

Assessment of Impact of Flood/Landslide on Riparian Vegetation in Pambayar, Periyar, Chalakudiyar And Bharathapuzha

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Abstract

Kerala experienced many small and large flood and landslide events. From 15th to 18th August 2018 the worst flood event ever since 1924 was occurred. This study was to understand the impact on Riparian vegetation in the Pamba, Periyar, Chalakkudi and Bharathapuzha rivers. A rapid assessment method was used. This paper provides the executive summary of ten detailed research report supported by Kerala State Biodiversity Board.

Introduction

The changing climatic dynamics and peculiar physiographic condition amplifying with the climate change impacts, especially the extreme weather conditions predicted by various studies make the State of Kerala as one of the most vulnerable States in India with respect to the natural disasters. Flooding and landslide/landslips are the two most severe natural disasters we are expecting in the near future. During the months from June to August 2018, Kerala experienced many small and large flood and landslide events. From 15th to 18th August 2018 the worst flood event ever since 1924 was occurred. When we consider the ecological impact of the flood, the preliminary observations

have shown that the riparian regions of the major rivers in Kerala are one of the areas which are highly affected by the flood and landslide. The high intensity flow of water through the rivers along with river bank slumping and continuous water inundation caused major changes to the riparian flora. In many places the entire vegetation is lost either due to bank slumping or due to inundation. Considering the importance of the area there is a need to conduct a detailed analysis on the impact of current rain ravage on the riparian flora of the rivers which has affected most severely and areas where we have some background data on the riparian vegetation is attempted here as experimental cases for a critical assessment. The present study was a part of the detailed scientific analysis of the impact of flood on biodiversity, initiated by Kerala State Biodiversity Board (KSBB) to formulate recommendations for restoration and follow up activities. The study was undertaken by Centre for Environment and Development (CED, 2019)

Materials and Methods

Study Area

The study covered 128 Km stretch of Pampayar, 208 Km of Periyar, 82 km of

Chalakupuzha and 136 km of the three major tributaries of Bharathapuzha on both banks and prepared the riparian area land use map, physical impact maps and prioritised area maps in GIS platform. It has also enumerated the riparian flora, identified the species with conservation importance, analysed the impact of flood/landslide on riparian ecosystem and species, identified species useful for river bank afforestation programs and suggested integrated management plan for river rejuvenation.

Approach and Methods

In order to assess the previous condition of the study area and local knowledge on the utilization of the flora, the study followed a participatory approach by involving BMCs representatives and local people.

The study made use of the service of the scientist who has explored the riparian areas of the rivers for its riparian floristic diversity and its ecological significance in recent years for conducting the impact assessment of the area using the previous the data. The major studies/reports referred for identification and comparison of the floristic components and other details of the rivers under study include: Amitha (2010), CED (2010), Joby (2012), Sunil et. al (unpublished), Jomy et. al (unpublished) Maya et. al (unpublished).

The major activities involved in the study are: i) Preparation of base maps field study ii) Key Experts Consultation Workshops, iii) Literature Survey and preparation of an appraisal of the study area, iv) Intensive field surveys along the river banks by research fellows and investigators v) Analysis of collected data and vi) Preparation of GIS maps of the riparian landuse before flood/landslide, physical impacts of the flood/landslide on

the riparian areas and the prioritised areas for intervention.

Major Findings

Mapping of Riparian Land Use and Enumeration of Flora

- The major vegetation types on the banks are mixed tree crops, natural vegetation, barren land, rubber/tea/coffee/oil palm plantations, Teak plantation by forest department, vegetable cultivation and paddy cultivation.

Enumeration of Floristic Biodiversity

- The study enlisted a total number of 1243 species of flowering plants belonging to 150 families from the riparian areas four rivers under study. The highest number of species is recorded from Periyar (799) followed by Pampa (549), Chalakupuzha (470) and 3 tributaries of Bharathapuzha together have 421 species. Majority of the species are herbs (47%), followed by trees (25%), shrubs (15%) and climbers (13%).
- The plant other than the cultivated species which area having high conservation importance are identified based on the parameters like IUCN threatened status (Critically Endangered, Endangered and Vulnerable categories are taken), Endemism (Endemic various regions of India viz. Peninsular India, Western Ghats, Southern Western Ghats, Kerala etc.), Medicinal use of plants in various systems of medicine, other uses like utility for local livelihood, capacity protect river banks etc.
- Out of 1243 species 545 species are classified as having high conservation value based on IUCN threatened status,

Endemism, used in various systems of medicine, used for local livelihood activities, habitat of many animals/fishes and capacity protect river banks. There are 40 threatened species as per IUCN Red List Version 2019-1, 4 critically endangered (CR), 13 endangered and 23 vulnerable species. 198 species are endemic to various regions of India, 11 endemic to Kerala, 92 to Southern Western Ghats (SWG), 55 Western Ghats (WG), 32 Peninsular India (PI) and the rest 8 species India endemic. 334 plants are seen as used in various systems of medicine like Ayurveda, Siddha, Unani, Homeopathy, Folk, Tibetan, Sowa Rigpa, Chinese, Modern medicine and Veterinary medicine. 214 species are having local importance like raw material for local livelihood activities, plants very much associated with the wild animals and fishes for its breeding, nesting and also staple food and found to be very much useful in checking river bank erosion, stabilizing banks, and controlling floods etc.

Impact on Ecosystem and Species

Physical Impact: The study identified and mapped the major physical impact areas of 2018 flood/landslide mainly erosion and sand/mud deposition. Periyar is the most highly affected by erosion. 15% of the total distance under study is affected and 63% of the eroded areas are under high erosion category. This is followed by Pampayar where 13% of the total distance under study is affected and 54% of the eroded areas are under high erosion category. In Chalakudyar 87% of the total distance studied is affected, only 23% of the eroded areas are under high erosion category. The tributaries of

Bharathapuzha under study are comparatively the least affected River by bank erosion. About 30% of the total distance under study is affected but only 11% are under high erosion category.

- Periyar is also in first position in sand/mud deposition on the banks and inside the River. About 34% of the total distance is affected at various scales and 31% is under the high deposition category. In Pampayar 74% of the total distance studied is affected and 17% is under high deposition category. 11% of the total distance studied in Chalakudiyar is affected and 16% of the mud/sand deposition is under high category. In the tributaries of Bharathapuzha about 26 % is affected but only 5% under high deposition category. Major depositions are in Thootha and Kalppathi tributaries.
- Another major impact on the riparian ecosystem due to flood is deposition of non-degradable wastes, mainly plastics on the trees and other vegetation causing damage to the species and ecosystem and is found as a major issue in all Rivers.

Species Loss

The study found that 604 flowering plants are affected by flood/landslide in the four rivers. However, total loss of a species from the entire stretch is not found. The only one species which is probably lost is *Lagenandra keralensis* Sivad. & Jaleel, reported only from its type location at Bhoothathankettu is not found there because the collection location is now almost filled with sand now. About 60% of the plants of the plants affected are herbs, followed by shrubs and trees (15%) and climbers (10%). Highest percentage of species affected is in Pampa where 51%

of the total species affected. This is followed by Periyar (44%), Chalakudy (42%) and tributaries of Bharathapuzha (40%).

- Most of the species damage is occurred due to bank erosion and deposition. Plants belongs to 189 species growing close to the bank uprooted and washed out because large trees uprooted in landslide in the up streams collided with them. It is found that 114 out of the 545 species identified as having high conservation value were affected. 11 out of the 40 IUCN red listed species were affected in one or other Rivers. This includes 2 critically endangered species, 4 endangered and 5 vulnerable species. 47 out of the 197 endemic species, 70 out of the 334 medicinal plant species and 42 out of the 214 other locally important species were also affected in one or other Rivers.

Spread of Invasive species

- One of major impact of the August 2018 flood/landslide in Kerala to the riparian ecosystem/vegetation is the spread of invasive plants listed by a study published by Kerala State Biodiversity Board (Sankaran et. al, 2013).
- Initially there was a positive sign of washing out many such species from the banks but in a later stage it is found that all these plants are growing profusely in many other areas, especially in the mud/sand deposited areas.
- The present study has identified 48 out of the 82 invasive species of Kerala from the riparian areas of the four Rivers. This includes 13 out of the 20 high risk category (A) species, 14 out

of the 22 medium risk category (B) species, 13 out of the 14 low risk category (C) species and another 13 out of the 26 insignificant category (D) species identified from all over Kerala.

- The tributaries of Bharathapuzha is having the highest distribution of invasive species (37) followed by Periyar (34), Pampayar (29) and Chalakudiyar (25) species.
- It is also noticed during the study that all these invasive species are spreading to more areas mostly in the newly deposited areas and this require special attention in the future action plan for conservation of riparian biodiversity.
- Managing invasive species in the landscapes remains a challenge world over. But this is needed to prevent the further spread of the species to other areas. There are four major control measures generally accepted for controlling invasive species are i) mechanical removal, ii) eradication of weeds using chemical, iii) biological control and iv) cultural techniques. Expertise is needed to identify resources and the threats to them, and the ability to prioritize by threat, by geographic site or resource being threatened, and by individual plants.

Identification of Potential species for River Bank afforestation

- The study has developed criteria for identification of species potential for future River bank afforestation programs based on IUCN Red Listed Species (Critically Endangered, Endangered and Vulnerable), Endemic Plants (4 categories), Medicinal value of species, Other local Importance of the species and plants mostly growing naturally near the River side. 288

species are identified for future river bank afforestation programs. This include 169 trees, 43 shrubs, 54 herbs and 22 climbers under 4 prioritised classes (14 species in the very high importance, 69 high, 158 medium and another 47 low importance category)

Prioritization of areas for intervention

- The study has prioritized and mapped the river banks of the four rivers under study for intervention by local bodies/BMCs at various stages.
- Out of the 1108 Km stretch of the four rivers explored during the study, a total distance of 134 Km (12%) is identified as very high priority which needs intervention in the first stage, 429 Km (39%) is identified as high priority for second stage of intervention, 358 Km (32%) is identified as medium for long term intervention and 187 Km (17%) is identified as in low priority areas which need not much intervention other than regular monitoring.
- It is found that 51 km of the very high priority areas are in Periyar followed by Pampa (35 km), tributaries of Bharathappuzha (28 km) and Chalakudy (20 km). In Bharathappuzha very high priority areas are manily in Thootha tributary followed by Kalpathi (5.3%) and no such areas identified in Gayathri tributary.

The Way Forward

The study found that the growing population and resultant anthropogenic interventions in the name of developmental activities along with climate change and extreme events has made many changes in the land use and land cover of catchment as

well as the riparian zone. Based on the scientific concept that the rivers are far more than the waters within their banks that act as a holistic system wherein any change at any part of the basin has repercussions in other parts of the basin and wellness of the system, the study suggested a detailed framework for a management action plan for the reviving the Rivers of Kerala.

Integrated Scientific Approach

Normally, the river management activities in Kerala is being undertaken mainly by various departments such as Irrigation, Agriculture, Kerala Water Authority, Kerala State Electricity Board etc., because of the focus of development in these sectors. The activities were heavily dominated by civil construction. Although generally effective in meeting the objectives, this single-discipline approach ignored other ecological values of rivers. Thus, there is a need for creating an autonomous body coordinating all activities related to river management. The use of science in many plans is found to be inadequate. As a result, there is reliance on community preferences without adequate assessment of their scientific or economic realism. A shift in management practice is occurring all over now. This requires detailed investigation based on local condition rather than importation and misapplication of river rehabilitation techniques and processes from abroad. A shift in community and manager attitude towards river management and the process of implementation in the community is also needed.

Based on the above criteria, the study has suggested a detailed framework for developing of a management action plan for the reviving the Rivers of Kerala to be initiated and implemented by the local bodies by strengthening the BMCs with

active participation of KSBB and other institutions as mentioned in the framework. The major components of an ecosystem based holistic approach for River management suggested are:

- **Watershed Management:** Developing a catchment area treatment plan with high priority to rejuvenation of degraded ponds and construction of new ponds, checking drainage obstructions to ensure Environmental/Ecological flow in River concentrating on the Streams, Drainages, and wetlands in the catchment.
- **River Water Quality Management:** Addressing river water pollution issues (Solid and Liquid waste disposal, Flow Modification, Channel Reconfiguration, Fish Passage, In-Stream Species Management, Dam Removal/Retrofit, Floodplain Reconnection, In-Stream Habitat
- **Wise use of Resources:** Environmental sustainability of the entire basin area
- **Riparian Area Management:** Bank stabilization, Biodiversity enhancement and proper management of riparian areas considering River bank slumping/erosion, deposition of sand and mud, loss of vegetation, spread of invasive species etc.
- **Socio-economic Considerations:** Wise use of wetlands various Local Economic Development Activities (Heritage/ Aesthetics/ Recreation/ Education), Encroachment, Land Acquisition for development activities

- **Capacity Building and awareness creation:** Proper awareness creation and capacity building of various stakeholders

Role of Local bodies

The role of Local Government Institutions and BMCs in the river conservation is highlighted as the 73rd and 74th amendments to the Indian Constitution, envisages local bodies as the third tier of government along with the Central and State governments and the Kerala has devolved a large number of development functions to local bodies and has seriously attempted to operationalise the constitutional provisions in letter and spirit. Thus planning and implementation of any activities for river basin management will be easy through the local bodies by strengthening the BMCs with active participation of KSBB and other line departments and R&D and academic institutions.

The BMCs (Local Bodies) has to play an important role in the river restoration activities. The experience from the flood/landslide and the acute water scarcity in many parts of State in summer months during the past few years have provided an exceptional opportunity to rethink about our approach to the River management. The Government is now thinking more holistically about the State's development after flood. The local bodies in the State are also want to take up the case very seriously and looking for scientific technological support.

The local bodies, both urban and rural, have to clearly define their roles and responsibilities of the elected representatives and staff to involve in the activities. There should be a local level policy to involve the grass route level people to participate in the river

rejuvenation activities right from the base data collection. The *gramsabhas* has to be strengthened through this policy initiative. As the rivers are the cultural centres of the community, the role of religious leaders also shall be considered.

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