



# KERALA FLOOD 2018

## THE DISASTER OF THE CENTURY



**RAJIV GANDHI  
INSTITUTE OF  
DEVELOPMENT STUDIES**



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**A REPORT ON**

**KERALA FLOOD 2018  
THE DISASTER OF THE CENTURY**

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## **About RGIDS**

The Rajiv Gandhi Institute of Development Studies (RGIDS) is a nongovernmental research organisation, registered under the Travancore Cochin Literary Scientific Charitable Societies Registration Act, 1955. It has been engaged in social science research, training and policy support to both Central and State Governments since its inception in 2005. Its strong academic base and core competence in the areas of decentralised governance and central state relations have been contributing significantly to the State of Kerala.

The institute has also been involved in training and capacity building of the elected representatives of Panchayati Raj Institutions. RGIDS has conducted various research studies for the Ministry of Overseas Indian Affairs, National Institute of Rural Development (NIRD), Kerala Institute of Local Administration (KILA), Planning Board, Kerala State Higher Education Council (KSHEC), etc. With its strong academic base and expertise in the field of centre-state relations, decentralised governance and decision making, RGIDS fosters an innovative and practical approach while addressing contemporary challenges facing the society.

## **Committee**

RGIDS constituted a six-member committee to evaluate and suggest remedial measures on "The Cause and Impact of Kerala flood 2018" The committee was headed by Shri. Michael Vetha Siromony (Rtd IAS and former Additional Chief Secretary to the Government of Kerala). The members of the committee include Dr. Oommen V Oommen (Former Chairman, Kerala State Biodiversity Board), Shri. John Mathai (Former Scientist, National Centre for Earth Science Studies), Shri. Muhammed Ali Rawther.M (Former Director, Kerala State Electricity Board Ltd), and Shri.Thomas Varghese (Former Deputy Chief Engineer, Irrigation Department, Government of Kerala). Shri.B.S. Shiju (Director, RGIDS) was the Convener of the committee.

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Thiruvananthapuram

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## **Abbreviations**

ADB	: Asian Development Bank
BMC	: Biodiversity Management Committee
CWC	: Central Water Commission
CEA	: Central Electrical Authority
CEZ	: Coastal Regulation Zone
CEC	: Central Electricity Authority
CWC	: Central Water Commission
DMA	: Disaster Management Authority
DMP	: Disaster Management Plan
EAP	: Emergency Action Plan
EAC	: Emergency Action Plan
IMD	: Indian Meteorological Department
KSEBL	: Kerala State Electricity Board Limited
KSHEC	: Kerala State Higher Education Council
LSF	: Local self-governments
MNREGA	: Mahatma Gandhi National Rural Employment Guarantee
NDMA	: National Disaster Management Authority
NIRD	: National Institute of Rural Development
PMU	: Project Management Unit
PQLI	: Physical Quality of Life Index
RBC	: River Basin Council
SEIAA	: State Level Environment Impact Assessment Authority
SPV	: Special purpose vehicle
UN	: United Nations



## **Executive Summary**

Kerala experienced a disaster of gigantic proportions with the flood of August 2018. Weathermen have said it is the biggest to have hit the State. The disaster that struck in the middle of August changed the ecosystem, both on land and water, which adversely affected the bio resources (bio-diversity), livelihood and capital wealth (Infrastructure). While 483 human lives and thousands of livestock were lost, the disaster incurred immense losses to the State's infrastructure, as many roads, bridges and thousands of houses were damaged /washed away. Large quantities of agricultural produce were lost putting the livelihood of farmers at risk. The flood has opened the vision on what the future development is to be? The present development plan, with scant regard to the fragility of the environment, needs restructuring to withstand the frequent onslaught of disasters, especially in the light of climate change. The flood was very unprecedented and rainfall in hilly districts were three times more, and the State was also not prepared for such mega scale, as it has not experienced a flood of this magnitude, except the recorded one in 1924. This flood can be called as the 'Flood of this Century', which hit Kerala continuously from 8th to 18th of August.

The reservoirs were already full in July end unlike other years and there was no place in the reservoirs to accommodate any more excess rain water. Considering the safety of the dams, the water had to be released from all the dams. The respective district administrations could not take adequate precautionary steps as they were also deprived of any information regarding the quantum of water release, duration and the likely places of inundation, etc. Lapses were many as the dam water scoured the riverbeds and the low-lying areas were flooded. The Sea was also rough with high tide and wave setup not allowing water to flow out; all this added to the flood and related problems. The ecosystem damage is beyond an assessment. The government after assessing the loss requested for a Central assistance of around Rs 40000 crore through a Memorandum to the Govt. of India. But actual loss incurred to the infrastructure and livelihoods is far beyond what has been calculated and projected.

The deluge exposed the various deficiencies in the system. Flouting and violating the norms compounded the problems. The lack of co-ordination and timely decision making by the

responsible authorities aggravated the flood into a disaster. Apparently the authorities did not give adequate attention with the seriousness, it deserves to, the weather forecasts by the agencies such as IMD. Kerala experienced the best of the support from youth volunteering, NGO's, Political bodies, media houses, religious organisations and the fishermen who became the real Life Savers. The administrative machinery failed in properly managing the disastrous situation and also identifying safe places /immediate relief centers, which resulted in confusion within the community.

The Committee observed that the flood made a huge impact across diverse sectors, especially dam management and power generation, agriculture, housing, environment, biodiversity etc. All the major dams in Kerala overflowed except the Aanayirankal and Thenmala dams during the flood. It emphasised the fact that under no circumstances, the dams should be allowed to overflow and this was a major administrative failure. Moreover, the fact that most of the rivers experienced a drought-like situation soon after the flood, when the shutters of the dams were closed, further confirms that the severity of the flood was several times magnified due to dam openings. Analysing the impact of the flood across the sectors, the Committee has put forth several suggestions and recommendations.

It recommends a strategy to rethink about the operations of the hydel power stations so as to maximise the power generation, thereby avoiding the opening of the spillways to control the flood situations, which needs to be developed. Further, the Committee has called for institutionalising a proper strategy for opening of the major dams with advance information to the concerned district authorities, local bodies and public, through all sources of media. Kerala State Electricity Board Limited (KSEBL) and Irrigation Department is urged to see that by the commencement of the water year, i.e., by 1<sup>st</sup> June, all the gates, spillway shutters and hydel machines of the major stations in the State shall be made fully operational to properly manage the reservoirs during heavy rainfall situations. An appropriate water management system should be evolved for maximising the usage of the water storage in the reservoirs for electricity generation/irrigation as well as other domestic purposes.

The Committee has proposed that the damage to agriculture sector needs to be assessed scientifically. It also recommended an expert committee, to be constituted, to look into the land-use pattern in hilly areas. Cultivation of crops on slopes, which induce heavy tilling, etc. need to be discouraged. Alternative economic and eco-friendly crops should be recommended panchayat wise as a long-term conservation strategy. It has suggested that high-rise buildings should not be permitted in the steep slopes of Western Ghats, as the areas are landslide prone. In the relatively flat areas of Western Ghats (Wayanad, Palakkad and Idukki) special attention should be given for farming vegetables, fruits and horticulture. Kuttanad being a unique eco system with repeated floods, water intrusion in the protected paddy fields, canals and bunds in a state of disrepair, dwelling units on the bunds, problems of sewerage etc., the challenges faced here are many. Hence a special purpose vehicle (SPV) for the development of Kuttanad is recommended.

On the housing front, the Committee recommends Government to implement a new construction policy against resorts both public and private, especially in the affected hill districts. Government may regulate the public from constructing huge houses and other buildings in areas of Western Ghats in general and to have strict restrictions in the ecologically sensitive areas. Reclamation of flood plains for dwelling sites is to be curbed.

It is recommended to have a Disaster Management plan at the District and Grama Panchayat levels, which has to be a reference document for implementation. The plan has to be periodically revised and be made available in the public domain. The Committee suggests to develop and integrate pre-project plans for reallocation and rehabilitation of local people likely to be displaced by the landslides and flood, keeping in view their socio-cultural and livelihood needs.

The Committee, after careful study and examination of the 2018 flood, is of the opinion that such mega floods which are unprecedented need to be tackled on river basin basis as many districts fall under each river basin. The President of all the Grama Panchayats, (who are also chairpersons of BMC's) falling in the river basin should be made members of the River Basin Council (RBC). The District Panchayat President, covering the maximum area of the river

basin, could be made the chairperson. The district collectors and all the functional line departments' head should also be members of the RBC. In addition, the State government can nominate experts from the state and also from the national bodies like CWC (Central Water Commission), CEA (Central Electricity Authority) etc. so that required expertise is made available. International experts through UN organisations may also be invited for the RBC. This river basin approach of disaster management will be a model plan, which will be more scientific, holistic and sustainable. The committee further proposes that both technology and environmental care be given priority in rebuilding a resilient Kerala. The governance issues related to disaster, transparency, social audit and grievance redressal system should be part of the efforts.

The committee recommends a high level body at government level to monitor water release, reservoir management and power generation in the State. It would take many years for the State to restore to the normalcy in terms of ecosystem, infrastructure and community. Being a mega disaster the State has to focus on rehabilitating the affected people and rebuilding strong infrastructure in a time bound manner. Globally demonstrated good practices, lessons learned and with the participation of all the affected people will strengthen rebuilding process.

## 1. Introduction

Kerala is one of the well-developed states of India in terms of its Physical Quality of Life Index (PQLI), governance, social equity and religious harmony. It experienced a disaster of gigantic proportions with the flood of August 2018. Weathermen have said it is the biggest to have hit the state in close to a century. The disaster that struck the state in the middle of August changed the ecosystem, both on land and water, which adversely affected the bio resources (biodiversity), livelihood and capital wealth etc. While at least 483 human lives and thousands of livestock were lost, the disaster incurred immense losses to the state's infrastructure, as many roads and bridges, thousands of houses were damaged or washed away. Large quantities of agricultural produce were lost putting the livelihood of farmers at risk. The disaster dented tourism industry of the state. It drew the attention of world organisations including the United Nations (UN), Asian Development Bank (ADB) and the World Bank. The total loss is estimated around Rs 40,000 Crore. The flood and associated events made lakhs of Keralites suffer for the next five to 10 years. It will take many years for the state to recover from this huge setback. However, this calamity needs to be accepted as a challenge and yet an opportunity to rebuild the state and to provide better standard of living to all sections of its society.

As a result of the state's varied geographical features, it often experiences the fury of some of the natural hazards like flood, droughts, landslides, coastal erosion, lightning and earthquakes. In periods of prolonged and heavy rainfall, it experiences flood in the low-lying areas and landslides in the steeply sloping segments of Western Ghats. Coastal erosion is a recurring phenomenon that is of grave concern, especially in the segments with high density of settlement. The state is also rocked by minor tremors frequently. The incidence of lightning with casualties in the state is one of the highest in the country. After the December 2004 earthquake, the state was also struck by tsunami taking a toll of more than hundred lives. Further, recent cyclonic events of Ockhi and the major floods of 2018 had their crippling effect on the state's economy. The flood of 2018, believed to be events with a long return period, has opened our vision on what the future development is to be? The present development plan, with scant regard to the

fragility of the environment, needs restructuring to withstand the frequent onslaught of disasters, especially in the light of climate change. The greater value of the ecosystem of the Western Ghats—the source of all the 44 rivers in the state—to the lowlands with a chain of kayals (lakes) and backwaters with dense settlement as well as to the coastal region with its dynamic front with the sea needs to be taken into consideration, before going ahead with any development plan. It is also essential to work out long-term disaster management plans even at micro level for the state to mitigate the miseries emanating from the repetitive cycle of disasters and to improve its resilience.

The main objectives of the study include:

- a) The cause of August 2018 flood in Kerala;
- b) Steps taken by the various authorities to meet the calamity;
- c) Response mechanisms of the State in water management;
- d) Response and defects of disaster management;
- e) Lessons learned from the calamity; and
- f) Preventive measures (both short- and long-term) for mitigation of impacts

## **2. Geographical Features of the State**

The State of Kerala is located in the southwestern part of Indian peninsula. It has a geographical area of 38,863 sq.km. With a population of 819 people per sq.km (Census of India, 2011), Kerala is one of the most densely populated states in India. On the basis of the physiography, the Resource Atlas of Kerala – 1984 shows that there are five zones from west to east—mountains and peaks (>1800m), highland, midland, lowland and coastal plains and lagoons. Mountains and peaks of the Western Ghats mostly from the crest of the mountain ranges and mark the inter-state boundary. Highland, with an elevation ranging from 600 to 1800 m, has a rugged topography and occupies about 20.35 per cent of the state. Natural forests, plantations and mixed crops dominate the land use. Most of the dams that generate power, and some of them with interstate diversions, are located in this zone. Midland forms an area of gently undulating topography with hillocks and mounds. It forms the western fringe of the highland with lateralised rocky spurs with an elevation ranging from 300 m to 600 m. It

covers about 8.44 per cent of the total area of the state. Coconuts, rubber, tapioca, mixed crops, and paddy fields along the valley dominate the land use. Lowland consists of dissected pen plains with elevation ranging from 10 m to 300 m. Nearly 54.17 per cent of the state's total area is lowland and is constituted by floodplains, river terraces, valley fills, and sedimentary formations. Coastal plains and lagoons/estuaries are identified with alluvial plains, sandy stretches, abraded platforms, beach ridges, beach dunes, barrier flats, raised beaches, lagoons, marshes and estuaries. This is a vast area fringing the coast, covering about 16.4 per cent of the area of the state with an elevation ranging between 0 m and 10 m. Water bodies running either parallel or oblique to the coastline are a characteristic feature of the Kerala coast. Many of the perennial rivers of the state debouch into these water bodies. Vembanad Estuary (kayal), a Ramsar-listed wetland, is the largest with six major rivers flowing into it.

### **3. What Kerala experienced during flood 2018**

The state faced the wrath of nature in the form of flood and landslides during the monsoon of 2018. The calamity left in its wake a trail of destruction all throughout the state with several areas submerged under water, landslides in the hills and flood in the valleys and plains. The continuous rainfall from 8<sup>th</sup> to 18<sup>th</sup> of August was excessive and unprecedented, especially in the hilly districts of Idukki and Wayanad which is around 290 mm, instead these areas received around 700 mm of rainfall that acted as the trigger for the floods.



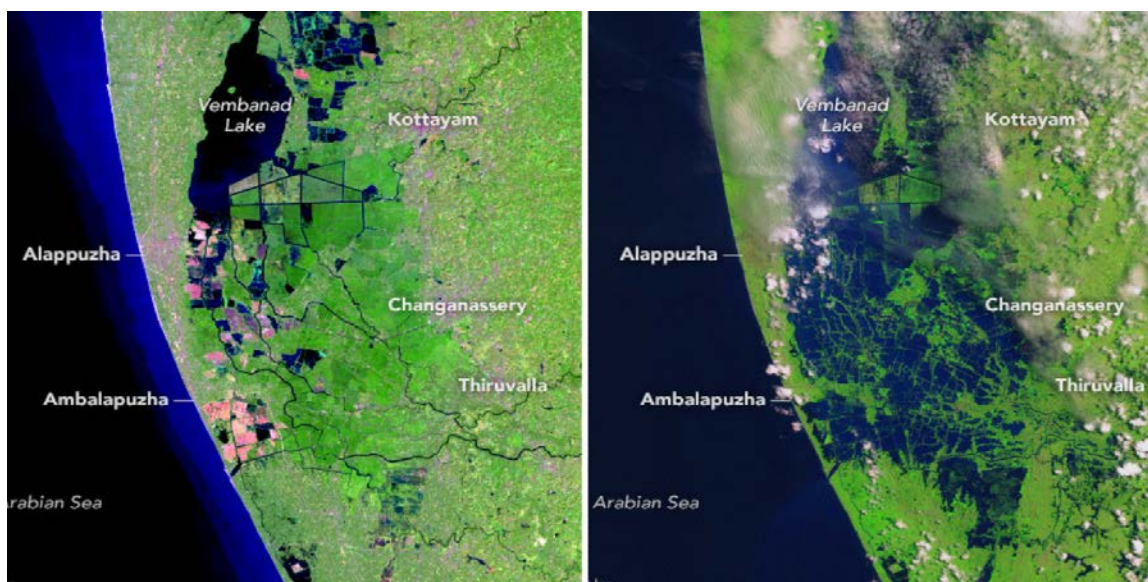
The dams in the state had more storage of water by the month of July 2018 itself. In addition to that, excessive rain water from August also got stored in them, which was more than required. This water was used only as a resource for power generation and the purpose of the dams for flood control was not factored in. When the reservoirs were almost full and there was no more scope for further manipulation of water within them, shutters of all the 34 reservoirs were opened without considering the impact, it would have created downstream and the people on the river banks.

The district administration themselves did not had adequate information to convey to the people in the flood-prone areas, which led to an information gap. Conveying right information to right people at the right time was missing, which compounded the misery. The district administration also had no idea of how much area will be inundated if the shutters of reservoirs are opened, and also of the precipitation of such duration. The lack of flood mapping added to the problems for the stakeholders, as they had no idea of the areas to be inundated. This information was to be modeled and conveyed to the respective authorities for disaster mitigation, which the district administration failed to do so. Moreover, no adequate evacuation warning could be given to the people.



#### 4. Map of affected areas





Source: NASA's image before and after Kerala flood 2018

## 5. Rainfall and flood

According to the Indian Meteorological Department (IMD), from 1<sup>st</sup> June to 22 August 2018, the state received 2411.30 394.4 mm rain compared to the normal 1770 mm (Table 1). In 2018, the southwest monsoon reached parts of southeast Bay of Bengal, south Andaman Sea and Nicobar Islands on 25<sup>th</sup> May. It advanced over Kerala on 29<sup>th</sup> May, three days prior the normal date of 1st June and covered the entire southern peninsular India by 14th June. Normally the state gets around 2039.6 mm rainfall from June to September in 120 days, but the rainfall during southwest monsoon season 2018 (1<sup>st</sup> June to 28<sup>th</sup> August 2018) has been exceptionally high. Kerala so far received 2411.30 mm against normal of 1770 mm (above normal by 36 per cent). The highest excess rainfall was recorded over Idukki District (84 per cent above normal) followed by Palakkad (66.80 per cent above normal). The rainfall over the state during June, July and August (1-19 August) has been 15, 18 and 164 per cent above normal, respectively. Eleven of the state's 14 districts were severely affected and the preliminary estimate of loss projected (not including loss of 483 lives and 55,439 ha (135,454 acres) of agricultural land) by the Government of Kerala is Rs 40000 crore.

**Table 1: Rainfall and its deviation from normal (1<sup>st</sup> June to 28<sup>th</sup> August)**

Sub Division/ Districts	Actual rain fall in mm	Normal rain fall in mm	Percentage/ Departure	Remarks
Kerala	2411.3	1770.0	36.2	Excess
Lakshadweep	461.4	816.0	(-) 43.5	Deficient
Alappuzha	1940.1	1418.7	36.7	Normal
Idukki	3559.4	1933.5	84.1	Large Excess
Kasargode	2349.4	2706.4	13.2	Normal
Kollam	1585.7	1094.5	44.9	Excess
Kottayam	2339.6	1602.0	46.0	Excess
Kozhikode	2941.7	2324.7	26.5	Excess
Malappuram	2652.9	1825.2	45.4	Excess
Palakkad	2293.7	1375.1	66.8	Large Excess
Pathanamthitta	1982.2	1424.6	39.1	Excess
Thiruvananthapuram	967.3	700.7	38.1	Excess
Thrissur	2079.1	1891.5	10.0	Normal
Wayanad	2906.9	2368.5	22.7	Excess

Source: Indian Meteorological Department (IMD).

The rainfall over Kerala has been in general above normal throughout the season. Specially, there were two consecutive active spells with above normal rainfall peaking around 14 and 20 June, respectively. Another peak rainfall activity was experienced around 20th July. Extreme rainfall observed (7 cm or more) during 8<sup>th</sup> to 19<sup>th</sup> of August is given in Table 2.

**Table 2: Rainfall observed in different stations (8-19 August 2018)**

<b>8 August 2018</b>		<b>10 August 2018</b>		Perinthalamanna	15
Nilambur	15	Peermade To	16	Vellanikkara	14
Vythiri	14	Idduki	12	Angadipuram	14
Iddukki	13	Nilambur	9	Thiruvananthapuram	14
Peermade	12	Paravam	7	Myladumpara Agri.	14
Mananthavady	12	Aryankavu	7	Alwaye PWD	14
Vellanikkara	11	Manantoddy	7	Taliparamba	14
Vadakkancherry	11	<b>11 August 2018</b>		Kannur	14
Thodupuzha	11			Kodungallur	14
Kunnamkulam	9	Idukki	9	Trivandrum AERO	13
Irikkur	9	<b>12 August 2018</b>		Haripad	12
Kuppady	8			Kayamkulam AGRI	11
Chengannur	8	Nil		Maveukara	11
Ambalavayal	8	<b>13 August 2018</b>		Kollamkode	11
Konni	8			Erankulam South	11
Ponnani	7	Munnar KSEB	11	Ottapalam	11
Mavelikkara	7	Vadakara	9	Chengannur	11
Piravom	7	Idukki	8	Chalakovudi	11
Punalur	7	Manantoddy	8	Kollam Rly	11
Chalakovudy	7	Kannur	7	Punalur	11
Irinjalakuda	7	Vyttri	7	Kozha	11
		Palakkad	7	Vadakara	10
<b>9 August 2018</b>		<b>15 August 2018</b>			
Nilambur	40				
Manantoddy	31	Peermade To	27		

Peermade to	25	Idukki	23		
Munnar KSEB	25	Munnar KSEB	22	Thritla	10
Palakkad	21	Karipur AP.	21	Chittur	10
Myladumpara	21	Manjeri	20	Mancompu	10
Mannarkkad	17	Kozhikode	20	Alapuzha	10
Chittur	15	Irikkur	18	Tellichery	9
Ambalavayal	12	Alathur	18	Kunnamkulam	9
Idukku	10	Kochicial	17		
Kuppady	9	Thodupuza	17		
Konni	8	Manantody	16		
Mancompu	8	Perumpavur	16	Neyyattinkara	9
Kurudamannil	7	Vadakkanchery	15	Kumarakam	9
Chengannur	7	Quilandi	15	Ambalavayal	9
Ottapalam	7	Vyttri	15	Kochi I.A.F.	9
Punalur	7	Peravam	15	Nedumangad	9
Parumbikulam	7	Parumbikulam	15	Enamakkal	9

Source: Indian Meteorological Department (IMD)

Fresh spell of active rainfall commenced since 8th August and continued till 18th August. Thereafter, there has been gradual decrease in rainfall over the State. Heavy to extreme rainfall occurred across the state during 14<sup>th</sup>, 15<sup>th</sup> August. The average rainfall on 15/16<sup>th</sup> August for the entire State was at about 140 mm/day. The highest rainfall recorded during 2018 southwest monsoon over the State was at Nilambur on 8th August (398 mm) and Peermedu (Idukki catchment area) recorded 349 mm for a single day on 15th August. It is also clear from the data in the Table 2 that Peermedu, located in the water divide of Periyar

and Pamba river basin, has received 1615.7 mm of rain in a matter of 11 days, which is more than half of average annual rainfall of Kerala.

The unprecedented flood after the heavy rainfall, which came along with several big and small landslips and landslides, was a natural calamity that struck the State after a century. However, the flood became a huge disaster taking away 483 human lives and making thousands homeless, because of the lack of timely responsible human intervention. With more than 80 small and big dams, Kerala should not have had a flood as compared of the one in 1924, and it is paradoxical that state still experienced such a huge calamity.

The elevated tidal level corresponding to the new moon phase during Karkidakavavu along with the wave setup caused the stagnation of flood waters in the kayals and backwaters, more so in the Vembanad estuarine system. This has led to the accumulation of floodwaters reaching to greater heights resulting in the flooding of adjacent lowlands.

## **6. Causes of floods**

Dr. E. Sreedharan, well-known technocrat (also known as Metro Man), opined the lack of inadequate data with dam authorities, co-relating the rain fall precipitation at various points of the catchments and rate of rising of water in the reservoir with the time lag between precipitation and rising of water level. Red alerts were therefore not taken seriously. Heavy silting of reservoirs resulted in significant decrease in the storage capacities. Formation of artificial islands in the river beds in the absence of a healthy and controlled sand-mining policy resulted in thick jungle growth with huge trees in these islands, which led to severe blockage to the river cross section (This was particularly so in Bharathapuzha River, which resulted in river overflowing its banks). The cause of deluge that struck was as a result of human omissions and commissions.

All the dams in the state were opened simultaneously, which was a major contributing factor for the flood. Over the last 20 to 30 years, the land-use pattern in the state had completely changed due to the reduction in forestland. Encroachments of land and

unscientific constructions in the catchment areas of dams and high ranges increased the volume of damage. For example, back in 2005, the Government College in Idukki was destroyed in a landslide and the same was reconstructed again without conducting any environmental impact study. The landslide and similar activities (mass wasting) in the upper catchment areas, silt deposition and soil erosion have reduced the effective storage capacity (Maximum Draw down Level) of the dams.



Circular failures were noted in almost all the catchment areas. A research Study by **IIT, Gandhinagar**, has concluded that the flood in Kerala is a combined impact of extreme rainfall and reservoir storage and that reservoir operations need to be improved using skillful forecast of extreme rainfall.

### **6.1 Causes of landslide**

Landslides are normally triggered by heavy rains, earthquakes, or rise in ground water and undercutting by rivers. In Kerala, landslides commonly occur in localised areas of the Western Ghats region, where the slope is steep and the soil is over saturated as a result of prolonged rainfall. These events vary from those affecting a parcel of land to the larger ones with much causality.

The State experienced unprecedented landslides in the year 2018, most of which occurred in the districts of Idukki and Wayanad.



While Idukki experienced a total of 143 landslides, Wayanad was hit with almost 247 landslides, out of which 200 can be classified into road slips. Even though these road slips do not affect the catchment areas in Wayanad, these cannot not to be taken lightly, as they happen mainly due to lack of scientific designs in construction of roads.



The overall terrain setting in the highland of Kerala brings out two prominent plateau like landform commonly known as plantation surfaces. Peerumedu plateau, Wayanad region that merges with Mysore plateau, Attappady and Nelliampathy are nearly flat lands at about 600-800 m elevation. Similarly a near level landform is seen around Munnar where the valleys are at about 1500 m elevation and the hills reaching to more than 2000m. These flat lands are flanked by steep to very steep slopes where the incidences of landslides are highest. Uncontrolled land use practices with cutting and leveling, drainage manipulation and promoting agriculture practices with frequent tilling in these slopes are some of the activities that have contributed to an increase in slope failures and landslides recently. These sloping regions are also the source points of many rivulets that feed majority of the rivers in Kerala ensuring greater water availability.

A common form of destabilising the steep slopes is by the toe disturbances. Indiscriminate construction of hilly roads and construction of houses by cutting and leveling the slopes are rampant in the highlands of the state. Soil piping or subsurface erosion leading to land subsidence is another active process during monsoons and in most of the places it is triggered by human activities. The two major causes for recent landslides are given below:

- a) Nature of soil:** The soil in the highland region like Idukki and Wayanad is slightly reddish, silty and the cohesive strength is less. Hence, when the soil is saturated, it has a tendency to swell. By making an artificial cutting of more than 2 to 3 meters, road structures come down, thereby inducing a possible landslide. This is what is happening frequently in 'Wayanad Churam'. This kind of landscaping for any purpose such as agriculture or construction, depending on the nature of the soil, must be regulated.
- b) Oversaturation of soil:** Unscrupulous terracing and cultivation practices that promote infiltration, water retention that led to the excess entry of water into the subsoil, are also one of the reasons behind the landslides.

The sudden flooding in the hilly areas moved downwards, due to the peculiar nature of the Kerala terrain, to the midland. In addition to the heavy rains in the mid land, the entire low lying and mid land area got inundated, thus causing heavy damages like severe erosion, landslides, water logging, etc. It affected the life and properties of people residing in these densely populated areas in the state. The poor management of water in the reservoirs, dams and other water-retaining structures belonging to the Power and Water Resource Departments worsened the situation of flooding. Due to new moon on 12th of August, the sea was very rough and during this time the roaring waves deposited and took away the sand and mud in the coastal areas, resulting in the pozhi's getting closed with sand bar and water could not be discharged into the sea. The lack of coordination between the officers in timely communicating the alarming situation to the people residing in the flood-prone areas also increased the vulnerability of the situation. It is also to be noted in this aspect that in certain districts, the district administration was not aware of the openings of spillway shutters of dams resulting in huge damages, whereas in some other districts, the shutters of dams were kept opened well in advance (Neyyar, Peppara and Themmala) and with no adverse impact.

The severely flood-affected areas can be classified into three regions:

- a) Region 1 (Wayanad, Malappuram and Kozhikode Districts)
- b) Region 2 (Palakkad, Thrissur, Ernakulam, Kottayam and Idukki Districts)
- c) Region 3 (Pathanamthitta and Alapuzha Districts (Chengunnur and Kuttanad areas).

In the Region 1, two major dams, Karappuzha and Kuttiyadi, and canal system of Banasura Sagar Dam comes under the control of Irrigation Department whereas the other three dams come under Kerala State Electricity Board Limited. Of these, the canal system of Karapuzha Dam reservoir has not been made functional so far. Due to the unexpected rainfall in the Wayanad District, especially in Panamaram, Padinjarethara and Vythiri, heavy slippage and landslides occurred and the Kuttiyadi Dam reservoirs get flooded due to

the heavy inflow of water, and the shutters were opened without considering the consequences and hardships. Moreover, no warning was given to the people living in the downstream of the dams. Wayanad District has got a relentless rainfall of 96.67mm on 16th August alone and continuous rain since 8th of August 2018. The roaring flow of the flood water ate away the lives and property of the people living in the downstream until it reached the Arabian Sea. It may be noted that the changes made in the land-use pattern in the district had contributed substantially for the occurrence of landslides and slippages. Also paddy cultivation has been almost completely wiped off from the Wayanad district.

The situations in Region 2 were entirely different, where inundation occurred in the plain lands of Aluva town and its suburbs, North Paravur, Cherai, Chalakudy town and its periphery, and extended up to Edappally under the Kochi Corporation area. The water discharged from the Idukki reservoir through the Cheruthony Dam spillways (aggravated by the opening of all the 13 spillway shutters of the Mullapperiyar Dam), the outflow from the Dams in the Munnar region, Idamalayar reservoir and also from the Upper Sholayar, Peringalkuthu and Bhoothathankettu Dam induced such a severe situation in the basins of Periyar and Chalakudy Rivers. There was huge lapse in communicating the flood situation that was increasing day by day, which resulted in heavy loss to the people and their valuable records, certificates, vehicles, livelihood, etc. The worst flood-hit area in the history of Kerala comes under this region.



The third region comprising places like Pathanamthitta, Ranni, Chengannur, etc., experienced severe damages, even though all these places lie in the central mid land region. Almost all the dams in the upstream of Pampa River starting from Kochupampa belong to the Kerala State Electricity Board Limited, and only the barrage at Maniyar comes under the control of the State's Irrigation Department. The unprecedented rainfall, almost four times than the normal, and lack of communication about the opening of the spillway shutters, etc., contributed to inundation of these regions. In fact, the Alapuzha District was experiencing a flood since one month before the disastrous second spell. The stagnation of water in the Kuttanad region increased the area of inundation in the upper mid lands making life miserable to the people there.



## **7. Impact across sectors**

The August flood made a huge impact across diverse sectors, especially dam management and power generation, agriculture, housing, environment, etc.

### **7.1 Dam management and power generation**

Normally during the months of June, July and August, the water level in the reservoirs in Kerala reaches around 40--50 per cent of their capacity. However, during this period, unlike previous years, the water levels in almost all dams reached their maximum levels. The power generation in the respective power houses was not so controlled as to reduce the alarming higher levels of water storages. The KSEB Limited of the Government has not taken any steps towards this direction. Usually in Kakki, Pamba and Idukki reservoirs, the maximum water level reaches during the end of the northeast monsoon. If power generation were so adjusted or excess water properly released from the respective dams by opening the respective spillways at appropriate time, the water levels in the reservoirs could be brought down to a much manageable level. However, what happened in August was that when the water level reached the maximum, all the dams were suddenly opened which led to the alarming flood, damaging lives and properties.



During the year 2017, the total water storage in reservoirs in Kerala for hydel power generation on 1<sup>st</sup> of August was 1077McM (Million Cubic Metres). However, in this year, during 1<sup>st</sup> of August 2018 itself, the total reservoir storage in the hydel project dams was 3821McM, which was almost four times the usual water storage.

**Table 3: Water storage level in Idukki and power generation from Moolamattom powerhouse (1<sup>st</sup> June to 11<sup>th</sup> August 2018)**

<b>Date</b>	<b>Storage (in %)</b>	<b>Power generation in Million Units (MU) at Moolamattom (Max: 18.72 MU)</b>
June 01	24.98	8.50
June 10	29.50	3.10
June 25	44.05	3.19
July 01	47.30	2.19
July 10	53.00	4.70
July 15	65.30	2.30
July 20	77.90	9.84
July 22	80.00	8.54
July 25	85.30	12.35
July 31	91.70	15.00
August 01	92.00	15.00
August 11	95.74	15.00

Although the water storage on 15<sup>th</sup> July at Idukki reservoir was 65.30 per cent, the power generation was only 2.30 MU in the place of a maximum capacity of 18.72 MU. This clearly indicates the lack of planning from KSEB Ltd, since there was forecasting of heavy rainfall after July 15th. Usually the Idukki reservoir stands full due to the inflow from north east monsoon, but this year the storage during June and July months was at higher level, and in spite of the warning from IMD about higher rate of rainfall in Kerala during July and August, the generation at Moolamattam power house was very low. Moreover, power was purchased at higher rates from outside the state.

The Committee noted that the highest rainfall recorded at 298 mm during the south west monsoon of 2018 was at Nilambur on 18<sup>th</sup> August, which is why, unlike the previous years; Nilambur was hit with the heavy flood for a short period. It is also observed that anything above 300 mm is considered to be very high rainfall and should be considered as extreme events. Peerumedu station, which comes between the upper catchment areas of Idukki and Pamba, had received a rainfall of 1615 mm within 11 days, which is more than half of Kerala's average.

Although there is a standing instruction from the KSEB that all the machines in the major power houses are to be kept ready for operation after completing all the maintenance works at the beginning of the water year, i.e., June 1<sup>st</sup>, the committee noted that, two machines at Moozhiyar power house (110 MW) and one at Moolamattom (130 MW) (another one is shut down for renovation works) were not functional even during the month of August. This also contributed towards the higher level of water storages at Idukki, Pamba and Kakki reservoirs.

As per the GO No (P) No.05/2018/DMD dated TVM 29.09.2018, the severe flood that hit the state affected 1259 of 1664 villages. Moozhiyar, Ranni, Chengannur, Pandanadu, Aluva, Chalakkudy and Kuttanad were some of the areas that suffered the most. The Committee analysed in detail how the opening of the dams added to the flood. Some of its observations are given below:

- a) **Pamba Basin:** When Kochupamba, Anathodu (Kakki reservoir) and Moozhiyar dams was opened simultaneously, the water from these reservoirs was been released simultaneously, which was one of the major reasons for flood in Thriveni, Ranni, Maraman, Aranmula, Pulladu, Pandanadu, Chengannur, etc. In some areas, the water level rose up to 16 feet caused by the impulse discharge from the dams.
- b) **Muthirapuzha Basin:** Water from Kundala, Mattupetty, Pallivasal, Kallarkutty and Ponmudi dams got together in the Muthirapuzha basin.



- c) **Periyar Basin:** Water from Mullaperiyar and Cheruthoni dams, which are part of the Periyar basin, joined in Panankutti together with the water from Muthirapuzha basin, converged at the Lower Periyar dam. As such, the water from the Lower Periyar and Idamalayar dams (a portion from Peringalkuthu reservoir also contributed to Idamalayar basin through Watchmaram diversion scheme) came together at Boothathankettu which was kept opened/overflowed by which Aluva, North Paravur and the adjoining areas were flooded. This caused the Nedumbassery airport to be shut down due to heavy damage inflicted upon by rising flood level, damaging compound wall, runway and airport buildings. The Committee felt that the closure of the airport for two weeks affected lakhs of passengers and the trauma they experienced is beyond assessment.



- d) **Chalakydy Basin:** The dams in Chalakydy basin that include Upper Sholayar, Parambikulam, Aaliyar and Kerala Sholayar overflowed and the water was released into Peringalkuthu Dam, which overflowed as well, resulting in flood at Chalakydy and nearby areas.
- e) **Wayanad:** Water from Banasurasagar Dam was released untimely without any warning by which Wayanad and nearby areas were flooded. The overflow of Kabani

River added to the already devastated situation in Mananthavady. The Committee observed this was indeed an avoidable disaster.

## **7.2 Lapses observed by the committee**

The Committee pointed out that all major dams in Kerala overflowed except the Aanayirankal and Thenmala dams during the flood. It emphasised the fact that under no circumstances, the dams should overflow and this was a major administrative failure. Moreover, the fact that most of the rivers experienced a drought-like situation soon after the floods, when dams were closed, further confirms that the severity of the flood was several times magnified due to dam opening.

It is also significant to note that the weather forecast from IMD at the time was not sensitive and serious enough for such a high-level disaster. The state, district and local administrations failed to take the warning seriously and the Disaster Management Authority (DMA) did not act at the required speed for relocation which was marginal, resulting in confusion among the various government agencies. Predictions from IMD and Skymet were also not taken seriously. The committee also observed that the general public is not aware of the different degree of alerts issued during such natural calamities, and the government should take necessary initiatives to create awareness programmes for the same.

One of the major objectives of dam management is to control flood and prevent droughts. As the dams were already full, there was less space to operate and dams were filled the moment the water was available. There was no space to store further water in the dams, which led to the water being released at once. The inflow to the down streams, which was already facing floods due to rainfall, increased the magnitude of flood disaster. Some of the significant lapses observed by the Committee are given below:

- ❖ Lack of coordination between dam management authorities, irrigation authorities and district administration regarding dam opening, water release and duration of release,

area of inundation, extend of rise in river water levels with the release of water from reservoirs, etc.

- ❖ The shutters in the Thottappalli spillway were not opened in time to discharge the flood and the mouth of the Thottappalli pozhi were closed due to the rough sea waves during that period.
- ❖ The sudden release of water from the dams raised the water level so rapidly that there was not enough time and opportunity to respond to the situation and for eviction. The potential damage from water suddenly released from a dam is much greater than that of the gradual rising of water level in the river.

**a) Committee's recommendations**

The Committee urges the KSEBL to see that by the commencement of the water year, i.e., by 1 June, all the hydel machines of the major stations in Kerala shall be made fully operational to manage the reservoirs during heavy rainfall situations. A strategy to rethink about the operations of the hydel stations so as to maximise the power generation, thereby avoiding the opening of the spillways to control the flood situations, needs to be developed.

- ❖ The water flow from Peringalkuthu reservoir to Idamalayar reservoir through Watchumaram must be properly regulated by revamping the existing gate system. A proper plan in respect of the power generation strategy, based on the weather forecast by various agencies, before commencement of the water year shall be envisaged.
- ❖ A proper strategy shall be evolved in the opening of major dams, such as, advance information to concerned district authorities, local bodies and public, through all sources of media. A proper water management system should be evolved for maximising the usage of the water storage in the reservoirs for electricity generation/irrigation as well as other domestic purposes. Dam safety measures shall be

taken up in a phased manner to renovate the structures of the dams and their operational equipments.

- ❖ The committee suggested that there should be a controlled release from Mullaperiyar dam, which will help in regulating the water level at Idukki Dam.
- ❖ With water level going down and the rivers drying up at appropriate places, the panchayat needs to build check dams at adequate distance across the river. Rivulets need to be constructed which will improve the water percolation. It is a proven technology for water conservation as they take care of the water table. Periodical removal of the sand and silt accrued needs to be removed in an incremental way and in a sustainable manner so as to avoid over harvesting is detrimental to the ecosystem.
- ❖ Every Dam in Kerala has the Rule Curves that needs to be taken into account before commencing the procedure to fill the dams. This has to be re-examined so that each dam in the state will have a clear rule curve that has to be strictly followed. The evaluation of the Rule Curves of the dam will reveal the lacunae of conservation and release, and operation during the flood. The Kerala dams clearly failed in flood moderation during the August 2018 flood, as the dams were already full when the flood occurred. The Bureau of Indian Standards 1994 code has also prescribed a rule for reservoir operation, which has a very clear stipulation in this regard and would also include releasing of all inflows up to the safe channel capacity.
- ❖ The CWC and CAG highlighted the need for a Dam Operation Manual and also Emergency Action Plan (EAP) and it is doubtful whether the dams of Kerala have one.
- ❖ The Idukki Dam falls in the Periyar River basin, which alone has 20 dams, 17 reservoirs and has six diversions namely Kuttiyar, Vadakke Puzha, Azhutha, Narakkanam, Kallar and Erattayar. It filled up to 90 per cent, for the first time in 2018, left with little role to play in flood control in the mid of the southwest monsoon.



- ❖ According to the CWC reports, the worst-affected districts were Wayanad-Kabani sub basin; Idukki-Periyar sub basin; Ernakulam-Periyar and Chalakudy sub basins; Alleppy and Pathanamthitta-Pamba sub basin. It is evident that the dams played key role in these sub basins and they did not follow the rule curves or the emergency plans or inundation maps, and violated basic norms of reservoir management.
- ❖ There should be controlled release in Mullaperiyar Dam, which will help in regulating the water level at Idukki dam. Special scientific measures should be taken in case of Alappuzha District as it was one of the worst hit places during the floods.

### 7.3 Agriculture

Flood severely affected the agriculture sector in terms of crop and yield losses. Diseases also affected the crops under cultivation. Floods came as another severe blow to the farmers who were already under stress due to the unsustainable prices for their produce. Many farmers struggling with loan indebtedness need great support to sustain and to continue their agricultural activities. In the high and middle lands, where plantation crops are the predominant crops, farmers were badly hit due to the continuous rain and over stagnation of water in the cropped area.



This affected their yield and wilting and weathering of the crops were also noted. Large-scale premature dropping of the yield in cardamom, pepper, coffee, arecanut, cocoa and coconut are reported. Rubber plantation, as a predominant crop of the state, is hit by low price; many areas are left untapped and the heavy rain has hit the plantations and the growers. The interactions with the farmer representatives and the field visit have convinced the committee of the severity and the farmers' plight.

**a) Committee's recommendations**

- ❖ The damage to agriculture sector needs to be assessed scientifically. Panchayat-wise aerial maps can be used to assess losses in the area.
- ❖ Good quality planting materials need to be supplied to the farmers as there may be a shortage of planting materials, which has to be procured or raised, so that only quality planting materials are supplied especially perennials.
- ❖ Paddy cultivation is relatively environment-friendly and enriches the ecosystem. Hence restoring paddy cultivation should be given priority with adequate support. Paddy fields are an alternative area for flood control and water retention. In fact areas of paddy cultivation have been left fallow and recovery plan needs to be taken up.

Paddy needs to be focused as the priority area and adequate and timely inputs should be given to the farmers.

- ❖ Ensure timely credit for the needy farmers taking into account of their loan, if any availed.
- ❖ The biggest depletion is the soil fertility and loss of micro nutrients. This has to be scientifically assessed and agro region-wise assessment should be done and a replenishment plan needs to be implemented. Enriching the soil and its fertility needs to be taken as a government programme rather than leaving the same to the farmers who may or may not be able to do so.
- ❖ Kerala has experienced farmers' suicide for so many years. Farmers need special counseling due to crop loss, etc. as a result of floods. Counseling needs to be organised anticipating their problems.
- ❖ A special package needs to be initiated in Wayanad, Idukki and other hilly areas, which has suffered crop/plantation damage as a result of the flood and landslides.
- ❖ An expert committee has to be constituted to look into the land-use pattern in hilly areas. Cultivation of crops in slopes, which induce heavy soil tilling, etc. need to be discouraged. Alternative economic and eco-friendly crops should be recommended panchayat-/ward-wise as a long-term conservation strategy.
- ❖ Idukki District, especially its hilly areas like Vattavada, Kanthalloor, Marayoor (Anchunadu) may be made use of for hill vegetables as Kerala imports them from neighbouring states. Such vegetables are laden with heavy pesticide content creating health issues. Moreover, bringing vegetables from other states incurs huge transportation cost leaving carbon foot print on the eco system/enviorment. This opportunity must be put to the best use by procuring hilly vegetables locally, which would support the farming community and also create green jobs locally.

- ❖ Organic agricultural practices need to be encouraged in the Western Ghats, which will gradually improve soil fertility, and reduce water pollution as all major rivers of the state originate from the Western Ghats. This is the time to initiate the restoration of the lost ecosystem in the region.
- ❖ Agricultural practices in Wayanad should be revisited. The “Wayalnadu” should literally be recreated and paddy cultivation must be revived. It is advisable that specific varieties endemic to Wayanad be cultivated, branded and sold in the market to boost the local economy. Also, Wayanad-specific organic coffee, tea and spices along with fruits should be popularised. This will help in bringing back the economy to a sustainable level. Banana plants, arecanut and coconut trees must not be cultivated in paddy fields. Farmers may be helped financially for this transformation until they become self-supportive.
- ❖ Wayanad is a potential district for Milk Production because of better climate, higher elevation and availability of good biomass. Traditional animal husbandry practices need to be encouraged. With the establishment of the Veterinary and Animal Sciences University in Wayanad, it should be possible to provide the farmers the necessary skills and advises, if needed. Agricultural University, Ambalavayal Research Station and M.S. Swaminathan Research Foundation (MSSRF) are capable of providing all scientific support for the restoration of the soil fertility and agro-diversity in Wayanad.
- ❖ Idukki District also needs special attention as it is in the Western Ghats. Ecotourism should be given adequate focus to help increase the livelihood of people without causing further environmental degradation. Waste management in the hill towns should be done using modern technology and encourage organic cultivation in possible areas. At no cost, the rivulets in the hills be polluted.
- ❖ Munnar panchayat, municipality in particular, should not continue the raw solid waste disposal at Nallathanni, which is creating water pollution. Kerosene engine-driven boats should not be allowed in Mattupetty reservoir in the name of tourism, which



affects adversely the health of people living downstream. Instead, only pedal boats must be permitted. Even elephants avoid drinking water from the Mattupetty reservoir (Kerosene polluted) and encroach upon jersey farm nearby. The tourism potential of Munnar should be eco-friendly driven.

- ❖ High-rise buildings should not to be permitted in the slope of Idukki hills, particularly in and around Munnar, as the areas are landslide prone. Idukki district be developed for farming vegetables, fruits and horticulture.
- ❖ Adequate quantum of water should be made available at the right time and at right places by constructing small check dams, vented cross bars, dykes, lift irrigation schemes, etc., as envisaged in the Package for Rehabilitation of Farmers of the Districts of Kasargod, Wayanad and Idukki in 2008--2009.
- ❖ All the available ponds, whether private or public, small or big, etc., should be deepened, widened, protected and maintained, so as to raise water table level.
- ❖ The Meteorological Department should be strengthened with up to date technologies, so that correct and reliable information of each and every places, according to movement of clouds and winds to be made available.

#### **7.4 Kuttanad wet land deserves special dispensation**

Kuttanad has a unique ecosystem which suffers regularly from flood and other natural calamities. In 2018 unfortunately, Kuttanad had a prolonged water logging in response to two floods over a period of around 2 months. This situation was created mostly due to the lack of draing flood water into the see through the Thotappaly spillway and the defective Thannoor Mukkam band. To worsen the situation the rough sea caused back flow of water inundating larger areas of Kuttanad. This resulted in the extensive crop loss and livelihood and added to the misery of the people for a prolonged period.



Being also a tourist area, Kuttanad should have a SPV (Special Purpose Vehicle) to the area/region so that it can strengthen itself in a sustainable way. The SPV may have to be a lean one with top-notch experts for each discipline to provide unity of command, avoid departmentalism and ensure accountability. The SPV could be owned by a Committee constituted by all the local bodies under which the Kuttanad Wetland falls. The chairmanship may be on rotation based on the descending order of the area of the local body. All the local self-governments (LSGs) falling fully or partially in the basin of the rivers flowing into Vembanad Lake may be made associate members. This may be designed considering the provisions of the Wetland Rules 2017 and the institutions made therein. It is a matter of concern that appropriate technology for sanitation is yet to be developed for low-lying areas like Kuttanad. Even developing an extensive sewerage treatment system should be considered in Kuttanad because of the importance and the eco system service it renders to the country, which is estimated to be Rs.900 crore per year. As a short-term measure, the unit cost for construction of latrines in Kuttanad should be increased for high platform units and also eco-friendly toilet units, etc. Subsidy also should be increased in proportion. Special measures should be arranged for removing septage before monsoon and adequate mobile units with sucking machines should be purchased and kept. Another problem afflicting Kuttanad is the presence of houseboats and other

boats far beyond the carrying capacity of the lake adding to the pollution load. A policy decision should be taken not to add any more boats to the fleet already present. Many of the boats don't have fitness certificates from the Port department and such boats should not be allowed to operate as accidents can befall any day to the tourists visiting the state. Kuttanad is a sink for pesticides, insecticides, fertilisers and heavy metals.

The wetland system with abundance of diversity is on a degradation path. Encouragement of organic farming is important to avoid drinking water contamination with pesticides, insecticides and fertilisers especially through inundation. The productivity will be lesser in the first 4 to 5 years of shifting to organic cultivation, and hence subsidy may be provided for this in a diminishing scale. Government should establish an institution for organic certification, branding and marketing so that organic cultivators will get credibility and better price. The river basins of all the four rivers (Achankovil, Pamba, Manimala and Meenachil) draining into Kuttanad should be included in the mission.



The downstream and upstream of the Thottappalli spillway should be dredged suitably, at least once in two years, in order to accommodate a portion of the flood water. In this way, water stagnation in the upper reaches can be avoided to an extent. A separate study is to be

conducted for the renovation and rehabilitation of the Kuttanad and upper Kuttanad area in the changed scenario without damaging the ecosystem of the area through an accredited agency.

The Thottappalli spillway and the Thanneermukkam bund may be redesigned to cater to the needs of the present and the future requirements based on the study report of Kuttanad Water Balance Study conducted by the Dutch Government during the 1980-85 periods, and also the recommendation of Swaminathan Commission. Both the committees had recommended for increasing the size of the waterway of the Thottappalli Spillway and certain modifications to the Thanneermukkam bund. The assistance of Dutch Government should be made available for sorting out the problems in Kuttanad, as they were having such geographical area as of Kuttanad-the two places in the world where farming is done below sea level. Proper dam management, Dam break analysis and flood mapping for each river and dam in the state should be done so that the public can be aware of the situation in such a calamity. The prone areas of flooding should be marked with the levels of flood in the yester years, including this year.



## 7.5 Housing

The 2018 flood caused heavy damages to houses. A large number of people were displaced. It is reported that more than 15,000 houses have been completely damaged and more than a lakh houses are partly damaged, which also need repair, retrofitting and renovation. People who lost their houses are the most affected as many of their lifetime investments have been lost. It creates a situation of immense psychological pressure, and hence this must be given utmost priority for assistance.

### a) Committee's recommendations

- ❖ As the demand for construction materials will go high, the availability of building materials namely sand, brick, rock, wood, etc. may be in short supply. In order to facilitate supply of building materials, design, technical assistance, etc., the building centres or Nirmiti Kendra can be strengthened.
- ❖ An environment-friendly technology must be followed while constructing new houses. Since Kerala has demonstrated a popular method of cost-effective technology in housing, the same may also be promoted, as it will be eco-friendly and economic.
- ❖ Government may also construct offices which are affected by the flood. In the case of those buildings requiring reconstruction, government should follow different technologies in the same building which will have a demonstration effect and people would like to replicate it as seeing is believing.
- ❖ The area suitable for housing needs to be geologically assessed and certificate need to be given before relocating the houses.
- ❖ As Kerala severely suffers from repeated floods, the construction should be in such a way that it be able to withstand water stagnation and flooding for a few days.

- ❖ Habitants must be encouraged to insure all housing infrastructure and movable properties, as insurance is one of the most effective interventions in disaster resilience.
- ❖ Retrofitting of existing buildings in vulnerable area must also be looked into.
- ❖ The fishermen living in the coasts may be rehabilitated in decent houses so that they are not subjected to natural calamities every year.
- ❖ Government should refrain the public from constructing huge houses and buildings. Also, higher taxes need to be levied from people who proceed to construct buildings in the ecologically sensitive areas.
- ❖ Government should implement a new construction policy against building home stays and resorts, both public and private, especially in affected areas of districts like Idukki and Wayanad.

## **7.6 Disaster Management Plan by Local Bodies**

Consequent on the 73rd and 74th Constitutional Amendments, the Kerala Legislature passed the Kerala Panchayat Raj Act 1994 and the Kerala Municipality Act 1994 to enable the local governments to function as the third tier of government. Out of the 29 functions transferred by the government, 26 functions were transferred to the rural Local Governments as per the 11th schedule of constitution (the functions relating to minor forest produce, distribution of electricity and implementation of land reforms are not transferred) and out of 18 functions to be transferred to the urban Local Governments, 17 functions were transferred (the function relating to fire service is not transferred). As part of functional decentralisation, government has transferred public service delivery institutions such as schools, dispensaries, public health centres, community health centres, district hospitals anganwadis, district farms, krishi bhavans, veterinary institutions, etc. with staff and funds to the local governments to operate them. As on date, the state has 941 Grama Panchayats, 152 Block Panchayats, 14 District Panchayats, 87 Municipalities and 6

Corporations. The local government system affords subsidiary, people's participation, transparency, social audit, etc.

The transferred subjects to rural governments include water supply, upkeep of schools, hospitals, construction of roads and bridges, agriculture, etc, which have a bearing on the post-disaster amelioration. Regulation of land use and construction of land buildings, urban planning including the town planning and urban forestry, protection of environment and promotion of ecological aspects, which have direct pre-disaster management dimensions are the transferred subjects to urban governments. With the result, Kerala has highly decentralised governance with high transparency, accountability, public participation and least corruption among the states of India. It has a system whereby the state government is primarily responsible for disaster management, at the same time with strong and responsive local self governments with concurrent powers in disaster management.

#### **a) Committee's Observations and Recommendations**

The Committee found the following lapses with regard to disaster management in the state.

Predictions from IMD and Skymet were not met with enough seriousness.

- ❖ The state and district administrations failed to take the warning seriously and the disaster management authority did not act alerted at the required speed for relocation resulting in confusion in rescue and eviction.
- ❖ The general public is not aware of the different grades of alerts issued during such natural calamities and the government should take initiatives to create awareness programmes for the same.
- ❖ In the light of the above observations, the Committee has made the following recommendations:

- ❖ Need for Disaster Management plan at the State, District and Grama Panchayat levels
- ❖ All districts need to have a district disaster management plan, which has to be a reference document for implementation. The plan has to be periodically revised and be made available in the public domain. This is missing, as the panchayat functionaries are not aware of the district disaster management plan.
- ❖ Nodal agency to coordinate Disaster Management
- ❖ In pre-disaster preparedness, determine the hazard prone areas and safe areas for different disasters through a scientific study. Carry out hazard zonation at village level with cadastral base. Carry out risk analysis of the hazard-prone area and come out with mitigation plans.
- ❖ Make adequate regulation to restrict activities in hazardous and sensitive areas.
- ❖ With the involvement of fishermen, the seacoast or seashore may be protected by planting site-specific mangroves or other suitable trees as envisaged in CRZ norms.
- ❖ Involve local community by providing proper awareness and in the implementation of local level plans.
- ❖ A recent phenomenon that has been observed in Kerala houses is to have an additional roofing with corrugated sheets ( Aluminium) to prevent excess heat and leakages in the roofing system. Unfortunately this costs practical difficulties in rescue operation and airdropping food and relief materials to the marooned people. It would be probably ideal leave a part of the roof suitable for rescue operation in such events, should they occur.



## 8. Observations and Recommendations on Environment

- ❖ Nature should be respected and all violations against it need to be controlled to protect us from further disasters. Most of the landslides are caused by the human intervention without following the prescribed rules and regulations.
- ❖ The river banks have to be protected with bio fencing using bio materials. For example, in Panamaram panchayat, Wayanad, river banks were least affected where bamboo was planted along the rivers. Resources such as bamboo, reeds, wild saccharum and pandanus, which are locally available, should be used for covering the exposed banks and soils, and need to be included in the Mahatma Gandhi National Rural Employment Guarantee (MGNREG) work. This investment has multiple benefits such as that it is not very expensive and will also create employment opportunities. In view of the heavy erosion of the river banks, it would be appropriate to go this way, which will also reduce carbon print in the ecosystem, thereby making it eco-friendly.
- ❖ River bank encroachments need to be addressed immediately as they are a threat and add to the vulnerability of the area. Presently the state's irrigation department is in charge of protecting the riverbanks and it does so by constructing empanelment walls, which is done by dumping huge quantity of rubbles on top until they come to a certain level. This leads to a reduction in the carrying capacity of the river. Under no circumstances the irrigation department should be allowed to protect the riverbanks by using artificial methods. This is a continuous construction process irrespective of the changes of governments. Hence the entire activities of the river being controlled by the irrigation department need a rethink from the disaster point of view as well for the health of the river.
- ❖ The present unscientific practice of putting rubble (seawall) should be henceforth stopped because the rubble required for the seawall construction is sourced from

the hills of Western Ghats, which is another environmental disaster. It will result in the loss of both the mountains on the east and the seacoast of the west, which supports the livelihood of lakhs of people. A scientific study reveals that sea wall construction increases shore erosion.

- ❖ There is a need to check whether fragmenting Vembanad Lake through bunds and folders for agricultural purposes is a sustainable activity in the long-term. Instead, it is better to try to sustain the agricultural practices in the upper Kuttanad areas and wherever possible without much intervention so that the lost glory of Vembanad Lake can be restored which may bring in tourists in larger numbers. Encouraging more activities to increase sustainable tourism without degrading the environmental aspects, this will be a boost to the local and state economies in the years to come.

## **9. Forest and Biodiversity: Guidelines for Conservation**

Kerala has a rich biological diversity consisting of thousands of plants, animals which are conserved in the Western Ghats Mountains in the eastern side. The Ghats which is the origin of all the rivers in the state and which regulates the climate of Kerala needs special protective measures. In the 2018 floods the Western Ghats suffered tremendous destruction of its landscape resulting in the loss of precious biological diversity evolved over millions of years.



The eco-restoration and relocation of people from the unsafe and ecologically sensitive areas in the Western Ghats (hilly area) of the state have to be done site-specific and by law. People who live in the landslide-prone areas are to be relocated to the plane areas in the districts of Wayanad, Idukki, Kozhikode, Ernakulam, Kottayam, Pathanamthitta (Western Ghats region), etc. The houses to be constructed should be eco-friendly and with peoples' (owners) participation. Construction of houses should not be done in areas, which have more than 30-degree slopes. In fact, such areas should not be even used for annual agricultural activities, as it will trigger landslides again. Quarry mining should not be permitted in ecologically sensitive areas of the Western Ghats region at any costs. However, if minable rocks are present in other areas of the region, it should be allowed for local use with clearance from the State Level Environment Impact Assessment Authority (SEIAA). If need be, rocks should be brought from neighboring districts where mining can be done scientifically. Western Ghats is the abode of thousands of species of plants and animals including the ancestral varieties of several species of rice, spices, medicinal plants, etc. It should be lawfully protected and conserved for the coming generations after current needs are availed.

Kerala should pay more attention to responsible tourism without polluting and depleting its environment. Ancestors did agricultural activities for their livelihood in the Western Ghats region and have used large quantities of fertilisers and insecticides, which have adversely impacted the topsoil in the region resulting in the pollution of rivers during the floods. Moreover, the present generation is not keen in continuing agricultural activities, except a few.

The Biodiversity Act, Forest Act, Environment Act, Coastal Regulation Zone (CRZ) Rules and The Kerala Conservation of Paddy Land and Wet Land Act, 2008 must be implemented without fail. Unavailability of water is also affecting the agriculture in Wayanad and the government should take necessary measures to solve this problem. MGNREG manpower must be used for ecological restoration by using watershed management programme.

## **10. Recommendations and Cautions for Rehabilitation**

- ❖ Develop and integrate pre-project plans for reallocation and rehabilitation of local people likely to be displaced by the landslides and flood, keeping in view their socio-cultural and livelihood needs.
- ❖ Ensure that in all cases in high range areas, the essential minimum needed land for the rehabilitation is permitted. However, natural forest containing high endemic genetic resources should never be affected.
- ❖ Adopt best practice norms for infrastructure construction to avoid or minimise damage to sensitive ecosystem and despoiling of landscapes in the Western Ghats region.
- ❖ Support practices of rainwater harvesting and revival of traditional methods for enhancing ground water recharge, except on slopes.

- ❖ A comprehensive policy may be developed to protect watershed, reduce landslides and to prevent further ecosystem and biodiversity loss.
- ❖ Midland areas may be considered for rehabilitation, if needed. A large area of rubber estates that are uneconomical may be sourced through payment and used for relocating people from nearby riverbanks affected by floods.
- ❖ Riverbanks should be protected by planting more riparian vegetation to prevent soil erosion.
- ❖ Adequate space must be left on either side of the water bodies for them to expand during floods. The small rivulets may be revived so that flood water could reach the flood plane area (room for river).
- ❖ Rubble walls/concrete embankments should be avoided in general to protect the rivers.
- ❖ The low land area in Kerala needs special package to deal with the annual floods and occasional disasters like the recent one. Kuttanad and adjoining areas in Alapuzha and Kottayam districts should be developed as an ecotourism destination. In doing so, all necessary precautions/scientific methods should be adopted to protect the water and air quality. All house boats should have centralised STP facility and in no circumstance, raw sewerage should be allowed in to the Vembanad lake. By law, Kerala is obliged to protect and conserve the three lakes---Sasthancottah, Ashtamudi and Vembabad---as they are Ramsar sites of the UNESCO. The paddy cultivation pattern in Kuttanad needs to be relooked. Vembabad Kayal may be allowed to restore its past glory/status. Paddy cultivation may continue in Upper Kuttanad areas and other places using organic pattern. Cleaning all canals and water bodies around can increase the tourism potential of Alapuzha and eco-friendly practices must be implemented.
- ❖ All encroachments on waterways, riverbanks, downstream of dams should be cleared. River bank stabilisation by afforestation by planting bamboos, Pandanus, Wild

saccharum, Vetiver, etc. Water retention and more surface runoff. Quarrying rules must be strictly implemented. Road cutting should have gentle slopes. Soil stabilisation must be done using gully plugging/geo textiles. Dewatering strategies should be taken up in the region before north east monsoon. The opened up channel during the event can be retained as such for the dewatering purpose. This is utmost important as water infiltration into the soil may lead to further landslide events during the forthcoming northeast monsoon. At present the slope is in semi equilibrium and activities that destabilise it should not be taken up. Debris should not be removed from the region, as it will destabilise the slope. However, large fallen trees/rocks, which present a chance of slipping, can be removed with minimum disturbance.

- ❖ Afforestation activities can be taken up on the debris after the south west monsoon (2019). This will give sufficient time for natural vegetation growth, especially grasses and slope stabilisation.
- ❖ Fisher folk staying in the seashore are to be relocated to at least within 500 meters range from the high tide region so that the seashore is made available for the fishing and coastal development.
- ❖ As a precautionary measure, temporary relocation of the people from the region during the forthcoming northeast and southwest monsoons is advised. Periodic evaluation of the site for stabilisation is recommended.

## **11. Lessons Learnt**

Weather forecasting has to be more accurate and specific, and needs to be at sub district level for effective intervention. There should be a system in forecasting weather at panchayat level, especially in areas of the Western Ghats regions such as Kozhikode, Wayanad, Idukki and Pathanamthitta. Currently, such systems are only placed at district level, which should be made to panchayat level. For example, in Karnataka, the government has invested in such systems at panchayat level, and they have got a better

methodology and have done it in a very detailed way which Kerala should follow as it is more prone to the flood.

There needs to be periodic interaction between IMD and the authorised agency for forecasting in getting proper information. Another important aspect to be addressed is the flood mapping by making the flood of 2018 as the benchmark.

There should be clear protocol, and advance information system regarding the release of water quantity from the dam in such advance time for suo motto information for the people to move safer places/or adequate time for the administration to inform and time to vacate to safer places. There is also a need for an Emergency Action Plan (EAC) for each dam which would clearly cover the level of water to be covered, duration, rainfall, etc.

The alerts has to be periodical and people in the vulnerable areas need to be continuously informed. Merely alerting the public through mike announcements is not enough. The disaster management protocol clearly states that people from every survey number that is to be hit by water must be informed beforehand, and then only the announcements are needed. In the recent flood, people were confused as in when or where they should move from their houses to rescue shelters. Kerala is being placed in the Zone 3 in terms of earthquake and the vulnerability needs to be reassessed in view of the 2018 flood. Building codes has to be enforced at panchayat levels itself so that the panchayat secretary, overseer or whoever responsible can look into the earthquake aspect of the land before giving permission for any kind of constructions. These areas have to be put under observation and studied, and the service of a geologist needs to be used to make reports on the safety of the buildings located, and also for the planning and locating houses in hilly areas. They should also be involved in the recovery plan.

The Flood 2018 has cautioned us about the the land-use pattern. Farming should only be done at flatland areas and cultivation at sloppy areas must be restricted. There should also be a list of do's and don'ts by laws and designs. For example, if one needs to construct a

house at an ecologically sensitive area, one should think about the design beforehand and certain activities that would disturb the land must be prohibited by law, and permission for construction by the concerned authorities must be given based on that particular design.

## **12. The Road to Recovery: Implementation Strategy**

### **12.1 River Basin Council**

The Committee, after careful study and examination of 2018 flood, is of the opinion that such mega floods which are unprecedented need to be tackled on river basin basis as many districts fall under each river basin, for example, Pampa River basin (Pathanamthitta and Alappuzha), Periyar River basin (Idukki, Ernakulam, Kottayam, etc.). Any intervention has to be on a river basin basis starting from the origin of the river and also along the river flowing which alone will make a good impact on coordinated efforts and there will be an understanding between all the river basin players. Development schemes in controlling the flood from the upper catchment to the lower level will be meaningful taking into account the flow of the river and check dams, river bank taming, etc., need to be done.

All the Panchayats through which the river passes through should be made members of the River Basin Council (RBC). The district panchayat president, covering the maximum area of the river basin, could be made the chairperson. The district collectors and all the functional line departments' head should also be members of the RBC. In addition, the State government can nominate experts from the state and also from the national level like CWC (Central Water Commission), CEA (Central Electrical Authority) so that required expertise can be made available. International experts through UN organisations may also be invited for the RBC. This river basin approach of disaster management will be a model disaster management plan.

### **12.2 Governance Issues**

There is a need for a strong Disaster Management Plan (DMP) at district, block and more so at the panchayat level, since they being the first responders. As recommended by



NDMA (National Disaster Management Authority), a Disaster Management Plan needs to be prepared at Panchayat level. The plan has to be vibrant and should be known to the community and to all the stakeholders. The Biodiversity Management Committee (BMC) constituted in all the local self-governments including Panchayats, Municipalities and Corporations as per the Biodiversity Act 2002, Government of India and Kerala Biodiversity Rules 2008 is in vogue now. The Kerala government has issued an executive order authorising the BMC to be the environmental protectors locally and the present disaster management plan should involve the BMC of the respected LSGs. The BMC may be requested to provide the necessary inputs for the local disaster management plans as segmented disaster occurs.

### **12.3 Social Audit**

There should be a well-defined social audit system to ensure that the plans are prepared by taking the aspirations of the people into account and also to make sure that they are implemented properly. For this, project ideas generated should be placed in the Gramasabha/Ward sabha before they are shortlisted by the local government. The finalised plan should be placed in all the Gramasabhas/Ward sabhas coming under the local government for information to ensure transparency. Implementation progress should also be placed in the Gramasabhas/Ward sabhas as a regular agenda item in all their meetings. Display boards should be erected at the project sites and the estimate amount, materials used, name of the contractor, administrative department and all other pertinent details should be displayed for transparency. All the disaster management-related files should be in electronic format and people should be given the right to see the files. The social audit cell in the Project Management Unit (PMU) should review the minutes' entry on disaster management in the GramaSabhas/Ward Sabhas, and corrective actions must be taken and published in the website of PMU, respective RBC and concerned local government.

### **12.4 Grievance Redressal System**

A grievance redressal system for summary disposal of grievances should be devised so that people would get assistance in time proportional to their loss as per government norms. It

will ensure that no undue favour, partiality, discrimination or nepotism is shown to anybody. Corruption in the system should also be looked into. For this, an appellate system may be devised in every district so that fast redressal of grievances would be possible. The voluntary appellate system could be formed under the Chairmanship of a retired magistrate/judge and a retired revenue and agriculture functionary not below the rank of a Tahsildar as members. Complaints, if any, over the decision of the appellate body could be filed with the Collector, whose decision shall be final.

All grievances should be addressed within one month's time. There should be display of the details of the beneficiaries on the website as is being done by the Ernakulam District.

### **12.5 Building Resilience**

Disaster management has to be given thrust in all development programmes and no development should weaken or add to the problems to the vulnerability of the area. There should be Local Disaster Management Plan document prepared involving all the stakeholders, primarily the people in the vulnerable area. All development plans should add and strengthen the disaster mitigation of the area.

Disaster resilience depends on the local community preparedness. Hence the local people must be given individual survival skills like swimming, practical aid, provisions to safeguard the elderly, women, differently abled, etc. At the local level, Panchayats need to be equipped with minimum equipment's like boats for rescue, ropes, diesel generators, public announcement system, powerful torch lights, first aid box, etc. The help of migrant population and guest workers need to be taken in strengthening the disaster management system. The document can be made more vibrant by involving all the stakeholders and primarily the people in the vulnerable area. Following the safety culture, should be made a habit. There should be a rescue team at local ward or panchayat level, which needs to be trained periodically and equipped and exposed, as they would be a great strength.

## **12.6 India Meteorological Department (IMD)**

The IMD is the main weather-related information dissemination unit, but currently there is gap in information which has been felt in the current flood. It needs to convey information to the district administration for warning, rescue, etc. Hence the credibility of the weather forecasting has to be built with all scientific inputs as the current system is inadequate in terms of inundation, area of flooding and how long, etc.,

The current system of district-level forecasting will not equip us to face the disasters. The Karnataka Disaster Management System, with local area forecasting and inundation area and alarming system, need to be studied and replicated. Weather forecasting system needs to build up.

## **13. Conclusion**

Kerala faced the Disaster of the Century in 2018. The State had to suffer economically, environmentally, socially and culturally. The disaster drew the attention of world organizations including the United Nations (UN), Asian Development Bank (ADB) and the World Bank. The Discovery Channel telecasted an one hour programme about Kerala flood 2018 on 12<sup>th</sup> November 2018. The disaster has exposed the gaps and the practices being followed and the deficiencies at various fronts from weather forecasting to water management, and lack of coordination in dams and reservoir management. Since the flood and landslide of 2018 had created massive impact in all spheres, it is required to glean out actions for future so that years of development and assets, both private and public are not destroyed again.

The committee has made certain recommendations like the need for a disaster management plan at panchayath level which will build resilience in the local community.

The flood management has to be based on a River Basin Council approach which would take care of the entire river basin in a co-ordinated manner involving the panchayaths and the districts. This will be a good pilot model plan in the State and Country. The land use pattern has to be re looked into, so that the land use is on a scientific basis and only such

crops which strengthen soil conservation will be recommended. The flood prone area is to be brought under mandatory insurance

The present IMD data regarding the forecasting is inadequate and needs strengthening to have area wise (Sub district level) forecasting. A high level body at government level is recommended to monitor the reservoir management and water release. An effective co-ordinated mechanism, transparency, district level grievance redressal system, social audit are also recommended. The technology and good practices available globally also to be taken in for rebuilding Kerala.

Climate change has become a reality, and the 2017 drought and 2018 flood are the results of climate change. Disaster management needs to be integrated in all development plans to be taken at the local/Panchayat level, and needs to be managed effectively in a coordinated manner by pooling resources. The recovery and rebuilding should be faster and the needs of all those who are affected should be addressed. Respecting nature and all the environmental laws and rules is required so that a Resilient Kerala can be built to face any such calamities, thereby keeping everyone safe and secure from disasters.

All the activities aimed at rehabilitation and eco-restoration should reduce the carbon footprint to the extent possible. Climate change over the past few decades has affected our lives considerably. Therefore, there should be scientific studies and approaches at all levels to mitigate the climate change-induced environmental degradation and biodiversity loss, to rebuild a greener, cleaner Kerala and restore it as “Gods own Country”.