



# **IMPACT OF FLOOD/ LANDSLIDES ON BIODIVERSITY**

COMMUNITY PERSPECTIVES



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**KERALA STATE BIODIVERSITY BOARD**

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AUGUST 2018



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# **IMPACT OF FLOOD/LANDSLIDES ON BIODIVERSITY - COMMUNITY PERSPECTIVES**

August 2018

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## FOREWORD

Kerala is the only state in India where Biodiversity Management Committees (BMC) has been constituted in all Panchayats, Municipalities and Corporation way back in 2012. The BMCs of Kerala has also been declared as Environmental watch groups by the Government of Kerala vide GO No 04/13/Envnt dated 13.05.2013. In Kerala after the devastating natural disasters of August 2018 Post Disaster Needs Assessment ( PDNA) has been conducted officially by international organizations. The present report of Rapid Impact Assessment of flood/ landslides on Biodiversity focus on community perspectives of the affect on Biodiversity and Ecosystems. It is for the first time in India that such an assessment of impact of natural disasters on Biodiversity was conducted at LSG level and it is a collaborative effort of BMC and Kerala State Biodiversity Board (KSBB). More importantly each of the 187 BMCs who were involved had also outlined the major causes for such an impact as perceived by them and suggested strategies for biodiversity conservation at local level. Being a study conducted by local community all efforts has been made to incorporate practical approaches for prioritizing areas for biodiversity conservation which can be implemented at local level.

I would like to express my sincere gratitude to Hon'ble Chief Minister of Kerala for entrusting this very important task to KSBB. The whole hearted co-operation of Hon'ble Minister for Local Self Government and other functionaries of LSGD deserve special commendation. The report is the collective efforts of a large number of people and I would like to extend my gratitude to KILA for equipping the BMCs to undertake such a task, BMC members, various departments for providing required data, core committee members and district level expert committee for their valuable suggestions and Department of Environment. Last but not the least I would like to express my thanks to all my dear colleagues who prepared the state report and the district level staff of KSBB without whose hard work this would not have been possible.

*Let us unite together "To ensure clean air, water and safe food" to the people of Kerala.*

**Dr. S.C. Joshi IFS (Retd)**

Chairman



## PREFACE

Between June 1 and August 18, 2018 Kerala State experienced flood and landslides which had severe impacts in all walks of life of the people and damaged livelihood assets throughout the state. The torrential rains triggered a number of landslides that devastated innumerable infrastructure facilities and washed away a vast variety of Biodiversity. The extensive havoc resulted by both flood and landslides necessitated a Post flood Impact Assessment in the state. As per the direction of the Chief Minister of Kerala, a rapid participatory assessment of the impact on Biodiversity in 187 Panchayats in 13 districts in the state was conducted. A multidisciplinary team of experts comprising 100 persons were selected for this noble cause. Apart from this, a 12 member core committee was also formed to monitor this rapid assessment. It is well eloquent to say that this is a first initiative in the country for doing such an assessment with the active involvement of State-District-BMC mechanisms through intensive trainings and survey. Various PRA tools were used to generate the data on livelihood alteration, biodiversity loss, landscape devastation, and the wash away of floral and faunal components for preparing this report. The impact on the local Biocultural diversity was also covered by this rapid assessment. Unlike other reports, this survey reflects the perceptions of the local people. The report reveals how the flood and landslides affected various landscapes, Agrobiodiversity, Species diversity and biocultural diversity of the state.

I am exceedingly grateful to all who have dedicated their valuable time and energy in assessing the impacts of flood especially the members in the core committee and Biodiversity Management Committee. I bestow my special thanks to the experts involved in this study and the elected representatives, officials from various departments, KSBB staff members and above all to the local community who shared their visions and experiences towards "Rebuilding Kerala-Post Floods". The report comprises a number of suggestions to rebuild the state from the havoc occurred due to flood and other natural calamities like cyclones etc. and to achieve the indexes towards the UN Sustainable Development Goals (SDGs).

This report will be officially submitted to the Honorable Chief Minister of Kerala during the inaugural ceremony of the State Biodiversity Congress to be held at Govt. Brennen College, Thalassery on 27th January 2019 to assume the necessary actions towards the Sustainable Development of all the sectors.

**Dr. V. Balakrishnan**  
Member Secretary



## EXECUTIVE SUMMARY

The report of Rapid Impact Assessment of flood/ landslides on Biodiversity is a collaborative effort of Biodiversity Management Committee (BMC) and Kerala State Biodiversity Board (KSBB) with the technical inputs from a wide range of research institutes and other stakeholders. The objective of the process was to undertake a rapid assessment of the damages to ecosystem and biodiversity after the floods/ landslides and to lay the foundation for a recovery and ecosystem based reconstruction process at local level. It is for the first time in India that such an assessment of impact of natural disasters on Biodiversity was conducted at LSG level incorporating community perspectives of the affect on Biodiversity and Ecosystems. The report also outlines long term and short term strategies for environment and biodiversity inclusive sustainable development and provides recommendations for a green growth for Nava Keralam.

A joint team of 4 BMC members, 2 experts and 5 volunteers with representation from KSBB was constituted to conduct a rapid impact assessment of floods/ landslides on Biodiversity in 187 Local Self Government (LSGs) spread across 13 districts. The team visited the affected areas and data was collected in a prescribed format using Open Data Kit software. Focal group discussions were held with farmers, fishermen, tribal people, students etc. The team also conducted field visits to understand the extent and nature of damage and to record the findings in the designated format. The team also held consultations with representatives of line departments for more information and data was also compiled from other secondary sources.

### SALIENT OBSERVATIONS

All the three distinct physiographic zones of Kerala the highlands, midlands and low lands (coastal plains) were affected. The worst affected districts were Wayanad (Kabini basin), Idukki (Periyar basin), Ernakulam and Thrissur (Periyar and Chalakudy basins), Alappuzha and Pathanamthitta (Pamba basin). The impacts to the natural environment differed based on the geographical location. In the hilly terrain, the major impacts are caused due to landslides. Landslides are reported in highlands in Idukki, Wayanad and Palakkad districts. The entire Kuttanad region lying in Alappuzha, and Pathanamthitta Districts (low land regions) were submerged in the flood water for 8 to 15 feet. In hilly areas the major impacts were due to combined effects of landslides and floods. The impact of landslides combined with floods may be more long lasting as any change in habitat and landscape will take more time for the species to recover. Apart from the heavy rainfall the topography, land use change and habitat degradation might also have played a major role on the intensity of floods, as it is observed that some districts which received more than 50 % of excess rain was not very severely impacted.

<b>Landscapes</b>	<b>:</b>	<b>771</b> different landscapes including riverine, forest, plantations and agricultural fields
<b>Agricultural crops (varieties)</b>	<b>:</b>	<b>287</b>
<b>Floral diversity</b>	<b>:</b>	<b>1053</b>
<b>Faunal diversity</b>	<b>:</b>	<b>695</b>



## 1. IMPACT OF FLOOD/LANDSLIDES ON MAJOR ECOSYSTEMS

33 % of affected area are in high land region, 49% midland and 13 % low land. Landslides and floods were reported in 47% of study area while flood alone was reported in 44% of area. The impact was most severe in 27% of total study area while it was severe in 58% of area. Soil erosion was the major impact in 86 % of area. Industrial pollution is very minor at 29.9 % and is restricted to certain pockets of industrialized areas as Elloor

The most affected areas are Idukki (Periyar basin), Ernakulam and Thrissur (Periyar and Chalakudy basins), Alapuzha and Pathanamthitta (Pamba basin), Wayanad (Kabini basin)

In Wayanad it is observed that the banks of Panamaram River & Mananthavadi River have collapsed mainly because of loss of considerable amount of natural vegetation along the river banks due to encroachments and other unsustainable land management practices in comparison to Kabini river. In Kabini river, however, natural vegetation along the river banks are not much affected whereas the other side the river bank without vegetation has eroded.

In Wayanad the local people say that the major reason for the disaster is the land use change, many marshy places and wetlands have been filled up. Small canals were constructed to drain the water from the marshy areas so that it can be made suitable for banana cultivation. This has led to drying up of marshy areas.

The major impact on the riverine ecosystem was on the places where concrete bunds have been constructed across the rivers.

A new water body has been formed at Thalappuzha under Begur Range in Thavinjal grama panchayat due to landslide. At the same time drying up of forest is also seen in such areas.

In Periyar sand bars were formed along the banks where the force of flowing water is comparatively low. Periyar and its tributaries got widened after the flood due to river bank erosion whereas its depth got reduced in low lands due to sedimentation. In some areas as Mankulam river, Idukki the depth of the river has increased.

In the Bharathapuzha river, a sandbar was created at the Ponnani estuary that has provided a semi-permanent walkway into the sea during low tide.

In Kunthipuzha river at Thathengalam near Mannarkkad at Palakkad a large sand island has been formed after flood.

Forest ecosystem has been severely affected due to landslides in Pozhuthana, Thirunelli, Mananthavadi and Thavinjal in Wayanad. Huge loss to biodiversity occurred in these region. Shola forest, evergreen forests and grass lands are also affected.

In Idukki 18 panchayats were badly affected all of them located in the ecologically sensitive areas of the Western Ghats.

Thattekad bird sanctuary, Ernakulam an important bird sanctuary of Kerala, home to 322 species of birds including long distance migratory birds, located close to the Periyar River was affected as plastic and solid wastes accumulated in the water bodies inside the sanctuary. A sandbed has appeared on a 5-km stretch from Thattekad to Kuttikal on the Periyar riverside. The sand bed has affected the movement of animals in the sanctuary. As the shrubs on the river bank were washed off in the flood, the roosting habitats of the birds may be affected.





**Table 1 Major Impact of floods/ landslides on ecosystem**

River bank erosion and collapse
Deposition of sand and sand bar formation in low lands
Change of river course
Pollution due to plastic/electronic wastes etc.
Lowering of surface water table in the neighbouring areas after the floods
Reduced depth of river bed
Landslides
Land subsidence
Collapse of hill slopes
Fissures/ Crack in Earth
Sand piping
Mud slides
Soil erosion
Changes in the colour and quality of water
Loss of riparian vegetation
Reduction in level of water in rivers immediately after floods
Deposition of alluvial, muddy, clayey soil
Increase in catch of exotic fish species such as African mushi, Sucker fish, Carps etc
Less inflow of water to river due to clogging of water channels
Inflow of estuarine water into the paddy fields
Change in pH of water

**Table 2 Major Ecosystems affected**

Periyar river
Pamba river
Chalakydy river
Kabini river
Manimala river
Achenkovil
Bharathapuzha river
Kole wetlands
Kuttanad wetlands
Hilly areas as Kurichiar Mala, Makkimala etc in Wayanad
Ranni forest division
Thattekad bird sanctuary



## 2. IMPACT OF FLOOD/LANDSLIDES ON SPECIES DIVERSITY

The impacts could be direct or indirect depending on habit and habitats. Most of the impacts are due to changes in the habitats, inundation for a longer period and displacement of animals during the flood. Changes have occurred in distribution patterns, all of which will have long term impact on ecological processes.

**Aquatic Birds:** At Thattekad Bird Sanctuary, about 30 species of water birds have been adversely affected due to habitat changes caused by flood.

**Lepidoptera ( Butterflies and Moths) and Odonates ( Dragonflies and Damsel flies) :** The early stages of butterflies, moths and odonates were subject to the detrimental effects of the floods. Moth and butterfly larval forms, normally seen in August–September period in the landscapes, were relatively lower in abundance after the rains and floods. The larval forms of odonates are aquatic and might have been washed away along with flood waters.

**Amphibians and Reptiles:** Tadpoles of frogs were washed away in several areas including Nelliampathy, where they later died due to the drying up of these pools. Breeding sites of the endangered purple frog at Kootickal were completely destroyed due to landslides. Reptiles especially snakes, were displaced from their natural habitat, and found in abundance along with flood waters.

**Fishes:** The percentage of native species of fishes is reduced in fishermen catch. Presence of Red bellied pacu, Malaysian catfish, African mushi, Sucker catfish, Giant gourami, Carps etc. were reported from several waterbodies.

**Invasive species of plants:** Spread of Invasive plants such as Lantana, Mikania, and Mimosa.

### Key observations

The Panamaram heronry, a small islet on the Kabini river, is covered with vegetation, predominantly with bamboo. Many avian species including the threatened white ibis, purple heron, large egret, intermediate egret, small egret, pond heron, night heron, and little cormorants breed here. During the floods the trees where the birds used to nest have been destroyed and presently the rocky bottom of the river is visible. Concrete bunds were built nearby and river has changed its course.

Sightings and killings of snakes were widely observed as floods have displaced them from their natural habitat.

Kottickal, Kottayam an Ecologically sensitive area of Western ghats was severely affected by landslide and affected the habitat of rare purple frog species.

A decline in sightings of butterflies, dragonflies, damselflies was reported widely. The floods may affect the dragonflies and damselflies as their larval stage is having aquatic habitat. They play an important ecological role as predators of mosquito larvae and other insects. It is observed that skimmers have reduced in numbers in Pathanamthitta.

A decline in clams in Vemband Lake, Pathanamthitta and Alapuzha was noted. The black clam is a keystone species in Vembanad Lake, and a source of livelihood for thousands ensuring the sustainability of ecosystem. Mass death of earthworms was reported in Wayanad



### 3. IMPACT OF FLOOD/LANDSLIDES ON AGROBIODIVERSITY

All three subsectors (crops, livestock, and aquaculture/fisheries) have suffered losses and damages in the flooding and landslides of 2018. Idukki, Pathanamthitta, Alappuzha and Wayanad are the most affected districts due to flooding of Pamba, Periyar, Achenkovil and Manimala and Kabini rivers. The rapid increase in the built up area has played a significant role in aggravating the impact of floods in Pampa river basin.

The major crops affected included Tubers, Spices, Banana and Rice. Hilly tracts such as Idukki and Wayanad saw large tracts of agricultural land and plantation crops wiped out due to floods and landslide. In Idukki, spice plantations were adversely affected and native varieties of Pepper, Cardamom, Tuber etc were destroyed. The mid-lands and low-lands (Kuttanad and Kole regions) on the other hand were characterized by massive flooding and inundation of fields, resulting in rotting of crops and wilting of trees, causing significant losses to farmers.

In many places paddy fields have been damaged due to deposition of silt, sand and muddy soil. The local people are of the opinion that recovery is not possible as the large part of the top soil has been washed off or due to landslides turned these areas unfit for cultivation. The depletion of oxygen in the soil may decrease soil microbial communities following flooding. Silt deposited by flood may add to the problem. Even the crops such as Pokkali fields which survived showed disease attacks in Ernakulam.

The districts affected by floods with inland fishing systems were Alappuzha, Ernakulam, Kottayam and Thrissur districts whereas Malappuram and Kollam districts were more affected in marine fisheries sector. There have also been significant changes in the type of fish being caught in major rivers after the floods.

**Table 3 Major Impact of flood/ landslide on Agricultural ecosystem and Agrobiodiversity**

Partial loss of local landraces of Pepper, Rice, Cassava, Tapioca, Banana etc
Top soil erosion
Impact on native breeds as Kuttanadan ducks
Deposition of sand, silt, stones, clayey soil, muddy soil etc in Agricultural fields
Loss of soil fertility
Increased acidification of soil
Deposition of solid, liquid and industrial waste in agricultural fields
Spread of invasive weeds as Barnyard grass in Wayanad
Spread of invasive species as African snail
Mass mortality of soil organisms as earthworms



Spread of exotic aquatic weeds such as Water hyacinth ( *Eichornia* ) Giant salvinia ( *Salvinia molesta* ) in Kuttanad region

Growth of Parthenium ( *Parthenium hysterophorus* ), Anathottavadi ( *Mimosa diplotricha* , Venpacha ( *Sphagneticola trilobata* ) in fields

Profuse growth of small herbaceous weedy plant Thelkada ( *Heliotropium indicum* ) in kole wetlands of Alappuzha all along the paddy field posing serious problem in agriculture.

Increased incidence of diseases in Karimeen at Munroethuruthu and Vembanad-Kuttanad

Escape of exotic and ornamental fish from aquaculture farms

Washing away of exotic aquarium plants from farms

Damage to traditional agricultural/fishing implements

The panicles of rice plants, especially in pokkali rice fields became chaffy resulting in considerable reduction in yield

Early flowering of crops, decrease in fruit production of crops

Rotting of roots of tuberous crops

Increased diseases in crops such as bacterial leaf blight in paddy leading to yellowing and drying of leaves

Incidence of fungal disease in Pepper

Defoliation, Bark rotting, decrease in latex production in Rubber plantations

Increased attack by Army worms in Paddy fields in Ernakulam

Moths and Leaf cutting bees, stem borers, leaf folders and leaf webbers has shown an increasing trend after floods.

**Table 4 Major Agro ecosystems affected**

Kuttanad - Globally Important Agricultural Heritage Site

**Local Agro ecosystems -**

1. Chengalikodan Banana,
2. Central Travancore Jaggery,
3. Palghat Matta
4. Wayanad Scented Rice ( Gandhakasal, Jeerakasala) are grown

Veemabanad Kole wetlands- A Ramsar site

Vembanad Clam fishery

Traditional Agroecosystems of Pokkali and Kole lands





## Major Causes of disaster- Community perspective

- Land use change in wetlands
- Encroachments and Construction in flood plains
- Removal of river bank vegetation
- Construction activities in hill slopes
- Unscientific agricultural practices as Cultivation of Agricultural crops such as tubers on slopes leading to loosening of soil and soil erosion.
- Unscientific construction of rain water pits and ponds.
- Generally people observe that river banks having thickets of bamboo and vegetation withstood the flood.
- Unregulated levelling of hills
- Unsustainable utilization of forest produce
- Degradation of Traditional water harvesting structures
- Quarrying

## Major Recommendations

- Impacted areas to be categorized and afforestation with suitable native species for slope stabilization
- Land use change should not be encouraged and that any construction activities near the river bank should be done only after conducting social and environmental audit at local level.
- For any activities near the forest a green growth policy should be adopted.
- For maintaining the pristine nature of wetlands a panchayat level water conservation policy should be adopted.
- In Gramasabha meetings biodiversity and environment conservation should be discussed and action plan developed.
- Rejuvenation of small streams and tributaries- eg rejuvenation of the natural flow of Varattar prevented flooding of the adjoining areas otherwise the damage would have been much more severe.
- Agricultural schemes including those for compensation for natural disasters is being implemented based on the area under cultivation of a particular crops. The diversity in the field or the conservation value of the varieties lost are not considered.
- Special package for custodian farmers and those maintaining Agriculture diversity in fields should be considered.



**Table 5 Floral biodiversity impacted by floods/landslides.**

No	Vegetation Type	No. of Species/Varieties
1	Water plants	29
2	Grass	57
3	Herbs	277
4	Shrubs	174
5	Climber	129
6	Trees	287
7	Agricultural crops	287
8	Traditional varieties	393
9	Locally conserved varieties	22
10	Riparian Vegetation	98

**Table 6 Faunal biodiversity of Kerala impacted by floods/landslides.**

No	Fauna Type	No. of Species/Breeds
1	Belowground Biodiversity	49
2	Amphibians	52
3	Insect	237
4	Fish	120
5	Birds	113
6	Mammals	50
7	Molluscs	25
8	Reptiles	49
9	Livestocks	34
10	Domestic Birds	22

**Table 7 Agrobiodiversity of Kerala impacted by floods/landslides**

No	Agrodiversity	No of varieties
1	Ladies finger	5
2	Amaranthus	6
3	Elephant foot yam	7
4	Cashew	7
5	Arecanut	8
6	Chilly	8
7	Coconut	13
8	Colocasia	16
9	Dioscorea	16
11	Tapioca	45
12	Bitter gourd	7
13	Banana	43
14	Nutmeg	5
15	Paddy	49
16	Pepper	36
17	Brinjal	8
18	Beans	20



**Table 8 Impact of natural disasters on major landscapes**

District	Gramapanchayat	River/Streams/Canal			Lake system			Protected areas			Farm			Plantation			Landscape change due to human intervention			Paddy Field			Well			Pond					
		M	S	VS	M	S	VS	M	S	VS	M	S	VS	M	S	VS	M	S	VS	M	S	VS	M	S	VS	M	S	VS			
Tvm	Aryanadu																														
	Kallikkad																														
	Kalliyoor																														
Kollam	Adichanalloor																														
	Mundrothuruthu																														
	East kallada																														
	West Kallada																														
Pathanamthitta	Ithodiyoor																														
	Aranmula																														
	Ayiroor																														
	Cherukole																														
	Eraviperoor																														
	Kadapra																														
	Koipuram																														
	Kozhencherry																														
	Kulanada																														
	Kuttor																														
	Mallapuzhasserry																														
	Nedumpuram																														
	Niranam																														
	Pandalam Mun.																														
	Peringara																														
	Ranni Angadi																														
	Ranni																														
	Ranni Pazhavangadi																														
	Ranni Perunad																														
	Thiruvalla Mun.																														
Thottappuzhasserry																															
Alappuzha	Ambalappuzha North																														
	Ambalappuzha South																														
	Budhanoor																														
	Champakulam																														
	Chengannur Mun.																														
	Chennithala																														
	Thrippunthura																														
	Cheriyand																														
	Cheruthana																														
	Edathwa																														
	Kainakary																														
	Karuvattia																														
	Kavalam																														
	Mannar																														
	Muhamma																														
	Muttar																														
	Nedumudi																														
	Neelamperoor																														
	Pandanad																														
	Pulinkkundu																														
Puliyoor																															
Ramankary																															
Thakazhy																															
Thalavady																															
Thannermukkom																															
Thiruvandoor																															
Veeyapuram																															
Veliyanad																															
Kottayam	Arpookkara																														
	Kallara																														
	Kootikkal																														
	Kumarakam																														
	Maravanthuruthu																														
	Mulakkulam																														
	Paippad																														
	Thiruvappu																														
	IV Puram																														
	Udayanapuram																														
Vazhapally																															
Idukki	Velloor																														
	Adimali																														
	Bisonvalley																														
	Erattayar																														
	Idukki-Kanjikuzhy																														
	Kamakshi																														
	Kanchivar																														
	Konnathady																														
	Mankulam																														
	Mariyapuram																														
	Munnar																														
	Nedumkandam																														
	Pallivasal																														
	Rajakkad																														







CHAPTER 7  
**BIODIVERSITY FOR CLIMATE  
RESILIENT NAVAKERALAM**



## **Major recommendations for Biodiversity Conservation for Climate Resilient NavaKeralam based on quick community based assessment**

Biological diversity is the basis for life itself and plays an important role in providing ecosystem services such as clean water, clean air as well as services such as pollination, regulation of pests and diseases etc. Biodiversity and ecosystem services contribute directly to human well-being and development priorities. Biodiversity is the critical foundation for sustainable development and human well-being by providing natural resources including food, fiber, fuel, and medicinal plants. Ecosystem resilience to climate change depends on biodiversity. But unfortunately as the impact of biodiversity loss is long term and is not usually noticed or felt in normal conditions on day to day basis remedial measures and fund allocation for it are often not considered while formulating sectoral plans.

Kerala provides a geographical and ecologically circumscribed but complex mosaic of land where the development-environment link is getting neglected and disrupted. The environmental systems here are very fragile because of the inherent nature of geography, climatic conditions and ecological characteristics. The geographic settings of the state are much different from other states and the life line of the state is the rivers. The complex interconnections between forests in the mountains, rivers and the ocean maintain the dynamism of life in the state, besides providing long term assets for sustainable development. The natural inclination of the land towards the sea and lesser average width of state compared to other states of India demands careful land use planning, especially along the 44 river basins of Kerala. Further the population density of the state is also more along the coastal plains and along the river basins. Watersheds and floodplains of rivers are therefore of particularly strategic importance for the state.

Over the years the state has lost much of its green cover due to changes in land use patterns, building and road construction in the hills and unsustainable tourism practices harmful to the state's ecosystem and biodiversity. The recent episode of flood has demonstrated that scientific management of its lands and waterbodies in general and hilly areas and rivers and its flood plains in particular, are highly relevant from the sustainable developmental perspectives, through the process of rebuilding Kerala- Navakeralam. While envisaging the whole process of rebuilding Kerala, an ecosystem approach is therefore all the more important, with a stronger focus on healthy rivers and richer biodiversity.

### **Sustainable consumption and Production**

As Mr Braulio, Executive secretary to Convention on Biological Diversity, the UN multilateral treaty to which India is a party explains "With the fight against biodiversity loss, we invest in people, their lives and their wellbeing." NITI Aayog's comprehensive national strategy for Sustainable development also states that biodiversity conservation and maintenance of healthy habitats for wild life have to be aligned with sustainability goals. In the light of this the focus of Rebuild Kerala should be to promote Sustainable consumption and production. The Environment White Paper approved by the State Government is committed to design an environment friendly economic system for clean water, soil, air and biodiversity and to formulate Action Plans and implement them with people's participation.

Ministry of Environment and Forests along with National Biodiversity Authority (NBA) has developed 12 National Biodiversity Targets and Action Plan (NBAP) for India to be achieved by 2010. Besides these targets, all the State Government departments are involved in achieving United Nations Sustainable Development Goals (SDGs) set for 2030;



some of which are similar to National Biodiversity targets. Due to these international and national commitments through SDGs and NBTs which are to be achieved by various departments of Government, there is an urgent need for the state to have Kerala specific land use policy and develop necessary institutions to achieve the above mandates/goals to prevent occurrence of large scale calamities in future. The Kerala State Biodiversity Board (KSBB) is a statutory advisory body of Government of Kerala with the primary mandate of conservation of biodiversity, sustainable use, and equitable sharing of the benefits arising out of utilization of biological resources. Biodiversity conservation requires cross sectoral strategies to protect biodiversity and KSBB has identified 28 organizations including Departments of State Governments such as Fisheries, Forests, Agriculture, Livestock and Animal Husbandry, Mining, Education, Local-level institutions etc directly or indirectly implementing schemes with positive or negative impacts on biodiversity.

## **Major Recommendations of Quick Assessment Survey**

After the recent floods, the Government of Kerala, especially Hon'ble Chief Minister, proposed to conduct a community based quick assessment study by Kerala State Biodiversity Board (KSBB) on the impact of flood on the biodiversity of the state. Accordingly KSBB with the help of 187 BMCs carried out a quick assessment of impact of flood in 13 districts of Kerala. Meanwhile, an international team consisting of United Nations Organization and European Union had also conducted a study on the impact of flood and suggested four pronged strategy for post flood rebuilding Kerala programme under Resilient Kerala initiative of Navakerala Mission. These four pronged strategies also called pillars are:

**Pillar 1: Integrated water resources management (IWRM)**

**Pillar 2: Eco-sensitive and risk-informed approaches to land use and settlements**

**Pillar 3: Inclusive and people centred approach**

**Pillar 4: Knowledge, innovation, and technology**

The recommendations made to the State Government by Kerala State Biodiversity Board are therefore aligned with the above mentioned four pillars. The major recommendations are:

### **1. Institutional structure for cross sectoral strategies to conserve biodiversity**

1. Constitute a **State level Steering Committee of Biodiversity** with Chief Secretary as Chairman and Secretaries of all associated departments as members to provide guidelines and coordination for holistic integration of functioning of all related departments and statutory bodies/ Authorities constituted under various related Central and State Acts and Rules to achieve SDGs and NBTs.
2. Designate **District level Forest officers** for implementing Biodiversity Act 2002 especially for implementing regulatory functions.
3. Constitution of an **Integrated River and Lake Management Authority** to manage holistically the River Basin and Lakes with community participation considering the entire basin as a single ecological unit. Implementation of a basin-wide master plan linking all LSG in upstream, and downstream zones within next 6 months.
4. Development of a network of trained officials "The Virtual Biodiversity Cadre" by identifying two officials, **who have knowledge to deal with biodiversity and environ-**



**ment in each of the 28 biodiversity related line department/ institution** for developing concerned departments policies and schemes in consonance with biodiversity conservation.

## **2. Policy Initiatives and policy reforms recommended**

1. KSBB had proposed a draft Land use policy during 2010 including associated policy like organic policy with emphasis on land use for clean environment, water, soil and food which may be modified by Land use board and adopted as an overarching policy for all type of land use in the state.
2. Presently Kerala State Action Plan on Climate Change does not ensure consideration of Biodiversity conservation aspects in the Action plan of different sectors. It must be ensured that action plan of all sectors incorporates Biodiversity conservation in their sectoral schemes.
3. Organic Kerala Mission to be included as part of Nava Keralam to implement the Organic farming policy, strategy and action plan to maintain diversity of beneficial insects and soil health. Presently Agriculture development policy 2015 does not provide much incentive for the conservation and sustainable use of indigenous varieties as well as its marketing. It is strongly recommended that
  - a. The farmers should be encouraged through incentives and other means for producing indigenous varieties of different crops.
  - b. The existing market channels like Haritha market as well as new market avenues need to be developed for procuring the indigenous varieties at appropriate rates for providing farmers ready market without delay as their shelf life may be limited.
4. Stringent implementation of the Kerala Conservation of Paddy Land and Wetland Act, 2008 and amendments, to ensure that Paddy lands are conserved and managed as wetlands for ground water recharge and biodiversity conservation.
5. MOEF has identified 18 areas as Important Coastal and Marine Biodiversity Areas in Kerala. So far in Kerala only one site Kadalundi- Vallikkunu is declared as Community reserve. It is recommended that conservation of important coastal and marine biodiversity areas as Community-Based Marine Protected sites may be taken up.
6. Presence of exotic species like Red bellied pacu, Arapima and Alligator gar in the catch after the floods shows the need for strict implementation of the existing policies to control and monitor exotic species and aquarium flora. Implementation of the Kerala Inland Fisheries and Aquaculture Act, in order to prevent farming of banned exotic species
7. Appropriate policy for strict quarantine and biosecurity measures for any exotic species brought to the state may be developed. It is recommended to develop state database on Aquatic Invasive Alien species and quarantine and management strategies for control the spread of IAS.
8. Regulate or prohibit the use of fishing crafts and gear, which are deemed as destructive to biodiversity. Bycatch reduction methods should be made mandatory to reduce the catch of non-targeted species.
9. Expanding the scope of Minimum Legal size for commercially exploited marine bio resources.



10. Strict regulation of tourist boats in backwaters based on carrying capacity studies and strict regulations for waste management by tourism department.
11. For people centred approach to biodiversity conservation, biodiversity rich areas outside protected areas may be identified and notified as Biodiversity Heritage Sites (BHSs)
12. Notification of species on verge of extinction under Section 38 of Biodiversity Act and a stronger focus on point endemics (species limited to a single locality).

### **3. Financing biodiversity conservation**

1. It is recommended that Local Self Government Department must make certain fixed percentage allocation out of Panchayat plan fund for Biodiversity and Environment conservation.
2. The River Management Fund accrued through sand mining revenue to be used mainly for eco-restoration of the river and river banks instead of utilizing it for construction purposes
3. A fixed amount of sectoral schemes of Agriculture and allied sectors to be utilized for conservation of biodiversity, native varieties and breeds etc.
4. The possibilities for international funding for climate resilience, including REDD plus, green climate fund and funding of GEF may be better explored.

### **4. Recovery and Resilience strategies**

#### **4. 1. Aquatic ecosystem ( Integrated water resource management)**

The major recovery needs identified in the action plan proposed by majority of BMCs are

- (1) restoring natural river ecosystems and riparian vegetation along the banks,
- (2) protecting river banks from soil erosion
- (3) land use planning especially in hill slopes, wetlands, flood plains
- (3) disposing of silt, sand and debris deposited due to the floods and landslides
- 4) Species recovery programmes by suitably augmenting native species

#### **Restoring natural river ecosystems**

1. The River banks of Pampa, Periyar, Kabani, Bharatapuzha, Chalakudy and Manimala faced bank erosion and siltation following floods and landslides. To build resilience of the ecosystem it is necessary to support the restoration of degraded river banks and buffer zones. River Basin level plans should be prepared through participatory process in a priority basis at areas affected severely and implemented in a phased manner with suitable watershed measures, eco – restoration of catchments and water recharging.

The study demonstrates the role of riparian vegetation in preventing river bank erosion and hence massive eco-restoration programmes in the catchments of rivers and lakes through conservation of riparian vegetation and planting of suitable species is recommended. Riparian management should be taken up by BMCs, through a Green army comprising of LSGs, VSS, and local NGOs.



2. Upstream river basin management with a focus on the conservation of forests, downstream management in the mid and lowlands with sustainable Agricultural practices with a focus on multi-cropping and integrated farming has to be developed. This should be integrated with a coastal zone management with afforestation by mangroves and creation of a green buffer zone in the coastal zone.
3. A massive **Kerala State Wetland Restoration Programme** may be launched, which include cleaning up of rivers, ponds and lakes with full participation of people. Removal of sand deposited in rivers and river banks should be undertaken only after holistic studies throughout the river basin with regard to its impact on Biodiversity and its cascading affects downstream is undertaken.
4. Coastal Bioshield belt with community participation.

Sea walls have been constructed in as much as 310 km of coast ( 53% of coast) resulting in Artificial coast. These artificial coasts are eroding coasts. The overall erosion characteristics of Kerala is 63.02 % (Sum of high + medium + low + artificial ). Vegetative and mangrove afforestation with community participation must be taken up at sites requiring eco restoration

### Land use planning

1. A large variety of freshwater fish regularly migrates as a group, swimming against the flow in rivers, and enters the flooded fields mainly to breed. The monsoon flood cycle and the seasonal inundation of floodplains of rivers are critical factors determining the survival of many species of freshwater fishes. This life cycle of aquatic species has been affected by the large scale conversion of wetlands and encroachments into flood plains which should be regulated.
2. A Kerala State Wetland Register may be prepared for each Panchayath under the leadership of the Biodiversity Management Committee and put in public domain. Wetlands in the State may be prioritized on the basis of their biodiversity, economic and cultural values for long-term conservation.

### 4.2 Non forest terrestrial landscapes ( Inclusive and People centered approach)

The survey suggests that landslides have occurred in areas not identified as landslide prone also, some of the landslides occurred on the fringes of forests and other hill slopes subjected to human interventions, construction activities and check dams etc. Quarrying in some areas was also suggested as one of the reasons for landslides. Landslides in the Kurichiar Mala in Wayanad is one of the most affected areas.

The widespread flooding in urban and semi-urban areas of Kerala has reaffirmed the importance of urban planning. Cities in many cases harbour great biodiversity, managed and maintained by citizens. In Kerala many areas are conserved in rural and urban areas as Sacred groves most of which has withstood the floods.

### Slope stabilization in Hilly areas

1. For landslide prevention on slopes a comprehensive assessment of the region, identification of the type of plants suited for sloping areas, and planting the right mix of native species is necessary, which can be taken up by LSGs/ BMCs.
2. Sustainable groundwater management plan based on groundwater potential and estimated rate of land subsidence of different areas, to minimise the adverse environmental impacts of groundwater development.



## Urban landscapes

Promotion of ex situ conservation of RET/ endemic species in rural and urban public places and wastelands

Development of sustainable cities by promoting urban green areas, vertical gardens etc through residents association.

## Agro ecosystems

The floods and landslides have resulted in widespread loss of local landraces of crops as Paddy, Pepper, Colocassia, Cassava, Banana etc. It has also affected the farms of custodian farmers in Wayanad, Kannur, Idukki etc. More importantly the major impact on Agroecosystem is the impact on soil, loss of soil fertility, spread of invasive weeds. etc .

**The present survey suggests that the major recovery needs will be that since the floods occurred while the paddy fields were kept ready for sowing most of the top soil was washed off and sand was deposited. Topsoil erosion caused due to rains and deposition of silt/sand in paddy fields, has resulted in changes to its physical and chemical properties, water logging, and anaerobic conditions. All the surviving plants show symptoms of nutrient deficiency. It is widely reported that, after the flood, earth worms died in large numbers in various areas of Idukki district. Also due to the heavy soil erosion the farm lands lost its water absorption capacity. There is very low moisture retention in the soil, which is reflected in wilting of the plants during sunny days soon after the floods along with drastic lowering of water levels in wells. The damage to the soil structure, loss of soil fertility, loss of soil dwelling organisms as earthworms, advent of crop diseases, and the proliferation of weeds can have long term effects.**

Hence in Agricultural sector the major short term and medium term recovery needs to be taken up by Agriculture department includes restoration of agricultural land through leveling / desilting / reclamation. Land restoration measures need to be supplemented by nutrients and soil ameliorants to counter increase in soil acidity due to washing away of topsoil.

## Resilience Building needs.

In addition to these short term measures the resilience of the sector needs to be build up in the long term. The major resilience building needs should be oriented to meet the Aichi Biodiversity Targets and National Biodiversity Targets. Aichi Biodiversity Target 13 and Sustainable Development Goal 2 lays down that by 2020, the genetic diversity of cultivated plants and (farmed and domesticated animals) of wild relatives is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity. The development of a strategic approach to integrate adaptation to climate change into agriculture through maintenance of Agro bio-diversity is necessary.

The following long term resilience building needs for Mainstreaming biodiversity for Sustainable Agriculture are recommended in Agriculture and allied sector :

- 1. The present study points out the continuous loss of diversity of Agricultural crops earlier used by farmers as also the local flood tolerant landraces grown in Pokkali and Kole fields. Kerala has been delineated into 23 agro-climatic zones based on agro ecological conditions including soil, climate, terrain and water. In view of this it is recommended that an Agro ecological approach to the agricultural sector with climate-resilient locally adapted cropping pattern is to be adopted as also suggested by Planning Commission.**



2. Ensure seed sovereignty of the farmers by ensuring supply of locally suitable seeds in each agro-climatic zone. The seeds of many local landraces and farmers varieties are no longer available. Hence BMCs should take up identification of custodian farmers and creating a network of traditional farmers which will enable ensuring supply of cultivars. BMCs can also support Community seed bank in each Agro climatic zone for ensuring seed supply.

Community gene banks has been successfully promoted by FAO in Andhra Pradesh where drought resistant crops such as millets, sorghum, beans, bajra, jowar, cowpea, grams, cereals and other local varieties were collected, especially traditional ones, and stored at village level. This has enabled to restore marginal lands to cultivation and minimize the risk of total failure in case of disease and to prevent malnutrition in rural areas. Such concepts can be introduced by BMC throughout the state, to begin with initially in Tribal areas of Attapady and Wayanad to conserve the genetic diversity of crops and their wild relatives and also to address the problems of malnutrition due to limited food basket in tribal area.

### 3. Ex situ conservation of indigenous varieties in Diversity blocks:

*Ex situ* conservation of Agricultural diversity in each district by establishing Agro diversity gardens or diversity blocks will serve to conserve the genetic diversity of crops and create awareness and showcase the rich diversity of food crops for future generations. Such diversity blocks can be maintained by LSG/BMC with active participation of custodian farmers.

One such successful initiative is The Rice Diversity Block at Panavelly Wayanad maintained by Thanal Agro Ecology Centre as part of the Save our Rice Campaign. Indigenous Rice Diversity Blocks are fields that maintain the various varieties of paddy across years, either as a collective effort. It conserve 219 indigenous varieties of paddy and is visited by hundreds of farmers and scientists, it has become an inspiration for farmers to conserve indigenous varieties of seeds. The Save our Rice campaign has facilitated the maintenance of many RDBs across six states – Kerala, Tamil Nadu, Karnataka, West Bengal, Chattisgarh and Jharkhand. Together, these RDBs conserve more than 1,000 indigenous varieties, which over 30,000 farmers have adopted. Many of these varieties also compete well with the HYVs, show a better resistance to pests and diseases, stress tolerance properties and are adapted to local climatic conditions

4. **Integrated home garden development** The homesteads of Kerala were often explained as centers of tropical biodiversity similar to tropical forest ecosystem and one of the most productive unit of land. The BMC can facilitate development of linkages with custodian farmers and promote model homesteads in each Panchayat.

It has been proven that native breeds of cattle like the Vechur, High range Dwarf and Kasaragod Dwarf, goat breeds like Malabari and Attapadi Black, Chicken breeds like Naked neck and Thalasseri, Duck breeds like Chara and Chempalli can better with-





stand heat and water scarcity compared to exotic breeds. Further, these native breeds require less feed and management and are more resistant to diseases. Increased farm productivity by integrated and sustainable use of local crop and livestock diversity with attention to under-utilized crops and breeds should be promoted.

**A major impact of the floods and landslides has been the loss of soil biota and pollinators. To sustain these life sustaining elements, BMCs along with Haritha Keralam mission and other local level organization should take up programmes of organic agricultural practises to spearhead an organic revolution in Kerala.**

## 5. Capacity building and Awareness

- i. Capacity building of the working group on Biodiversity, Environment, Climate change and Disaster management to perform Environmental auditing of all developmental schemes being implemented at local level
- ii. Capacity building for strengthening BMCs for formulation of Local Action Plan for Biodiversity and their implementation and monitoring at panchayat level.
- iii. Capacity building of MNREGS for clearing exotic/ invasive species

## 6. Knowledge, Technology and Research studies

The following Knowledge gaps have to be addressed to Mainstream Biodiversity in Governance.

1. Mapping of flood prone areas along the river banks and develop strategies to prevent hazards due to flooding.
2. Develop a database of Agro biodiversity based on Agro ecological zones- This database will be the basis for genetic resource to be used for hybridization programmes and will serve as the base document for planning for agriculture at LSG level
3. Studies on the trade off due to conversion of monoculture plantations to mixed species planted forest.
4. Develop database of traded bioresources including both terrestrial and aquatic bioresources, volume of extraction, estimation of sustainable yield and develop sustainable harvesting protocols for priority species
5. After Cyclonic Okhi, 400 kg of ghost nets were collected from two different locations in the Vizhinjam seabed in just 90 minutes. Ghost nets usually traps and kill marine species. Biodegradable nets can be explored to avoid ghost fishing and it also minimizes the pollution of plastics in the coastal/marine environment.
6. A database on the pet traders to be maintained and illegal trade to be regulated. The species enlisted as Endangered, Critically Endangered, Near Threatened should be excluded from trading.
7. Pollution in Vembanad and other backwater due to tourism much beyond the carrying capacity affects the biodiversity. Introduction of green technologies for powering Tourist boats by non-conventional energy and fitted with green toilets.
8. Status Report of the Biodiversity of Kerala should be brought out periodically by consolidating the information from various sources



9. Since fresh water resources are one of the most degraded, a Status of Environment Report for Rivers of Kerala is to be brought out. KSBB had conducted a Riverine monitoring program during 2010 through participatory process. It is proposed that regular financial support for monitoring of biodiversity of wetlands should be allocated.
10. Regular monitoring of Rare, Endangered and Threatened (RET) species and critical habitats, coastal marine habitat lost (mangroves, sand dunes, mud-flats, etc.) assessing their status and range of distribution and, identifying potential habitats for protection. Red data book for Kerala to be developed. Periodic assessment and distribution maps of threatened and endemic species of threatened species
11. A database of ex situ collections and conservatories of flora and fauna in the State need to be developed.
12. Urban biodiversity indexing and Regular monitoring of urban vegetation with involvement of voluntary organisations is necessary
13. Promotion of Citizen science involvement in biodiversity monitoring, documentation and conservation.







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