.	*Indianthus virgatus* (Roxb.) Suksathan & Borchs.	Channa Kookkila Malamkoova Rakkila Kattukuppa	Marantaceae	Middle Zone
14.	*Justicia adhatoda* L.	Aadalodakam	Acanthaceae	Middle Zone
15.	*Ochlandra scriptoria* (Dennst.) C.E.C. Fisch.	Eera Kolanchi Oodal Ottal	Poaceae	Middle Zone
16.	*Ochlandra setigera* Gamble	Oda	Poaceae	Middle Zone
17.	*Ochlandra travancorica* (Bedd.) Benth. ex Gamble	Eetta	Poaceae	Middle Zone
19.	*Ochlandra wightii* (Munro) C.E.C. Fisch.	Eera	Poaceae	Middle Zone
19.	*Pandanus canaranus* Warb.	Thazakaida	Pandanaceae	Middle Zone
20.	*Pandanus kaida* Kurz	Kaitha	Pandanaceae	Middle Zone
21.	*Pandanus palakkadensis* Nadaf	Nattukaitha	Pandanaceae	Middle Zone
22.	*Pseudarthria viscida* (L.) Wight & Arn.	Moovila	Fabaceae	Middle Zone
23.	*Rotula aquatica* Lour.	Kallurvanchi	Boraginaceae	Lower Zone
24.	*Saccharum arundinaceum* Retz.	Ambottal Munjapullu Mekhapullu	Poaceae	Lower Zone
25.	*Strobilanthes ciliatus* Nees	Cherukurunji Kurunji Vellakurunji	Acanthaceae	Middle Zone

26.	*Syzygium occidentalis* (Bourd.) Gandhi	Attuchamba Karinjara	Myrtaceae	Middle Zone
27	*Vitex negundo* L.	Karinochi Vellanocchi Vennochi	Lamiaceae	Middle Zone

IV. Herbs

Sl. No	Scientific name	Vernacular Name	Family	Zone – Lower/ Middle/ Upper
1.	*Acorus calamus* L.	Vayambu Vashanpa	Acoraceae	Lower Zone/ Middle Zone
2.	*Aerva lanata* (L.) Juss.	Cherula Cherupula Cheruvula	Amaranthaceae	Middle Zone
3.	*Alpinia calcarata (Haw.)* Roscoe	Aratha Chittaratha Kolinchi	Zingiberaceae	Lower Zone/ Middle Zone
4.	*Alpinia galanga* (L.) willd.	Aratha Kolaratha	Zingiberaceae	Lower Zone/ Middle Zone
5.	*Anaphyllum wightii* Schott	Keerikkizhangu Sulli	Araceae	Lower Zone/ Middle Zone
6.	*Andrographis paniculata* (Burm. f.) Nees	Kiriyathu Nilamkanjiram	Acanthaceae	Middle Zone
7.	*Begonia floccifera* Bedd.	Kalthamara	Begoniaceae	Lower Zone/ Middle Zone
8.	*Begonia malabarica* Lam.	Kalpuli Janaamkolli Kayyalapulian	Begoniaceae	Lower Zone/ Middle Zone
9.	*Chrysopogon zizanioides* (L.) Roberty	Ramacham Vettiver	Poaceae	Lower Zone/ Middle Zone

10.	*Colocasia esculenta* (L.) Schott	Chembu Seppankizhangu Kaattuchembu	Araceae	Lower Zone
11.	*Crinum viviparum* (Lam.) R. Ansari & V.J. Nair	Veluthapolathali Puzha lilly	Amaryllidaceae	Lower Zone/ Middle Zone
12.	*Cryptocoryne spiralis* (Retz.) Fisch. ex Wydler	-	Araceae	Lower Zone
13.	*Curcuma amada* Roxb.	Mangainchi Mannayinchi	Zingiberaceae	Middle Zone
14.	*Curcuma aurantiaca* Zijp	-	Zingiberaceae	Lower Zone
15.	*Cyperus malaccensis* Lam.	-	Cyperaceae	Lower Zone
16.	*Fimbristylis schoenoides* (Retz.) Vahl	-	Cyperaceae	Lower Zone
17.	*Hedychium coronarium* Koenig	Sugandhi Saugandhikam	Zingiberaceae	Lower Zone
18.	*Indigofera tinctoria* L.	Neelayamari	Fabaceae	Middle Zone
19.	*Lagenandra meeboldii* (Engl.) C.E.C. Fisch.	-	Araceae	Lower Zone
20.	*Lagenandra ovata* (L.) Thw.	Aandavazha Karin-pola	Araceae	Lower Zone
21.	*Orthosiphon aristatus* (Blume) Miq.	Poochameesa	Lamiaceae	Lower Zone/ Middle Zone
22.	*Plectranthus amboinicus* (Lour.) Spreng.	Panikoorka Kanjikoorka Kannikoorka	Lamiaceae	Middle Zone

V. Epiphytes

Sl. No.	Scientific name	Vernacular Name	Family	Zone – Lower/ Middle/ Upper
1.	*Pholidota imbricata* Lindl.	Pannamaravazha	Orchidaceae	Upper Zone/ Middle Zone
2.	*Rhynchostylis retusa* (L.) Blume	Maravasha Seethamudi	Orchidaceae	Upper Zone/ Middle Zone
3.	*Vanda tessellata* (Roxb.) Hook. ex D. Don	Arathamaravazha Maravazha Maravanchi	Orchidaceae	Upper Zone/ Middle Zone
4.	*Vanda testacea* (Lindl.) Rchb.f.	Maravazha	Orchidaceae	Upper Zone/ Middle Zone
5.	*Vanda thwaitesii* Hook. f.	-	Orchidaceae	Upper Zone/ Middle Zone

VI. Climbers/Woody Climbers

Sl. No.	Scientific name	Vernacular Name	Family	Zone – Lower/ Middle/ Upper
1.	*Abrus precatorius* L.	Chuvannakunni Kunnikuru	Fabaceae	Upper Zone/ Middle Zone
2.	*Anamirta cocculus* (L.) Wight & Arn.	Kaipalathumka Kollakkaya Pechuvalli	Menisperma-ceae	Upper Zone
3.	*Aristolochia indica* L.	Karalakam Garudakodi Kadalivegam	Aristolochia-ceae	Upper Zone/ Middle Zone
4.	*Asparagus racemosus* Willd.	Sathavari Chathavalli Sathavali	Asparagaceae	Upper Zone/ Middle Zone
5.	*Bauhinia phoenicea* Wight & Arn.	Vallimandaram Thukarakalli	Fabaceae	Upper Zone/ Middle Zone

6.	*Calamus metzianus* Schltr.	Odiyan-chooral	Arecaceae	Upper Zone
7.	*Calamus thwaitesii* Becc.	Aanachooral Thadiayanchooral Valiyachooral	Arecaceae	Upper Zone
8.	*Calamus travancoricus* Bedd. ex Becc.	Arichooral Cheruchooral Kattuchooral	Arecaceae	Upper Zone
9.	*Dioscorea esculenta* (Lour.) Burkill	Cherukizhangu Cheruvallikizhan-gu Nanakizhangu	Dioscoreaceae	Upper Zone
10.	*Embelia ribes* Burm. f.	Vayuvilangam Vizhalari Vizhal	Primulaceae	Upper Zone
11.	*Entada rheedeii* Spreng.	Kakkavalli Kukkumkai Paranda Paranda-ka-valli Thellikody	Fabaceae	Upper Zone
12.	*Ficus lawesii* King	-	Moraceae	Upper Zone/ Middle Zone
13.	*Piper hymenophyllum (*Miq.) Wight	-	Piperaceae	Upper Zone/ Middle Zone
14.	*Piper longum* L.	Kattuthippali Thippali	Piperaceae	Middle Zone
15.	*Strychnos colubrina* L.	Modirakanjiram Vallikanjiram	Loganiaceae	Upper Zone

2.5. PLANTING IN SITE

Planting plans help accelerate the establishment of plants and helps to ensure that the appropriate species are included. It also reduces the exposure period to erosion. Re-vegetation consists of selecting the appropriate plant species for the management area and introducing them in a manner which promotes successful establishment. This includes watering until the plant is established, appropriately locating plants on banks and terraces so the water table will be accessible to the plant roots, and selecting appropriate species to match site conditions.

If planting is done in pits taken for in-situ composting, care should be taken to properly mix the top soil with the compost before planting. Planting methods may differ based on planting material used. For example, it may differ between seedling and cutting. Seedling should be planted at the same depth it was in the pot or nursery. Cuttings can be planted as a single branch, called a live stake. Once it is planted in small pits of few inches depth, it will start to root and grow. Choose material that is free of disease, and insect infestation. Certain seedlings may die after planting because of less care or management. Casualty replacement should be done to maintain the continuity of the riparian vegetation.

2.6. PLANT PROTECTION, MAINTENANCE AND AFTERCARE

The success of many riparian planting and other silviculture treatments depends on periodic maintenance (watering, invasive removal, protection from predators) until vegetation becomes well established. Considerable maintenance in the first 5–7 years after planting is often needed, which may include staking, pruning and replacing dead plants, irrigation, and additional invasive species removal.

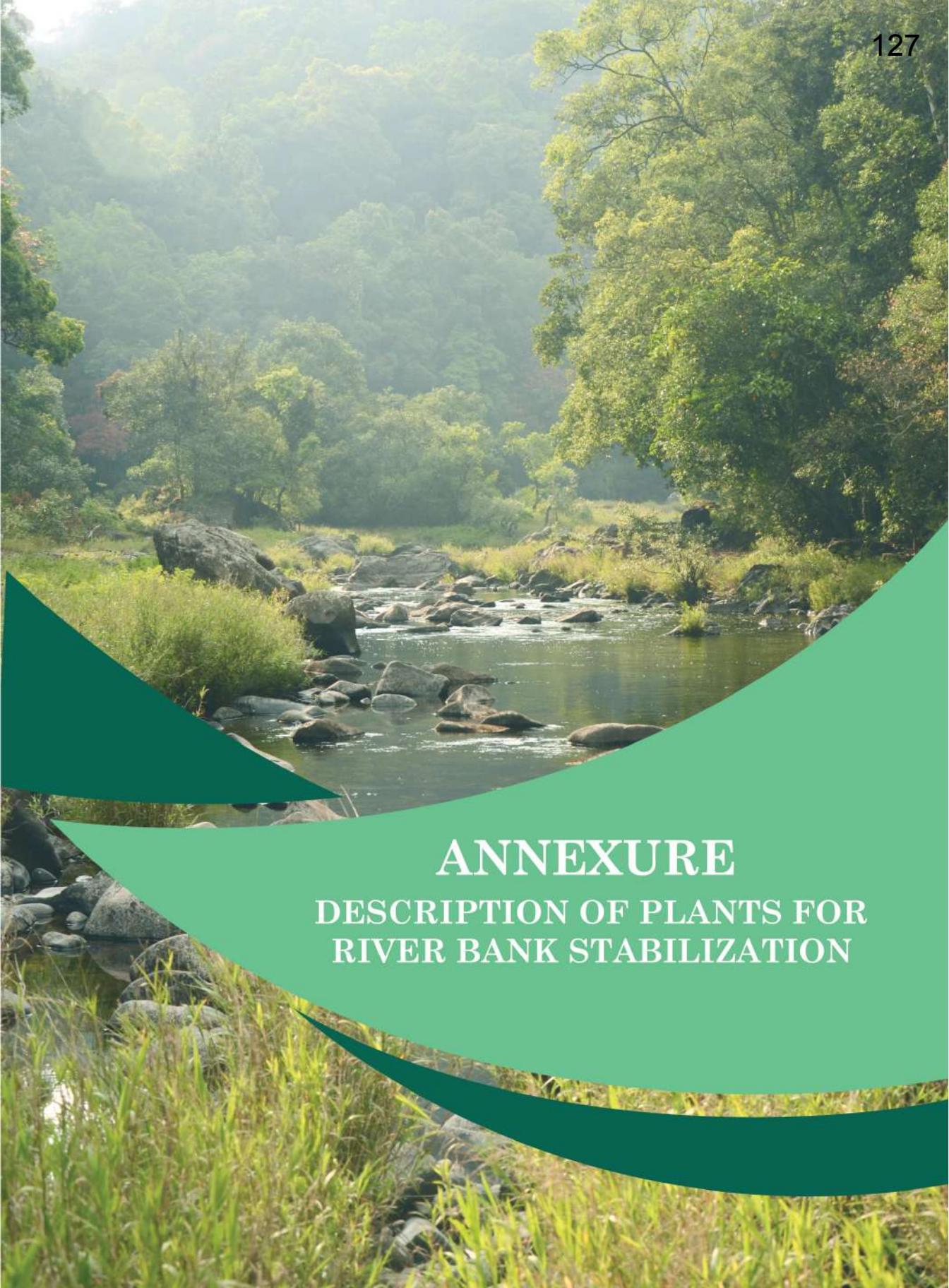
The high rate of human and natural disturbance in riparian areas results in patches of exposed soil susceptible to colonization by many invasive, often exotic, plants. Many of these exotic species pose threat to riparian areas, but some weeds like *Michania macrantha, Chromolina odorata*, are highly invasive and can form monocultures or become the dominant species excluding native species. In addition, the protection of plantings from cattle, goats, and other herbivores is often necessary to limit damage and mortality of plantings and improve growth of trees and other plantings.

After planting, seedlings should be protected up to the period of its establishment. Barbed wire fence of height 1.5 m will give protection of seedlings from grazing and browsing. Continuous monitoring is necessary to evaluate its growth performance and check the growth of weeds and other plants around the seedling. A mulch ring can be established to protect the plants from weeds. Care should be taken to avoid the attack of insects and pests and occurrence of diseases.

2.7. CONCLUSION

Riverbank stabilization is necessary

whenever there is a problem exists and needs fixing. Though several river bank stabilization methods are available, selection of suitable site specific method(s) among them is a tedious process. Biostabilization methods using plants/trees has been proved to be efficient in this aspect. Whenever there is a river bank stabilization problem, restoration of the riparian zone with native plant species that have a fast vegetative development is a viable option.The biostabilization method would be a good option because of certain attributes; eco-friendliest method, less disturbance to ecosystem during implementation and economically cheap as compared to other methods, and long term measure with additional benefits like climate change amelioration, food security, livelihood security of local people and sustainable development. These guidelines as such or with some modifications can be applied in any river stabilization program after a detailed site study.



ANNEXURE

DESCRIPTION OF PLANTS FOR RIVER BANK STABILIZATION

LARGE TREES

Adenanthera pavonina L.

(Manchadai, Maniadi, Manjati)

© Sanil MS

Deciduous trees; 20 m high; bark grey to reddish-brown, smooth, blaze dull yellow. Leaves bipinnate, alternate, stipulate; stipules minute, free, lateral, cauducous; leaflets 8-20, alternate, oblong, oblong-elliptic. Flowers bisexual, pale yellow. Fruit a pod straight to falcate to slightly twisted, spirally coiled after dehiscence, thin, septate within, tapered at base, apex acute, glabrous; seeds elliptic-lenticular, glossy, red.

Propagation: Indehiscent pods can be collected from the tree before dehiscence and can be sun dried until seeds are released. Hot-water treatment or sulphuric acid scarification for 45 to 60 minutes or boiled water treatment for 1 minute followed by 24 hours cold water soaking. Pre-treated seeds can be sown in plastic trays filled with vermiculate and watered regularly. The seedlings can be pricked out into polythene bags of size 22.5 × 17.5 cm filled with potting mixture and kept under shade for about a week for establishment.

Artocarpus heterophyllus Lam.

(Chakka, Pilavu, Plavu, Kottachakka)

© Sreekumar VB

Evergreen trees, 25 m high, bark blackish-grey, with green and black, exudation milky white latex. Leaves simple, alternate, obovate-oblong, or elliptic-ovate. Flowers unisexual, minute, yellowish-green, in spikes enclosed by spathe-like bracts, male from young branches, catkin narrow-cylindric. Fruit a sorosis oblong, yellowish-green, fruiting perianth yellow to light orange, fleshy; seeds elliptic-oblong, smooth, glossy.

Propagation: Mature seeds can be used for propagation. Thorough was hing to remove the slimy coating around the seeds is necessary. The seeds start germination within 10 days and 80-100% germination can

be achieved within 35-40 days after sowing. Vegetative propagation of superior clones is also possible.

Bhesa indica (Bedd.) Ding Hou

(Penali)

© Robi AJ

Evergreen trees, to 30 m high; bark grey mottled with greenish-white; brittle; blaze creamy brown, surface slimy. Leaves simple, alternate, stipule large, deciduous. Flowers bisexual, in terminal panicles, pale yellow. Fruit a capsule, two lobed, two valved, reddish-brown; seeds fleshy with aril.

Propagation: Propagation can be done through seeds. Seeds can be sown in polythene bags of 22.5 × 17.5 cm size filled with soil sand mixture (3:1) and maintained under shade and irrigation. Branch cuttings can also be used.

Calophyllum inophyllum L.

(Pinna, Punna, Surampunna)

© Sreekumar VB

Tree, 20 m tall; bark smooth or with boat-shaped fissures, brown to pale grey; exudate milky or yellow; branchlets compressed, slightly flat or 4-angled, glabrous. Leaves broadly elliptic-oblong or obovate. Flowers white, fragrant. Drupes globose to obovoid, short apiculate, smooth; seeds subglobose, 2 cm across.

Propagation: Fruits can be collected from the tree by lopping of the branches and the fallen mature seeds can be collected. The fleshy pericarp and seed coat need to be removed before sowing and storage. Seeds can be dibbed in vermiculture or sand maintained moist in germination trays. Seedlings can be pricked out in to polythene bags of 22.5 × 17.5 cm size filled with potting mixture.

Caryota urens L.

(Aanapana , Choondappana , Eerumbana, Kalippana)

© Sreekumar VB

Stems solitary, 20 m tall. Leaves borne along the upper third of the stems; leaflets with jagged margins and elongate apices. Inflorescence borne among and below the leaves. Flowers reddish brown to purple. Fruit globose, purple.

Propagation: Propagation is through seeds. Gloves should be weared to protect hands. It can also propagated using the suckers.

Chukrasia tabularis A. Juss.

(Chandanaveppu, Chuvannakil, Karadi, Vembu, Vellanangu)

Trees, 35 m high, bark thick, dark brown, deeply cracked. Leaves alternate, leaflets subopposite. Flowers yellowish-white, in terminal

© Mohina Macker

panicles. Fruit a capsule, 4-5 valved, ovoid, dark brown; seeds many, thin, broadly winged at base.

Propagation: Ripe capsules can be collected and spread out in the sunlight for 2 to 3 days to dehisce and seeds can be separated by gentle thrashing. Utmost care is required to protect seeds from being blown away by wind. Seeds can be stored in gunny bags for three months and can be sown by broadcasting in open raised nursery beds and lightly covered with soil. When the seedlings reach about 5 to 8 cm height, transplantation can be done into polythene bags of 22.5 × 17.5 cm size filled with potting mixture

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Corypha umbraculifera L.

(Kodappana, Sitalam, Talippana)

Stem solitary, dark grey with distinct

© Sreekumar VB

leaf scars. Leaves large, 3-8 m in diameter. Inflorescence terminal, about 6 m long; primary flower branches arise horizontally from the main axis; ultimate flower branches 12-40 cm long, white, smooth. Flowers bisexual, arranged in clusters of 3-6 flowers. Fruit globose, 3 cm in diameter. Seeds smooth and very hard.

Propagation: Mature fruits can be collected and after removal of fleshy part seeds can be air dried for 3-4 days. Then it can be sown in standard nursery beds with basal covering of thick plastic sheet. Germinated seedlings can be transplanted to polythene bags of 25 × 25 cm.

Drypetes confertiflora (Hook.f.) Pax & Hoffm.

(Kaduvapidukkan)

Trees, 25 m high; bark greyish, smooth. Leaves simple, oblong or elliptic-oblong. Fruit a drupe, subglobose.

© Robi AJ

Propagation: Ripe fruits can be collected and the fleshy fruit rind needs to be removed properly. The processed seeds can be sown in river bed soil.

Dysoxylum malabaricum Bedd. ex Hiern

(Akil, Vellakil)

© Sanil M S

Trees, 35 m high, bark greyish-yellow, rough, verrucose; lenticels warty, fissured; aromatic, outer bark dead, corky. Leaves alternate, estipu-

late; leaflets opposite, subopposite or alternate, elliptic-oblong, ovate-oblong or lanceolate. Flowers bisexual, greenish-yellow, fragrant. Fruit a capsule, verrucose, bright yellow; seeds 3-4, reddish-brown.

Propagation: When the ripe fruits attain bright yellow colour, collection can be done from standing trees or from ground. Seeds can be separated by hand or can split open longitudinally using a sharp seed cutter without injuring the seeds. Seeds can be stored well in wet gunny bags for 6 weeks. The seed coat should be peeled off by hand before sowing in vermiculture medium. The seedlings after one or two weeks can be potted in large polythene containers of 40 × 18 cm.

Elaeocarpus tuberculatus Roxb.

(Adraksham, Rudraksham, Thodayam)

© Vinayaraj VR

Trees, 25 m high, bole buttressed; bark thick, grey mottled with white, smooth; young stem, buds; branches monopodial. Leaves simple, alternate, clustered at the tip of branchlets, obovate, base cuneate or round. Flowers bisexual, white. Fruit a drupe, oblong or ellipsoid, green, tomentose, stones single, compressed, coarsely tuberculate, 1-2-celled.

Propagation: Propagation is through seeds and germination can be enhanced by stratification of seed with 1% H_2SO_4, mechanical scarification or dried in sunlight for five days will also break the dormancy. For vegetative propagation, the stem cuttings of small shoot portions of pencil thickness with meristems can be used by treating with IBA (1200 ppm) and NAA (400 ppm) for two hours.

Ficus racemosa L.

(Atthi)

© Sanil M S

Deciduous trees, 30 m high; bark thick, surface reddish-brown or yellowish-brown smooth. Leaves simple, alternate. Syconium orange,

pink or dark crimson; achene granulate.

Propagation: The seeds are reddish brown in colour; 1000 seeds have 0.9g weight. The seeds will have drastic lose of viability after six months. The seeds can be sown in Petri plates with soaking in hot water at 65°C for 10 minutes recorded 11.0% germination. The stem cuttings treated with rooting hormone 1000 ppm IBA can also be used.

Holigarna arnottiana Hook. f.

(Cheru , Kattuchera, Karincheru)

© Sanil M S

Evergreen trees, to 20 m high; bole buttressed; bark pale brown, rough; exudation milky, caustic, black on drying. Leaves simple, alternate, crowded at the tips of branchlets, oblanceolate. Flowers yellowish-brown. Fruit a drupe, obliquely-ovoid, glabrous; seed parietal.

Propagation: Propagation can be done through seeds

Holoptelea integrifolia (Roxb.) Planch.

(Aavel, Aavil, Avelkurunnu, Njettaval, Njetavil)

© Malaramuthan Rajamoni

Large deciduous trees, to 25 m high, bark whitish-grey, smooth; blaze yellowish-grey, streaked with light brown; branchlets pubescent. Leaves simple, alternate; ovate-oblong, ovate or elliptic-ovate, base rounded or subcordate. Flowers greenish-purple, in axillary fascicles. Fruit a samara, orbicular, wings nerved, glabrous, seed one.

Propagation: Fruits can be collected from the tree by lopping off the branches and seed needs to be air dried. Seeds can be sown in plastic trays filled with vermiculite and watered regularly and overhead shade is necessary. Seedlings can be transplanted polybags filled with potting mixture when reach about 5 to 6 cm in height.

Hopea parviflora Bedd.

(Irumbagam, Iripu, Kambagam, Thambagam)

© Sanil M S

Evergreen trees, 35 m high, bole straight, buttressed, bark light brown or grey, rough fibrous; branchlets reddish-brown, slightly pubescent. Leaves simple, alternate, ovate, lanceolate or ovate-lanceolate. Flowers creamy yellow, tomentose racemose panicles. Fruit a nut, glabrous; wings 2.6 × 1.8 cm, glabrous.

Propagation: The fruits can be collected from the field when the wing colour changes from green to brown. The fallen fruits can be collected from the field; however, as the fallen seeds germinate soon, collection may be done soon after seed fall. De-winging prior to sowing is recommended. The seeds may be dibbled in vermiculite or river sand medium with or without wings, horizontally or with wings downwards. Germinated seedlings can be pricked out to polythene bags or root-trainers filled with appropriate potting mixture. Branch cuttings of 2 cm to 3 cm thickness and 7 cm length when dipped for one minute in IBA 2000 ppm solution can also be used for vegetative propagation.

Hydnocarpus pentandrus (Buch. - Ham.) Oken

(Kotti, Maravetti, Marotti, Neeratti, Niralam, Thamana)

© Sanil M S

Dioecious trees, 25 m high, bole fluted; bark surface pale brown with white patches, smooth, brittle; branchlets pubescent. Leaves simple, alternate, elliptic, elliptic-lanceolate or elliptic-oblong, apex acuminate, Flowers greenish-yellow, solitary or in small fascicle. Fruit a berry, globose, rind thick, brown, rough with uneven surface; seeds numerous, yellowish, obtusely angular.

Propagation: Mature fruits can be collected from the tree by lopping off the branches. Collection of fallen fruits should be avoided as far as

possible. Once, the pericarp is broken, after depulping, seeds can be extracted by the hand and it can be sun-dried. Then seeds can be soaked in cold water for 24 hrs. The freshly collected and pre-treated seeds can sown in vermiculite in germination trays and watered regularly. The seedlings can be potted in polythene bags of 20 × 10 cm size.

Kingiodendron pinnatum (Roxb. ex DC.) Harms

(Chukennappayin, Churali, Ennappayin, Kiyavu, Kulavu)

© Binoy NM

Evergreen trees, 30 m high, bark 5-8 mm thick, surface greyish-brown with green blotches, rough; exuding a reddish sticky resin. Leaves imparipinnate, alternate; leaflets 5-9, alternate, margin entire, glabrous, coriaceous. Flowers bisexual, white, axillary and terminal panicled racemes. Fruit a pod, ovate-ellipsoid, turgid, obtusely beaked, prominently veined, dark brown, indehiscent; seed one, pendulous.

Propagations: Seeds are soaked in water for 24 hours and sown in sand bed. In air layering, 100% success was recorded with growth hormome IAA 1000 ppm within 20 - 55 days.

Knema attenuata (Hook. f. & Thoms.) Warb.

(Chorapali, Chorappathiri)

© Sanil M S

Dioecious trees, to 18 m high, bark surface greenish-black to greenish-brown, with green and white, smooth, exfoliations irregular; bran chlets rusty tomentose. Leaves simple, alternate, oblong or ovate. Fruit a capsule 2-valved, ovoid, rusty tomentose; seed one.

Propagation: Can be propagated through Seeds.Fresh seeds with initial moisture content of 37% yields 83% germination in 28-32 days using river sand as the sowing medium. In the case of vegetative propagation, ring air layering method can be adopted which

yields 75% success with IBA 1000 ppm. The seeds will lose its viability after 8-10 days under normal room conditions.

Lophopetalum wightianum Arn.

(Vembala, Venkadavam, Venkkotta)

© Sanil M S

Evergreen trees, 30 m high, bole buttressed;bark, yellowish-brown. Leav es simple, opposite or subopposite, elliptic, elliptic-oblong, oblong, ovate or ovate-oblong. Flowers pinkish to dull red. Fruit a capsule 8-3-angled, trigonous, 3 valved, brown, smooth, pointed at both ends; seeds thin, brown, compressed.

Propagation: Healthy seeds can be directly sown to nursery beds filled with sand. Seeds starts germination after 20 days.

Neolamarckia cadamba (Roxb.) Bosser

(Kadambu, Vellakadambu, Aattuthekku, Kadaarvayura)

© Ravi Upadhyay

Deciduous trees, 20 m high, bark pale brown, vertically shallowly groo ved, exfoliating in small rectangular flakes; branches horizontal. Leaves simple, opposite, decussate, ovate or elliptic-oblong, apex acuminate, base truncate or obtuse, margin entire, glabrous above, pubescent beneath. Flowers bisexual, yellowish. Fruit a capsule on a fleshy globose, orange yellow; seeds angular, minute.

Propagation: Propagated through seeds. Best sown in a nursery, direct sowing is not very successful because of small-sized seeds and the sensitivity to drought, excessive moisture and direct sun. The germination begins in about 10 - 14 days in rainy season.When the seedlings are 8 - 12 weeks of old, can be transplanted to poly bags. It is recommended to use a

medium that is enriched with organic matter. After 6 - 7 months, when the seedlings reach about 30cm tall, can be transplanted into the field.

Persea macrantha (Nees) Kosterm.

(Kulamavu, Kulirmavu, Kurma, Malamavu, Uramavu)

© Sanil M S

Evergreen trees, 30 m high, bark surface pale brown. Leaves simple, alternate, clustered at the tip of branchlets. Flowers pale yellow, in panicles from upper axils and terminal. Fruit a berry globose, green with white specks, aromatic; seed one, globose.

Propagation: Fruits are collected from the ground soon after fall or from the tree by shaking the branches manually. De-pulp the fruits and wash them thoroughly in water and needs to dry under shade. Freshly collected seeds can be sown in germination trays filled with vermiculite and watered regularly. After completion of germination, the seedlings can pricked out into polythene bags of 22.5 × 17.5 cm size filled with soil and maintained under shade.

Poeciloneuron indicum Bedd.

(Poothamkolli)

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Large evergreen trees; to 30 m high; bark thick, grey to brown, rough; bole straight, buttressed sometimes with stilt root; exudation milky yellow. Leaves simple, opposite, elliptic, elliptic-oblong or linear-oblong. Flowers yellowish-white, fragrant, in axillary and terminal panicles. Fruit a capsule, globose, beaked, pink, 1-celled; seed one, fleshy.

Propagation: Propagation is through seed and it is shade tolerant in the early stages, but strongly light demanding later.

Pterocarpus marsupium Roxb.

(Karavenga, Venna, Venga)

© Sanil M S

Deciduous trees, 30 m high, bark surface grey or greyish-black, rough, deeply vertically cracked, exfoliations small, irregular, fibrous; exudation blood-red. Leaflets alternate, elliptic-oblong, oblong-ovate or oblong. Flowers yellow, in terminal and axillary panicles. Fruit a pod, broadly winged; seed one, subreniform.

Propagation: The mature pods can be collected by lopping off the branc hes or from the ground; should be dried properly and prevent insect and fungal attack. The seeds can be tied up in a cloth or gunny bag and soak in water for 24 hours; the excess water can allow draining off. After 2 to 3 days the germinating seeds can be used for sowing. The young seedlings can be pricked out and planted in polythene bags of size 22.5 × 17.5 cm.

Reinwardtiodendron anamalaiense (Bedd.) Mabb.

(Cheeralam)

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Trees, 20 m high, bark thick, smooth, greyish-brown. Leaflets alternate, elliptic, lanceolate, elliptic-lanceolate or elliptic-obovate, acute. Flowers yellowish-white. Fruit a berry, ovoid, white, scaly; seeds 1-2.

Propagation: Propagation can be done through seeds.

Sterculia guttata Roxb. ex DC.

(Aanathondimaram, Kavalam, Kithondi, Peenari, Thondi)

Deciduous trees, 20 m high; bole straight; bark greyish-brownish, sm ooth. Leaves simple, alternate, broadly ovate-oblong, ovate or broadly obovate-oblong. Flowers white, dotted with pink. Fruit an aggregate of 1-5 radiating follicles, obovoid, red tomentose, smooth and pink within;

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seeds ovoid, black, smooth, shining.

Propagation: The mature seeds can be soaked in water overnight and it yields 50-90 % germination.

Terminalia paniculata Roth

(Maruthu)

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Deciduous trees, 30 m high; bark thick, surface brown, rough. Leaves simple, lower leaves subopposite, upper alternate, elliptic, oblong, ovate, elliptic-oblong or ovate-oblong. Flowers white, sessile. Fruit a drupe, reddish-brown, with one large and 2 small wings; seed one.

Propagation: The mature fruits which are brick red in colour, can be used for raising propagules and it can be collected by looping off the branches and also from the ground. The fruits need to be sun dried. The seeds retain viability for five months in sealed tin and gunny bags. The seeds can be sown in vermiculite, sand or soil in standard nursery beds and if the seedlings reach with two pairs of leaves, it can be pricked out and planted in polybags of 22.5 × 17.5 cm size filled with soil.

Trewia nudiflora L.

(Malamkumbil,Naikumbil,Pambarakumbil, Thavalamaram)

Deciduous dioecious trees, 20 m, bark greyish-brown, smooth; young parts tomentose or glabrous. Leaves simple, opposite. Flowers unisexual, pale green. Fruit a capsule 2-3 cm across, woody, dark brown, broadly rounded, 3-4 loculed, pericarp very thick; seeds globose, ovoid.

Propagation: This species can be propagated by seed and average numbers of seeds ranges from 4200-8100 seeds/kg. The mature capsules can be collected. Seeds can be separated after fruits have been spread out in the sun for several days to soften. It has reported that soaking seed in water for up to 48 hours accelerates germination. The germination starts after 10-14 days fresh seeds have 70-80%

germination. Seedlings raised in the nursery should be copiously watered during dry weather as they are sensitive to drought.

Vateria indica L.

(Painimaram, Perumpiney, Vellappayin)

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Evergreen trees, 30 m high, bark greyish, blotched with white and green, smooth; exudation, sticky, resinous. Leaves simple, alternate, oblong, apex acuminate or obtusely acute, Flowers bisexual, white, 2-3 cm across, fragrant, in terminal panicles. Fruit a capsule, pale brown, ovoid or oblong-ovoid, single seeded.

Propagation: The ripe fruits can be collected as soon as they fall on the ground; fruits lying on ground are prone to the attack of weevil. Seeds can be stored in gunny bags for about 10 days. No pre-treatments are required before sowing and freshly collected fruits can be sown in polythene bags of 22.5 × 17.5 cm size filled with soil sand mixture (3:1) and maintained under shade and irrigation.

MEDIUM TREES

Acronychia pedunculata (L.) Miq.

(Chakkimaram, Mavaranchi, Muttanari)

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Evergreen trees, bark greyish-yellow.Leaves opposite, obovate, obova te-oblong. Flowers bisexual, yellowish-white. Fruit a berry, subglobose, pale-brown, obscurely lobed; seeds black.

Propagation: Propagation can be done using seeds.

Aegle marmelos (L.) Correa

(Koovalam, Vilvam)

Deciduous trees 12 m tall, branchlets cylindric, sometimes slightly angled. Leaves alternate-3-foliolate, sometimes 5-foliolate. Flowers bisexual, greenish white or yellow, fragrant. Fruit a berry, ovoid, 6-10 cm across, woody, yellowish, many seeded; seeds oblong and flat.

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Propagation: Propagation can be done using seeds. Vegetative propagation through root sukers is also possible. The highest rooting percentage (60%) was recorded both with 0.2% and 0.4% IBA followed by 0.8% IBA (40%).

Aporosa acuminata Thw.

(Neervetti)

© Sanil M S

Slender shrubs with weak branchlets. Leaves entire, glabrous. Fruit ovoid, glabrous or hairy; seeds obovoid;

glabrous with red aril.

Propagation: Propagation can be done using seeds.

Aporosa cardiosperma (Gaertn.) Merr.

(Aechil, Kotili, Ponvetti, Vetti)

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Evergreen trees, 15 m high; bark thick, greyish-brown. Leaves simple, attenuate, bifarious, elliptic-oblong, elliptic, oblong male flowers: yellow, solitary or clustered female flowers: pale green, 3-8 together. Fruit a capsule, globose, yellow; seed one, brown.

Propagation: Propagation can be done using seeds.

Baccaurea courtallensis (Wight) Muell.-Arg.

(Mootilpazham, Mootippuli, Mootiltthoori)

Evergreen trees 15 m high; bole uneven with tubercles; bark greyish-yellow; branchlets terete, rough. Leaves simple, alternate, oblanceolate or elliptic-oblanceolate. Flowers unisexual, dark crimson, in densely clustered slender racemes on mature stem. Fruit a capsule, subglobose, ovoid, ellipsoid or obovoid; seeds 3, oblong, aril white.

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Propagation: Can easily propagate through mature seeds and vegetative propagation techniques.

Barringtonia acutangula (L.) Gaertn.

(Iluppa)

Evergreen trees, 15 m high, bark surface dark brown, Leaves simple, alternate, clustered towards the tip of branchlets. Flowers red, in terminal pendulous racemes. Fruit a fibrous berry, oblong-ovoid, bluntly quadrangular; seed one, ovoid.

Propagation: Ripe fruits can be collected from the ground and also from

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the trees. Seeds can be extracted from shade- dried fruits by peeling off the rind. The seeds should be sown immediately after collection in sunken beds at 7.5 × 7.5 cm to a depth of about 0.5 cm.

Briedelia retusa (L.) A. Juss.

(Mullumaruthu, Mulluvenga, Mullankkayini)

© Sanil M S

Deciduous trees, 20 m high, bark greyish-brown; young trees armed with sharp thorns; branchlets thinly hairy. Leaves simple, alternate, broadly elliptic, oblong, elliptic-oblong, apex obtuse retuse or subacute, base round, obtuse, margin entire or slightly crenulate. Flowers unisexual; greenish-yellow, sessile or shortly pedicellate. Fruit a drupe, purplish-black, seated on the persistent, slightly enlarged calyx; seed one in each pyrene.

Propagation: Propagated through seeds. Fresh seed has a germination percentage of about 75 percentages. The pulp should be removed from the seeds before sown, and should be soaked in cold water for 24 hours.

Butea monosperma (Lam.) Taub.

(Brahmavriksham, Chamatha)

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Deciduous trees, 10 m high, bole crooked, irregular; bark grey to greyish-brown; exudation red. Leaves trifoliate, alternate. Flowers bisexual, bright red, in terminal or axillary, densely fascicled. Fruit a pod, 12.5-28

cm long, oblong, the base flat, wing-like and indehiscent, the tip splitting round the apical seed; seed obovate, compressed.

Propagation: Propagation can be done through seeds. The hormone treatment using IBA + NAA (100 ppm) also gave 20-60% rooting depending on twig diameter class and month.

Callicarpa tomentosa (L.) L.

(Cheruthekku, Kattuthekku, Naikumbil, Nallapompil)

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Trees, 10 m high, bark thick, brown, rough. Leaves simple, opposite, ovate or elliptic. Flowers pinkish-purple, densely tomentose. Fruit a drupe, globose, 3 mm across, glabrous, black; seeds 3-4, oblong, angular.

Propagation: Propagation can be done through seeds.

Cinnamomum malabtrum (Burm. f.) Blume

(Karappa, Patta, Vayana, Vellakodala)

© Sanil M S

Trees, 20 m high, bark reddish-brown, smooth or slightly. Leaves simple, opposite or subopposite, elliptic-oblong, oblong or oblong-lanceolate, apex acute or acuminate. Fruit a berry, subtended by shallow fleshy cup.

Propagation: Propagation can be done using seeds. Vegetative propagation using stem cuttings is also possible.

Cinnamomum riparium Gamble

(Aattuvayana)

Small trees, 6 m tall; bark brown; branchlets slender, smooth, slightly angular when young, terete on maturity. Leaves simple, opposite and subopposite, estipulate, tri-nerved; Flowers greenish yellow, minutely

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sparsely sericeous to glabrous. Fruits berry, ellipsoid, smooth; seed 1, ellipsoid.

Propagation: Seeds have short viability. Soaking the seeds for 24 hours in lukewarm water hastens germination, which may take 1 - 6 months at 20°c. The germination rate of fresh seed is about 50%, falling to 25% for the next 6 months.

Cinnamomum verum Presl

(Edana, Kunthakaimaram, Thamala)

© Sreekumar VB

Trees, 20 m high, bark 8-10 mm thick, brown, rough. Leaves simple, opposite or subopposite, ovate, elliptic ovate or elliptic-lanceolate. Flowers bisexual, in terminal and axillary, pale yellow. Fruit a berry, 1-2 cm, ellipsoid to oblong-ovoid, dark purple, surrounded by the enlarged perianth.

Propagation: Propagation can be done using seeds. Vegetative propagation by cuttings and layering is possible. Hard wood cuttings treated with IBA 2500 ppm yields 45% rooting. IAA 100 ppm is also possible; 82.6% rooting of hard wood cuttings obtained using NAA – 2500 ppm.

Cleistanthus collinus (Roxb.) Benth. ex Hook.f.

(Odugu, Odaku)

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Deciduous trees, 15 m high; bark dark brown, nearly black, rough. Leaves simple, alternate, distichous. Flowers unisexual, yellowish-green, in glomerules borne on main leafy branches and short lateral branchlets.

Fruit a capsule, subglobose or wide oblong. Seeds 3, globose, black.

Propagation: Propagation can be done using seeds.

Crataeva magna (Lour.) DC.

(Neermathalam, Neerval, Mavulangam)

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Trees, 10 m high, bark 2-3 mm thick, surface grey, smooth, longitudinally wrinkled. Leaves alternate, digitately trifoliate; rachis 4-12 cm long, slender, grooved above, glabrous; petiolule 4-7 mm long, slender; leaflets unequal, ovate, ovate-lan ceolate or broadly elliptic. Flowers bisexual, creamy white. Fruit a berry, globose or ovoid, yellowish-grey, rind woody, scurfy; seeds brown, embedded in pulp.

Propagation: Propagation can be done using seeds.

Dimocarpus longan Lour.

(Chempoovam,Malampoovathi, Poripunna)

© Sanil M S

Evergreen trees, 18 m, bark greyish or reddish-brown, smooth, flaking off in thin scales; branchlets prominently white lenticellate, reddish-brown tomentose. Leaves paripinnate, alternate, elliptic-oblong or oblong-lanceolate, apex acute or acuminate, base oblique or acute, margin entire. Flowers polygamous, yellowish-white. Fruit a schizocarp of 1-2 cocci, globose, reddish-brown; seed one, black, covered by fleshy aril.

Propagation: Propagated through seeds. Germination takes place within 7-10 days.

Elaeocarpus variabilis Zmarzty

(Kara, Kattakara, Kotlampazhamaram, Malamkara)

Buttressed tree; bark greyish-brown;

branchlets, young leaves and buds densely pubescent. Leaves simple, alternate, elliptic-ovate, elliptic-obovate. Flowers white, in axillary and terminal racemes; peduncle puberulus when young. Fruit a drupe, oblong.

Propagation: Propagation can be done using seeds.

Garcinia gummi-guta (L.) Robs.

(Korakkapuli, Kodampuli)

© Sanil M S

Evergreen trees, 20 m high, bark black, rough, thinly scaly; blaze creamy yellow; exudation pale yellow, sticky; branchlets terete, glabrous, drooping. Leaves simple, opposite, elliptic or elliptic-oblanceolate or lanceolate. Flowers yellowish-white. Fruit a berry, ovoid to subglobose, yellow or red, 8-10 grooved; seeds 6-8, ovoid, compressed, pale brown, veined; aril succulent, white or red.

Propagation: Propagation can be done using seeds. Vegetative propagation using stem cuttings is also possible.

Humboldtia vahliana Wight

(Aattuvanchi, Karappongu, Korathi)

© Binoy N M

Trees, 18 m high, bark 5-6 mm thick, dark brown mottled with white; blaze pink; internodes of the branchlets solid, terete, glabrous; branchlets sometimes zig-zag. Leaves paripinnate, alternate. Flowers bisexual, white, in many flowered, axillary brown velvety racemes; Fruit a pod, 15-20 X 3.7-6 cm, elliptic, compressed, sutures thick valves prominently veined, brown villous; seeds 3-4, almost orbicular, glabrous.

Propagation: Seeds can be used for propagation. Stem cuttings from 1-2 year old juvenile plants also give maximum rooting of 90% along with 80% survival by using IBA at 1000 ppm.

Madhuca neriifolia (Moon) H. J. Lam

(Attu-ilippa Iluppa)

© Barathan N

Evergreen trees, 15 m high, bark dark brown to grey. Leaves simple, alternate, linear-oblong. Flowers yellowish-white, in axillary subterminal fascicles. Fruit a berry, ellipsoid, beaked; one seeded.

Propagation: Seeds can be used for propagation and seeds pre-treatments such as soaking overnight; cracking the seed coat, etc. will enhance the rate and percentage of seed germination. Propagation through st em cuttings is also possible.

Mallotus aureopunctatus (Dalz.) Muell.-Arg.

Large shrubs to medium trees. Leaves opposite, oblong or obovate, acuminate. Flowers few, unisexual; inflorescence racemes, shorter than leaves. Fruit a capsule, 3 lobed with hard conical spines.

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Propagation: Propagation can be done using seeds.

Ochreinauclea missionis (Wall. ex G. Don) Ridsd.

(Aattuvanchi, Neervanchi)

© Anuraj K

Evergreen trees, 12 m high, bark greyish-brown, shallowly irregularly grooved; young shoots glabrous. Leaves simple, opposite, decussate, elliptic, elliptic-obovate or elliptic-oblong, apex acute or obtuse,

base attenuate or decurrent, margin entire, glabrous. Flowers bisexual, yellowish-white. Fruit a drupe, globose, fleshy; seeds ovoid, few in each cell.

Propagation: Seed can be used for propagation.

Oroxylum indicum (L.) Benth. ex Kurz

(Palakapayyani, Vellapathiri)

© Sanil M S

Medium sized trees; bark 5-6 mm thick, surface brownish-grey; bole smooth. Leaves compound; leaflets 3-5 in each pinnae, opposite. Flowers bisexual, in lax terminal racemes, reddish-purple outside, pinkish-yellow within, racemes to 30-50 cm long; Fruit a capsule, compressed, tapering at both end; seeds thin, papery.

Propagation: Seeds should be collected before splitting of pods during February – March and should be soaked in water for least 12 hours before sowing. Generally, seeds without any pre-treatments yeilds 80%-90% germination. Hardwood and limb cuttings of 30 cm length with 4-5 buds per cutting treated with NAA 200 ppm + IBA 3000 ppm is ideal which produce maximum sprouting (86.67%).

Otonephelium stipulacum (Bedd.) Radlk.

(Poripoovam, Pavirimulei)

© Vinayaraj VR

Trees, 18 m high, bark 5-6 mm thick, pale brown, smooth, peels off in irregular thick scales. Leaves paripinnate, alternate, exstipulate; leaflets 4-8, opposite, subopposite or alternate. Flowers polygamous, cream coloured. Fruit a drupe of 1-3 cocci, oblong or ovoid, covered with soft prickles; seeds 1-2, brown, smooth.

Propagation: Propagation can be done using seeds.

Pongamia pinnata (L.) Pierre

(Minnari, Ungu)

© Sanil M S

Evergreen trees, 18 m high,bark surface grey, smooth. Leaves alternate, leaflets opposite; leaflet elliptic-acuminate, elliptic-lanceolate, ov ate or ovate-oblong. Flowers purplish-white. Fruit a pod, obliquely oblong, flat, thick, pointed at both ends, indehiscent; seed one, reniform.

Propagation: The seeds are elliptical, reddish brown, fairly hard, weigh about 1200g/1000 seeds. The mature pods can be collected from the tree when it is leafless stage by shaking the branches manually. The seeds can be soaked in cold water for 24 hours and pre-treated seeds can be sown in germination trays filled with vermiculite and to be watered regularly. The seedlings are pricked out and planted in polybags of 22.5 × 17.5 cm size filled with potting mixture and can be maintained under shade.

Notes: The large size, richness in food and high moisture nature of the seeds yields poor germination percentage and are susceptible to fungal attack. The treatment with fungicide, Thiram (1.0%) yields better results to overcome fungal attack

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Salix tetrasperma Roxb.

(Attupala, Puzhappanji, Vanchi, Vanchimaram)

Deciduous dioecious trees, 25 m high, bark pale brown, rough, vertically fissured; blaze red; young branches silky pubescent. Leaves simple, alternate; stipules lateral, ovate, cauducous. Flowers unisexual, in axillary catkins. Fruit a capsule, 2-4 valved; seeds 1-4, oblong, with long deciduous hairs.

Propagation: Can easily propagate through mature seeds.

Sapindus trifoliatus L.

(Soapinkaimaram, Urulungi, Urunjikai)

Trees, 18 m high, bark greyish-brown; brittle or semi fibrous; branchlet slenticellate. Leaves paripinnate, alternate, estipulate; elliptic-oblong, elliptic-lanceolate, elliptic or lanceolate, apex acuminate, base oblique, round or acute, margin entire, glabrous. Flowers polygamous, green-

© Jithin Jose

ish-white. Fruit a drupe, globose, greenish-yellow, wrinkled when ripe; seeds 2-3, globose, black.

Propagation: Propagated through seeds. After removing the pulp of the fruits, seeds can be washed under running tap water for 15–20 minutes. Immersed in an aqueous solution of liquid detergent containing 2–3 drops of Tween- 20 and 7–8% sodium hypochlorite solution treatment will be increasing the rate of germination.

Syzygium cumini (L.) Skeels

(Njara, Njaval, Perinnaral)

Medium sized trees; bark white, light pink inside. Leaves to 18 x 8 cm, ovate, oblong, long-acuminate at apex, acute at base; nerves many, close, shining above; petiole 1.5-2 cm long. Panicles to 10 cm across, on leafless branchlets. Flowers 6-9 mm across, subsessile; calyx tube 3 mm broad, turbinate; filaments 7

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mm long. Berry 10 × 7 mm, obovoid, deep blue.

Propagation: Can easily propagated through mature seeds.

Syzygium lanceolatum (Lam.) Wight & Arn.

(Njaval)

Trees, 12 m high, bark greyish-brown, smooth. Leaves simple, opposite, elliptic, elliptic-oblong, or elliptic-lanceolate. Flowers white, 5 mm across, in axillary and terminal cymes. Fruit a berry, ovoid, bright scarlet.

Propagation: Seeds can be used for propagation. Mature seeds can be collected and after depulping it can soaked overnight and sown in standard nursery beds.

Tabernaemontana alternifolia L.

(Kundalappala, Kunninpala, Kuruttupala)

Vithin kumar P.T

Small trees, to 8 m high; bark corky with shallow fissures, latex milky. Leaves simple, opposite, elliptic-oblong, apex acuminate, base acute. Flowers pedicellate, lobes short, oblong, obtuse; corolla white, tube cylindric. Fruit included two boat-shaped orange pods, up to 4 cm long, with recurved beaks.

Propagation: Propagation is through seeds.

Trema orientalis (L.) Blume

(Aamathali, Amapotti, Amarathi, Omamaram , Potamaram)

Dioecious trees, to 15 m high, bark 0.6 cm, thin, greyish or bluish-green, rough, lenticellate; branchlets scabrous to adpressed pubescent. Leaves simple, alternate, ovate-lanceolate.

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Flowers unisexual, greenish, in axillary fascicles or cymes. Fruit a drupe, 4 × 3 mm, globose, black; stylar tip persistent; seed globose.

Propagation: Through mature seeds and vegetative propagation using stem cuttings.

Wrightia tinctoria (Roxb.) R. Br.

(Aiyappala, Dhanthappala, Irumpala Thondappala)

Deciduous trees; upto 15 m; bark 8-10 mm thick, grey, smooth; latex milky white. Leaves simple, opposite, oblong-lanceolate or elliptic-ovate. Flower bisexual, white, scented, in terminal cymes appearing along with new leaves. Fruit of 2 follicular mericarps, slender, smooth, green, cylindric, cohering at the tip; seed 16 mm long, black, commate at one end.

Propagation: Through mature seeds and vegetative propagation using

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stem cuttings. Semi-hardwood stem cuttings with 2-3 nodes treated with concentration of IBA 2000 ppm are ideal for large scale multiplication. IBA -2500 ppm yields rooting percentage more than 50% but less profuse and survival was very low.

Xanthophyllum arnottinum Wight

(Madukka, Madakka, Mottal)

© Vinayaraj VR

Trees, to 10 m high, bark greenish-grey, smooth, semi-fibrous. Leaves simple, alternate, spiral, oblong, ovate-lanceolate or oblong-lanceolate. Fruit a drupe, globose, green, rugose, 1-seeded.

Propagation: Propagation can be done using seeds.

SHRUBS

Agrostistachys indica Dalz.

© Vinayaraj VR

Large shrubs to small trees. Leaves simple, subopposite to alternate, elliptic-oblong, acute, coriaceous, base attenuate. Fruit a capsule, 15 mm across; seeds globose, glabrous.

Propagation: Vegetative propagation

Bambusa balcooa Roxb.

(Baruwa, Bhaluka)

© Sreekumar VB

Densely tufted, tall bamboo; culms 12-20 m high and 8-15 cm in diameter, grayish green, thick-walled; nodes thickened with a whitish ring above, hairy below; young shoots blackish-green, green with yellow, brown or orange tinged culm-sheath. Leaves oblong-lanceolate, glabrous above, pale and puberulous beneath. Inflorescence a large panicle, bearing spikate branching with bracteate heads.

Propagation: Culm cuttings during march season can be collected from one year-old culms of healthy growing clumps especially 50 cm above the ground. This can be treated with 200 ppm NAA by pouring 200ml of solution into the internodal cavity. The hole can be covered with packing tape to avoid spilling of solution from the internodal cavity. Culm cuttings can be placed into the nursery beds at spacing of 20 cm horizontally in such a manner that the obliquely cut surface faces upward. The adjacent hollow sides can be filled with sand and cuttings can be planted 5-7 cm below surface on the bed covered with a thin layer of fine sand.

Bambusa bambos (L.) Voss

(Mula, Mullumula, Pattil)

Culms from a thick stoloniferous rhizome, erect, to 30 m tall and 10-20 cm across; culm sheaths broadly triangular, densely brownish-hairy within, and scattered hairy without. Leaves to 20 cm long; sheaths

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glabrous. Inflorescence a compound panicle with the spikelets in heads. Fruit a caryopsis linearly cylindric.

Propagation: Seen in deciduous forests, also grown in homesteads. Propagation can be done using seeds. Vegetative propagation using culm cuttings and off-set planting is also possible.

Clerodendrum infortunatum L.

(Perivelam,Perukilam,Vattapparuvalam)

© Sanil M S

Shrubs; young shoots tawny villous. Leaves simple, opposite, ovate or orbicular. Fruit a drupe, globose, bluish-black on ripening; seeds 2-4, globose.

Propagation: Vegetative propagation using branch cuttings is possible.

Dendrocalamus asper (Schult.f.) Backer

© Siril George

Bamboo with large woody culms between 15-20 m tall and 8-12 cm in diameter, and relatively thick walls (11-20 mm). Culm internodes are 40-50 cm long, pale green and covered with short brown hairs. Culm-sheaths deciduous; pale green; pubescent; with dark brown hairs. Inflorescences clustered at the nodes; in globose dense clusters. Fruit a caryopsis with adherent pericarp.

Remarks: This species is widely cultivated in India and used as structural timber for heavy construction, bamboo boards, furniture, musical instruments, containers, household

utensils and handicrafts. Young shoots are edible

Propagation: Flowering cycle and seed-setting is reported to be about every 60-100 years. Two-noded culm cuttings treated with 500 ppm of IBA is ideal for propagation.

Dendrocalamus brandisii (Munro) Kurz

© Siril George

Evergreen, clump-forming bamboo. Culms erect, tapering towards the top, reaching up to even 30m height, 13-30 cm diameter with wall thickness of 2.5 - 4.0 cm. Mature culm smooth ashy-gray to greenish-gray coloured, loosely spaced and thornless. Inflorescence bractiferous mostly clustered at the nodes in globose. Seed ovoid caryopsis, hairy above, tipped with the persistent style and crustaceous pericarp.

Remarks: The species is known to flower sporadically as well as gregariously. It is used for house building, baskets and decoratives. Young shoots are edible

Propagation: Propagation is through seeds. Seeds germinated in moist filter paper medium in petri dishes gave >90 % germination in 10 days. Apart from seeds, this species can also be propagated vegetatively using culm cuttings. IBA proved the best for early sprouting and rooting from the rhizomatous cuttings with 2500 ppm for 30 minutes.

Dendrocalamus longipathus (Kurz) Kurz

© Sreekumar VB

Clump-forming bamboo, culms usually 10 - 20 m tall; 6 – 12 cm in diameter, with internodes 25 – 60 cm long and a wall 12 mm thick; culm-sheaths persistent, 35 - 50 cm long. Fruit a caryopsis with adherent pericarp, ovoid.

Remarks: Native range of this species is Assam to Peninsula Malaysia.

Propagation: Propagation is through seeds; germination rates of 33 - 50 %;

seed starting to sprout within 2 - 8 days. For vegetative propagation, rhizome, culm and branch cuttings can be used.

Dendrocalamus sikkimensis Gamble ex Oliv.

© Siril George

Culms 10–18 m, 10–13 cm in diameter; internodes becoming orange. Branches several, sometimes one branch dominant. Culm sheaths deciduous, leathery, very densely dark brown velvety; Spikelets comprising 2-3 fertile florets; with diminished florets at the apex, pseudospikelet clusters, 4 cm in diameter. Spikelets lanceolate. Caryopsis obovoid, apex beaked.

Remarks: Native range of this species from Eatern Himalayas to China.

Propagation: Propagation is through seeds. For vegetative propagation, one to two year old culms can be selected and propagated using NAA 200 ppm.

Dendrocalamus strictus (Roxb.) Nees

(Kalmula, Illi, Kallanmula)

© Sreekumar VB

Gregarious, densely tufted unarmed bamboo. Culm 4-7 cm diameter, yellowish green, sparsely covered with white powdery mass when young. Leaves ovate-lanceolate, apex long acuminate. Inflorescence verticillate clusters, or in large globose heads at the nodes. Fruit a caryopsis, obovate to subglobose, reddish-brown, beaked with persistent style.

Propagation: Seeds can be pretreated for 24-48 hrs in cold water. Seed germination varies from 25 to 61 per cent and may be over within a period of 7-17 days. De-gluming the seeds accelerates germination. Seeds priming with 1.0% KNO_3 solution is ideal for large scale production of seedlings. About 40 to 70 per cent of rooting can be obtained in culm cuttings depending on the period of collection, age of culm and treatment with growth regulating substances.

Cuttings treated with NAA 100 ppm during February and March may give maximum rooting.

Desmodium gangeticum (L.) DC.

(Pullati, Moovila)

© Sanil M S

Erect under shrubs, up to 1.2 m tall; stem angled, hairy when young. Flowers white, fascicled in terminal and axillary. Fruit a pod, 4-7-jointed.

Propagation: Vegetative propagation using branch cuttings.

Homonoia retusa (Graham ex Wight) Muell.-Arg.

Shrubs. Leaves simple, alternate, oblong to spathulate, apex obtuse to retuse, margin serrate to dentate. Fruit a capsule ca. 3.5 mm across.

Propagation: Vegetative propagation using branch cuttings.

© Robi AJ

Homonoia riparia Lour.

(Aattuvanchi, Kadallari, Neervanchi)

© Vinayaraj VR

Large shrubs; branchlets pubescent, reddish. Leaves simple, spiral, closely packed linear-oblong, acute at either ends, covered with yellow scales below and pubescent along nerves. Flowers dioecious in axillary long racemes. Fruit a capsule 5 mm across, globose, hairy.

Propagation: Vegetative propagation is using branch cuttings.

Indianthus virgatus (Roxb.) Suksathan & Borchs.

(Channa, Kookkila,Malamkoova, Rakkila, Kattukuppa)

Erect herbs, to 4 m high; Leaves ovate-oblong, rounded at base; Flowers paired. Fruit a berry obovoid, rugose.

Propagation: Vegetative propagation using rhizomes.

Justicia adhatoda L.

(Aadalodakam)

© Sanil M S

Evergreen, much-branched perennial shrubs with a strong, odour, 1.2-6 m tall. Leaves simple, opposite. Flowers in compact, axillary, pedunculate spikes. Fruit capsule, pubescent; seeds globular, glabrous.

Propagation: Vegetative propagation using branch cuttings.

Ochlandra scriptoria (Dennst.) C.E.C. Fisch.

(Eera, Kolanchi, Oodal, Ottal)

© Sreekumar VB

Rootstock rhizomatous, branched; culms erect, to 10 m tall; culm sheaths thin. Leaves linear-lanceolate, apex acuminate. Fruit small.

Propagation: Propagation is through seeds. Vegetative propagation is also standardised.

Ochlandra setigera Gamble

(Oda)

Culms erect or scandent, internodes 20-30 cm long; culm sheath persistent, obtuse with an abrupt, subulate tip, thin, papery, striate and wrinkled above; ligule small. Leaves lanceolate-acuminate, tip subulate, twisted, base rounded. Inflorescence

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axillary or terminal spikate panicles. Fruit a caryopsis, oblong, narrowed towards the tip.

Propagation: Propagation is through seeds. Vegetative propagation is also standardised.

Ochlandra travancorica (Bedd.) Benth. ex Gamble

(Eetta)

© Sreekumar VB

Tall reed-like grasses; rootstock rhizomatous, branched; culms to 5 m tall, densely clumped, hollow. Leaves scattered. Fruit ovoid, beaked, smooth.

Propagation: Propagation is through seeds. Vegetative propagation through rhizomes is also possible.

Ochlandra wightii (Munro) C.E.C. Fisch.

(Eera)

© Sreekumar VB

Erect shrubby bamboo; culms, nodes prominent with grayish bands on both sides, average internode length 50 cm. Leaves oblong-lanceolate, acuminate, whitish beneath. Inflorescence terminal spikes, rachis thick. Fruit a caryopsis, fleshy.

Propagation: Propagation is through seeds. Vegetative propagation is also standardised.

Pandanus canaranus Warb.

(Thazakaida)

Large shrubs, distally branching. Leaves spirally arranged, linear-at-

tenuate. Fruit a drupes forked with short horns.

Propagation: Propagation is through seeds.

Pandanus kaida Kurz

(Kaitha)

A large shrub, prop-roots basal, rather few and short. Leaves to 3-4 m long, rarely longer, and up to 9 cm wide, Female inflorescence pedunculate, bearing several (3-5) foliaceous bracts. Fruit round surrounded by bracts..

Propagation: Propagation is through seeds.

Pandanus palakkadensis Nadaf

(Nattukaitha)

Large shrubs. Leaves linear, both margins and midvein spiny. Infructescence terminal, 1-2 fruits per infructescence, a solitary syncarp. Fruit drupes with 1500-1600 per infructescence. Seeds 1 per locule, ellipsoid.

Propagation: Propagation is through seeds.

Pseudarthria viscida (L.) Wight & Arn.

(Moovila)

Viscid pubescent subshrubs up to 75 cm tall. Leaves 3-foliolate. Flowers in axillary or terminal, often branched racemes. Fruit a pod, linear-oblong, compressed, pubescent with hooked hairs; seeds 4-6, reniform.

Propagation: Vegetative propagation is using branch cuttings.

Rotula aquatica Lour.

(Kallurvanchi)

Stout branching shrubs; branched virgate, usually pinkish, glabrous. Leaves simple, alternate or fascicled, Flowers solitary or in few flowered cymes axillary. Fruit a drupe, 1-seeded pyrenes, free, yellowish, smooth.

Propagation: Vegetative propagation is using branch cuttings.

Saccharum arundinaceum Retz.

(Naim-kana,Ambottal,MunjapulluMekhapullu)

Shrubby perennials; culms solid; leaf-sheaths overlapping, glabrous and smooth, fairly tight. Inflorescence terminal panicle, branches glabrous except the finer ones. Pedicelled spikelet similar, but both glumes more heavily bearded and the lower glume only 1-nerved.

Propagation: Vegetative propagation using rhizomes.

Strobilanthes ciliatus Nees

(Cherukurunji, Karimkurinji, Kurunji, Vellakurunji)

© Robi AJ

Shrubs, branches terete, glabrous. Leaves simple, opposite, acuminate at both ends, glabrous, nerves 5 pairs, flowers 5-15. Calyx 5 mm long, lobes oblong, connate below the middle. Corolla 15 mm long, white with violet or blue patches on lower lobes. Staminal sheath hairy.

Propagation: Vegetative propagation is using branch cuttings.

Syzygium occidentale (Bourd.) D. N. Gandhi

(Attuchamba, Karinjara)

Large shrubs. Leaves linear-lanceolate, acuminate at both ends, nerves indistinct. Flowers yellow. Fruit a berry obovoid to globose.

Propagation: Propagation is through seeds. Vegetative propagation through stem cuttings using growth hormones is also possible.

Vitex negundo L.

(Indrani, Karinochi , Nochi , Vellanocchi, Vennochi)

Vithin kumar P.T

Shrubs or small trees, bark thin, grayish brown or grayish white, blaze yel-

low. Leaves narrowly oblong or elliptic to lanceolate, base acute, apex acuminate. Flowers bisexual, many, fragrant, panicles terminal, corolla deep purple to violet. Fruit drupaceous, obovoid or subglobose, green, glabrous, black when ripe, fruiting calyx cupular, pubescent.

Propagation: Seeds and vegetative parts are found suitable for raising propagules.

HERBS

Acorus calamus L.

(Vayambu, Vashanpa)

A strongly aromatic semi-aquatic perennial herb. Leaves narrow, linear to narrowly ensiform, glossy bright green, apex acute. Flowers pale green, fragrant, arranged compactly on a sessile, cylindrical. Fruits (berries) green, angular, fleshy, containing 1-3 oblong seeds.

Propagation: This species can be easily propagated through rhizomes. Rhizomes can cut into small pieces and planted.

Aerva lanata (L.) Juss.

(Cherula, Cherupula, Cheruvula, Peela, Pongalpoovu)

© Sanil M S

Herbs, white woolly tomentose. Leaves simple, alternate, ovate, apex obtuse. Spikes axillary, to 1 cm, densely tomentose; bracts and bracteoles 1 mm, ovate.

Propagation: Vegetative propagation using branch cuttings is possible.

Alpinia calcarata (Haw.) Roscoe

(Aratha, Chittaratha, Kolinchi)

Leafy stem 1-1.5 m. Leaves sessile, lamina glabrous. Inflorescence terminal, lower cincinni 4-flowered, upper 2-flowered; peduncle densely pubescent. Fruit globose, pubescent, orange-red. Seeds many.

Propagation: Vegetative propagation through rhizome.

Alpinia galanga (L.) Willd.

(Aratha, Kolaratha, Kolinji, Para-ratha)

Aromatic perennial herb; root stock cylindric. Leafy stem to 2 m high, many. Leaves oblong-lanceolate, apex acute, base cuneate. Inflorescence terminal on the leaf shoot, dense-flowered; peduncle densely pubescent. Fruit 1 cm across, globose, orange-red.

Propagation: Vegetative propagation using stem cuttings is possible

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Anaphyllum wightii Schott

(Keerikkizhangu, Sulli)

Tall herbs, rhizome creeping. Leaves

usually narrower, elliptic to oblong, apex acute, sessile or petiolulate. Fruit a globose achene.

Propagation: Through rhizomes.

Andrographis paniculata (Burm. f.) Nees

(Kaakanjiram, Kiriyathu, Nilavepu, Nilamkanjiram)

© Sreekumar VB

Slender herbs; branches glabrous. Leaves simple, opposite, elliptic, acuminate at apex, base acute, decussate, glabrous. Panicle terminal and upper axillary, glandular-hairy; flowers many, distant. Capsule oblong, acute, hairy; retinacula spoon shaped; seeds 8, glabrous.

Propagation: Propagation is through seeds.

Begonia floccifera Bedd.

(Kalthamara)

Leaves to 18 cm across, reniform or orbicular, obliquely cordate, distantly toothed, floccose-pubescent below, nerves 11, prominent. Flowers many; capsule seeds many, vertically ridged, brown.

Propagation: Propagated through seeds and stem cuttings.

Begonia malabarica Lam.

(Kalpuli, Janaamkolli, Kayyalapulian, Malayamkizhangu)

Small shrubs, to 2 m high; stem terete, glabrous. Leaves simple, alternate, ovate, strongly unequal at base. Male flowers: pink. Fruit a capsule 2 × 1.5 cm, wings obtuse.

Propagation: Propagated through seeds and stem cuttings.

Colocasia esculenta (L.) Schott

(Chembu, Seppankizhangu,Kaattuchembu, Madantha)

Herbs, rhizome stoloniferous. Leaves few to many, peltate, glabrous. Fruit an aggregate of berries, globose.

Propagation: Propagated through healthy tubers.

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Chrysopogon zizanioides (L.) Roberty

(Ramacham, Vettiver)

Perennials. Culms to 180 cm high, erect, tufted; nodes glabrous. Leaves linear or linear-lanceolate, convolute, glaucous. Sessile spikelets lanceolate. Glumes 3-4 mm long, lanceolate, coriaceous.

Propagation: Through rhizomes.

Crinum viviparum (Lam.) R. Ansari & V.J. Nair

(Veluthapolathali, Puzhalilly)

An erect herb with large globose or oblong bulbs. Leaves few or many. Fruit subglobose, short-stalked, beaked by the perianth tube; seeds rugose.

Propagation: Through bulbs.

Cryptocoryne spiralis (Retz.) Fisch. ex Wydler

Rhizome to 1.5 cm in diameter. Leaves with petiole to 25 cm long. Neuter flowers few, dark purplish-coloured.

Propagation: Through rhizomes.

Curcuma amada Roxb.

(Mangainchi, Mannayinchi)

Rhizomatous herbs, rhizome light yellow inside, white towards the periphery with the smell of green mango; sessile tubers thick, cylindric or ellipsoid, branches horizontal; roots fleshy, root tubers absent. Ovary trigonous, tricarpellary, syncarpous, densely hairy; ovules many; style long, filiform; stigma closely appressed within the anther lobes.

Propagation: Through rhizomes.

Curcuma aurantiaca Zijp

Herbs, rhizome small, yellow inside. Leaves bifarious, broadly ovate, acuminate, slightly and often unequally cordate at base. Flowers long, light yellow-orange. Fruit obovoid, slightly trigonal, pubescent; seeds many 6 x 3 mm, obovoid; aril lacerate, lobes 6-8, narrow, white.

Propagation: Through rhizomes

Cyperus malaccensis Lam.

Perennial, more than 1 m; rhizome with short stolons. Stem 4-6 mm in diam., sharply trigonous, sides concave above. Leaves reduced. Nut trigonous, slightly compressed, dark brown, glossy, very finely reticulate.

Propagation: Vegetative propagation through rhizomes.

Fimbristylis schoenoides (Retz.) Vahl

Annual or perennial. Stem slender, terete or compressed, deeply grooved, grey-green. Leaves c. 1/2 of stem length; Fruit a nut obovoid, bi- finely reticulate, pale yellow brown, glossy.

Propagation: Through rhizomes.

Hedychium coronarium Koenig

(Sugandhi, Saugandhikam)

© Sreekumar V B

Herbs, leafy stem to 1.5 m high, robust, densely clumped; rhizome horizontal. oblong, acuminate, glabrate, acuminate. Flowers 2-4 in each bract.

Propagation: Vegetative propagation through rhizomes.

Indigofera tinctoria L.

(Neelayamari)

© Sanil M S

Suffrutescent herbs, to 1.5 m tall; stem erect, appresed-pubescent. Leaves pinnately 5-13-foliolate; leaflets opposite, elliptic to obovate. Inflorescence axillary, spicate-racemose, many-flowered. Fruit a pod slightly curved, 8-12-seeded.

Propagation: Mainly through seeds. Vegetative propagation is possible.

Lagenandra meeboldii (Engl.) C.E.C. Fisch.

Rhizome thick, creeping. Leaves clustered, ovate, apex acute, base rounded,

nerves numerous, regularly arching; petiole 5-10 cm long. Female flowers in clusters; male flowers in a globose cluster of 3 mm across.

Propagation: Vegetative propagation through rhizomes.

Lagenandra ovata (L.) Thw.

(Aandavazha, Karin-pola)

© Sanil M S

Perennial herbs; rhizome creeping, 4 cm thick, usually in mud, cylindrical. Leaves entire ovate-oblong, acute. Male flowers many, in terminal globose head. Fruitlets obovoid, ridged; seed 1, brown.

Propagation: Vegetative propagation through splitting rhizomes.

Orthosiphon aristatus (Blume) Miq.

(Poochameesa)

Diffusely branched perennial herbs.

© Sandhya Sasidharan

Leaves simple, opposite, rhomboid to ovate-deltoid, apex acute, base cuneate, margins serrate from about the middle upwards, glandular-punctate beneath. Nutlets c. 2 mm long, ovoid-oblong.

Propagation: Propagation using stem cuttings is possible

Plectranthus amboinicus (Lour.) Spreng.

(Panikoorka, Kanjikoorka, Kannikoorka)

© Sanil M S

Branched, pubescent herbs. Leaves ovate or suborbicular, base cordate, margins finely serrate, apex obtuse or acute, fleshy; petiole to 2 cm long. Flowers shortly pedicelled, in dense thyrsoid panicle. Nutlets smooth.

Propagation: Vegetative propagation using stem cuttings is possible.

EPIPHYTES

Pholidota imbricata Lindl.

(Pannamaravazha)

© Sreekumar V B

Epiphytes with crowded pseudobulbs and tufted roots. Pseudobulbs 4-6 cm long, oblong-conical, tetragonous. Flowers pinkish-white, Fruit capsule ellipsoid, pendulous.

Propagation: Vegetative method thro ugh splitting bulbs.

Rhynchostylis retusa (L.) Blume

(Maravasha , Seethamudi)

© Sreekumar V B

Epiphytes, to 40 cm tall; stems stout, woody. Leaves obliquely bilobed. Flowers violet pink, closely packed; pollinia 2, globose, with long caudicle.

Propagation: Vegetative method through splitting stems.

Vanda tessellata (Roxb.) Hook. ex D. Don

(Arathamaravazha, Maravazha, Maravanchi)

Scandent epiphytic shrubs. Leaves 2-ranked, oblong, 2-lobed at apex, with a central acute tip, base sheathing, coriaceous, closely packed. Racemes axillary; flowers 5 cm across, white outside, inner tessellate with brown spots.

Propagation: Vegetative method through splitting stems.

Vanda testacea (Lindl.) Rchb.f.

(Maravazha)

Stem stout, woody, to 25 cm high. Leaves strap-shaped, keeled, unequally lobed at apex. Flowers pinkish, dorsal sepal obovate-oblong or spathulate, obtuse, spur cylindrical.

Propagation: Vegetative method through splitting stems.

Vanda thwaitesii Hook. f.

Stem stout, woody, to 25 cm high, covered with leaf base. Leaves strap-shaped, recurved, unequally notched at apex. Flowers greyish-green.

Propagation: Vegetative method through splitting stems.

CLIMBERS

Abrus precatorius L.

(Chuvannakunni, Kakani, Kunni,Kunnikuru, Gunj)

© Sanil M S

Woody perennial twining shrubs; young stems puberulent. Leaves even-pinnate; leaflets 12-16 pairs, oblong to elliptic, base and apex obtuse, lower surface sparsely pubescent. Flowers pink, in axillary racemes. Seeds many, 5-7 x 4-5 mm, subglobose, scarlet red with black eyes.

Propagation: Through seeds.

Anamirta cocculus (L.) Wight & Arn.

(Garaphala, Kaipalathumka, Kollakkaya, Nanchuvalli, Pechuvalli, Pettumarunna, Polla, Pollakai)

Woody climbers. Leaves simple, alternate, broadly ovate, apex acute, base truncate, margin entire; 5-ribbed, coriaceous. Flowers many, in large drooping panicles on old branches. Fruit of 1-3 drupes, 1 cm across, obliquely

© Sanil M S

ovoid, gibbous, black, smooth; seeds 1, black, glabrous.

Propagation: Propagation is through seeds and stem cuttings are also possible.

Aristolochia indica L.

(Garudakodi, Iswaramooli, Kadalivegam,Karalakam)

© Sanil M S

Twining perennial herbs; branchlets slender. Leaves simple, alternate, ovate-lanceolate or ovate - oblong. Flowers in few-flow-

ered axillary racemes. Fruit is a capsule, globose-pyriform, 6-ridged, dehiscing from the base, after dehiscence parachute-like; seeds 4-6 mm across, broadly deltoid, flat, winged.

Propagation: Through seeds.

Asparagus racemosus Willd.

(Chathavalli, Sathavari)

© Sanil M S

Woody perennial climbers; stem often spinescent, terete, green; rootstock with fascicled elongated tuberous roots. Flowers bisexual, 5-6 mm across; bracts triangular; Fruit a berry 4-6 mm diam., globose, purple on ripening; seeds 2-5 and 2 mm across, globose.

Propagation: Through tuberous roots.

Bauhinia phoenicea Wight & Arn.

(Vallimandaram, Thukarakalli)

© Vinayaraj VR

Large climbing shrubs. Leaves to 10 cm across, orbicular, deeply bifid above, lobes acute, cordate at base; 9-ribbed from base, nervules parallel. Flowers in extra-axillary racemes, axis 10-20-flowered. Pods oblong, broaden above, densely rusty, pubescent; seeds many.

Propagation: Propagation is through seeds and stem cuttings.

Calamus metzianus Schltr.

(Odiyan-chooral)

Clustering, small diameter rattans; Leaves to 1 cm long; leaf sheath pale green, densely armed with spines, spines yellowish, with numerous small spines in between; knee conspicuous; leaflets regularly arranged. Fruit ovoid, scales in 17 rows, channelled in the middle, light yellow with white border and brown apex.

Propagation: Propagation is through

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seeds. Fruit can be de-pulped by soaking in water; cleaned seeds can air dry overnight and can be sown in standard nursery beds.

Calamus thwaitasii Becc.

(Aanachooral, Pannichooral, Thadiayanchooral, Valiyachooral, Vandichooral)

© Sreekumar V B

Clustering and high climbing canes; stem to 20 m or more in length, with sheath to 6 cm in diameter; sheath armed with spines; Fruit ovoid, scales in 12 vertical rows, with median grooves, yellow with brown margins.

Propagation: Propagation is through seeds. Fruit can be de-pulped by soaking in water; cleaned seeds can air dry overnight and can be sown in standard nursery beds.

Calamus travancoricus Bedd. ex Becc.

(Arichooral, Cheruchooral,Kattuchooral, Vallichooral)

© Sreekumar V B

Very slender climbing canes; stem with sheath, 2.5 cm across; spines, 5 mm long, recurved; ocrea papery; flagellum 1-1.3 cm long. Rachis to 45 cm long with claw like spines; leaflets clustered, lanceolate, acuminate at apex. Male inflorescence to 1 m long; partial inflorescence 8-10, to 10 cm long. Female inflorescence 30-40 cm long; partial inflorescence 3-4, 12 cm long.. Fruit 0.8-1 cm across, globose, covered with about 24 rows of scales.

Propagation: Propagation is through

seeds. Fruit can be de-pulped by soaking in water; cleaned seeds can air dry overnight and can be sown in standard nursery beds.

Dioscorea esculenta (Lour.) Burkill

(Cherukizhangu, Cheruvallikizhangu, Nanakizhangu)

© Ganesan R

A climbing shrub. Leaves pubescent, reniform or orbicular cordate, with sharp stipular thorns.tubers are small sweet, numerous, spiny roots absent.

Propagation: Propagated through tubers, each tuber weighing around 50 - 80 g with dormant buds, can be planted *in situ* 4 – 8 cm deep with the stem pointing downwards.

Embelia ribes Burm. f.

(Vayuvilangam, Vizhalari ,Vizhal)

Climbers; branchlets slender, white. Leaves simple, alternate, elliptic,

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acute at both ends; nerves many, parallel, faint. Flowers small, white, many. Fruit a berry 3-4 mm across, globose, bluish-purple; seed one.

Propagation: Through seeds.

Entada rheedeii Spreng.

(Kakkavalli, Kukkumkai, Paranda, Paranda-ka-valli, Thellikody)

© Sreekumar V B

Lianas, tendrillate, stems glabrous. Leaves bipinnate, pinnae 2 or 3 pairs, the terminal pair modified into a

tendril. Flowers 3 mm long, densely packed, yellow. Fruit a pod to 1 m long, thick, woody, crenate on both sutures; seeds many, biconvex, 5 cm across, orbicular, smooth.

Propagation: Through seeds.

Ficus lawesii King

Large scandent epiphytic shrubs; branchlets angled, densely covered with stipular scars, glabrous. Leaves oblong-lanceolate, acuminate, acute at base, reddish when dry; Fruit a receptacle axillary, paired, globose, glabrous.

Propagation: Through seeds.

Piper hymenophyllum Miq.

Slender climbers. Leaves simple, alternate.. Spike to 20 cm long, slender, drooping; male spike shorter; bracts oblong, adnate to the rachis with free margins, hairy; Fruit a berry, ovoid, beaked.

Propagation: Through cuttings.

Piper longum L.

(Chapala, Kattuthippali, Thippali)

Scandent or straggling shrubs. Leaves simple, alternate, ovate, acute at apex, cordate and strongly oblique at base. Female spike stout, erect; peduncle 1.5 cm long; bracts peltate, orbicular. Male spike

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to erect, slender. Berry 2 mm across, glabrous, black or deep red.

Propagation: This species can be propagated through seeds and stem cuttings

Strychnos colubrina L.

(Modirakanjiram,Vallikanjiram)

© Vinayaraj VR

Tendrillate climbers. Leaves simple, opposite, broadly elliptic, abruptly acuminate, shining, green or black when dry; 3-ribbed. Cymes axillary

and terminal, peduncled. Flowers many; pedicels 2 mm long. Berry globose, greenish; seeds 2.5 cm long, ovoid, flattened.

Propagation: Through seeds.

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About the authors

Dr. Syam Viswanath is the Director of KFRI and has around 26 years of forestry research experience as scientist in ICFRE. He is specialized in Agroforestry and related socio economic and ecological research with special focus on projects related to various aspects on Bamboo and Sandalwood. He has undertaken 10 externally aided and 8 internal research projects in different ICFRE Institutions like IWST Bangalore, IFGTB, Coimbatore and TFRI, Jabalpur. Syam Viswanath is a consultant for UNIDO on bamboo and also serving as courtesy Professor in SFRC, University of Florida USA in Agroforestry and also served as Guest Faculty in Azim Premji University at Bangalore teaching open course on 'bamboos'. Guided 15 PhD students. He has more than 125 research publications and authored ten books.

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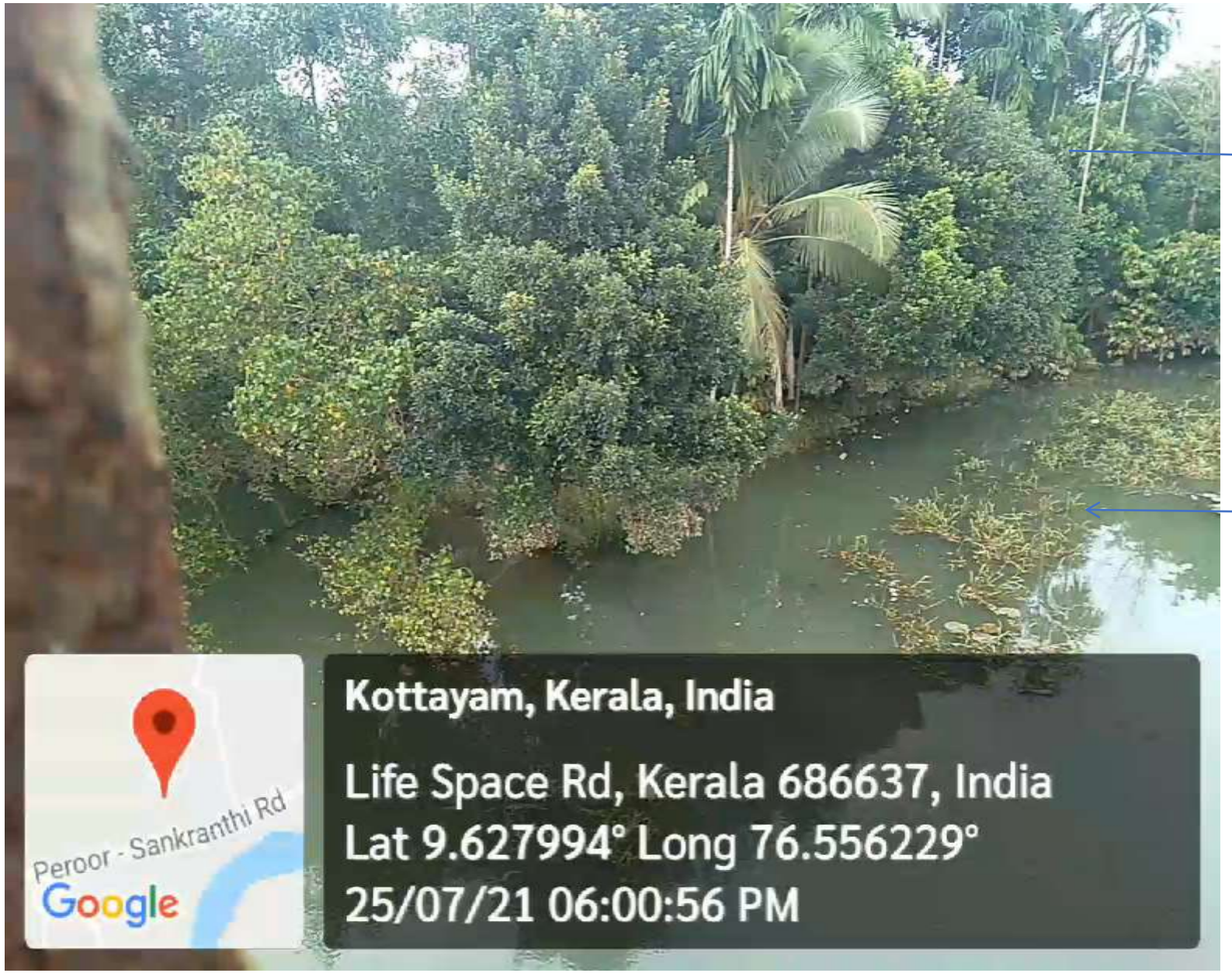
Issues Facing

- ✓Continuous and heavy precipitation in steep and undulating terrain resulted in landslides, collapse of river bank, uprooting of trees etc.
- ✓These sediments are deposited near the banks in low land region
- ✓Trees are grown naturally over these sediments
- ✓Blockage to the flow of water
- ✓River has average width of 70m at Pala
- ✓Reduced to 45-60m within Ettumanoor to Kottayam

FLOOD LEVEL


FLOOD LEVEL



FLOOD LEVEL
+5 MSL TO +6 MSL

WATER LEVEL
+2.7 MSL


THIRUV
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686016, India
Lat N 9° 37' 2.7372"
Long E 76° 33' 37.5516"
09/08/21 09:43 AM


GPS Map Camera
Peroor
Google
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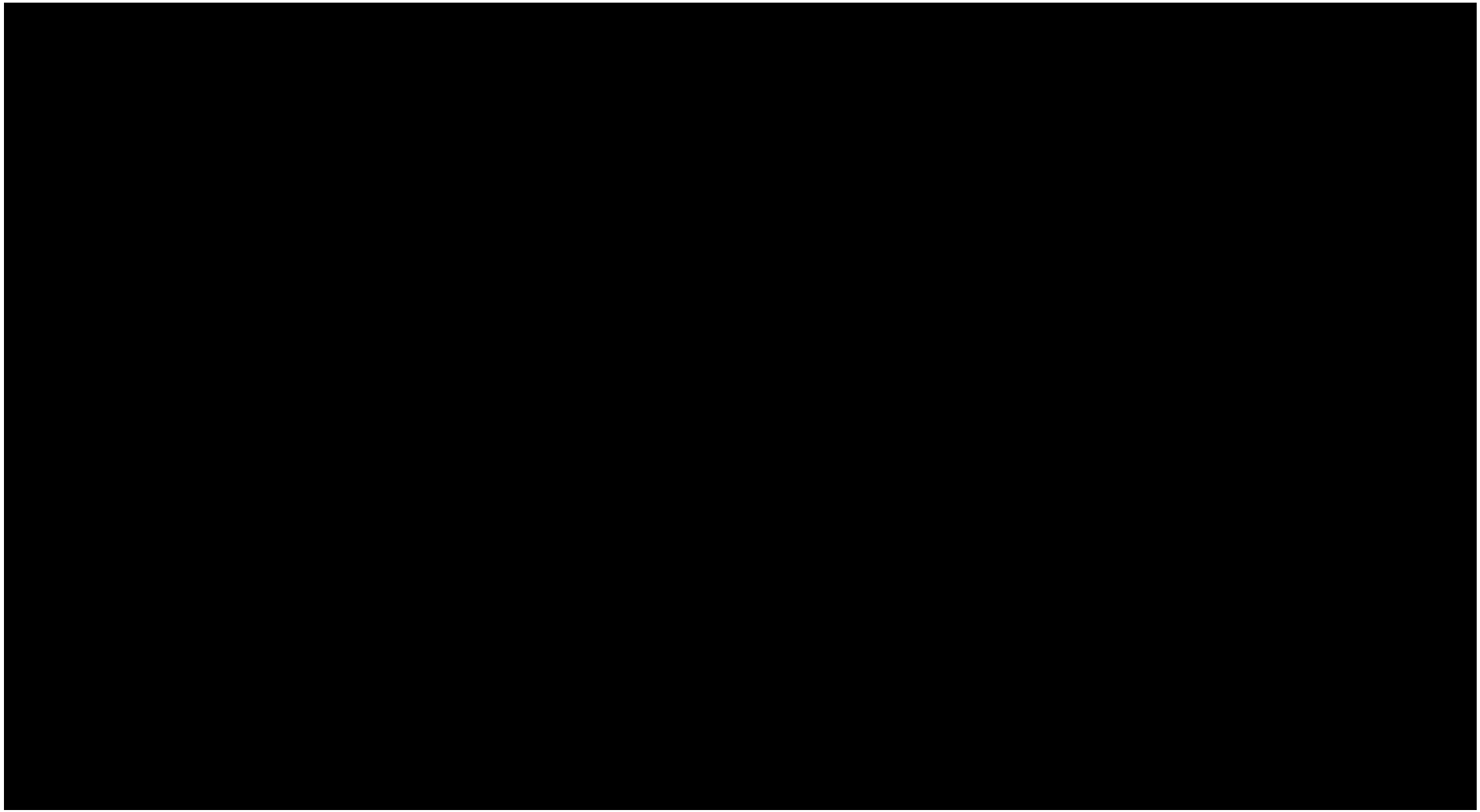
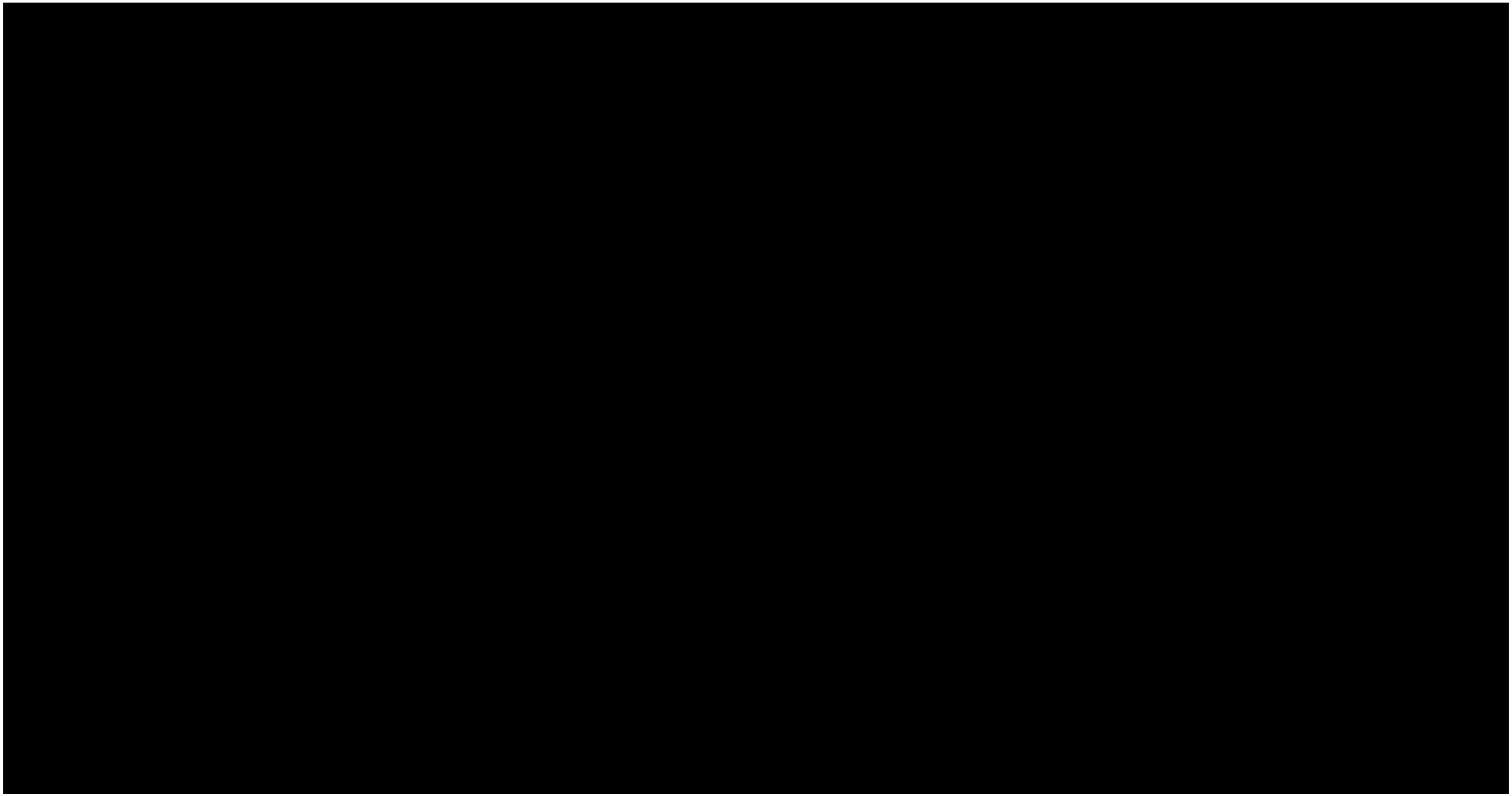
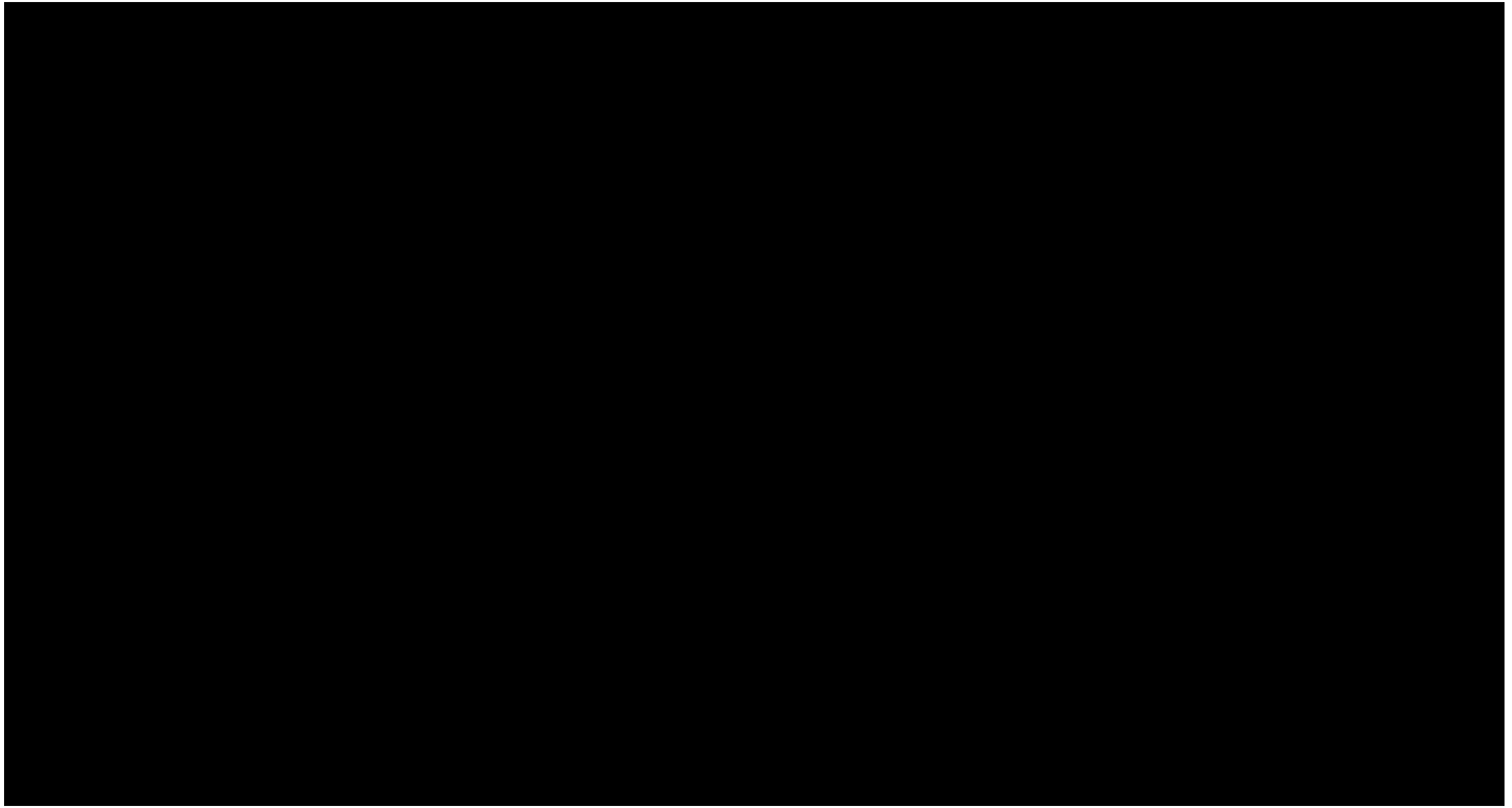
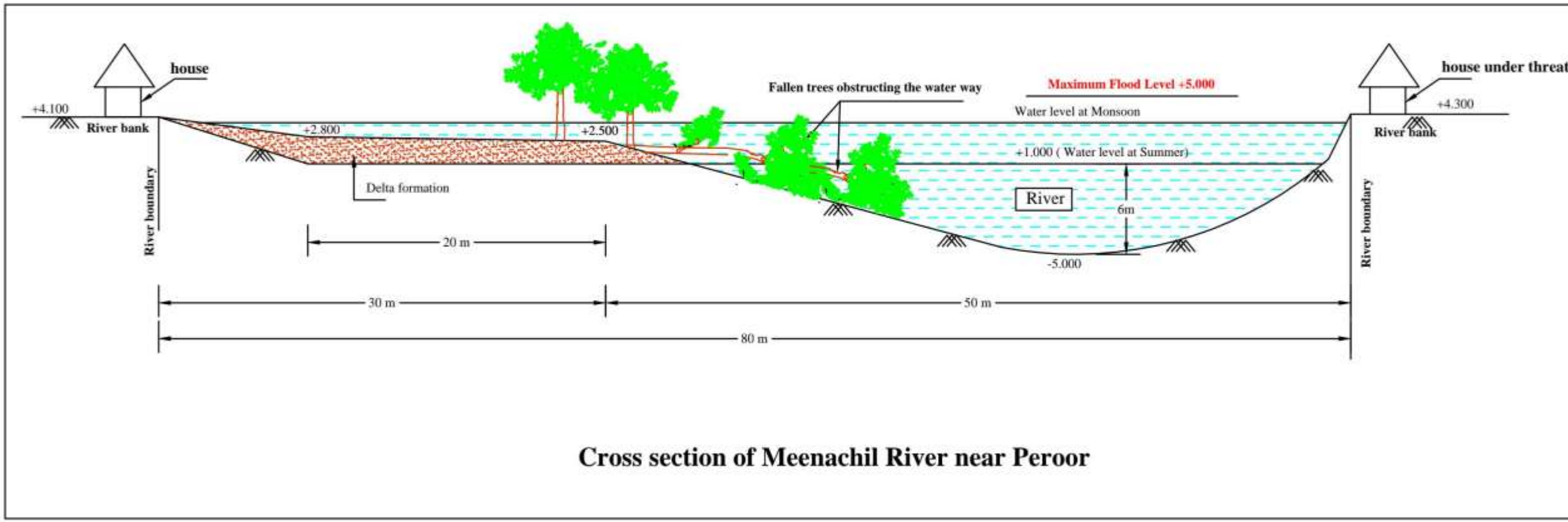






HYDROLOGICAL DATA

- Hydrology wing is running different rain gauge stations in these areas
- The summer water level within Peroor to Vembanad lake is within +1m to 0.5m with respect to MSL
- The flood water level in this area is from +6.4m to +1m MSL



Cross section of Meenachil River near Peroor

SOLUTION

- Reinstating the original width and depth of River by removing the deltas and naturally grown vegetation which are obstructing the flow in the water way ,so as to restore the conveyance capacity of the rivers,for easy flow of flood water as well.