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Kerala

Post Disaster Needs Assessment

Floods and Landslides - August 2018

October 2018

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Foreword

From June to August 2018, the state of Kerala experienced the worst ever floods in its history since 1924. Torrential rain ravaged the state, causing floods and landslides in all 14 districts. Nearly 342 landslides in revenue land were reported from 10 districts. An estimated 5.4 million people were affected, and 433 persons lost their lives. Relief assistance was provided to displaced families as per the prevailing norms in the State, over and above the norms of assistance laid by Government of India. The response machinery of the state government such as Fire and Rescue Services and Police and the National Disaster Response Force, the Army, the Navy, the Airforce, the Coastguard and the Border Security Force were mobilized and coordinated at the State and District Level which helped to save many lives. The spontaneous efforts of the community especially the fisherfolk deserve special mention, reports estimate that they saved about 65,000 lives.

As people started to move back into their homes, the state has moved from a relief to a recovery phase. The Government of Kerala commissioned the post disaster need assessment (PDNA). It was initiated on 18 September 2018. The PDNA, jointly developed by international development partners - European Union, World Bank and UN system - represents a tool and methodology for assessing damage and loss and estimating recovery needs.

The Kerala PDNA was undertaken jointly by line ministries and experts from the United Nations and the European Union. The PDNA team worked tirelessly to produce this report in a very short time frame. The process was participatory and included several rounds of consultations with all stakeholders and communities in the affected areas. Our sincere thanks are due to all who contributed to this report.

The Kerala PDNA builds on the Joint Rapid Damage and Needs Assessment (JRDNA) undertaken by the World Bank and the Asian Development Bank. The PDNA includes the sector chapters and recovery needs from three infrastructure sector chapters: Transport, Power, Water Resources and Irrigation. Along with the three sectors, the PDNA covers a total of 15 sectors and cross-cutting issues, an analysis of the macro-economic and human development impact and a recovery strategy. Going beyond a traditional PDNA, the report also suggests options for a recovery policy and institutional arrangements for undertaking recovery in Kerala over the next five years.

Our vision for recovery is to move toward Nava Keralam – a new Kerala based on the four pillars of recovery: Integrated water resources management based on principles of "room for river" and "living with water"; Eco-sensitive and risk informed land use and settlements to build a green and resilient Kerala; Inclusive and people centered approach (leave no one behind) and Promotion of knowledge, innovation, technology through partnerships to build back faster, safer and sustainably.

This PDNA is dedicated to the people who were affected by this calamity. We look forward to working with all stakeholders in the implementation of the recovery programmes proposed in this PDNA report towards a resilient and green Kerala.

Government of Kerala

Acknowledgements

The PDNA for the floods and landslides was made possible due to the collaborative efforts of the Government of Kerala, the Kerala State Disaster Management Authority, the United Nations agencies, the European Commission (and , Swiss Agency for Development and Cooperation (SDC) , European Union Civil Protection and Humanitarian Aid (ECHO)

The State Government would like to extend special acknowledgment to the following authorities:

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To all the sector team members and contributors listed in Annex 1.

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Executive Summary

Background

Kerala, with a population of over 3.3 crore, is globally recognised for its impressive achievements in human development. Within India, Kerala ranks first among Indian states on the Human Development Index (HDI). In 2015–16, Kerala was among the top five Indian states in terms of per capita state domestic product and among the top four in terms of growth in per capita income.[1] Many other human development indicators for Kerala are at par with those of developed countries. For instance, the state reported a literacy rate in 2011 of 94%[2] (as against the national average of 73%), life expectancy at birth between 2011–15 of 75.2 years (the highest among Indian states and higher than the national average of 68.8 years)[3], and an infant mortality of 10 per thousand live births (the lowest among Indian states)[4]. The state also reported the lowest proportion of population below the poverty line (7%) as against the national average of 22%.[5] In 2015–16, 94% of households had access to improved drinking water sources, 98% of them were using improved sanitation facilities, and 99% of the households had electricity.[6] Human development has also been more equitable in Kerala than in other Indian states. For instance, Kerala is placed first among states in inequality adjusted HDI which indicates the least loss of HDI on account on inequality.[7]

Kerala, however, is highly vulnerable to natural disasters and the changing climatic dynamics given its location along the sea coast and with a steep gradient along the slopes of the Western Ghats. The Kerala State Disaster Management Plan identifies 39 hazards categorised as naturally triggered hazards (natural hazards) and anthropogenically triggered hazards (anthropogenic hazards). Kerala is also one of the most densely populated Indian states (860 persons per square kilometres) making it more vulnerable to damages and losses on account of disasters.

Floods are the most common of natural hazard in the state. Nearly 14.5% of the state's land area is prone to floods, and the proportion is as high as 50% for certain districts. Landslides are a major hazard along the Western Ghats in Wayanad, Kozhikode, Idukki, and Kottayam districts. Seasonal drought-like conditions are also common during the summer months. Kerala experienced 66 drought years between 1881 and 2000.[8] Dry rivers and lowering water tables in summer have led to water scarcity both in urban and rural areas. Other major natural hazards are lightning, forest fires, soil piping, coastal erosion, and high wind speed. The state also lies in seismic zone III.

Disaster Event

Between June 1 and August 18, 2018, Kerala experienced the worst ever floods in its history since 1924. During this period, the state received cumulative rainfall that was 42% in excess of the normal average. The heaviest spell of rain was during 1-20 August, when the state received 771mm of rain. The torrential rains triggered several landslides and forced the release of excess water from 37 dams across the state, aggravating the flood impact. Nearly 341 landslides were reported from 10 districts. Idukki, the worst hit district, was ravaged by 143 landslides.

[1] *Ministry of Statistics and Programme Implementation, Government of India accessed at mospi.nic.in/sites/default/files/press...statements/State_wise_SDP_31_03_2017.xls*

[2] *Census of India 2011, Registrar General of India*

[3] *Office of the Registrar General of India, Ministry of Home Affairs cited as Table 9.1 in the Economic Survey 2017–18, Ministry of Finance, Government of India accessed at http://mofapp.nic.in:8080/economicsurvey/*

[4] *Sample Registration System accessed at http://www.censusindia.gov.in/vital_statistics/SRS_Report_2016/8.Chap%204-Mortality%20Indicators-2016.pdf*

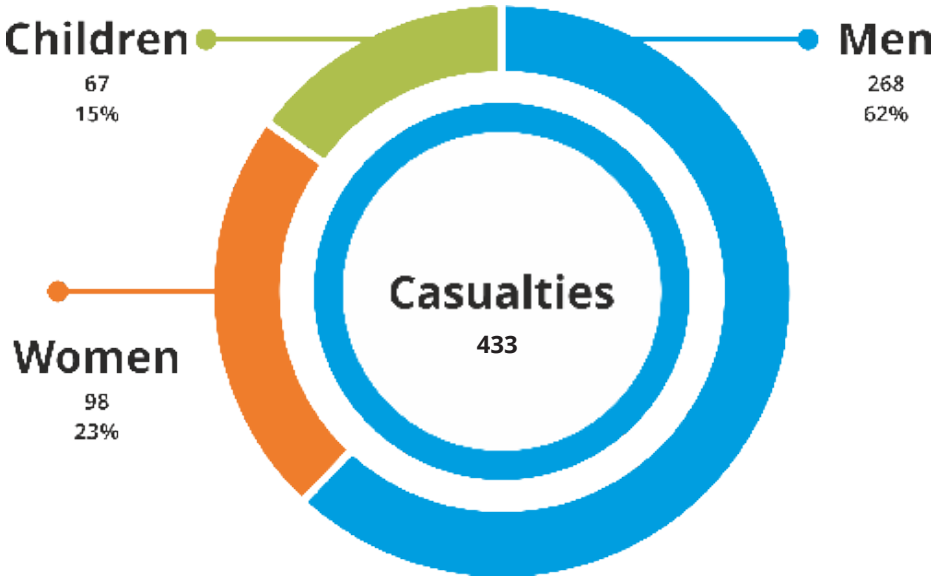
[5] *Press Note on Poverty Estimates 2011-2012, Government of India, Planning Commission, 2013, http://planningcommission.nic.in/news/press_pov2307.pdf*

[6] *National Family Health Survey -4 2015–16 State Fact Sheet: Kerala accessed at http://rchiips.org/nfhs/pdf/NFHS4/KL_FactSheet.pdf*

[7] *Inequality Adjusted Human Development Index for India's States, M.H. Suryanarayana, Ankush Agrawal and K. Seeta Prabhu, UNDP, http://www.undp.org/content/dam/india/docs/inequality_adjusted_human_development_index_for_indias_state1.pdf*

[8] *Page 46, State Disaster Management Plan*

Figure 1
Disaggregated Data on Casualties



Source: Kerala State Disaster Management Authority

According to latest reports of the state government, 1,259 out of 1,664 villages spread across its 14 districts were affected.[9] The seven worst hit districts were Alappuzha, Ernakulam, Idukki, Kottayam, Pathanamthitha, Thrissur, and Wayanad, where the whole district was notified as flood affected. The devastating floods and landslides affected 5.4 million people, displaced 1.4 million people, and took 433 lives (22 May–29 August 2018) (Figure 1).

Immediate Response and Relief Operations

The state government responded swiftly with rescue and relief operations and saved many lives by rapidly mobilising the following national forces:

- Kerala Fire and Rescue Services: 4,100 individuals and the entire rescue equipment deployed
- National Disaster Response Force (NDRF): 58 teams, 207 boats
- Army: 23 columns, 104 boats
- Navy: 94 rescue teams, one medical team, nine helicopters, two fixed wing aircrafts and 94 boats
- Coast Guard: 36 teams, 49 boats, two helicopters, two fixed wing and 27 hired boats
- Air Force: 22 helicopters from Air Force and 23 fixed wing aircrafts
- Central Reserve Police Force: 10 teams
- Border Security Force: Two companies and one water vehicle team.

In addition, the fishing community of the state rendered phenomenal voluntary assistance towards search and rescue in the flood affected areas. Nearly 669 boats

[9] *Government order No. (P)No.05/2018/DMD dated Thiruvananthapuram, 29.09.2018*

that went out with 4,537 fishermen are estimated to have saved at least 65,000 lives.

The Government of India announced an additional assistance of INR 600 crore (USD 85 million)[10] which included ex gratia payment of INR 2 lakh (USD 2,800) per person to the next kin of the deceased and INR 50,000 (USD 700) per head to those seriously injured. The Ministry of Rural Development sanctioned an additional INR 1,800 crore (approximately USD 260 million) under the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) for 2018–19 for 5.5 crore person days of work.

Relief assistance was provided to people in camps including immediate food supplies (rice, wheat, and pulses), drinking water, kerosene and other life-saving items. Food packets and assistance of INR 10,000 per family to clean inundated houses were also disbursed.

Disaster Effects and Impacts

The devastating floods and landslides caused extensive damage to houses, roads, railways, bridges, power supplies, communications networks, and other infrastructure; washed away crops and livestock and affected the lives and livelihoods of millions of people in the state. Early estimates by the government put recovery needs at about USD 3 billion; however, it was felt that a comprehensive assessment of damage, loss, and needs would amount to much more.

The PDNA estimates the total damages to be around INR 10,557 crore and total losses to be around INR 16,163 crore amounting to a total disaster effects of around

[10] *A conversion rate USD 1 = INR 70 is assumed everywhere in this report.*

Table 1
Sector-wise Summary of Disaster Effects (Damage and Loss) and Recovery Needs

Sector	Damage	Loss	Total Effect (D + L)		Total Recovery Needs	
	INR Crores	INR Crores	INR Crores	USD Million	INR Crores	USD Million
Social Sectors						
Housing, Land and Settlements	5,027	1,383	6,410	916	5,443	778
Health and Nutrition	499	28	527	75	600	86
Education and Child Protection	175	4	179	26	214	31
Cultural Heritage	38	37	75	11	80	11
SUB-TOTAL	**5,739**	**1,452**	**7,191**	**1,028**	**6,337**	**906**
Productive sectors						
Agriculture, Fisheries and Livestock	2,975	4,180	7,155	1,022	4,498	643
SUB-TOTAL	**2,975**	**4,180**	**7,155**	**1,022**	**4,498**	**643**
Infrastructure sectors						
Water, Sanitation and Hygiene	890	471	1,361	195	1,331	190
Transportation[a,b,c]					10,046	1,435

Sector	Damage	Loss	Total Effect (D + L)		Total Recovery Needs	
	INR Crores	INR Crores	INR Crores	USD Million	INR Crores	USD Million
Power[b,c]					353	50
Irrigation[b,c]					1,483	212
Other infrastructure[b,c]					2,446	349
SUB-TOTAL	**890**	**471**	**1,361**	**195**	**15,659**	**2,236**
Cross–cutting sectors						
Environment	26	0.04	26	4	148	21
Employment and Livelihoods	881	9,477	10,358	1,480	3,896	557
Disaster Risk Reduction	17	583	599	86	110	16
Gender and Social Inclusion	0.9	0	0.9	0.13	35	5
Local Governance	28	0	28	4	32	5
SUB-TOTAL	**953**	**10,060**	**11,013**	**1,574**	**4,221**	**604**
TOTAL (A)	**10,557**	**16,163**	**26,720**	**3,819**	**30,715**	**4,389**
Integrated Water Resources Management (B)	0	0	0	0	24	3
GRAND TOTAL (A+B)					**30,739**	**4,392**
GRAND TOTAL (ROUNDED OFF)					**31,000**	**4,400**

[a] Recovery costs for roads from urban and rural infrastructure sections are included

[b] In Rapid Damage and Needs Assessment, the cost of damage and loss has not been quantified

[c] Estimates taken from the World Bank–Asian Development Bank Joint Rapid Damage and Needs Assessment (JRDNA)

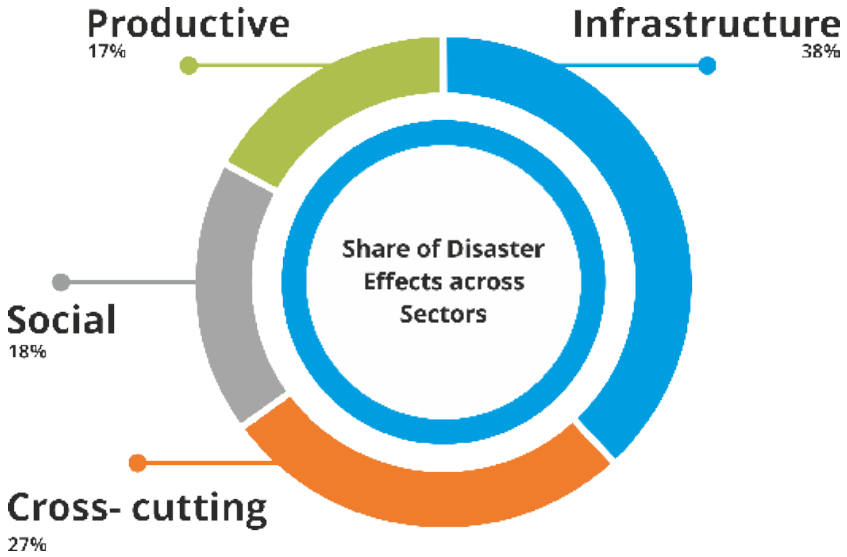
Note: Figures are rounded and so column totals may not add up precisely

INR 26,720 crore (USD 3.8 billion) without including the damage estimates from the Joint Rapid Damage and Needs Assessment (JRDNA) conducted by the World Bank and the Asian Development Bank (ADB). The total estimated damage does not include damages to private buildings and properties including shops, showrooms, business units, private hospitals/educational institutions and private vehicles. It does not take into account losses incurred by private traders and business units and also damage, and loss suffered by Kochi airport, road transport and waterways. The total damage and loss now estimated at INR 26,720 crore in this report would be much higher, if these were included.

The total recovery needs are estimated at INR 31,000 crore (USD 4.4 billion) including the recovery needs estimated by the JRDNA (Table 1). The assessment, done across social, productive, infrastructure and cross-cutting sectors, estimates both private and public loss.

The share of estimated total disaster effects among the main sectors of social and economic activity reveals that the most affected are the infrastructure sectors (38% of the total effects), which includes transportation, and water, sanitation and hygiene along with power, irrigation, and other infrastructure sectors. This is followed by the cross-cutting sectors (27%), social sectors (18%), and productivity sector (17%) (Figure 2).

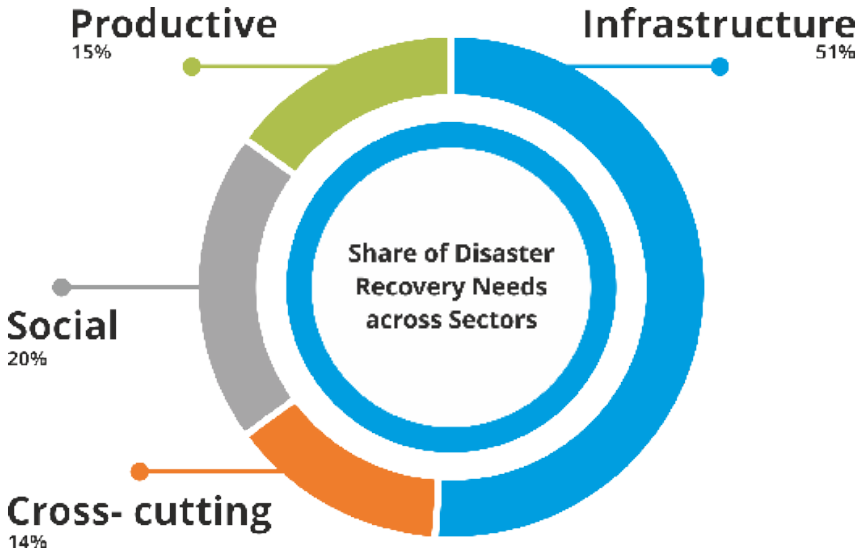
Figure 2
Share of Disaster Effects across Sectors



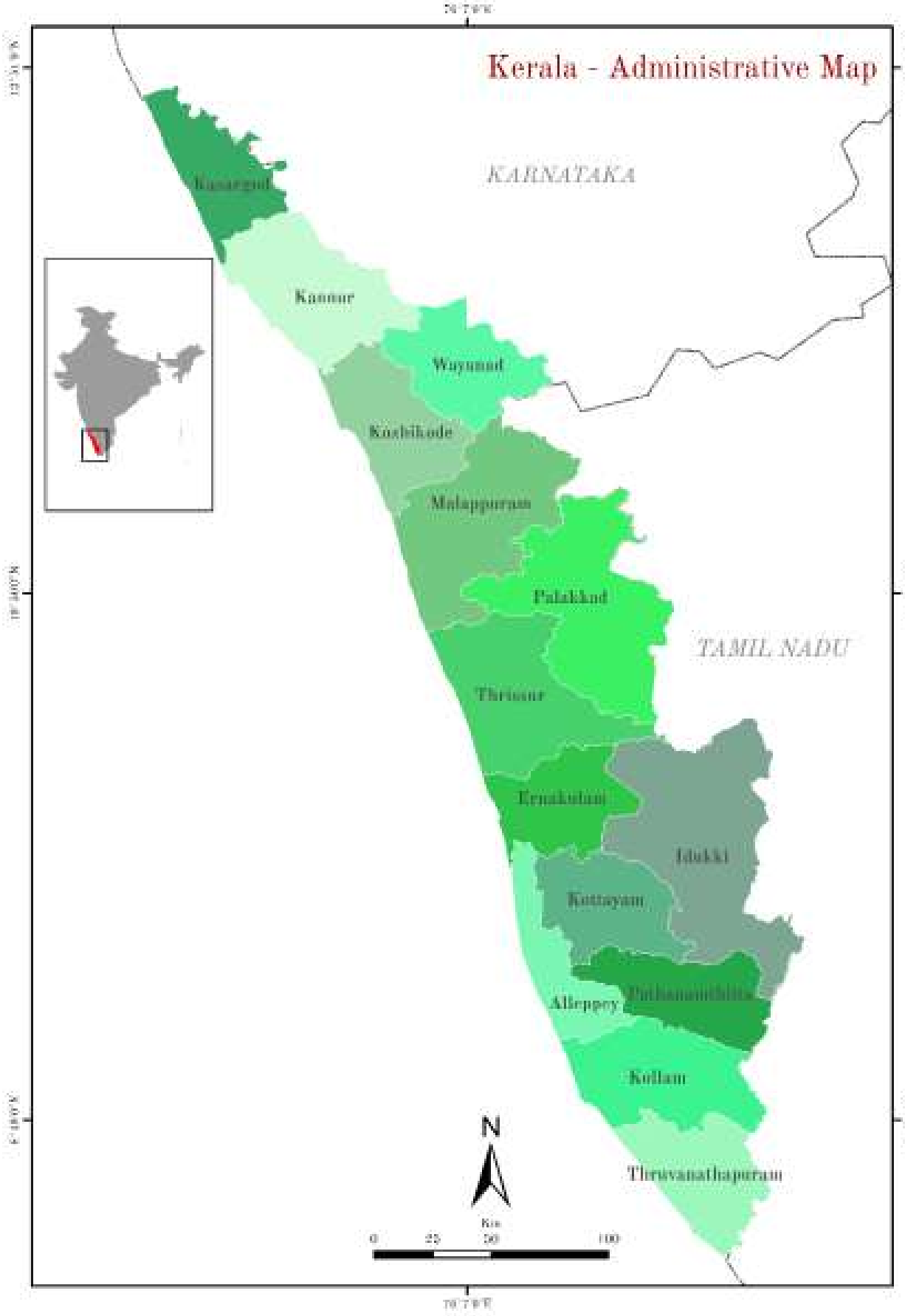
Source: Based on Table 1

The share of estimated recovery needs among the main sectors of social and economic activity reveals that infrastructure sectors have highest recovery needs (51% of the total recovery needs), followed by the social sectors (20%), productive sectors (15%) and cross-cutting sectors (14%) (Figure 3).

Figure 3
Share of Disaster Recovery Needs across Sectors



Source: Based on Table 1


Kerala - Administrative Map
KARNATAKA
TAMIL NADU
Kasaragod
Kannur
Wayanad
Kozhikode
Malappuram
Palakkad
Thrissur
Ernakulam
Idukki
Kottayam
Alleppey
Pathanamthitta
Kollam
Thiruvanathapuram
N
Kms
0
25
50
100

Human Impact Assessment

Close to 14 lakh people had to be evacuated to relief camps during the floods as their homes were inundated with flood water. Thousands of people also took shelter with relatives and friends. Access to piped water was disrupted for 20% of the state's population (67 lakh people). An estimated 3,17,000 shallow wells were damaged and contaminated in six worst affected districts[11] directly affecting 14 lakh people. Over 95,000 household latrines were substantially damaged affecting nearly 4 lakh people.[12]

Over 1.75 lakh buildings have been damaged either fully or partially, potentially affecting 7.5 lakh people. More than 1700 schools in the state were used as relief camps during the floods. Most of the camps closed after 10 days. Floods affected teaching and learning in almost all the districts with institutions being closed from 2 to 23 days. A total of 1613 schools have been affected by the floods. Some schools in Alappuzha were closed for more than a month.

However, even when the schools reopened, the attendance was as low as 20% in many schools. Students are also not attending school owing to trauma and stress because of loss of family/friends and large-scale damage to their homes or neighbourhood. Students, particularly from class X and XII are anxious because of loss of books and notes which may affect their learning. The PDNA sector team reports that there is a danger of children, especially girls dropping out of school unless steps are taken to make the school safe again. Trauma and stress, if left unattended, could affect learning outcomes of the children and have even impact their adult lives adversely.

Although there was no epidemic outbreak following the floods, health impact was substantial as close to 332 health facilities were fully or partially destroyed. Furthermore, 61 ayurveda institutions and 59 homeopathic institutions were damaged as a result of the floods.

Among the worst affected were workers in the informal sector who constitute more than 90% of Kerala's workforce.[13] It is estimated that nearly 74.5 lakh workers, 22.8 lakh migrants, 34,800 persons working in micro, small and medium enterprises, and 35,000 plantation workers (majority being women), have been displaced from employment. Thousands of casual workers and daily wage earners such as agriculture labourers, workers in the coir, handloom, and construction sector and in the plantations have experienced wage loss for 45 days or more.

Interviews at relief camps revealed that families in Kerala were paying an enormous non-quantifiable emotional price in the aftermath of the floods in the form of shock, psychosocial damage, distress, trauma, and insecurity from loss of home, livelihood, assets, possessions, and most importantly death of close friends and relatives. Besides loss due fatalities and destruction of homes, people were grieving over the loss of precious jewellery, family photographs, and religious objects. The loss of essential documents including birth certificates, graduation certificates, ration cards, and land records was adding to the stress burden significantly.

Macroeconomic Impacts

Kerala has suffered huge economic losses on account of the floods. According to a conservative estimate, close to 2.6% of Kerala's gross state domestic product (GSDP) got washed away by the floods instantly. The damage to agriculture and allied activities was immense. It included damage to crops not only in flood hit areas but also in other areas due to incessant rains followed by high temperatures leading to destruction of seasonal crops and reduction in yields of tree crop. The estimated loss in primary sector alone is INR 26,850 crore.

[11] *Additional Memorandum on Kerala Floods by State Relief Commissioner, Disaster Management, Government of Kerala, p. 32*

[12] *Suchitwa Mission Damage Assessment – 13.09.2018*

[13] *Kerala Sate Planning Board, "Economic Review 2016" accessed at http://spb.kerala.gov.in/EconomicReview2016/web/chapter03_08.php*

Many small traders suffered loss of stocks held in anticipation of Onam sales. While some of them are regular GST assessees, there are others who have opted for the Compensation scheme. The former category faces a serious problem. They had already paid input tax on their stock and had the right to claim credit for the same when the output was sold and return filed remitting the output tax collected. Since the stock for which they had paid input tax has been damaged in the floods, the input tax paid by them has become irrecoverable. The Government of Kerala could consider compensating the business community without changing the GST procedure and GSTIN platform by (i) starting with the valuation of individual loss and determination of compensation, (ii) developing a compensation package for the loss (both direct and consequential loss); and (iii) offering subsidised finances to business persons.

These losses and damages are likely to slow down Kerala's economic growth. According to conservative estimates, Kerala's growth rate could slip by around 1.2% in 2018–19. This loss could however be mitigated by the multiplier effects of an increase in (i) public expenditures and (ii) private consumption expenditures on account of remittances.

The loss of income and slowing down of economic growth are likely to reduce revenue collections. At the same time, public expenditures on disaster relief, reconstruction, and recovery are likely to rise substantially. It is estimated that, without factoring in additional resource mobilisation, the revenue deficit could rise to INR 31,332 crore, which would be nearly two-and-a-half times the budget estimate of INR 12,860 crore for 2018–19 before the disaster.

The state needs to have a medium-term expenditure restructuring plan (for the next five years) so as not to deviate from the fiscal consolidation path for a longer period. The state should target containing the revenue expenditure growth to close to 14% annually while maintaining growth of revenue receipts at 17% per annum after the liability for post-flood rehabilitation and reconstruction has been completed. A detailed plan would have to be envisaged to reach these targets.

Nava Keralam: Building a Green and Resilient Kerala

Nava Keralam is the government's vision of converting the crisis into an opportunity by more explicitly embedding the idea of building a green and resilient Kerala into the Approach Paper to the Thirteenth Five-Year Plan, the Disaster Management Policy, the State Water Policy, and the Gender Equity and Women's Empowerment Policies of Kerala.

The recovery policy framework for building a Green Kerala committed to: (i) the Chief Minister's vision of a Nava Keralam (New Kerala), and (ii) the concept of 'build back better and faster' rests on four pillars:

- 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

Pillar 1: Integrated Water Resources Management

At its core, IWRM calls for internalising the themes of 'room for the river' and 'living with water'. It emphasises cross-disciplinary coordination of water, land, and related resources in a river basin, watershed or catchment to achieve long-term

sustainability. With IWRM in place, it is possible to make proper plans for water safety and water security based on actual and planned land use resulting in multiple basin plans. Coordinated land and water use demands inter-sectorality at the level of policy, planning, and implementation. IWRM aims to break existing inter-sectoral barriers to establish a holistic framework for coordination. This is in line with the State Water Policy's directive to 'revamp the present piecemeal approach, which is mostly based on engineering solutions'.

River basin management with a 'room for the river' approach emphasises ecological conservation and restoration. This approach aims to lower flood levels in the rivers by increasing the wet areas of the rivers, giving them more room and space. Upstream river basin management with a focus on the conservation of forests assumes particular significance as all the short, fast-flowing, monsoon-fed rivers originate in the Western Ghats that have witnessed serious forest degradation. Equally important is the issue of coastal zone management.

An important prerequisite for IWRM is the availability of sufficient and reliable data and state of art hydrological models to support environmental and social impact assessments including mitigating measures to arrest environmental deterioration. This needs to be accompanied by a process of citizen education and democratic dialogue, such that the need for integrated water resource planning is communicated and appreciated at all levels.

Recommendations for recovery centre around protecting natural river flows and giving room to the river—concepts that inform the citizen education programmes. Preparation of basin-wide master plans linking upstream, and downstream zones should be prioritised.

Pillar 2: Eco-sensitive and Risk-Informed Approaches to Land Use and Settlements

An eco-sensitive and risk-informed approach needs to ensure that buildings are reconstructed using disaster resilient techniques, at the right location, away from flood plains and slopes. According to the Kerala State Disaster Management Policy, physical reconstruction must take into account the hazards of the particular location, resources and capacities people involved in the rebuilding, and the adoption of designs that offer resilience against floods, cyclones, earthquakes, and droughts.[14]

Additionally, for designing 'green buildings' to make Kerala a green state, it needs to capitalise on its experience and capacity to deploy alternative construction technologies with low carbon footprint including expertise drawn from Laurie Baker, Habitat Technology Group, Centre of Science and Technology for Rural Development (COSTFORD), People's Movement for Sustainable Architecture, and government sponsored Nirmiti.[15]

The reconstruction of houses and public building using appropriate technologies offers a major opportunity for the skilling and green job creation in the sector. It is recommended that an Integrated Strategic Environmental Assessment be applied to mitigate the negative impact of the surge in construction activities. This approach developed by the UN Environment has been implemented during the post-conflict reconstruction of Sri Lanka and the post-disaster reconstruction of Nepal.

Pillar 3: Inclusive and People-Centred Approach

The recovery strategy for Nava Keralam will be premised on comprehensive vulnerability mapping (including inter-sectional vulnerabilities) to inform all stages of disaster recovery. During the recent rescue and relief operations, the extreme vulnerabilities of the elderly and persons with disabilities in the state became

[14] Government of Kerala, Kerala 2000 State Disaster Management Policy, Kerala State Disaster Management Authority

[15] There are about 40 such organisations working on alternative housing technologies in Kerala. If each of these organisations is entrusted with the task of constructing 500 houses, the required 18,000 houses can be constructed within the next six months, i.e. before the next south-west monsoon.

conspicuous. It was realised that the requirements of excluded groups need to be prioritised across all aspects of disaster mitigation and resilience building—early warning systems, relief operations, design and construction of buildings and community infrastructure, psycho-social interventions, livelihood enhancement measures and so on.

Mechanisms should be instituted for including the socially excluded in all aspects of the recovery strategy. Additional livelihood opportunities should be offered to women while simultaneously reducing their care burden by extending the working hours of anganwadi centres and setting up day care homes for the elderly. It is recommended that the MGNREGS be used to fill in the livelihood deficit in the aftermath of the floods. Furthermore, there should a focus on re-skilling of women and workers from scheduled castes and tribes, so as to engage them in climate-resilient agricultural work and natural resource protection under the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) 2005.

Men and women should be given joint title deeds for the newly constructed homes and proactive measures should be taken to include people who are conventionally excluded by the state's social security programmes such as migrant workers and transgenders.

Strengthening the grama sabha, concurrent monitoring social audit and redress of grievances should be made an integral part of all programmes aimed at recovery.

Pillar 4: Knowledge, Innovation, and Technology

Knowledge, innovation, and the appropriate technology are vital in addressing the sustainable development and climate change challenges that Kerala faces. The Kerala floods illustrated the potential of information technology in both rescue and relief operations. The web-based application www.keralarescue.in as well as the use of social media including WhatsApp by voluntary groups and government officials helped to identify victims, camp locations, requirements in the camps, volunteer registration, and facilitate both rescue and relief operations. In many locations, these WhatsApp locations functioned as virtual 'control rooms'. Social media was also used to mobilise thousands of volunteers for one-time cleaning operations. Web-based applications were also used to assess damages to houses and buildings (Rebuild Kerala app), forming the basis for compensation packages, as well as to mobilise financial resources for recovery through the Chief Minister's Disaster Relief Fund portal. Information technology can also be used to re-coup lost documents, geo-tag beneficiaries, conduct social audits and help with redress of grievances.

The magnitude of the floods and landslides has underscored the need for research and knowledge generation activities. While downstream conditions hampered discharge of water, flooding was also a result of inappropriate human interventions in the middle and upper parts of river basins. There is a need therefore, for research on the role of deforestation, quarrying, unscientific road construction, slope modification, sand mining from river beds, construction on stream channels, narrowing and blocking of drainage channels and so on, in aggravating landslides and flooding. Such research outcomes can inform land-use maps for recovery and reconstruction projects, in particular road construction, location of hospitals and schools, and also for regular development planning.

The availability of state-of-the-art geographic information system (GIS) technologies facilitates the creation of such maps, as well as in their dissemination to local government agencies. Given Kerala's decentralised governance architecture, there is a need to enhance the knowledge base of local government with such maps, at appropriate scales, to improve understanding at the micro-level of the

interconnectedness of risk factors and their cumulative impact. This understanding also needs to be imparted to citizens through grama sabhas and other forums. The student community and the youth, who proved their ability to respond to the crisis, need to be roped in as agents of knowledge generation and dissemination.

Knowledge generation and effective dissemination can help in early warning and risk information communication to the last mile. Knowledge generation and innovation also assume critical importance in the production of green technologies particularly in the context of housing and sanitation, as well as in expanding the scope of livelihood activities that carry a low carbon footprint.

Essential Building Blocks

Priority actions areas to build a green and resilient Kerala are:

Reviewing Land Use Patterns: Profitability of farming in Kerala has been adversely affected by the fragmentation of agricultural lands, dramatic reduction in land used for paddy cultivation, rising agricultural wages and globalisation of supply chains. The recovery period offers an opportunity to create a new land-use policy which enables the re-deployment of available land to maximise its natural ecosystem functions. Paddy lands could be conserved and managed as wetlands for ground water recharge, biodiversity conservation, and greenhouse gas emission reduction. It will also be possible to acquire and use land for ecosystem services such as biodiversity conservation and disaster risk reduction (DRR).

Changing Consumption Patterns: Fuelled by remittances and growing incomes, Kerala's environmental footprint of consumption transcends state or even national boundaries. The government can and should systematically analyse its consumption pattern and see how its environmental footprint both locally and outside the state can be controlled and minimised. Kerala should aspire to become not only 'locally' green but should also begin to care about environmental destruction everywhere.

Sustainable Building Guidelines Kerala should reverse the trend of constructing 'modern' buildings that are not suitable for local weather conditions and encourage high energy consumption. Instead, it should adopt a locally 'sustainable building guidelines', similar to the one in the United Kingdom, whereby each building is systematically analysed for its carbon footprint based on its construction and operation. Use of material locally available is maximised and need for energy for cooling and lighting is minimised. This will also create thousands of new 'green jobs' in the state.

Maximise Use of Solar Energy: Given the potential for solar energy generation round the year, Kerala should aspire to be fully solar powered at least in housing, offices, and commercial establishments by 2030. As an interim measure, the government may stipulate that all new building construction, including buildings with aluminium roofs, have built in solar panels. Similar guidelines have been created in France which has much less potential for solar energy generation.

Green Technology Centres: Every household in Kerala has many opportunities to apply green technologies in household composting, domestic sewage management, solar energy, and resource recycling. Young people from villages can be trained in green technology installation and maintenance and hired at 'green technology centres' developed as cooperative societies in villages. In addition to improving environmental quality, these centres can create thousands of high skilled jobs in the community.

Environment and Natural Resource Managers: Even though environmental guidelines exist for quarrying or sand mining, there is no local capacity to implement them. Kerala can be the first Indian state to employ an Environment and Natural Resources Manager in every local government body to map the valuable natural resources within the jurisdiction of the local body (rivers, ponds, streams, hills, sacred groves etc.) and advise the local administration on how they can be managed effectively.

Integrate Solid Waste Management Centres: Solid waste management in Kerala is not modern or well managed. Currently solid waste management is the responsibility of the local government bodies. However, they are unable to exercise this mandate correctly due to shortage of funds and expertise. It will be more appropriate to look it as a state-wide issue and see what waste streams would need centralised solutions (waste-to-energy plants, incinerators, or landfills), which waste streams could be locally managed (household level, ward level composting etc.), and which waste streams should be addressed by extended producer responsibility.

Greening the Tourism Sector: Revenues from tourism, if used creatively, can bring in funds and reasons for maintaining environmental resources in a better manner. Management of solid and liquid wastes, for instance, is a major issue in most places of tourist attraction. A comprehensive approach to greening the tourism sector, including an eco-tax for tourists could be a major step towards making Kerala's tourism green. Similar measures could also apply to major pilgrim destinations.

Creating Green Jobs: Making Kerala a 'green state' could create new jobs locally, and also make the state a hub for green technology advisory services nationally and internationally. To give one example, the Cochin International Airport Limited is the first international airport in the world to go fully solar. Such expertise can be built in many other areas including waste management, ecotourism, and organic farming. Kerala should not just aspire to be a green state, but also a provider of such expertise to the rest of the world.

Climate Change Resilience: Improving climate literacy and promoting decentralised action for adaptation and mitigation are critical for building climate change resilience. Every local government should have a climate change adaptation plan and private individuals should be educated on the climate footprint of their personal actions from the food they eat to the mode of transport they use and the lifestyle choices they make. Kerala, with the highest forest cover of 52.3% among big states in India and increased focus of local self-governments on climate change adaptation, can emerge as a world leader in community-based climate resilience actions.[16]

Innovations for Greening Kerala

The PDNA has identified several innovative ideas across sectors for the greening of Kerala as it starts building back better and faster.

Integrated Water Resource Management: Learning from the international best practice of water resource management from the Netherlands, Kerala can promote best practices like 'room for the river', 'living with water', and 'building with nature'. An analysis of the sector proposes that the state should launch a Hydrological Crash Programme for collecting available data using state-of-the-art hydrological software and build a hydrological model for a pilot basin. The government should also prepare a master plan for the Kuttanad area, start an awareness programme on living with water in flood prone areas, and set up a Kerala Water Partnership to organise dialogues and promote communication for behaviour change.

Housing, Land, and Settlements: In line with the state government's vision of a 'Nava Keralam', the reconstruction processes envisage an eco-sensitive approach using construction technologies based on local materials, fulfil the aspirations of the public, reduce the carbon footprint, and create more local green jobs. To achieve this, it is proposed be set up 70 housing facilitation centres to assist the house-owners choose designs appropriate to the location, procure materials and provide technical support to construct houses. Over 17,000 houses will be reconstructed and 2.17 lakh dwelling units repaired over a period of three years. Nearly 2,800 masons will be trained in disaster resilient construction technologies and 140 units of small scale building materials production centres will be established to rebuild and repair the 2.17 lakh houses that were affected by the floods and landslides. In the long term, it is proposed to review the existing building codes and bylaws for urban and rural areas. Kerala could emerge as the pioneer state to develop separate guidelines for construction on highlands and slopes for inclusion in the National Building Code.

The recovery strategy proposes to empower the Local Self Government Department (LSGD) offices to facilitate the adoption of risk resilient housing designs. The LSGD will also function as a regulatory body, guiding house-owners on appropriate structures for specific sites. It will work in close coordination with the Livelihood Inclusion and Financial Empowerment (LIFE) Mission.[17]

Health: Kerala is encouraged to transition to a 'safe and green hospital' concept through the allocation of adequate resources to health facilities that are most at ecological or hazard risk. Multiple gains are possible by integrating DRR with low carbon energy use, water conservation, sustainable consumption, and environmental protection. The green hospital approach could be extended beyond the 482 damaged allopathy hospitals to the reconstruction of the 1219 anganwadi centres. In the short-term, the recovery plan is to target life-saving interventions through curative and preventive approaches. The emphasis in the medium term is on improving health care access by restoring health facilities, improving capacities of the health workforce, and promoting DRR. The long-term plan is to promote ongoing health sector reforms, strengthen health facilities, and the health information system.

Education: The education sector proposes green schools that create a healthy environment conducive to learning and environmental protection. Efforts will be made to strengthen existing biodiversity parks in all schools and develop green-building infrastructural designs for schools and educational centres suitable to the topography, climate, and local conditions. About 1767 schools, education centres and child care institutions affected will be repaired and reconstructed. About 1990 school toilets will be repaired. The recovery and reconstruction strategy will focus on ensuring uninterrupted continuation of education service delivery. School buildings will be constructed or refurbished keeping in mind the notion of green and safe schools.

Medium term needs in the sector will be dominated by the reconstruction of damaged buildings and allied services. It is proposed that specially designated medical facilities for children with special needs be established in the community health centres. The Department of General and Higher Education will establish timelines for educational institutions to complete basic infrastructural reconstruction as per the Kerala Education Rules, 1958. It is suggested that steps be taken to strengthen existing disaster preparedness strategies and developed new ones. Children's Committees and Home Committees should be established and local governments should receive support for drawing up timelines for building back safe and violence free schools with participation from the community and the children.

Cultural Heritage: Kerala's cultural heritage has suffered four types of damage and loss: monetary loss, an indirect loss of income to the state and the sector, socioeconomic utility loss to thousands of tourists, pilgrims and local residents, and the location-specific tangible as well as intangible damage and loss. In the short term, focus will be on debris clearance, de-silting and repairs for quick resumption of livelihoods. In building back better for tangible, intangible, and movable heritage, it is proposed that Kerala will (i) introduce damage prevention measures on archaeological sites and develop risk management plans for built heritage sites; (ii) involve local communities in the recovery process; (iii) adopt a holistic approach in dealing with damaged structures and use eco-friendly material and resources; (iv) use traditional vernacular principles that respect nature, and are climate conscious and user-friendly; (v) establish a state level inventory of intangible cultural heritage; and (vi) develop databases for storing and documentation.

Agriculture, Livestock, and Fisheries: The recovery vision for the sector is to develop sustainable, responsible, integrated, inclusive, eco-friendly, and resilient agriculture (crop, livestock, fisheries/aquaculture) consistent with the policies of Government of Kerala and Government of India. In the short term, focus will be on restoration of the three subsectors, through the provision of inputs and restocking, replacement or repair of assets and infrastructure, reviving economic activity, strengthening farmers' capacity, and finding alternative income sources for the population. Special efforts will be made to target the most affected population irrespective of gender or age.

The sector recovery priorities in the short term are to address immediate needs by restoring crops production through land clearance, preparing the paddy land and sowing, bailing out water and planting paddy, distribution of agro-inputs, land preparation, clearing existing drainage systems, and restoring farm machinery and equipment. In the medium to long term, further resources will be required for restoring the crop economy, soil health, and plant protection monitoring. In the case of livestock, short term measures will be taken to improve the provision of feed and fodder and veterinary drugs. In the medium to long term, further resources will be required for restoring the livestock economy, promoting traditional breeds, developing area specific action plans for natural calamities, strengthening value chain systems, and developing veterinary healthcare centres. For the recovery of fisheries, short term focus will be on the revival of aquaculture and fisheries system, immediate mitigation measures, and the cleaning of water bodies. In the medium term, it will be necessary to strengthen the Kerala Inland and Aquaculture Act, develop fisheries co-management, systematic management of aquafarms, insurance compliance, and de-siltation of water bodies.

It is proposed that Kerala adopt an integrated flood resilient approach and community-based water resource management practices. The state should develop early warning systems and effective communication with enhanced GIS/tech-backed capabilities. Traditional drainage systems should be protected and developed. Efforts should be made to enhance and reinforce integrated farming systems, and promote ecologically and environmentally sustainable integrated agriculture.

Water, Sanitation and Hygiene: The damage and loss in the water, sanitation, and hygiene (WASH) sector is across water supply, sanitation, and solid waste management. The immediate needs are the repair and restoration of damaged infrastructure, debris clearance, improving shallow wells, raising awareness on the need to upgrade wells, and strengthening the water quality surveillance systems. The long term vision of the state government is to overhaul the infrastructure in the sector ensuring wider access of water supply services and move to Open Defecation Free status.

Cross-Cutting Themes:

Environment and Climate Change: The recent disasters demonstrated the link between environment and disaster risk. While the floods cannot be exclusively attributed to climate change impact, climate change predictions do indeed forecast increases in rainfall intensity in Kerala in the years to come. Furthermore, coastal cities in Kerala are prone to waterlogging and flooding due to increased water inflow as well as sea level rise. The agriculture and related activities in Kuttanad, which is a below sea level area, are expected to be severely affected by climate change. So, regardless of whether the present event is linked to climate change, the floods of 2018 and the tropical cyclone Okhi before that serve as warnings about the extreme events which Kerala may expect more frequently in a world with changing climate. Therefore assessment of vulnerabilities and actions in climate change adaptation and mitigation should be integral to the 'New Kerala' being envisaged in the post-disaster setting.

In addition to the environmental issues created by the disaster in its wake, the recovery strategy must address the underlying problems of environmental degradation and abuse that exacerbated the impact of the floods through a 'comprehensive post-disaster environmental assessment'. Conscious effort will be made to minimise the environmental footprint of post-disaster reconstruction. Kerala should adapt international best practices in managing asbestos, and develop a comprehensive plan to raise awareness about the adverse health impact of asbestos and increase local government capacity to deal with it. It is proposed that the state establish a comprehensive plan for regular monitoring of all its water bodies (both in terms of quality as well as quantity). Approaches such as 'room for the river' and 'making space for water' may be adopted to enhance flood protection instead of creating dams and embankments. Removal of sand deposited in rivers and river banks should be undertaken only after site-specific studies have been conducted and expert suggestions taken on board.

Employment and Livelihoods: The idea of 'build back better' needs to be rooted in environmental sustainability, cost effective technologies, green job creation, skill development, climate resilient livelihoods via decentralised planning, and social-cum-gender inclusion. Kerala should create 'green jobs' (with low carbon footprint than at present) based on the principles of environmental sustainability and cost effectiveness. Skill development would be a critical component in the recovery period and beyond. Kerala's ecological endowments along with its habitat pattern provide a solid foundation for much of its economic activities—agriculture, livestock, fisheries, agro-processing industries, sourcing construction materials, water transport, or the much acclaimed tourism. In the short and medium term, the government can consider creating emergency employment through cash-for-work and other quick employment projects, developing special compensation packages for Kudumbashree members, and introducing appropriate insurance packages for climate resilient agriculture. The focus over the medium term will be on the restoration and regeneration of natural capital, promotion of alternative technologies in building construction, and promotion of climate resilient agriculture.

Disaster Risk Reduction: The vision set out for Nava Keralam is to ensure zero mortality due to disasters with minimum economic losses and disruption of services. To achieve it, the principles of risk-informed programming will be embedded across all the sector recovery plans with additional investments for disaster preparedness and response. This includes the revival of the State Disaster Response Force, enhancing the operational efficiency of the fire and police personnel, setting up robust early warning mechanisms, employing effective risk and behavioural change communication strategies, and implementing community-based disaster risk

management approaches. It is proposed that Kerala integrates DRR across key sectors with the necessary technical guidance from training institutions and the academia. Important measures proposed in this regard include the development of a comprehensive land-use management policy and Act, necessary amendments in the existing building regulations, ensuring environment impact assessment, and the formulation of special development control regulations for hills and coastal areas.

Gender Equality and Social Inclusion: This PDNA seeks to assist the Government of Kerala in strengthening the development trajectory of the state by ensuring that no vulnerable group is left behind, thereby helping fast-track the building of Nava Keralam in a sustainable, eco-sensitive, inclusive, and empowering manner. A recovery strategy should necessarily factor in the specifics of geography, culture, and context to develop differentiated strategies to address the needs and priorities of vulnerable groups.

Considerations of class, caste, gender, and age as well as unequal access to and control of resources has particularly affected the socioeconomically disadvantaged in Kerala. These include the poor particularly the multi-dimensionally poor; vulnerable women including widows, household heads and pregnant women; vulnerable children especially those traumatised by the loss of lives and destruction; Scheduled Castes and Scheduled Tribes; the elderly; fishing communities; people living with disability; and 'invisible' populations such as lesbian, gay, bisexual, queer, inter-sex, and asexual persons; the destitute, the homeless poor, and those living on and off the street. The PDNA underscores the critical need to 'reach the last mile' of these affected population. These groups are particularly vulnerable given the risks of over-reliance on unpaid work carried out especially by women, the risk of unequal access to essential services and resources, and emerging psycho-social needs.

This disaster is an opportunity to establish a robust human rights-based approach across all phases of the recovery cycle, based on the principles of non-discrimination, participation, and 'leaving no one behind' imbedded in Agenda 2030.

Local Governance: The PDNA recognises that leadership of the local governments is paramount in achieving the vision of a Nava Keralam. In that context, the panchayats' role in restoring services, reconstructing houses, supporting local economic recovery and other public services will go a long way not only in restoring normalcy but also in rebuilding a resilient Kerala. To enable local governments to play this critical role in recovery and reconstruction, the capacity of local governments should be enhanced by (i) ensuring participation of people through gram sabhas and other platforms; (ii) disseminating information on recovery assistance packages; (iii) addressing grievances of the affected population; (iv) maintaining transparency and accountability in use of the funds for recovery; and (v) integrating recovery needs in their annual plans. To enable this, local self-governments will have to augment their capacity with technical experts to support their role in recovery. Local self governments may also need to revise their annual plans and develop a separate recovery plan for next three to five years.

Proposed Institutional Arrangements for Recovery

The PDNA recommends the setting up a new agency with a mandate for five years along the lines of Badan Rehabilitasi dan Rekonstruksi (BRR) in Indonesia and Canterbury Earthquake Recovery Authority (CERA) in New Zealand. Such an agency should be appropriately resourced to deal with the scale of the disaster, planning, implementation and financial management, and service delivery within a tight timeframe. Adopting a mission approach, the agency could be well placed to take forward the vision of Nava Keralam based on principles of sustainable development.

Financing for Recovery and Reconstruction

The state government requires INR 31,000 crore (USD 4.4 billion) for recovery and reconstruction. The following are some options for mobilising the required resources for recovery and reconstruction over a timeframe of five years:

Increase Borrowing: The state government can use the market instruments and borrow from national and international financial institutions. For instance, with the approval of the Government of India, the Government of Kerala may issue Reconstruction Bonds. The state could also borrow from the World Bank and ADB to support recovery and reconstruction by seeking permission from the central government to enhance its borrowing limit from the current 3% as stipulated by the Fiscal Responsibility and Budget Management (FBRM) Act in India to 4.5%. Overseas development assistance could be secured in terms of budget support or pooled basket funds or for specific projects for flood recovery.

Additional Funds from Centrally Sponsored Schemes (CSS): The state government may get additional funds from the central government under CSS like the MGNREGS for livelihoods, Pradhan Mantri Awas Yojana, (PMAY) for housing and other central schemes. While the National Disaster Response Fund (NDRF) does not typically support recovery and reconstruction, a part of the cost could be funded through the NDRF. The cost of the repairs, which is allowed through NDRF, could be utilised for supporting the reconstruction component.

Chief Ministers Disaster Relief Fund & Lottery: The Government of Kerala can consider raising additional resources, over and above INR 1,740 crore already mobilised through the Chief Minister's Disaster Relief Fund. The new lottery scheme floated by the state government is expected to mobilise about INR 80 crore.

Augmenting Resources Through Taxes: The Government of Kerala can consider augmenting resources through taxes. The possibilities for additional resources through taxation can include (i) widening the tax base: to bring additional business units in the state under the commercial tax net of the state government; (ii) introducing new taxes such as a tax on vacant houses, or a tax on construction of large houses of more than 3,000 square feet area. The state government may consider introducing carbon tax on motor vehicles and building materials with high carbon footprint such as cement, steel, glass, aluminium, and so on.

Others: The state government may request additional statutory block revenue deficit grant under Article 275 of the Constitution. For this, Kerala may need to submit a revised revenue receipt and expenditure statement to the Commission. Among other possibilities are tapping Corporate Social Responsibility (CSR) Funds, crowd-funding through digital platforms, seeking grants from NGOs and international NGOs for recovery and reconstruction, and setting up Voluntary Reconstruction Funds attract contributions from the Malayali diaspora including alumni of educational institutions.

The people of Kerala have demonstrated extraordinary resilience in coping with the unprecedented disaster. The state has also demonstrated the power of public action in dealing with the aftermath of the floods. The potential exists for Kerala to tap the wealth of its traditional knowledge, the wealth of green ideas, the minds of its diaspora, and the spirit of volunteerism to demonstrate cost-effective ways of ensuring equitable and sustainable development. The disaster presents a new opportunity for Kerala to lead the world in establishing a green and resilient state.

PDNA Process and Methodology

Following the devastating floods and landslides in Kerala, the state government commissioned the United Nations to conduct a Post Disaster Needs Assessment (PDNA). The PDNA was led by the Government of Kerala under the guidance of the Ministry of Revenue and Disaster Management and Directorate of Fisheries. The PDNA aimed to assess the damage, loss, and recovery needs across key affected sectors of the state economy. A first in India, the Kerala PDNA is unique as it also offers policy recommendations, suggestions for appropriate recovery-related institutional arrangements, and options for financing recovery. The Government of Kerala sees the flood recovery as an opportunity to rebuild a New Kerala and in that context this PDNA identifies four pillars for recovery focused on approaches that are green, sustainable, inclusive, participatory, and innovative.

The PDNA methodology, developed in 2008 by the European Union, the World Bank and the UN system represents a tool for a harmonised assessment and recovery strategy. It is a standard methodology which is used internationally to assess damage, loss, and recovery needs of any disaster. It presents a consolidated report based on sector analysis and priorities for recovery. The PDNA report also includes an assessment of the macroeconomic and human impact of the disaster. The methodology is adapted to local context before being applied in any country.

The PDNA in Kerala was initiated on 18 September 2018, engaging over 100 people from the government and international agencies. It complements the Joint Rapid Damage and Needs Assessment conducted by the World Bank and the ADB which assessed the damage and recovery needs of 12 sectors and social impacts.

The Department of Revenue and Housing appointed the Director of Fisheries as the State Coordinator for the PDNA. The Kerala State Disaster Management Authority (KSDMA) was closely engaged in the coordination and review of the PDNA process. The UN PDNA Coordination Team was represented by UNDP and UNICEF. Sector teams included representatives from various departments, district officials, the European Civil Protection and Humanitarian Aid Operations (ECHO) and 10 UN agencies: Food and Agriculture Organization (FAO), International Labour Organization (ILO), United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP), United Nations Educational, Scientific and Cultural Organization (UNESCO), United Nations Population Fund (UNFPA), United Nations Children's Fund (UNICEF), UNWOMEN, World Food Programme (WFP) and World Health Organization (WHO).

The PDNA covers the following sectors:

- Social Sectors: Housing, Land and Settlements; Health and Nutrition; Education; Cultural Heritage;
- Productive Sectors: Agriculture, Fisheries and Livestock;
- Infrastructure Sectors: Water, Sanitation and Hygiene; and
- Cross-Cutting Sectors: Environment; Employment and Livelihoods; Disaster Risk

Reduction; Gender and Social Inclusion; and Local Governance.

The PDNA includes a special report on Integrated Water Resources Management and a diagnosis of the floods and landslides, given its significance in the state of Kerala.

The Kerala PDNA started with an orientation on the methodology and agreements on the scope of the assessment. Data was collected over a 10-day period with field visits by all sector teams to the 10 most affected districts. The field visits were held to gather first-hand information on the extent of damage as well as to validate data given by the various government departments. Meetings were held with district and panchayat officials, members of various local associations, women's groups and affected people. These visits helped to assess the human impact of the disaster and develop recovery strategies focused on helping the most vulnerable people recover. A civil society expert group consultation was also held to gather views of diverse groups on rebuilding Kerala. The first draft of the PDNA report was presented to the Chief Secretary and Secretaries of the Line Ministries on 11 October 2018 and revised with inputs and feedback from relevant ministries and KSDMA. The final report was submitted to the Chief Minister of Kerala on 26 October 2018.

Flood Diagnostics

Flood Diagnostics

Kerala experienced abnormally high rainfall from 1 June 2018 to 19 August 2018 (about 42% above normal). Initially, months of June and July were somewhat wetter than usual with 15% and 18% precipitation above normal respectively. The situation took an unprecedented turn in August when in the first three weeks, the state experienced downpours 164% above normal—the worst flooding in nearly a century. Thirty-five dams across the state were opened to release flood runoff. All five overflow gates of the Idukki Dam were opened for the first time in 26 years. Heavy rains in Wayanad and Idukki districts caused severe landslides.

Several reservoirs were almost filled to capacity by the end of July due to continuous rainfall from 1 June; the first onset of flooding occurred toward the end of July. Severe rainfall was experienced at several places during8–9 August. Another severe spell of rainfall started from 14 August and continued till 19 August, resulting in disastrous flooding in 13 out of 14 districts. As per the India Meteorological Department (IMD), it has been found that the rainfall depths recorded during 15–17 August 2018 were comparable to the severe storm that occurred in the year 1924.

Due to such high rainfall, there was an absence of appreciable storage in reservoirs upstream, along with the shrinkage of carrying capacities of lakes, rivers, and the porous land. The limited capacity of Vembanad Lake and Thottappally Spillways worsened the flooding in the Kuttanad region and the backwaters. Many areas were submerged under water for more than two weeks.[1]

The above analysis gives a general picture of the effects of extremely high rainfall during 15–17 August 2018 on the Kerala water systems. At the climax of the disaster, 20%–25% downpour came in three days: 15–17 August 2018.

The study report on Kerala floods of August 2018 of the Central Water Commission (CWC) gives a thorough hydrological analysis of the effects of the heavy rainfall on the Periyar, Pamba, Manimala, Meenachil and Achankovil rivers, that drain into the Kuttanad wetlands, Chalakudi, Bharathepuzha and the Kabini basins.[2] This report can be referred to for detailed insights.

Based on the CWC report an analysis of the flood disaster is presented with a focus on the Bharathappuzha, Chalakudy, and Periyar rivers and the Kuttanad water body with inflow from the Muvattupuzha, Meenachil, Manimala, Pamba, and Achankovil rivers.

Flood inundation maps of Kerala covering the days after 15–17 August show that the majority of the flooding occurred in the areas around the backwaters and the lower reaches of the rivers where river bank heights were lower, and adjacent flat areas became waterlogged toexceptional levels of up to 1–2 m.

In the middle and upper reaches waterlogging was less although damage did occur in areas where strong currents and flood discharges, in excess of full bank flow, caught people by surpriseand damaged housing, trees, and crops close to the river bank.

[1] *Kerala Floods and Landslides 2018, Rapid Damage and Needs Assessment Report, Government of Kerala / World Bank / Asian Development Bank, September 2018*

[2] *Kerala Floods of August 2018, Government of India, Central Water Commission, Hydrological Studies Organisation, Hydrology (S) Directorate, September 2018.*

With respect to the outflow from the Malampuzha Dam, it is stated by CWC that,'During 8–9, August 2018 the total inflow into the reservoir was about 97 MCM against the release of 48 MCM. During 8–9, August 2018, the reservoir absorbed about 49 MCM of flood water and thus resulting less flooding in downstream area. During 15–17, August 2018 the total inflow into the reservoir was about 53 MCM against the release of 66 MCM, hence the released volume was about 13 MCM more than the inflow, which is insignificant in comparison to estimated runoff of 1510 MCM from the basin. This holds true for the flooding in the lower reaches of the Bharathappuzha. Itis not directly true for the discharge at locations immediately downstream such as Palakkad city, which is located close to the dam. Here the hydrograph at Palakkad should be compared with outflow from the reservoir to see how dam operations actually influenced the local flood flow.

Landslides occurred inland from the rivers and were independent ofthe high flood levels in the river. They happened mainly due to soils being soaked, soil piping, and human interventions such as road construction and housing. Reportedly, no major river bank slides occurred, confirming the general stability of the river banks. In the lower reaches of the rivers limited bank erosion was reported.

The largest flooded areas were those adjacent to the backwaters along the coast. Even areas within these wetlands that are normally flood-free were flooded to a large extent. Given the quantum of rainfall and the characteristics and the physical condition of the water systems, flooding of these areas and areas along the lower parts of the river was unavoidable. The outlets to the sea, whether natural Azhis and Pozhis[3] or the controlled ones, such as at the Thottappally Spillway and Thanneermukkom Barrage, did not have the capacity to evacuate high flood flows from the rivers, as they occurred, into the sea. The excess water gathered in low-lying areas. As the rains were exceptional,so were the flood levels that rose far above what people had experienced during earlier flood events which happened over the last 10 to 25 years. Along the Kerala coast the situation was aggravated by the perigean spring tide, a high tide occurring only three or four times a year, during11–15 August 2018, and sustained strong onshore winds, resulting in abnormally high sea levels, which further hamperedriver outflow to the sea.

As per the CWC report, the overall drainage capacity to the sea of the Kuttanad water body is far below the original capacity of the structures and the drainage canals/rivers draining towards them. The siltation of these canals, together with theoverall poor state of maintenance, has drastically reduced their capacities. Even smaller floodslead to waterlogging of built-up areas although people do not seem to mind the water—small floodsare often useful for flushing out polluted canals.

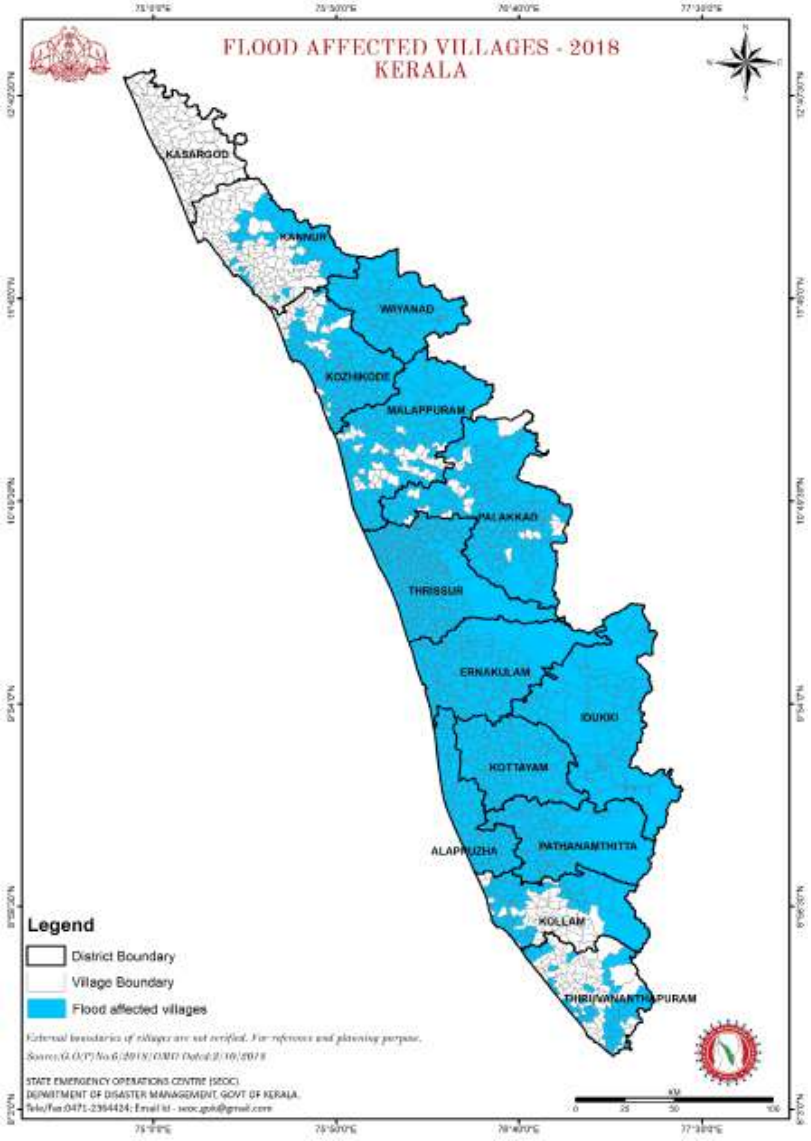
The proper operation of major dams—Idukki, Mullaperiyar, Parambikulam and Kakki—in the upper catchments of the Periyar, Chalakudy and Pamba rivers, respectively, would have had only a minimal add-on effect on the flood levels in their lower reaches and backwaters, and on the duration of waterlogging. Of course, protocols should be adhered to and these include operational rules for not only optimising power generation, irrigation supply, and safeguarding of the dam but also for downstream flood protection when heavy rains occur and environmental flow during periods of drought. Optimising dam releases for downstream flood protection will, in any case, allow for alleviation of extreme peak flows immediately downstream of the dam and thus reduce the damage caused. Controlled releases from dams located more than 100km upstream from the wetlands, will have little effect on the flood levels in the lower reaches, especially when the sea outflow is hampered.

[3] The lagoons or backwaters are connected to the sea through small openings called Azhis (when permanent) or Pozhis (when temporary).

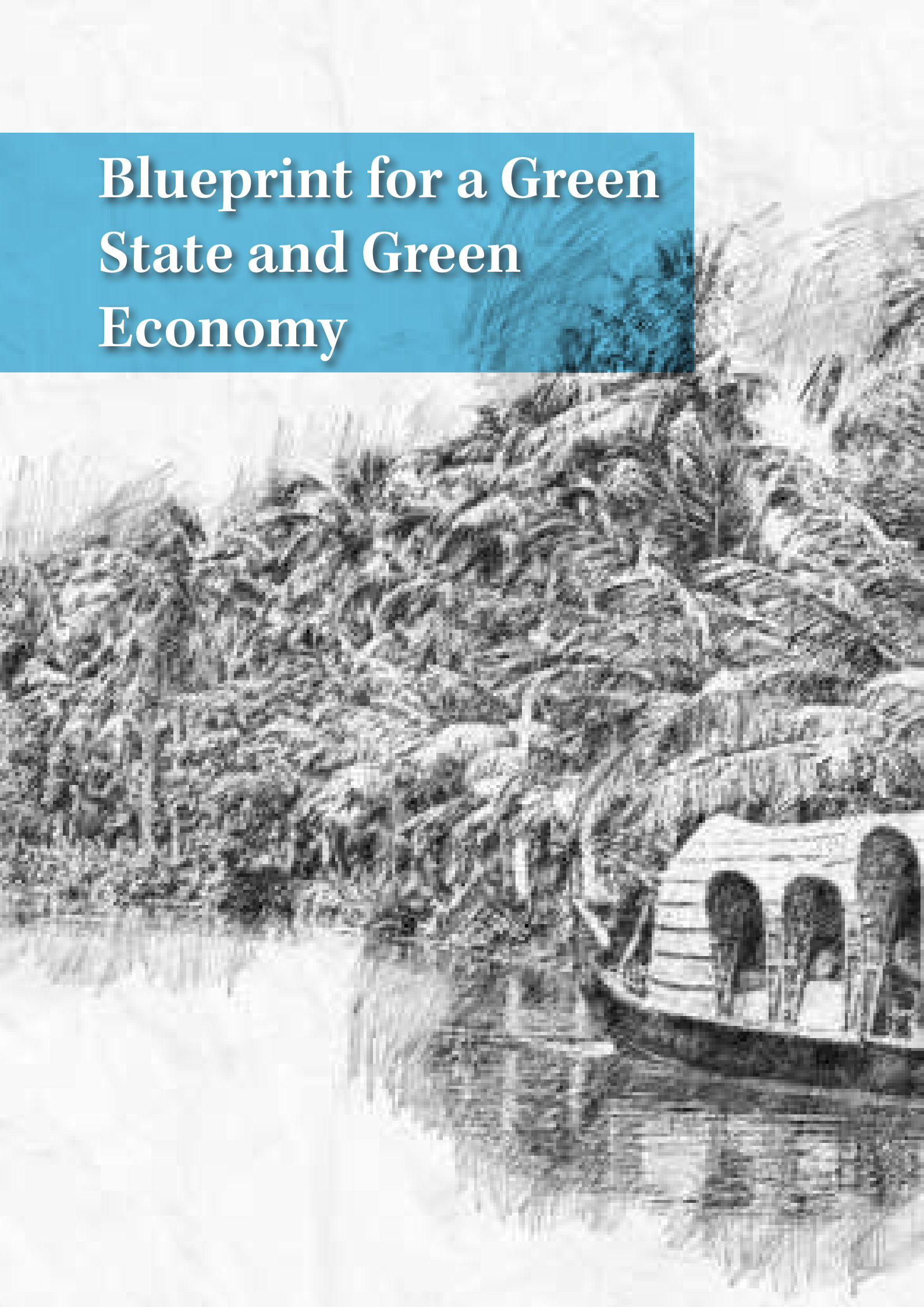
Small reservoirs will always have some flood shaving effect. The larger the reservoir capacity as compared to the flood volume from the reservoir's upper catchment, the more effective will be the flood control operational rules for downstream reaches.

Increased bed resistance in the rivers,caused by blockages in the middle and upper reaches by check dams, bunds, and poor maintenance, will shave off the peak of the floods and effectively slow down the inflow into the backwater areas, providing more time for sea outflow and reducing flood levels to some extent. River obstructions in the middle and upper reaches will however lead to local increase in flood levels. Further analysis will be needed to determine which measures with respect to river basin management are required to arrive at the right balance in flood risk reduction in the upper, middle, and lower parts of the river basins. Concepts to be considered are presented and elaborated on in the section on Integrated Water Resources Management.

In summary, the accumulation of several simultaneous and unique phenomena resulted in extreme floods in Kerala. These includeextreme rainfall, immediate runoff, low flood storage capacity in the reservoirs, poor drainage capacity of canals and sea outlets, and high spring tides.



Blueprint for a Green State and Green Economy



Blueprint for a Green State and Green Economy

The impact of the floods and landslides in Kerala has exposed underlying causes that need to be addressed in the recovery process. 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 tourism practices that have been harmful to the state's ecosystem and biodiversity. The issue of solid waste management has emerged as a serious one in the state, as much of the waterlogging due to the floods was caused by lack of proper drainage and collection of solid waste.

The flood recovery process provides a unique opportunity for reversing environmentally harmful practices and putting Kerala on the path of green recovery.

Reviewing land-use patterns: The land use patterns in Kerala have changed dramatically over the past 50 years. Kerala's economy used to be heavily agriculture based, but as more of the new generation received education and gained employment in other sectors, the emphasis shifted away from agriculture. The land used for cultivation of paddy reduced from above 7 lakh hectares in the 1970s to below 3 lakh hectares in 2010. Agriculture is also not profitable in other parts of the state due to the fragmentation of agricultural land, rising agricultural wages, and globalisation of supply chains. The post-flood recovery process is an opportunity for a comprehensive review of land use in the state so that land can be consolidated and directed towards its best ecosystem usage. Therefore, creating a land use policy which enables re-deployment of the land to maximise its natural ecosystem functions could be a model for the entire country. Paddy lands could be conserved and managed as wetlands for ground water recharge, biodiversity conservation and reduction of greenhouse gas emissions. Once an effective land use policy is in place, the use of land as a speculative instrument will stop and more land will become available to the real users, including for agricultural purposes. It will also be possible to acquire and use land for ecosystem services such as biodiversity conservation and disaster risk reduction.

Changing consumption patterns: Kerala is the number one consumer state in the country and the environmental footprint of this consumption goes beyond the state or even national boundaries, be it marble quarries in Rajasthan or deforestation in Indonesia. This is partly due to the economy which is dependent upon remittances from abroad. The unintended effect of a remittance economy is that consumption increases, creating even larger environmental footprints. Kerala can and should systematically analyse its consumption patterns and see how its environmental footprint, both locally and outside the state, can be controlled and minimised. A green state is not one which is locally green but which cares about environmental destruction everywhere.

Kerala can transform these challenges into opportunities and become the first green state in the country learning from international best practices. The following initiatives, which have good international models, may be considered.

Sustainable building guidelines: Construction is a major economic activity in Kerala and is at the root of many of its environmental issues, be it quarrying, sand mining or the import of other construction materials. The new trend of constructing buildings which are not suitable for local weather conditions and then creating a climate controlled environment within it, is causing high energy consumption. Kerala could adopt a set of locally sustainable building guidelines, similar to those in the United Kingdom, whereby each building is systematically analysed for its carbon footprint based on its construction and operation. The use of locally available materials is maximised, and the need for energy for cooling and lighting is minimised. This will also create thousands of new 'green jobs' in the state.

Maximising the use of solar energy: The climate of Kerala is suitable for the generation of solar energy 365 days a year. With solar energy technology undergoing dramatic changes around the world, and the corresponding decrease in prices of solar energy, Kerala could aspire to be fully solar-powered at least in housing, offices, and commercial establishments by 2030. As an interim measure, the government could stipulate that all new building construction, including aluminium roofs, should have built-in solar panels. Similar guidelines have been created in France, which has much less potential for solar energy generation.

Green technology centres: Every household in Kerala has multiple possibilities for the application of green technologies such as household composting, domestic sewage management, solar energy and resource recycling. It will be useful to have one green technology centre, developed as a co-operative society in every village, where young people from the village are trained in green technology installation and maintenance. There can be backward integration of these supply chains whereby district and zonal units producing solar panels, domestic compost units, etc., can be set up. While improving environmental quality, this could also create thousands of high-skilled jobs in the community.

Environment and natural resource managers: Due to the unique geography of the state, every village and city in Kerala has valuable environmental resources which are not well understood and therefore not managed. Even though environmental guidelines exist for quarrying or sand mining, there is no local capacity to implement them. Kerala could become the first Indian state to employ an Environment and Natural Resource Manager in every local government body whose responsibility it would be to map all valuable natural resources in the area (rivers, ponds, streams, hills, sacred groves, etc.) and advise the local administration on how they can be managed effectively.

Integrated solid waste management centres: Solid waste management in Kerala is not modern or well managed. One can see garbage piled up in virtually every city and complaints of unauthorised disposal of solid waste are routine. Currently solid waste management is the responsibility of the local government bodies. However, they are unable to exercise this mandate correctly due to shortage of funds and expertise. Also, due to the relatively small size of the local government bodies, including in cities, and high pressure on land (combined with 'Not in My Back Yard syndrome'), governments have not been able to address this issue successfully. It would be more appropriate to look it as a state-wide issue and see which waste streams need centralised solutions (waste-to-energy plants, incinerators, landfills), which waste streams could be locally managed (household level, ward level composting, etc.) and which waste streams should be addressed through extended producer responsibility.

Greening the tourism sector: Kerala is well known globally as a tourist destination. However, in most tourist attractions—be it Kovalam, Kumarakam, or Munnar—the

management of solid and liquid waste is a major issue, not only annoying the local population but also making these places unattractive to tourists. On the other hand, revenues from tourism, if used creatively, could bring in funds for maintaining environmental resources in a better manner. A comprehensive approach to greening the tourism sector, including the introduction of an eco-tax for tourists, could be a major step towards making Kerala's tourism green. Similar measures also apply to major pilgrimage destinations.

Creating green jobs: One of the major challenges faced by Kerala is that of creating jobs for its highly educated population. Turning Kerala into a green state would not only create new jobs locally, as in the sectors above, but also make the state a hub for providing green technology advisory services nationally and internationally. To give one example, the Cochin International Airport Limited (CIAL) is the first international airport in the world to be fully solar. There is a group of engineers and technicians who have now specialised in making green airports. There are over 5,000 commercial airports in the world. If CIAL engineers can provide advisory services to even 10% of them, it could employ hundreds of engineers and technicians and bring in hundreds of crores of rupees to the state. Same is the case with solar energy, waste management, ecotourism, organic farming, and all such sectors. Kerala should not just aspire to be green in itself, but also as a provider of such expertise around the world.

Climate change resilience: Climate change is still not considered a major issue in Kerala even though signs of climate change are visible across the state. In order to achieve better climate resilience one needs to improve climate literacy and decentralise actions for adaptation and mitigation. Every local government body should have a climate change adaptation plan and individuals should be educated about the carbon footprint of their individual actions, from meat consumption to modes of transport. Kerala, while urbanised in principle, is still living close to nature and hence could become a world leader in community-based climate resilience actions.

Haritha Keralam Mission (Green Kerala Mission):

Haritha Keralam is an umbrella mission integrating the components of waste management, organic farming and water resources management. It has an ambitious outlook to addressing the issues of piling waste, impending drought and health hazards due to the consumption of pesticide-treated vegetables and, in general, the agricultural dependency of the state.

The Haritha Keralam Mission aims to integrate the three most important and interrelated sectors through an orchestrated and cascading implementation of three sub-missions.

- *Household level segregation and safe disposal of organic waste through feasible options like composting, biogas, arrangements for institutional waste disposal, re-use, recycling and safe disposal of non-degradable and electronic waste are given priority.*
- *Rejuvenation of tanks, ponds, streams and rivers are the focus in the water resource sector.*
- *The thrust in promoting organic agriculture will be to produce safe-to-eat vegetables and fruits to make the state self-sufficient within the next 5 years.*

Meenangadi, the first carbon neutral gram panchayat in Kerala

Meenangadi, a gram panchayat nestled in the hills of the Western Ghats in Wayanad district, Kerala, is on its way to becoming the first carbon neutral gram panchayat in India. The gram panchayat aspires to achieve 'zero carbon footprint' by 2020, by reducing carbon emissions in the atmosphere and cancelling out carbon emissions by an equal amount of sequestration.

What comes close to the Meenangadi model is the English village of Ashton Hayes with a population of 10,000, which attempted to become the first carbon neutral community in United Kingdom in 2006. Ashton Hayes managed to cut carbon emissions by 24% but still could not achieve carbon neutral status.

The state finance minister, Thomas Isaac, launched the Meenangadi carbon-neutral pilot in June 2016, after returning from the climate change conference in Paris. The state government set a five-year target for the village to achieve carbon neutral status, which would then be projected as a model to be replicated across the state.

Before launching the pilot, the gram panchayat conducted a detailed household audit/survey to measure the amount of carbon emissions in the air, water and soil, due to houses, vehicles, agriculture, and other sources. This was supported by scientists, the NGO Thanal, and MS Swaminathan Research Foundation. It was found that the major source of emissions were vehicles running on the national highway that cuts through the village. A forest survey was conducted to assess vegetation cover. The audit showed excess carbon equivalent of 14,500 tons of carbon dioxide, nitrous oxide and methane. This has to be balanced to achieve carbon neutral status.

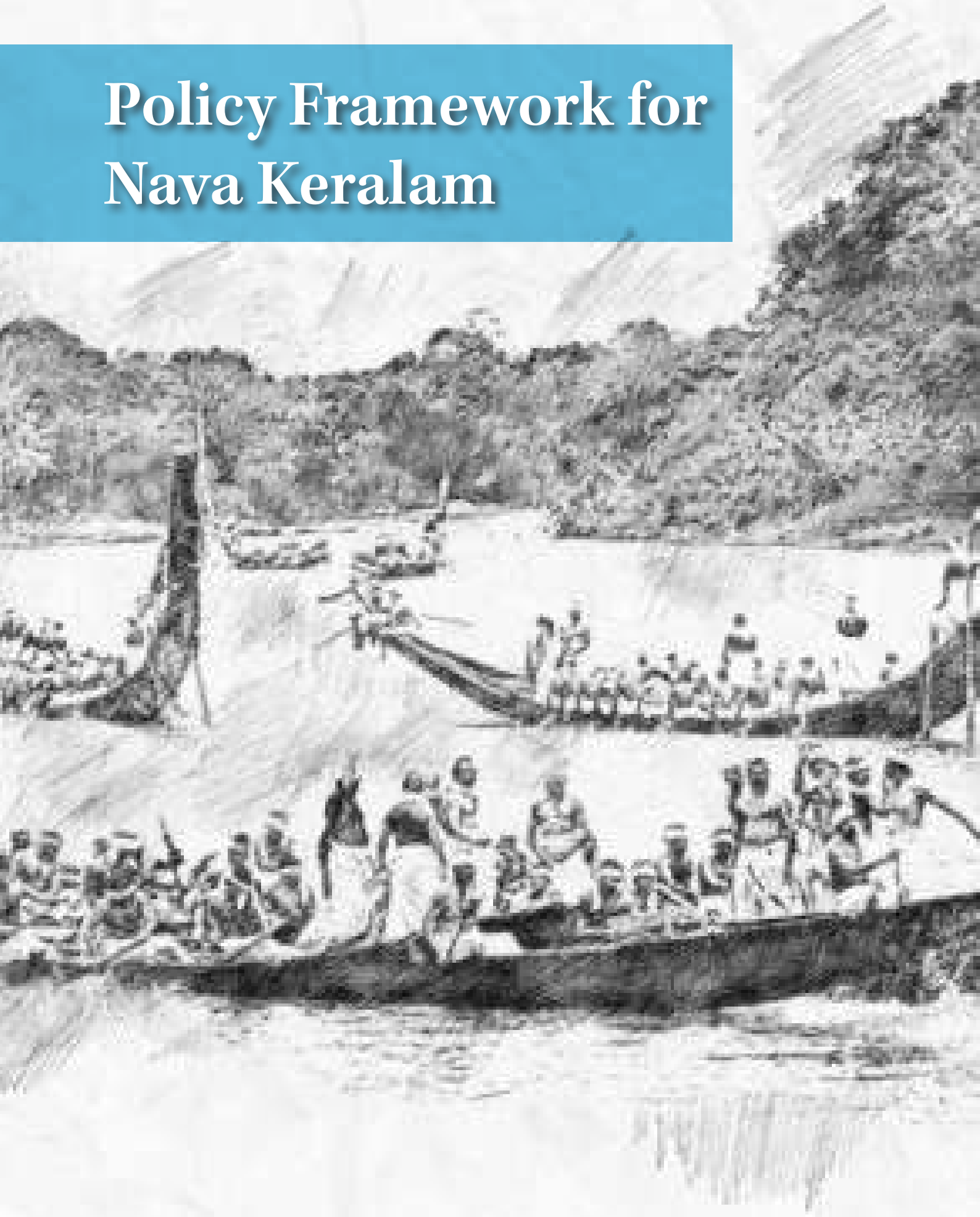
The first step was creating awareness among people on the importance of protecting ecosystems, reducing carbon emissions and adopting measures for climate change adaption. This helped get support from people who realised that the initiative was critical for their survival and that of future generations. Research points out that the average minimum temperature of the Western Ghats is expected to rise by 2°C to 4.5°C by 2050, if nothing is done to address it. For Meenangadi, the increase in temperature would mean a decline in rice production and the devastation of heat-sensitive crops of coffee, tea, cardamom and pepper.

A number of initiatives were taken up to make the panchayat carbon neutral. This included planting of trees on 1,53,781 m2 of land (equal to the size of 21 football grounds) with 450,000 coffee plants, 32,500 cardamom trees and over 20,000 shade trees. Organic cultivation was promoted and villages were given free organic vegetables seeds and buds. Globally, the agriculture sector produces one-third of the world's greenhouses gases, and organic farming could reduce carbon emissions by 46%–66%, according to Food and Agricultural Organization.

To reduce carbon emissions, the village crematorium, which used fire wood, switched to using liquefied petroleum gas (LPG). Small bio gas plants have been set up in many houses to convert organic waste into energy. The gram panchayat proposes to build a solar park to generate power for the village. Meenangadi set up a non-biodegradable waste management system and constituted a voluntary haritha karma sena (green army) for collecting and processing waste. There is a proposal to locally produce LED lamps, which are 80% more effective than other lamps. The village envisages creating more 'green jobs'.

Sources: Indian Express, 27 Feb 2018; Hindu 26 March 2017; Quartz India 6 March 2017)

Policy Framework for Nava Keralam



Policy Framework for a Nava Keralam (New Kerala)

The floods and landslides that occurred in the state of Kerala from June 2018 to August 2018 affected households in 1,260 villages in 13 districts and had a major impact on all sectors. The post-disaster needs assessment (PDNA) estimates the cost of recovery to be INR 30,739 crore. Recovery programmes, implemented over a five year period, are aimed at addressing the socioeconomic recuperation of the most vulnerable population groups, viz., farmers, fisherfolk, the elderly, the disabled, and migrant workers. The recovery will bring together multiple stakeholders working across sectors and will require substantial financial resources and technical capacities.

As the government embarks on the recovery with the participation of other stakeholders, a broad policy framework is required which provides a coherent narrative and binds all the sectors to a common vision of Nava Keralam. This chapter attempts to provide a policy framework and the approach to recovery in the key sectors. While doing so, it builds on and extends the vision embodied in the Approach Paper for the Thirteenth Five-Year Plan by the Kerala State Planning Board, Disaster Management Policy, State Water Policy and Gender Equity and Women's' Empowerment policies of Kerala.

Findings of the PDNA point towards the need to reduce the 'risk of communities to disasters' and emphasises a rebuilding process that 'addresses the root causes of vulnerability'.[1] The floods highlighted many areas of vulnerability, which operated in conjunction with and aggravated the impact of the floods. The recovery, therefore, needs to be hinged on a coordinated inter-sectoral approach that takes cognisance of the sustainability and equity dimensions. The Kerala Disaster Management Act states that disasters while highlighting 'particular areas of vulnerability and underdevelopment'.... 'may favour a much higher rate of economic and social change ... in areas such as land reform, alternative livelihoods, introduction of new technologies, housing and infrastructure improvements, and restructuring of the economic base'.[2] The Kerala State Action Plan on Climate Change also emphasises the need to understand the regional and local dimensions of vulnerability in order to develop appropriate and targeted adaptation efforts.[3] The floods and landslides recovery process is an opportunity to take forward the provisions in the Disaster Management Act and the action plan on climate change. The recovery process should build on the state's legacy of public action and people's participation in local governance, upholding the principles of social inclusion.

[1] *Kerala State Disaster Management Policy, Section 6.3 Post Disaster Phase – Recovery*

[2] *Ibid*

[3] *Government of Kerala, 2014. Kerala State Action Plan on Climate Change*

The policy framework for recovery is built on four broad pillars of work

Pillar 1: Integrated Water Resources Management Creating 'Room for the River' and 'Living with Water':

Abnormal water discharges from river basins, as was witnessed during the floods, warrant a thinking and approach to the management of land and water resources around river basins, and the problems therein. The State Water Policy explicitly states the need to 'integrate the problems and prospects of water resource systems by considering the river basin as the basic unit'.[4] The policy also states that 'sustainable development of water resources of the state calls for an ecosystem approach', to be 'facilitated through micro watershed-based planning and intervention'. This policy emphasis has, however, not been effectively operationalised in planning and implementation.

At its core, integrated water resource management (IWRM) emphasises cross-disciplinary coordination of water, land and related resources in a river basin, watershed or catchment to achieve long-term sustainability. With IWRM in place, it is possible to make proper plans for water safety, as well as food and water security based on actual and planned land use (including agriculture and allied activities), resulting in multiple basin plans. The IWRM aims to break existing inter-sectoral barriers to establish a holistic framework for coordination. This is in line with the State Water Policy's directive to 'revamp the present piecemeal approach, which is mostly based on engineering solutions'.[5]

River basin management with 'room for the river' approach emphasises ecological conservation and restoration. This approach aims to lower flood levels by increasing the wet areas of the rivers and giving them more room. Upstream river basin management with a focus on the conservation of forests assumes particular significance as all the short, fast-flowing, monsoon-fed rivers originate in the Western Ghats mountain ranges that have witnessed serious forest degradation. Agricultural practices in the mid and lowlands, with a focus on multi-cropping and integrated rice and fish farming, which protects natural drainage patterns and conservation of paddy lands needs to be encouraged.[6] This will be complemented by integrated coastal zone management that seeks to balance the livelihood requirements of fishing communities with the limits set by natural coastal dynamics.

An important prerequisite of IWRM is the availability of sufficient and reliable data and state-of-the-art hydrological models that enable the conduct of Environmental and Social Impact Assessments (ESIA) including mitigating measures that prevent environmental deterioration. This needs to be accompanied by a process of citizen education and democratic dialogue, such that the need for integrated water resource planning is communicated and appreciated at all levels. The IWRM approach brings together all stakeholders to develop and formulate an agreed-upon set of policies and strategies to achieve a balanced approach to land, water and natural resource management. It helps identify best practices for community use, safeguarding the environment, agriculture, economics, urban planning and business management to achieve healthy river ecosystems beneficial for communities, economies and ecological processes. While existing legislations encourage river basin thinking and management, effective implementation of the same is wanting. International benchmarks and the conduct of water audits of all water-related interventions may be thought of in this context.

Recommendations for recovery are centred on the core concept of protecting natural flows and giving room for the river, which is to form the basis for citizen education programmes. Preparation of basin-wide master plans linking upstream

[4] *Government of Kerala, 2008. Water Policy 2008.*

[5] *Ibid*

[6] *Kerala Conservation of Paddy Land and Wetland Act, 2008*

and downstream zones is prioritised. Developing sustainable and resilient agricultural practices integrating crop, livestock, and fisheries sectors will be an integral component of the recovery strategy.

These actions are part of a comprehensive package and are to be followed-up with short-, medium- and long-term actions for a full implementation of the approach.

Pillar 2: Eco-sensitive and Risk-informed Land Use and Settlements Approach

The floods and landslides caused considerable damage to housing. While the flood damage to houses was largely caused by the impact of swelling waters, damage to houses in hilly terrain were largely caused by faulty location on unstable mountain slopes. Landslides have made future housing prospects in these tracts untenable.

The Government of Kerala will reconstruct 17,316 new houses while conducting substantive repairs to 46,000 houses. Additionally, 41 hospitals will be reconstructed and 53 will undergo extensive repairs. Similarly, 114 completely damaged anganwadi centres will be re-built, and repairs undertaken for 1,219 partially damaged anganwadi centres, 1,613 schools and 152 continuing education centres. In the process of reconstruction of all the buildings it is important to keep in mind that reconstruction is not only in the right location, away from flood plains and slopes, but also uses disaster resilient construction techniques.

Additionally, if all these were to be designed as 'green buildings' they would already make a turnaround and contribute to making Kerala a green state. Kerala has demonstrated the feasibility of alternative, low carbon footprint construction technologies practiced by Laurie Baker, Habitat Technology Group, Centre of Science and Technology for Rural Development (COSTFORD), People's Movement for Sustainable Architecture, Government sponsored Nirmiti Kendras and so on, and therefore, the state has the experience and capacity to make this happen.[7]

The reconstruction of houses and public buildings should also be seen as a major opportunity for skill upgradation of people and green job creation in terms of construction activities. There should be special emphasis on the multiplier effect of resource use so that the materials and financial resources used for the building process will flow back and strengthen the local economy and the community. This is in tandem with the Hon'ble Governor's policy announcements during the last two Republic Day speeches, which emphasised the use of appropriate technologies for construction and green design concepts for all buildings. Adopting such measures in the recovery process enables the state to be a model for other states in this regard.

Physical reconstruction, as per the Kerala State Disaster Management Policy, needs to be sensitive to the 'hazards of the particular location, what kind of resources and capacities people have to be involved in the rebuilding, and what designs are appropriate, and resistant to floods, cyclones, earthquakes, and drought'.[8] Aligning with the broad directives of the state policy, the recovery pathway envisaged for this sector locates immediate and long-term housing recovery needs within an overarching framework of land use and multi-hazard zoning, with development and construction activities being restricted to certain zones. This is to be further supplemented by enhanced capacities to incorporate disaster risk resilient designs, citizen education on safe building practices and risk resilience, and adoption of construction technologies that ensure a reduced carbon footprint. This framework has been detailed in the chapter on housing in this report.

In line with the Government of Kerala's vision of a 'Nava Keralam', the reconstruction process envisages an eco-sensitive approach using local materials and construction technologies that are locally appropriate, fulfilling the aspirations of the public,

[7] There are about 40 such organisations working on alternative housing technologies in Kerala. If each of these organisations is entrusted with the task of constructing 500 houses, the required 18,000 houses can be constructed within the next six months, i.e., before the next south west monsoon.

[8] Government of Kerala, 2010 State Disaster Management Policy, Kerala State Disaster Management Authority.

reducing the carbon footprint, and creating more local green jobs. It is important to revive the distinctive traditional architecture of Kerala which is suited to the humid tropical climatic conditions of the state and is also environmentally sustainable.

In order to ensure technological competence and managerial efficiency it is proposed that Local Self-Government Department (LSGD) offices be given additional capacities to assist house-owners to choose designs appropriate to the location, procure materials and manage construction with technical support from Housing Facilitation Centres[9] to be established at the sub-district level. The LSGD offices will be empowered to facilitate the adoption of risk-resilient housing designs. The LSGD will also function as a regulatory body, guiding house-owners about the appropriateness of the proposed structure with regard to the particular features of the site. It will work in close coordination with the Livelihood Inclusion and Financial Empowerment (LIFE) Mission.[10]

Post-disaster reconstruction activities are likely to create a massive environmental footprint due to the large demand for construction materials and the rapid pace of reconstruction. Urgent need for housing is likely to escalate pressure to do away with environmental controls and safeguards. This can trigger further degradation of natural resources. It is recommended that an Integrated Strategic Environmental Assessment be applied to mitigate the negative impact of the surge in construction activities. This approach, developed by UN Environment, has been implemented during the post-conflict reconstruction of Sri Lanka and post-disaster reconstruction of Nepal.

Pillar 3: Inclusive and People-centred Approach—'Leaving No One Behind'

Among other things, disasters expose existing social inequalities and thereby compel us to take a closer look at them. Despite higher levels of literacy and social development, issues of social exclusion and resultant vulnerabilities pose difficult questions for the future of the state. The Gender Equality and Social Inclusion chapter of the PDNA reports that pre-existing gender, age, class, and caste discrimination coupled with unequal access to and control of resources has enhanced the vulnerability of the marginalised sections in the post-disaster situation. The floods and landslides have highlighted the particular vulnerabilities that the poor, Scheduled Castes (SC), Scheduled Tribes (ST), fisherfolk, women, transgenders, migrant workers, people with disabilities, elderly (in particular, elderly women), and households headed by women face in different stages of the disaster cycle across sectors such as health and nutrition, water and sanitation, housing, livelihoods and so on. While the relatively robust panchayati raj system and the Kudumbashree network offer spaces for participation, they have not been able to effectively address compounded vulnerabilities. Focusing on the particular vulnerabilities of the excluded and marginalised offers an opportunity to establish a human rights-based approach to recovery and rehabilitation.

The recovery strategy for a Nava Keralam will be premised on comprehensive vulnerability mapping that captures inter-sectional vulnerabilities to inform all stages of disaster recovery. The requirements of the excluded need to be prioritised across all aspects including early warning systems to inform relief operations, design and construction of buildings and community infrastructure, psycho-social interventions, and livelihood enhancement measures. The particular needs and vulnerabilities of the elderly in the state emerged starkly during rescue and relief operations, as also the needs of people with disabilities.

Recovery is an opportunity to overcome social exclusion through long-ranging structural reforms, together with shorter-term measures that prioritise the needs of

[9] It is proposed to set up 70 Housing Facilitation Centres (HFCs) in the state (approximately one for two blocks) to support the recovery programme. This would be supported by the district level executive engineers, LSGDs, and others. The HFC would be providing technical support to house owners with a staff of three engineers/ architects and three technical assistants. The main purpose of HFC is to bring social and techno-managerial support to the door step of the affected households for rebuilding activities.

[10] The LIFE Mission of the Government of Kerala aims to provide safe housing to nearly 4.30 lakh homeless and other people living below the poverty line within a period of five years.

the vulnerable. For example, additional livelihood opportunities should be offered to women while simultaneously reducing their care burden by extending the working hours of anganwadi centres and day care homes for the elderly. It is recommended that National Rural Employment Guarantee Act 2005 be used to fill in the livelihood deficit that has emerged in the aftermath of the floods. Furthermore, there should be a focus on skill upgradation of women and SC/ST unskilled workers, so as to engage them in climate-resilient agricultural work and natural resource protection under the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS).

It is also recommended that men and women be given joint title deeds for the newly constructed homes and proactive measures be taken to include people who are conventionally excluded by the state's social security programmes, such as migrant workers and transgenders.

Another important mechanism to include the socially excluded in all aspects of the recovery strategy is through the institution of mechanisms for social accountability and grievance redressal. Strengthening the gram sabha, concurrent monitoring social audit, and grievance redressal need to be made an integral part of all programmes aimed at recovery. Such measures echo the policy commitment expressed by the Hon'ble Governor in the post-Okhi scenario, calling for 'an environment of transparency, integrity and accountability'.[11]

Pillar 4: Promoting Knowledge, Innovation, and Technology

Knowledge, innovation, and the appropriate use of technology are vital in addressing the sustainable development and climate change challenges that loom large today. This is particularly so when a society gears up to cope with and recover from a disaster. The Kerala floods illustrated the potential of information technology in both rescue and relief operations. The web-based application <keralarescue.in> helped in identifying victims, camp locations, requirements in the camps, volunteer registration and so on, facilitating both rescue and relief operations. The use of social media and WhatsApp by volunteer groups and government officials enabled rescue operations, smooth dissemination of information regarding requirements at specific camps and locations, medical emergencies and so on. In many locations, these WhatsApp locations functioned as virtual 'control rooms'. In many areas, WhatsApp and similar applications have helped volunteers to remain connected as they continue to share information about recovery needs and in some cases mobilise financial resources for the same. Social media was also used to mobilise thousands of volunteers for one-time cleaning operations. Web-based applications were also used to assess damages to houses and buildings (Rebuild Kerala app), forming the basis for compensation packages, as well as to mobilise financial resources for recovery through the Chief Minister's Disaster Relief Fund (CMDRF) portal.

Information technology can be effectively used in recovery and reconstruction activities as well. It is being used to recoup lost documents by networking the database available with various departments and virtually consolidating the same. Geo-tagging beneficiaries can help to track the status of payment of compensation and to ascertain effective delivery.

Another area where web-based applications can be effectively used is in the context of social audits and grievance redress. Social audits are being mandated by most rights-based legislations and are being facilitated by the use of digital and web-based technologies as in the case of MGNREGS. The state government has already set up an independent unit for social audit,[12] which may be capacitated to undertake concurrent social audit and grievance redressal for reconstruction activities in order to ensure social inclusion and corruption-free implementation.

[11] Hon. Governor's address to the Legislative Assembly, Kerala on 22 January 2018.

[12] The MGNREGS Social Audit Society conducts regular social audits of MGNREGS.

The magnitude of the floods and landslides has reinforced the need for research and knowledge generation activities. While examining the factors that triggered the disaster, it is evident that while downstream conditions hampered discharge of water, flooding was also a result of inappropriate human interventions in the middle and upper parts of river basins. There is a need, therefore, for research to demonstrate, for instance, the role of factors such as deforestation, quarrying, unscientific road construction, slope modification, sand mining from river beds, construction on stream channels, narrowing and blocking of drainage channels and so on, in aggravating landslides and flooding. Such research outcomes can contribute to land use maps that inform recovery and reconstruction projects, in particular road construction, location of hospitals and schools as well as regular development planning.

The availability of state-of-the-art Geographical Information System (GIS) technologies facilitates the creation of such maps as well as dissemination of information. Given Kerala's decentralised governance architecture, there is a need to enhance the local government's knowledge base with such maps, to be made available at appropriate scales, enabling them to understand inter-linkages between various risk factors and their cumulative impact. This understanding also needs to be imparted to citizens through the gram sabhas and other avenues. The student community and the youth, who proved their ability to respond to the crisis, need to be roped in as agents for such a process of knowledge generation and dissemination.

Knowledge generation and dissemination also plays a critical role in disaster preparedness and planning. Two major problems that were identified in early warning communication to the last mile were 'warnings not understood' and 'warnings ignored'. Dissemination of risk information along with citizen awareness of such warnings and their implications needs to be enhanced. Once again, the energy and willingness of the youth across social categories to engage in the recovery process needs to be utilised for such dissemination, made more effective with the use of modern technologies and social media.

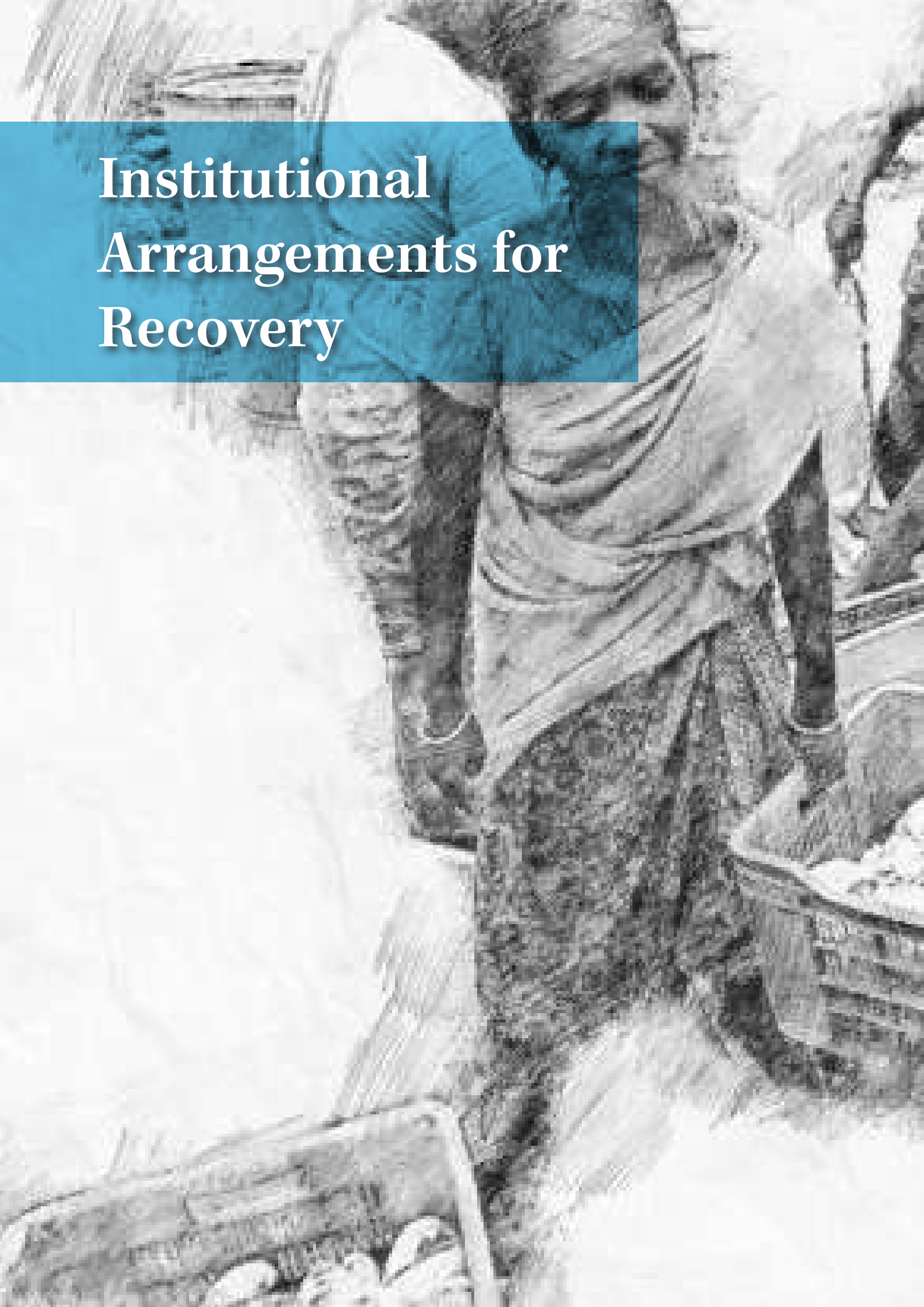
An area where knowledge generation and innovation assumes critical importance is in the production of green technologies, particularly in the context of housing and sanitation, which are the two sectors that have been most affected by the floods. It also plays an important role in expanding the scope of livelihood activities that carry a low carbon footprint.

Conclusion

As the state government undertakes its recovery programme it is important that an integrated policy framework for implementation of recovery is formulated with allocation of financial resources and adequate capacity for implementation of recovery. These pillars should guide all decisions taken with respect to the recovery programmes. It is also important that the Government of Kerala brings together all the stakeholders and enables the private sector, NGOs, and Kerala's diaspora to join the recovery efforts.

The floods that swept the state in the month of August can be treated as a once-in-a-century event. Society's response to it was equally overwhelming, bringing out the strength of solidarity and the spirit of voluntarism, which needs to be creatively harnessed in the process of recovery and reconstruction. A re-examination of our development priorities, its ecological implications, and social ramifications is the need of the hour, as the state embarks on the disaster recovery process.

Institutional Arrangements for Recovery



Institutional Arrangements for Recovery

The Post Disaster Needs Assessment (PDNA) estimates the total recovery needs at INR 31,000 crore (USD 4.4 billion). The recovery and reconstruction will be implemented over five years in 13 districts of the state, across 12 sectors. Given the large-scale recovery and reconstruction required, it is desirable that the government set up some special institutional arrangements.

The Government of Kerala has a strong practice of governance and a professionalised civil service known for its competent public administrative capacities and efficiency in delivery of services. The state is also recognised for its low levels of corruption and efficiency. It has a strong tradition of decentralised governance with some of the finest examples of service delivery and high level of achievement in the implementation of central government schemes. While these factors are a strong advantage, it is still necessary to review the current capacities of line ministries and systems to deliver assistance for the 54 lakh flood-affected people in the state. Recognising the enormity of the task ahead, it is advisable to have a separate institution or a special purpose vehicle (SPV) set up to oversee the recovery process over the next five years.

Institutional arrangements in a post-disaster context are generally of three types. The first type is using existing line ministries and systems to implement recovery. The second is to use a hybrid model whereby an existing department or agency can be scaled up to undertake recovery. The third is to establish a new agency which will undertake recovery.

Establishing a New Recovery Agency

In response to large-scale disasters, several countries have set up an independent agency to manage the recovery and reconstruction process. This is considered the international best practice and usually guarantees the most efficient delivery of services within the shortest possible time. A new recovery agency can be legally mandated, given the authority to plan and coordinate implementation, and monitor the overall recovery efforts. An institution with a specific mandate has several advantages: the first is that it has a single focus with a clear mission; second, it has dedicated capacities and a budget to do its job; and third, it has legal mandate with the authority to coordinate not only all national stakeholders but also all international stakeholders. This institution becomes the central point of coordination and oversight for recovery operations, thereby reducing transaction costs. The accountability for the recovery work lies with one institution.

Kerala has already developed some good practices in using an SPV – for example, the Cochin International Airport Limited and the Kochi Metro Rail Limited. At the national level, specific to disaster management, there are the Gujarat State Disaster Mitigation Authority and the Odisha State Disaster Mitigation Authority, which were established following large disasters and have evolved into permanent agencies. Among international best practices, there are several examples such as the Canterbury Earthquake Recovery Authority (New Zealand)[1] and Indonesia's Rehabilitation and Reconstruction Agency (BRR - Badan Rehabilitasi dan Rekonstruksi)

[1] *See Chapter 20 on best practices.*

for Aceh and Nias. Both these agencies were set up with a specific mandate and a specific start date and end date.

In line with such practices, it is recommended that an SPV be set up for the task of undertaking recovery. This SPV or recovery agency can be formed with a defined mandate and timeframe for its operation, aligned with the planned duration of the recovery programmes. The PDNA estimates that the recovery will be implemented over a five-year period, with some key sectors such as housing continuing during this period. The recovery agency can be set up for a period of five years in line with the duration of the recovery plan, at the end of which it can be dismantled.

Functions of the Proposed Recovery Agency

The key functions of the recovery agency would be to coordinate, plan, implement and monitor recovery programmes. The specific functions of the recovery agency may include the following:

- Provide leadership and direction to all recovery efforts undertaken by the state, districts, panchayats, international organisations, and NGOs.
- Commission detailed sector specific needs assessments and develop detailed recovery plans.
- Facilitate the development of sectoral recovery strategies, financing and project approval processes.
- Provide guidance to panchayats to develop local level recovery planning, priorities, and implementation efforts.
- Review and approve recovery projects and programmes, determine appropriate agencies/ partners to facilitate and execute recovery project implementation.
- Design assistance packages, eligibility criteria and delivery procedures.
- Facilitate recovery coordination at the district and panchayat levels with national and international NGOs and private sector players.
- Mobilise funds from national and international sources for recovery and reconstruction.
- Integrate disaster risk considerations in the recovery and reconstruction projects.
- Monitor the progress of recovery and reconstruction programmes to ensure quality, timeliness accountability and that benefits accrue to affected communities.

Structure of the Proposed Recovery Agency

The recovery agency will have the following staff structure:

- **Chief Executive Officer:** The recovery agency can be headed by a Chief Executive Officer (CEO), a senior bureaucrat from the state. The CEO may be appointed for five years or till the end of the recovery programme.
- **Director-level officials heading units at the state level:** The recovery agency may have at least five technical units and two units to support its overall functioning. The technical units could be set up to correspond to key areas of recovery such as 1) housing, 2) public infrastructure, 3) livelihoods and economic recovery, and 4) social services, including social inclusion,

environment and disaster risk reduction (DRR). To support the overall programme implementation of recovery, there would be three units with the following functions: 1) partnerships and coordination, 2) monitoring, audit and grievance redressal, and 3) finance and procurement.

- **District level officials:** At the district level, there will be at least one representative of the recovery agency who will work with the District Collector, the District Disaster Management Agency, the Local Self Government Department (LSGD) as well as groups such as Kudumbashree.

Staffing of the Recovery Agency

The staff of the recovery agency will be recruited in the following ways:

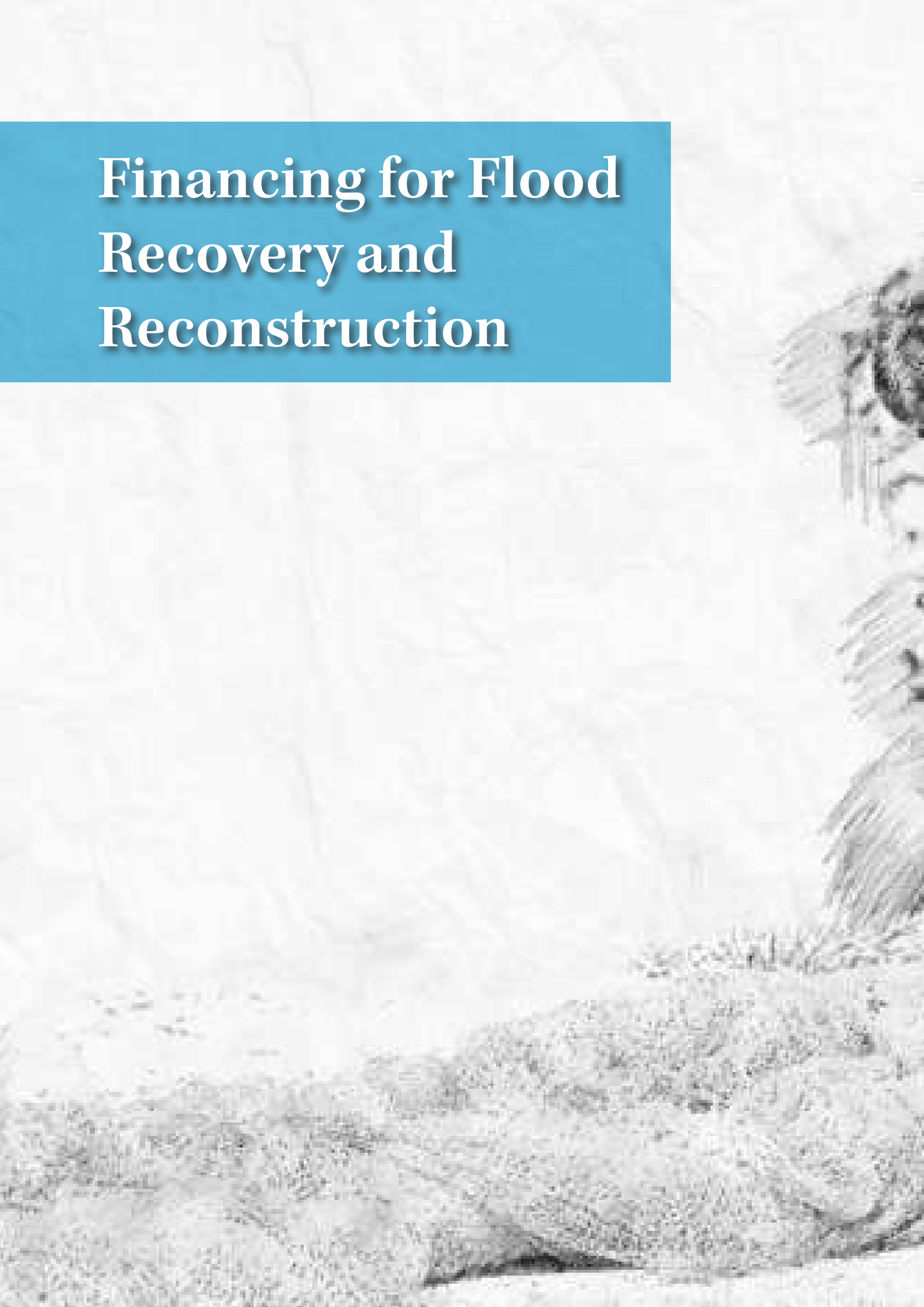
- To initiate the functioning of the recovery agency, one of the fastest ways would be to depute existing government officials from other departments for a period one year to fill various positions with competencies such as engineering skills, planning, and public finance management.
- To fill all positions within the recovery agency, the agency will be able to hire people on contractual basis from the open market. Kerala has a large pool of engineers and other qualified personnel who can be hired for a five-year period to fill these positions.
- Certain technical specialist positions can be filled with the assistance of UN agencies and other international partners. The costs for such personnel can be borne by the international development partners.
- The Government of Kerala may wish to invite qualified Keralites from other countries to provide pro bono services for short-duration assignments for specific areas.

INDONESIA: INSTITUTIONAL ARRANGEMENTS & LEADERSHIP OF RECOVERY

On 26 December 2004, a massive earthquake, registering 9.0 on the Richter scale, hit the coast of Indonesia. The earthquake triggered a massive tsunami, swamping the northern and western coasts of Sumatra, its outlying islands, and Aceh Province. National and international partners determined that existing institutional systems were insufficient to administer a recovery effort of this size and coordinate the large number of stakeholders on the ground. After three months of deliberation, the organisational mandate and institutional structure for a new ministerial-level agency for recovery was made public.

The newly formed ***Agency for the Rehabilitation and Reconstruction of Aceh and Nias (Badan Rehabilitasi dan Rekonstrucksi – BRR)*** *was established to bring coherence at the level of policy and programmes, channel available funds, and provide oversight for implementation activities. At the time, Indonesia was widely recognised as facing challenges due to endemic corruption. The President took decisive action to counteract fears about the financial management of BRR by appointing a former minister, known for his unassailable integrity and capable leadership style, to head the agency. International donors saw his appointment as an important step that guaranteed the effective delivery of services, institutional accountability and transparency—engendering the trust of impacted populations and a wide range of internal and external stakeholders. At the end of the recovery, BRR was able to deliver on USD 6.7 billion in partnership with 900 national and international organisations.*

Financing for Flood Recovery and Reconstruction



Financing for Flood Recovery and Reconstruction

Kerala needs to mobilise about INR 31,000 crore (USD 4.4 billion)[1] for its recovery and reconstruction over a period of five years, which is generally the time span needed for recovery. The annual resource requirement thus works out to be INR 6,200 crore. Assuming that the beneficiaries would contribute around 35% of these resources, the Kerala government may have to mobilise about INR 4,000 crore annually for five years at 2018 prices.

Recovery: A Collective Effort and Shared Responsibility

While the government takes on a major share of the total financial burden, the private sector, NGOs, philanthropic groups, and citizens would also contribute resources for recovery. As the household incomes have increased, private contributions in Kerala have also gone up manifold.

The government (state government and local self-governments) takes responsibility for rebuilding and repairing the public assets. Rebuilding private assets – except housing is generally left to the owners of the assets. If there were damage to private tourist facilities, owners would have to bear the expenditure for reconstruction, although the government may provide concessions or incentives for rebuilding these assets. However, rebuilding all the assets is beyond the fiscal capacity of the government. The assumption or expectation that the entire cost of recovery and reconstruction would be borne by the government, therefore, is not correct.

Even in respect of housing and livelihoods, where the government may consider assistance to the affected people, the quantum of assistance should just enable the affected people to rebuild their houses or resume their livelihoods. It is not the full replacement cost. The house owners contribute their resources as well. It is important to note that people are not passive recipients of recovery assistance.

The recovery and reconstruction need of INR 31,000 crore for Kerala over a time frame of five years could be raised through public and private finance. These channels include: a) Assistance from the Central government; b) Private donations and resources; c) Augmenting resources through tax revenue; d) Market borrowings; e) Efficiency savings and f) Overseas development assistance (ODA) .

Assistance from the Central Government

The important channels for mobilising public finance through Central government assistance are mentioned below:

National Disaster Response Fund (NDRF): Though the NDRF of the Central Government does not typically support recovery and reconstruction, a part of the cost could be funded through the NDRF. The cost of the repairs, which is allowed through NDRF, could be utilised for supporting the reconstruction component. The Kerala government has submitted a memorandum to the Central government,

[1] A conversion rate of USD 1 = INR 70 has been assumed for this report.

seeking assistance of INR 4,700 crore under NDRF. Kerala is expected to receive INR 3,500 crore under NDRF.

Additional funds from Centrally Sponsored Schemes (CSS): Kerala may get additional funds from the Central government under CSS like the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) for livelihoods, Pradhan Mantri Awas Yojana, (PMAY) for housing, and other central schemes. In view of the recovery and reconstruction needs arising from floods, the total assistance to the state through these schemes in next 5 years could come to INR 6,000 crore.

Supplementary Memorandum to the 15th Finance Commission: The Kerala government may request additional statutory block revenue deficit grant under Article 275 of the Constitution. For this, Kerala may need to submit a revised revenue receipt and expenditure statement to the Finance Commission.

Financing through Private Donations and Resources

Chief Minister's Disaster Relief fund (CMDRF): It is an important source of funding for flood recovery. The CMDRF has already mobilised INR 1,740 crore and expects to mobilise total funds of about INR 3,000 crore. With the government employees contributing funds to the CMDRF at regular intervals under the "salary challenge" programme, it will have significant funds available to support recovery and reconstruction.

Nava Kerala Lottery: The Government of Kerala has floated a lottery for recovery needs and expects to mobilise about INR 80 crore through this source.

Corporate Social Responsibility (CSR) Funds: If Kerala gets 4% of total CSR funds in India (which is about INR 15,000 crore annually), it would come to INR 600 crore annually. Most of the CSR funds are earmarked towards specific projects in different areas. It would be available mostly in the first two years and CSR contributions could decline thereafter.

Crowd funding through digital platforms: The state government has launched crowd funding digital platform to attract funds from the rich Kerala diaspora across the world, especially in the Middle East, US, UK, Europe, Canada, Australia, Singapore, Malaysia, and Sri Lanka.

NGO contribution: NGOs and international NGOs can bring in significant resources for recovery and reconstruction, especially in housing, livelihood, and house construction/ repairs. Inter-agency group (IAG) has been formed at state and district level by NGOs and INGOs to coordinate their support in recovery and reconstruction.

Setting up voluntary reconstruction funds at the local level: The state government may allow gram panchayats, municipalities and municipal corporations to set up voluntary reconstruction funds to attract contributions from diaspora, including alumni of educational institutions located in one's own village or town. Kerala's diaspora would be keen to contribute to one's own place of birth or childhood or residence. There are examples of such contributions towards reconstruction of schools and hospitals. Given the familiarity of the local self-governments with the potential contributors, these sources could be tapped more easily.

Augmenting Resources through Tax Revenue

Domestic tax revenue for recovery needs could be augmented by: a) Widening the tax base; b) Introducing new taxes; c) Improving tax collection efficiency and d) increasing the tax rate. The tax-GDP ratio in Kerala is only 9%, compared to 16.8% in India, 21% in emerging economies and 34% in OECD countries. This gives a good

opportunity to the Kerala government and local self-governments to increase the fiscal space for recovery needs by augmenting domestic tax revenue.

Widening the tax base: There are thousands of business units in the state, which do not come under the commercial tax net of the state government. A drive to include these units in the tax net will generate additional tax revenue.

Introducing new taxes: A new tax on vacant houses could be levied by local self-governments. There are about 1.2 million vacant houses and flats in Kerala. An additional tax of INR 2 per square feet per year would yield tax revenue of INR 220 crore (INR 2 x 1000 square feet x 1.1million). Several European countries have such taxes. In addition to raising the tax revenue, this step would bring 1.2 million houses into the rental market, reducing the rentals and making Kerala an attractive destination for the IT sector, compared to Bangalore or Chennai. Another idea could be a levy of tax on construction of large houses of more than 3,000 square feet area.

Carbon tax: The state government may consider introducing a carbon tax. The idea behind carbon tax is to contribute to the national effort to reduce the carbon footprint by 2030, in keeping with the Paris Agreement. Kerala could introduce a carbon tax on building materials with high carbon footprint such as cement, steel, glass, aluminium, and so on. The second candidate for carbon tax is motor vehicles.

Improving tax collection: In Kerala, the tax collections could be significantly improved. Studies show that there is a wide gap of 22%–35% between the tax potential and actual tax collected. As per the Kerala government budget statement of 2018–19, tax revenue of INR 11,800 crore is due for collection or is under litigation. Greater efficiency in tax collection could bring in significant resources for recovery.

Increasing tax rate and introducing cess: Tax revenue could also be increased by levying cess or additional tax. Article 279 A (4) (f) provides for special rates of Goods and Services Tax (GST) for a specific period for meeting natural calamity or disaster. A special rate (20% or 24%) could be levied, as against the standard rate of 18%, with the approval of the GST Council. Besides, the Central government could be requested to change the tax-sharing ratio between the Centre and the state to 30:70 for about two years. A Group of Ministers has been constituted to consider duty or cess to support recovery and reconstruction in Kerala. If such a tax or cess is introduced, the proceeds could fund part of the recovery programme.

Market Borrowings

The Kerala government can use market instruments to borrow from national and international financial institutions. However, market borrowings can create fiscal space only in the short-term, as it has to be repaid later.

Reconstruction Bonds: With the approval of the Government of India, Government of Kerala may issue Reconstruction Bonds. Several national governments have issued reconstruction bonds, which are purchased by retail investors. A larger number of people from Kerala who are living abroad would be interested in purchasing these Bonds.

Borrowing from domestic banks: Borrowing from NABARD (National Bank for Agriculture and Rural Development), HUDCO (Housing and Urban Development Corporation) and other domestic banks is another option, but the borrowing rate may be high.

Borrowing from international financial institutions: In the past, several states in India have implemented recovery and reconstruction programmes with the

assistance of the International Financial Institutions (IFIs). Government of Kerala is currently negotiating a loan from the World Bank and Asian Development Bank to support recovery and reconstruction.

However, to raise funds through market borrowings through various methods mentioned above, Kerala needs to get permission of the Central government to enhance the borrowing limit from the current 3% of GSDP as stipulated by India's Fiscal Responsibility and Budget Management (FBRM) Act, 2003. Government of Kerala has requested the Central government to raise the borrowing limit to 4.5% of GSDP, under Article 293 (3) of the Indian Constitution. If the borrowing cap were increased by 1%, Kerala government would be able to raise about INR 7,000 crore for recovery needs.

Efficiency Savings

By bringing economy in government expenditure and avoiding wasteful expenditure, Kerala government would be able to generate funds for recovery needs. Another shot-term step to mobilize resources is by re-prioritising the budget allocations or re-allocating funds of various schemes and programmes. The Kerala government has already instructed departments to effect a cut of 20% on budget allocation of state schemes during 2018-19.

Overseas Development Assistance (ODA)

Kerala government could make efforts to attract Overseas Development Assistance (ODA) for the recovery needs through budget support or pooled basket funds or for specific projects for flood recovery. These grants would reduce the dependence on borrowings from the market.

Integrated Water Resource Management

Integrated Water Resource Management

Summary

Integrated Water Resource Management or IWRM emphasises cross-disciplinary coordination of water, land, and related resources in a river basin, watershed, or catchment to achieve long-term sustainability. It highlights the importance of the ecosystem function and the need for integration of policies and costs across sectors.

In Kerala, the concept of IWRM has not yet been adopted in its water resources management policies, planning and programmes. If comprehensive IWRM had been applied according to international standards, the impact of the floods would definitely have been less.

The IWRM should be embedded in a long-term vision laid down in Kerala's sustainable development planning.

- With IWRM in place it is possible to make proper plans for water safety and water security, based on actual and planned land-use, resulting in multiple basin plans.
- The IWRM plans need to be based on sufficient and reliable data, and state-of-the-art hydrological models.
- Use international standards as benchmark for quality of data and hydrological models; apply concepts like watershed management, 'room for the river', 'living with water', and eco-engineering.
- Legislation with respect to water is abundant but needs to be made more coherent and more effective. International benchmarks may inspire. Consider applying a water audit to all interventions.
- Set up a high-level Kerala State Water Board for coordination between related state departments, with a top expert advisory body. The board is to be supported by a secretariat in the focal ministry.

Recommendations for immediate recovery:

- Promote best practices like room for the river, living with water, and 'building with nature'. Build these into a communication plan, with broadcasting for the general public and narrow casting to specific groups.
- Start a Hydrological Crash Programme. Start collecting available data now. Compare to international standards and improve. In parallel, set the requirements for the hydrological software and use that as a benchmark for total data collection and verification. Build the hydrological model for a pilot basin.
- Prepare a master plan for the Kuttanad area. It has the attention of many and was maybe the most affected area. All aspects of IWRM are encountered there.

Include upstream river basins and the coastal zone. Use the lessons learned for replication to other basins.

- Start an awareness programme at the panchayat level on living with water in flood-prone areas. Use simple manuals and consider monitoring of land use.
- Change the culture in Kerala to make water part of the hearts and minds of the people. Link this to the communication campaign. Set up a Kerala Water Partnership as an independent entity representing the public sector, private sector, knowledge institutes, and non-governmental organizations (NGOs). It can organise the dialogue and the communication, even joint research and development programmes.
- The cost for these immediate interventions is almost negligible compared to the cost of flood damage and wrong decisions on infrastructure investment. Seek financing now.
- These immediate actions are part of a comprehensive package and are to be followed up with actions for the short, medium and long term.

The IWRM aims to break inter-sectoral barriers to establish a holistic framework for coordination. It brings together all stakeholders to develop an agreed set of policies and strategies to achieve a balanced approach to land, water, and natural resource management. It helps identify best practices from various fields such as community use, safeguarding the environment, economics, urban planning, and business management to achieve healthy river ecosystems beneficial for communities, economies, and biological processes.

The IWRM largely focuses on different uses of interdependent finite water resources. High irrigation demands and polluted flows from agriculture mean less freshwater for drinking or industrial use; contaminated municipal and industrial waste pollutes rivers and threatens ecosystems; and if water has to be left in a river to protect fisheries and ecosystems, less can be diverted to crops. Unregulated use of scarce water resources is wasteful and inherently unsustainable.

Assessment of Kerala's Water Systems

A general assessment of issues related to water resources management in Kerala has been undertaken. A striking feature of the state is the chain of lagoons or backwaters (kayals) along the coastal region, connected to the sea through azhis (permanent openings) or pozhis (temporary openings). The best-known backwater system in Kerala is Kuttanad with large patches of cultivated areas below sea level. Urbanisation is visible even in the hilly areas. Less land is being used for low yield agriculture, and the emphasis has shifted to cash crops and rubber and other plantations, raising soil and water conservation concerns.

The upper watersheds of the rivers do not show heavy erosion as large parts are covered by national parks and forest reserves. Careful preservation and restoration of the upper catchment areas is an issue in view of high urbanisation, particularly in the hills, where due to heavy run-off, the topsoil is eroded and much of the natural capacity to absorb rainwater has been lost.

The rivers observed have clearly delineated main channels. The embankments are steep and stable to a degree. It seems the rivers are stable within their bed. The full bank capacity of the rivers is in the order of a 1 in 10–25 years maximum discharge depending on local topography. Flooding occurs with any higher river discharges. People live with limited flooding but were not prepared for the extreme floods of

1924 and 2018. This is particularly relevant in planning for future flood mitigation and lowering flood levels along the principles of 'Room for the River'. Regular flooding occurs in the low areas around the backwaters and lower river reaches. Apart from flood discharge inflow from rivers, flooding is caused by poor discharge capacities in the canals or blockage of discharge at the sea outlets (azhis and pozhis).

With respect to climate change the following applies for Kerala: frequency of heavy rainfall events is increasing and increase in precipitation extremes due to monsoon is very likely. Consequently, this will increase the magnitude and frequency of river floods.[1]

The projected sea level rise (SLR) along the coast is expected to be about 100 mm–200 mm over the next 100 years. Vulnerability to SLR would affect the majority of coastal communities living on sandy coasts, most of which are barrier beaches or spits. Backwater banks, islands, filtration ponds, and paddy fields are other sections of the coastal zone susceptible to SLR. This will have little consequence for the next planning cycle but is particularly relevant for the long-term scenario (over 50 years).

The coastal zone of Kerala is low land fringing the sea, extending over 590 km, with a height of less than 8 m above main sea level. To protect inland areas, seawalls are constructed over a length of about 340 km. The coast is prone to erosion. A recent study by the National Centre for Coastal Research (NCCR) has revealed that Kerala has lost almost half of its coastline to the sea in the last 25 years. Tidal activity and construction, including dredging, engulfed over 40% of the coast. At the same time over 21% of the Kerala coast has been recovered by accretion of fresh deposits.

Man-made interventions along the coast, such as breakwaters built to create small harbours, have detrimental effects on the natural coastline, e.g. the Thottappally Fishing Harbour breakwater configuration may have caused silting of the Thottappally sea outlet thus hampering outflow capacity.

The short, fast flowing, monsoon-fed rivers of Kerala often encounter salinity intrusion into their lower stretches during summer. When the fresh water flow reduces, two problems are encountered: (i) salinity propagates into the interior of the river; and, (ii) flushing of the system becomes less effective. Both have an impact on irrigation and water supply in downstream reaches. Temporary barrages are constructed to prevent salinity intrusion into the intake points of drinking water supply schemes, but they can prevent flow and create ecological problems, especially concentration of pollutants upstream.[2]

At many locations in the rivers, permanent and temporary cross and check dams are constructed for irrigation or water supply intake, often without regard to the resulting obstruction of higher discharge which can increase river levels upstream and cause unwanted flooding. The drainage channel system of Kuttanad is poorly maintained and silted, thus reducing drainage discharge capacities towards the Thottappally Spillway which itself has limited capacity of 380 m3 per second.

Kerala has a well-established hydrometric network. The quality of the data can, reportedly, not always be guaranteed. Reliable topographical, hydrometric, and bathymetric data are a prerequisite for planning of water resources development interventions as well as for the operational management of infrastructure, including flood forecasting and preparation of dam operation protocols.

The concept of integrated river basin management is generally known but not adopted mainly due to institutional constraints. In support of planning, design, and implementation for water resources development, the Kerala State Irrigation Department has a dedicated organisation. Basic data on river characteristics,

[1] Kerala State Action Plan on Climate Change August 2014. Also, Asia-Specific Observations based on IPCC Fifth Assessment AR5 Report, Intergovernmental Panel on Climate Change, http://www.ipcc.ch/report/ar5/.

[2] India: Kerala Rural Water Supply and Environmental Sanitation Project: Environmental Assessment (Vol. 2), Environmental Analysis Report (English), World Bank, 30 May 2000.

hydrology, GIS, etc., are the domain of the Irrigation Design and Research Board.

Adapting Best Practices for Water Resources Planning in Kerala

The main issues of Kerala's river basin management are:

- cross-sectoral coordination in policy development, planning, and implementation of infrastructure;
- upper catchment soil and water conservation and erosion protection;
- river channel management in view of uncoordinated construction of dams and bunds for irrigation and domestic water supply;
- poor state of repair of canal embankments (bunds) and silted-up and polluted drainage canals;
- sub-optimal operational conditions and state of repair of weirs, barrages, and spillways;
- sub-optimal protocols and adherence for dam operations without balanced consideration for downstream water demand, environmental flow, flood protection, and power generation;
- poor management of coastal river outlets;
- sub-optimal polder management, e.g. the Kuttanad area; and,
- lack of validated hydrological, bathymetric, topographical, land-use and remote sensing data.

These issues result in sub-optimal functioning of river systems, difficulty in managing irrigation and domestic water supply during periods of drought, water management of impoldered paddy fields and kayals and increase in flood risks across the basins. As the issues are interrelated, the concept of IWRM must be adopted and implemented.

A river basin plan must be developed incorporating all above aspects. As a first step, alternative development scenarios must be developed. From these, a preferred scenario with a long-term vision must be derived which will need political/ administrative support. Once a long-term vision is agreed upon, the plan may consist of various interventions for the short, middle and longer term including some internationally accepted good practices which are presented in the successive sections.

Hydrological Crash Programme

A reliable set of data is an essential prerequisite for basin planning (including hydrological modelling to improve the behaviour of the river under different circumstances) and scenario planning. Without robust data, proper calibration of the models cannot take place: rubbish in, gives rubbish out!

To obtain the required reliable data within a short period, a hydrological crash programme needs to be started in which all relevant data are collected, digitised, and thoroughly validated. Possibly the National Hydrological Programme (NHP) can assist and contribute.

The exercise in the first instance should take not more than six to nine months. In parallel, basin modelling can be undertaken. The developed models can be

calibrated once reliable data becomes available. These models will become decision support tools in which different scenarios or alternative measures can be simulated to enable fact-based decisions at higher administrative/political levels.

The crash programme should also include a component on data needed for coastal zone management and engineering.

Integrated Watershed Management in the Hilly Areas and Upper Sub-catchments

The upper catchments of the rivers are well managed as they are designated forest reserves or national parks. When this is not the case, upper watersheds are used for uphill agriculture, plantations of rubber trees, pineapples, tea plants, etc. To ensure good water absorption and water holding conditions of the upper soil, rigorous conservation, and erosion protection measures need to be taken.

An international best practice for managing smaller upper catchment of rivers and streams is Integrated Watershed Management (IWM) to improve farmers' livelihoods and sustainable estate management to protect the environment through integrated sustainable rural development (Figure 1). Through a participatory design process at the panchayat level, activities will be packaged into an integrated set of interventions.

- **Soil and water conservation:** Including sediment retention structures, afforestation and vegetative cover, and village infrastructure such as water supply facilities.
- **Livelihood improvement:** Physical investments to improve the income of farmers including terracing of slope land, horticulture and fruit and nut trees, grassland, livestock development, irrigation and drainage, and renewable energy supply.
- **Coordination and support services:** To ensure inclusion of vulnerable groups, quality implementation, the right institutional setting for sustainable operation and maintenance, mitigation of environmental and social risks, and monitoring and evaluation.

Mitigation of Flood Risks—Room for the River

Flood-risk management builds on two components to mitigate flood-risk damage (Flood-risk damage = Risk of flooding x Resulting damage):

- ensuring absorption and holding of water in the upper catchment areas of the river by building multipurpose storage reservoir and adopting IWM and
- Adopting 'Room for the River' principles to lower floodwater levels in rivers by increasing the wet areas of the rivers, i.e. giving them more room or space (Figure 3).

Adapting these principles to the context of Kerala may involve:

- strengthening or increasing crest heights of embankments and bunds;
- outward shifting of embankments/bunds or digging embankments to increase channel wet areas;
- removing lower bunds to allow free flow through floodplains;
- lowering of the floodplains or flat areas next to the river;

- removal of check dams and cross-bunds and other obstacles;
- dredging out the river and canal beds;
- creatingflood bypass using already low-lying areas or old river beds, e.g. those old river beds used by the recent floodwaters next to the main river channels; and,
- creating retention areas by linking lakes, irrigation canals, and kayals to temporarily store water.

Preventive damage control is done through a strict licensing policy for building in flood-prone areas. As Kerala sees rapid urbanisation and pressure on building plots, the concept of 'Living with Water' may be adopted for those who accept a calculated risk and build accordingly.

The Netherlands" Room for the River' project had as an equally important objective, ecological conservation and restoration. When planning any intervention, it needs to be accompanied by a proper environmental and social impact assessment, including mitigating measures to avoid environmental deterioration. For the basin plans this may be at a strategic level.

Integrated Coastal Zone Management

Integrated coastal zone management (ICZM) seeks to balance environmental, economic, social, cultural, and recreational objectives, all within the limits set by natural coastal dynamics. It requires integration of relevant sectors and levels of administration and of the terrestrial and marine components of the target territory. State-of-the-art morphological models are available to analyse and predict coastal morphological processes such as erosion. For Kerala this is relevant in engineering sustainable sea outlets.

Figure 1

Living with Water

In flood-prone areas, waterlogging of built-up land cannot always be avoided. The concept of 'Living with Water' can be adopted in developing a long-term vision for these areas. Apart from technical measures such as building of multi-storeyed housing to allow safe spaces during floods and mounts to where cattle can be evacuated, soft measures such as enhancing awareness of the risks, early warning, and communication can be undertaken.

In Kerala, living with water is brought into practice in the Vembanad Lake system and the Kuttanad wetlands. The conditions in these areas can be further improved through flood-safe housing, built mounts, reclaimed land from the kayals, or higher embankments. Living with water is also practiced in eco-tourism through houseboats. In keeping with the principles of living with water, it must be clear to people that extreme flood levels may occasionally occur and housing must be adapted accordingly. Due consideration needs to be given to water, sanitation, and hygiene (WASH) aspects.

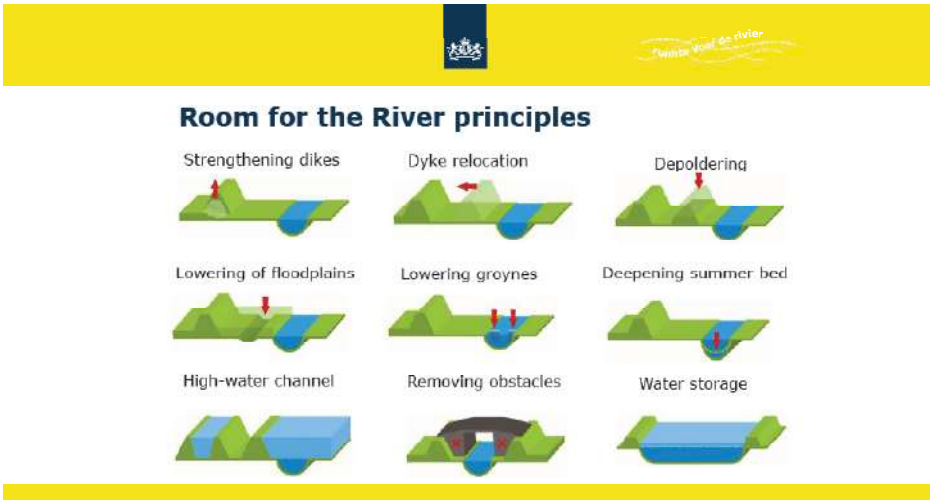
Building with Nature – Eco-engineering

Building with nature is a concept where natural phenomena are leveraged to cope with climate change risks posed in the form of storm surges, sea-level-rise (SLR), and floods. It is also called eco-engineering and is inspired by phenomena like oyster reefs that protect the coast or mangroves in front of dykes. Natural elements can provide the solutions necessary to guard against advancing waves and SLR and provide new sources of food and income. Eco-engineering could be an option for coastal protection, bund and embankment protection, and natural bypasses to enlarge the river's discharge capacity and thus keep floodwater levels lower.

Flood-risk Management

Flood control aims at preventing human casualties and limiting the material damage. Extreme floods cannot be prevented. Investment in reduction of flood risks is like an insurance premium. The amount of the premium depends on the risk level one wants to insure against. Flood-risk damage = flood risk x flood damage. Areas with potentially high socioeconomic damage could be protected against flood occurrences once in 50–100 years (or more);this however comes at a cost (high premium). Rural areas with fewer people and relatively low physical investments could receive less protection with lower investment (low premium).

Figure 2



Special Focus: Kuttanad Wetlands

The Kuttanad water system was among those most affected by floods, due to limited capacity of outflow to the sea. It is a priority region for improved water management and flood damage mitigation.

The Kuttanad wetlands extend from the southern part of Vembanad lake with outflow controlled by the Taneermukkum Barrage, the polder areas in and adjacent to the lake, and the polder areas south of the lake with a southern boundary of the Pamba river and an outlet canal controlled by the Thottappally Spillway (to block saltwater intrusion and discharge of floodwaters).

Kerala's coastal area is in many ways similar to that of The Netherlands. Both have a straight coastline running from north to south with natural sea barriers 5m–10 m above main sea level (msl). Sandy beaches are prone to coastal erosion. All along and behind the higher coastline one finds natural backwaters.

The Kuttanad is an impoldered backwater used for below msl paddy cultivation. In The Netherlands most backwaters are impoldered to allow for agricultural, urban, and industrial development. Polder development is characterised by a system of canals with water levels at msl or below. The canals typically run within embankments or dykes and are used as buffers for supply of irrigation water or for pumped water from lower lying polders. In Kuttanad, polders are mainly paddy fields. The canals also provide drainage for the whole polder system, achieved by free flow towards the sea or by using pumps. To gain a quick understanding of Kuttanad water management as it was around 1990, it is recommended to view the YouTube film Kuttanad - Water Balance Study Project (Indo-Dutch)[3]. Canals and water management structures are suffering from poor maintenance.

Any new improvement plan will also have to deal with environmental deterioration due to fertilisers and pesticides over the years, resulting in abundant uncontrolled growth of the water hyacinth. Tourism, fisheries, and ecological aspects for wetland improvement must be considered. An important component will be coastal zone management, with specific coastal engineering for sustained sea outlets for flood drainage out of the area. To improve water management in Kuttanad, a study must be undertaken to plan rehabilitation of the water system using state-of-the-art concepts in polder development and coastal zone management.

A good starting point would be a review of the Kuttanad Water Balance Study. A prerequisite for any further study would be the update of existing data and collection of new data on topography, polder infrastructure, hydrology, coastal bathymetry, and ecology. The methodology and tools developed for Kuttanad as a pilot area can also be applied in other Kerala river basins.

Enabling IWRM within Kerala's Governance Structure

The IWRM is considered part and parcel of integrated spatial planning encompassing both urban and rural development. The IWRM planning has to fit into formal spatial plans enacted in law.

Scope for Ensuring Crossectoral Coordination

The idea that IWRM has to be undertaken by institutions at every level of governance is gaining momentum. As Kerala is a federal state with a well-educated population, it should be able to manage its own resources in an autonomous way. There are only six shared rivers with the neighbouring state of Tamil Nadu, which are of minor importance and can be dealt with between the two states.

[3] *(https://www.youtube.com/watch?v=Z-wH-EujcTE&feature=youtu.be)*

Kerala has a strong government which gives autonomy to lower levels of government, in particular to districts and panchayats. At the district level, the local experts usually deal with operation and maintenance of smaller schemes.

There is a multitude of government entities that one way or another deal with water-related activities. They are not all of the same importance in IWRM. Therefore, we distinguish three rings. The first ring will deal with IWRM on a daily basis, the second ring frequently, the third ring occasionally. The Department of Water Resources (DWR) is the most conversant with IWRM. Immediately related are the Irrigation Department and Groundwater and Hydrographic Survey Wing (first ring). Also related are Agriculture Development and Farmer's Welfare, Environment and Climate Change, Fisheries, Harbour Engineering, Public Works, Mining and Geology, Soil Survey and Conservation, Surveys and Land Records, Town and Country Planning and Water Transport (second ring). More remotely related are those such as Education, which could be part of a third ring related to IWRM. There are no obvious coordination arrangements yet between the different directorates, apart from the first ring. Key persons recognise that this requires action.

The mandates of the DWR and the Department of Irrigation currently cover a lot of what is required for water resources management. On the other hand, for instance, the Energy Department manages dams for electricity production. For irrigation purposes, the flow of these dams is considered sufficient. Nevertheless, there is much scope for improved coordination between different sectors, which, to date, is considered not easy.

For a river-basin systems approach this cross-sectoral coordination is crucial to optimise a more robust system. This will require a shift in culture and possibly legislation. On the other hand, well-educated people in the government and civil society have a good grasp of what is required. Also, many laws and regulations are said to be in place but have not always become effective. There is some experience with local autonomy at the lower levels of government and a well-developed network of community service organisations to build on. Apparently, there is sufficient absorption capacity for further developing a river-basin systems approach.

Understanding the Need Gap in Awareness Generation, Capacity Building, and Operationalisation

Broadly comparing IWRM in Kerala with reference countries, there is much ground still to be covered. Awareness and expertise on IWRM and a systems-based approach is available, but it is limited and scattered across public agencies, private entities, knowledge institutions, and members of civil society. In fact, each entity has a different interpretation of IWRM depending on the sectoral background. Knowledge on IWRM is available among senior government officials and among less senior staff that still have to make a career—this knowledge, especially the latter, needs to be unlocked.

Several key state government agencies are aware of the importance of IWRM but a common understanding is yet to develop. It would strengthen cooperation and partnerships to enhance a common understanding of IWRM with coherent and consistent training programmes. Given the level of awareness among senior officers, it should be possible to train junior officials and functionaries on ground to incorporate a common IWRM approach intotheir tasks. One could start soon with a two-day workshop for key stakeholders.

Decision making on interventions in the river basins is often based on sectoral priority rather than an overall integrated plan. Planning is done meticulously, but implementation is often amiss. The impact of interventions by one department

on other stakeholders is not always taken into account. Checks and balances on changing land use may be improved by adapting international best practices. A tool like a Water Audit that can be applied to all spatial plans and their amendments to check their impact on the overall water system is also missing.

Still to be explored is the potential to tap into the Kerala diaspora. Contacts with the Kerala community in the Netherlands, confirm that there is international standard expertise available and committed to contributing. It is assumed that this expertise and commitment is available in other countries as well and is worthwhile tapping into.

The relatively new Kerala Disaster Management Authority (KSDMA) has proved to be capable of dealing with complex issues related to IWRM. The staff is aware of IWRM and champions the future application of international best practices for adequate river basin management in Kerala, including flood prevention, management, and relief. Close cooperation between the DWR and KSDMA, even informally, has the potential to convince decision makers on immediate steps forward.

Though district administrations and panchayats are especially empowered in Kerala, this study has not been able to verify the local IWRM capabilities. While there is no doubt about resilience after the disaster, disaster preparedness does not appear to have been adequate. Water management has been limited to small schemes, operations, and maintenance. It is doubtful if local tiers of government will be able to undertake IWRM, without adequate training and provision of tools. Other post-disaster needs assessment (PDNA) reports and consultation with civil society organisations (CSOs) reveal a solid base for local commitment to build on.

While there are many laws, it is not yet clear to what extent the existing laws strengthen or contradict one another. According to most respondents interviewed during the PDNA, enforcement remains a big problem. In particular land-use planning and administration and permissions and clearances can be used as tools to regulate human intervention.

The Centre for Water Resources Development and Management (CWRDM), Kunnamangalam, Kerala, may also contribute to the IWRM endeavour in the state. Though the institute could not be visited in the course of this PDNA, it is reputed in the state as an autonomous R&D institution in the water sector established by the Government of Kerala, under its Science and Technology Policy in February 1978. The centre was amalgamated with the Kerala State Council for Science, Technology and Environment (KSCSTE) in its Silver Jubilee Year—2003. The centre has contributed to the scientific hydrologic studies and water management in the region.

Bridging the Need Gap in Awareness Generation and Capacity Building

At this moment there is a momentum to promote IWRM, put it on the political map, and link it to any future spatial planning and physical development. To use this momentum and structure the potential for IWRM, the following may be considered.

Making adequate institutional arrangements

The Chief Minister's Office (CMO) is responsible for coordinating cross-sectoral development planning and implementation. With the Chief Secretary also being Secretary to the Council of Ministers, the necessary inputs for balanced political decision making can be brought into effect.

The concept of a legally constituted Kerala State Water Board (KSWB) could be used as a starting point, keeping international examples of such boards as benchmarks for

Kerala. The mandate of the KSWB would be to coordinate all water issues in Kerala. Specific issues may remain with specific departments, but the overall coordination and mandate to balance interests and prepare for political decision making would be with the KSWB. The preferred option is to have such a board attached to the CMO. Its members are the secretaries of the most relevant departments. An advisory panel of experts can provide perspective, advice, and knowledge base to create public support. The KSWB should be supported by a strong secretariat embedded in a focal ministry.

The KSWB should strive for basic water safety and security to be well-financed, separate from the annual budget to guarantee continued funding regardless of changing administrations (like the Water Infrastructure Fund in the Netherlands).

The Chief Secretary is the government administrative function where all the cross-sectoral elements of IWRM come together. Until a full KSWB is formally established, day-to-day coordination could be done through an inter-departmental Water Working Group that could be attached to the Chief Secretary's office. With the relevant secretaries as members, the group would need to convene at least twice a month. It would need a supporting mechanism to make coordination operational. The Water Working Group could be advised by a provisional expert advisory panel of experts from the government, the private sector, academia, and CSOs.

The Department of Water Resources as the focal department could start with Memoranda of Cooperation with the first ring stakeholders to ensure balanced arrangements to gain political backing. Such memoranda would have to be accompanied by bilateral Standard Operation Procedures. The DWR would need to provide a technical secretariat to the Water Working Group. The Water Working Group could report monthly to the Chief Secretary and quarterly to the Council of Ministers.

There is support for a review on existing water-related legislation. A water audit to check and approve interventions based on their impact on the water system, could be an operational mechanism for each development activity in rural and urban areas. A water audit should be done before issuing licenses and permissions for such activity. Environmental impact assessments attached to development plans should also be thorough. The KSWB could use the Water Audit as an operational tool.

Building partnerships

Kerala, with its well-educated population and the current post-disaster momentum, may be well positioned to start a culture change in water management. There appears to be no platform yet where professionals can meet from the public and private sector. Though there is the India Water Partnership, its effectiveness is still limited when compared with other countries. The prospect of setting up a Kerala Water Partnership (KWP) as an independent entity supported by its stakeholders looks attractive. It could become a platform for dialogue between all relevant stakeholders in the public, private, and water sectors, knowledge institutes, and NGOs. The KWP could organise annual International Water Day celebrations across the state, in March each year.

Dialogue could be started for specific interest groups like water supply, irrigation, etc., with a special focus group on IWRM to create coherence. Common interest programmes could be developed on capacity development, research, and advocacy. The Global Water Partnership (GWP) could support the KWP, providing an IWRM toolbox. Linking up the partnerships at global, national, and state levels may kick-start the process.

Potentially organised by the KWP, Kerala may celebrate an annual International Water Day each March.

Enhancing community participation

Kerala has a strong network of CSOs that often complement government initiatives. Also, resilience and motivation for self-help in the community are strong. The collective efforts in the wake of the floods have proved that water management can be done at the grassroots with suitable training and provision of tools. The CSOs can contribute to and take responsibility for awareness development/training, monitoring, enforcement by exposure and advocacy/feedback to the government, private sector and knowledge institutes.

If the full power of communities is mobilised for on-plot retention, neighbourhood planning, and implementation, maintenance of channels, reporting on waste dumping and pollution, the outcomes can be significant. The CSOs can thus safeguard the interests of the community, where the government cannot and should not reach. The potential of the Haritha Keralam Mission can be further explored covering household-level segregation and safe disposal of waste, rejuvenation of tanks, ponds, streams and rivers, promoting organic agriculture. The Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) may serve well here to combine IWRM and employment generation. Kudambashree Community networks could be brought into ensure that IWRM intervention designs do not work against the interests of women and they get equitable livelihood opportunities in these activities.

Encroachment over the past decades on bunds and river banks that are known to be flood-prone has been rampant. While resettlement of these populations elsewhere may be hard, the concept of 'living with water' may well be applied here. Future encroachment must be stopped and planned settlements must adhere to the principles of living with water meticulously. Besides formal land-use planning and enforcement, officials at the district and panchayat levels can play an important role, supported by community efforts, in flood risk reduction. Communities have to designate safe places to flee to with shelter, water, food, power and communication facilities.

Communication

Communication is the key to effective partnerships With transparency and accountability are at the core, requiring protocols for information sharing. An even broader communication strategy is recommended as an essential part of an IWRM approach right from the outset when a pilot basin is planned. It is an essential tool for the government to inform the general public about its plans at an early stage of recovery.

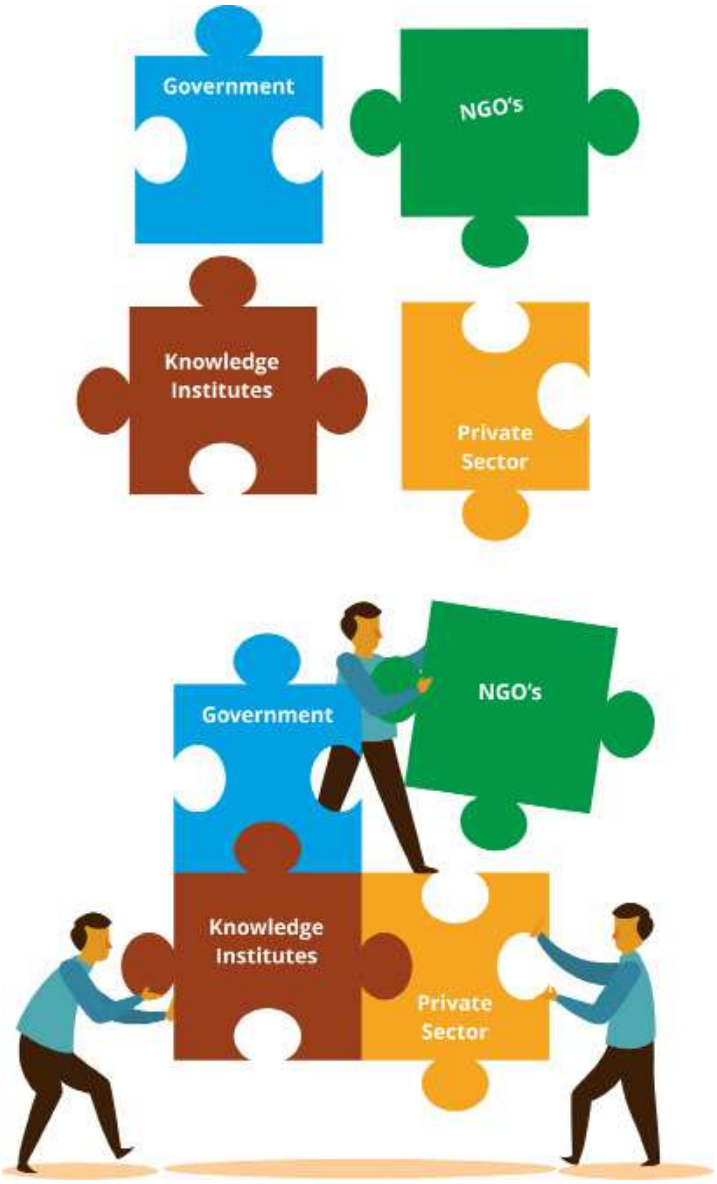
Inter-sectoral Links

The IWRM is cross-sectoral. Many links with IWRM can be seen in the assessments and recommendations throughout the PDNA report.

Environment: Soil erosion, forest area impact, riverine impact, water contamination, and reduction in biodiversity are environmental issues directly addressed by upper catchment soil and water conservation and erosion protection initiatives. These can be further mitigated through integrated watershed management interventions in the hilly and midland zones of the river basins. Dam operation rules need to take into consideration the sustainability of riverine ecosystems while taking decisions on the environmental flows all the year round. Giving more room or space for water

Figure 3

Partnerships between Government Agencies, NGOs, Knowledge Institutes, and Private Actors is Key



to flow through at higher discharges can go well with ecological restoration in the widened river reaches and river bypasses, thus contributing to a 'Green Kerala'.

Employment and Livelihood: Within IWRM there are ample opportunities for MGNREGS jobs including eco-restoration works. Also, at the panchayat level, jobs can be created while taking up the first watershed management infrastructural works on creek and small streams—building small check dams or cleaning out channels where waterlogging is a danger.

Agriculture, Fisheries, and Livestock: Long-term risk mitigation through maintenance of the natural flow of rivers, the prevention of soil degradation, the improvement of soil health, and an integrated flood-resilience approach are cross-linking components in the crop recovery strategy. The IWRM planning always aims for the water needs of fisheries to be balanced with requirements of other water users. There are ample opportunities for profitable coexistence of all claimants to the water including fisherfolk, paddy farmers, tourist entrepreneurs, and even

the wetlands. Just as the extensive Vembanad lake system continues into the Kuttanad Wetlands, so should these wetlands be seen as an intrinsic part of the overall Vembanad – Kuttanad basin (including the five river basins feeding into the area).The proposed authority should rather be named Vembanad / Kuttanad Development Authority within the overall institutional setting envisaged for the development planning of the Kuttanad Wetlands.

Housing, Land and Settlements: Keeping in mind room-for-the-river measures, recommendations for proper land use in the coastal, midland, and hill zones and Kuttanad (as a special zone) will need to go hand-in-hand with land reservations and construction bans in the floodplains and old river beds. Flood-risk maps would have to be part of overall hazard zoning.

Disaster-risk Reduction: Insight into the behaviour of a river basin (which comes with IWRM), and tools such as hydrological models and flood-risk mapping, can be used in the design of flood-risk awareness for strengthening of disaster preparedness and response.

Health and Nutrition: Ensuring clean and healthy rivers and ensuring clean water to all usersare to be seen as main contributors to preventive health care.

Local Governance: The IWRM tools, such as hydrological models, can contribute to forecasting and early warning systems for local disaster preparedness and last mile connectivity. Involving panchayats in local IWRM actions would be a most effective way of spreading the concept and making people more comfortable with enjoying and respecting water whilst living with water.

WASH: The WASH will always be part of IWRM, because quality of water supply is directly related to the health of its source. Proper sanitation and effective waste management are prerequisites to keeping clean and healthy water resources.

Gender and Social Inclusion, Cultural Heritage, Education and Child Protection: These are cross-cutting aspects against which an integrated river basin plan needs to be judged with respect to good governance, social responsibility, and capacity building.

Recommendations

Immediate

- Use the current momentum and get political and state commitment that a system-based IRWM approach will be adopted. This will ensure that administrators and civil servants have political support in IWRM.
- Organise a two-to-three day long IWRM workshop with stakeholders, sharing findings of this report and seeking comments and commitments on integrated watershed management, room-for-the-river principles, living with water, and eco-engineering.
- Start collecting, digitising, and validating all relevant hydrological, topographical, bathymetric, and remote sensing data, as a prerequisite to a hydrological crash programme.
- Ensure enforcement, including licensing for land use in flood-prone areas, at the state and panchayat levels.
- Undertake village-level campaigns to live with water, including improvement of basic flood and drainage infrastructure, accompanied by a communication

campaign. Link with the programmes/schemes of national and local missions.

- Start village- and district-level training in integrated watershed management to restore good water absorption and erosion protection in the upper watershed.
- Prepare terms of reference (ToR) and start initial local implementation of a hydrological crash programme.
- Prepare ToR for, and start local implementation of, a comparative study on IWRM legislation.
- Formulate ToR for a master plan for the Kuttanad Basin.
- Seek financing at the state and national levels and assess the potential for international support.Link up for financing with the National Hydrology Project.

Short term (up to two years)

- Prepare dam operation protocols, including balanced operational rules for optimising power generation, irrigation supply, safeguarding of the dam, flood protection when heavy rains occur, and the release of environmental flow during droughts.
- Improve operation and maintenance (O&M) supported by sufficient budget allocation.
- Start with simple guidelines that could be tested and embedded later in existing legislation.
- Set up a provisional Water Working Group with a technical secretariat to enhance cooperation between stakeholders. Link it to a focal department (DWR).
- Start with Memorandum of Cooperation between the DWR and most relevant stakeholders and accompany with standard operating procedures.
- Cooperate with universities that claim to have their own data sets and models.
- Set up a Kerala Water Partnership.
- Assessthe capacity and expertise available in Kerala for developingIWRM training programmes. Link up with national and international knowledge centres.
- Start implementation of a hydrological crash programme.
- Start a comparative study on IWRM legislation.
- Start a masterplan for the Kuttanad water body.
- Start building capacity on coastal zone management and coastal/marine engineering.
- Seek financing at the state and national levels and assess the potential for international support.Link up for financing with the National Hydrology Project.

Medium term (two to five years)

- Revise existing legislation to support IWRM, remove overlaps and shortcomings that need to be addressed. Present best practices from India and abroad as alternatives to choose from.
- Approve, finance, and implement the Kuttanad Master Plan for a pilot IWRM

programme and make the institutional changes required to get it approved, implemented, and enforced. Use experiences in the pilot for the other basins, based on available expertise developed in the meantime.

- Consider upgrading the Water Working Group to a Kerala Water Resources Committee, well mandated and supported by adequate legislation. Use international examples as benchmarks.
- Evaluate enforcement effectiveness.
- Prepare decision makers for scenario-based adaptive planning.
- Embark on the preparation of comprehensive river basin planning. Promote administrative/political discussion to arrive at a consensus on the preferred long-term vision in respect of water resources management.
- Analyse the educational capacity in Kerala in the context of creating IWRM training programmes at undergraduate, postgraduate, and doctoral and post-doctoral research levels.
- Allow for benchmark visits for key stakeholders to see best IWRM practices in other countries.

Long term (more than five years)

- Expand the Kuttanad example to other basins.
- Embed water safety and water security in long-term legislation.
- Budget for constant O&M and systems upgrade in IWRM as Kerala's economy develops.
- Evaluate the performance of the technical and institutional infrastructure every five years.

Cost of Recovery

No estimate is made of damage and immediate recovery costs, since this is covered to a large extent by the other chapters and the Joint Rapid Damage and Needs Assessment (JRDNA) report. Only cost for immediate follow-up and priority actions are indicated in Table 1. Further costing is considered part of follow up activities.

Table 1
Immediate Follow-up and Actions

Action	Budget USD	Budget INR lakh	Source	Actor	Remarks
Workshop	--	--	Routine state budget	Chief Secretary and Department of Water Resources (DWR)	
Initial data collection	--	--	Routine state budget	DWR	Should be done anyway. Key departments to contribute to data collection from their routine budget.
Enforcement	--	--	Routine budget of each organisation	Department of Land Use (DLU), Civil Society Organisations (CSOs), panchayats	Should be done anyway
Village level campaign	--	--	Routine budget of each organisation	DWR, CSOs, panchayats	To be found in prioritising routine expenditure
International guidance to upgrade databases	50,000	35	Bi- or multilateral	Chief Secretary & DWR	Key departments to contribute to local effort to data collection from routine budget
Comparative legal study	75,000	52.5	Bi- or multilateral	Chief Secretary, DWR, and Legal Department	Key departments to contribute to local effort to data collection from routine budget
Hydrological Crash Program	750,000	525	Bi- or multilateral	DWR	Key departments to contribute to local effort to data collection from routine budget
Masterplan (pilot) Kuttanad	2–3 million	1,400–2,100	Bi- or multilateral	Chief Secretary and DWR	Key departments to contribute to local effort to data collection from routine budget
Seek financing	--	--	Routine state budget	Chief Secretary and DWR	
Total	**3–4 million**	**2,100–2,800**			**Approximate, depending on distribution of local and foreign contributions and routine vs. additional investment**
Note: USD 1 = INR 70					

Housing, Land and Settlements

Housing, Land and Settlements

Summary

The June–August 2018 monsoon season caused significant damage to the housing sector due to floods and by landslides. Flood damage was foundation scouring, by soil settlement, and due to inundation for several days and occurred near rivers, canals etc. Flood damage could have been avoided if house construction had followed the minimum recommendations of the National Building Code of India[1] (NBC, 2005), such as plinth and lintel bands.

All the houses lost in landslides were located on unstable mountain slopes and would have suffered a similar fate regardless of building typology and construction technology used. Siting buildings on such slopes could have been avoided had there been regulations that required expert geologic inspection before excavation and construction on such slopes.

The field visits and interactions with the government engineers revealed that many buildings were damaged due to the non-compliance with building safety standards. Recovery action should therefore be integrated with disaster-risk reduction (DRR) measures thus embracing the principle of 'building back better' (BBB) and increasing resilience to future hazards. Repair works need special attention since the buildings have to be retrofitted considering that the locations are multi-- hazard prone. The principle of BBB is also part of the Priority 4 of the Sendai Framework for Disaster Risk Reduction.

The damage assessment of housing has been captured by the Local Self Government Department (LSGD) using the 'Rebuild Kerala' mobile application (app). Data compiled on 4 October 2018 shows that a total of 17,316 houses that are either completely destroyed or damaged beyond repair have to be rebuilt; another 2.17 lakh need repair and retrofitting. A total recovery expenditure of INR 5,443 crore is estimated to cover costs of rebuilding, repair and retrofitting, land cost, technical support, etc.

In line with the Government of Kerala's vision of a 'Nava Keralam', the reconstruction process is envisaged to adopt an eco-sensitive approach based on construction technologies that use local materials, fulfil the aspirations of the public, reduce carbon footprint, and create green jobs locally in large numbers. To achieve this, it is proposed to strengthen the LSGD team in each district with appropriate additional technical staff to take up the reconstruction in a mission mode. House-owners should be supported in choosing designs appropriate for the location, procuring materials and managing construction with technical inputs from Housing Facilitation Centres (HFCs) to be established at sub-district levels.

Several policy changes have been proposed to ensure that the 'New Kerala' emerges as a green and resilient state, which can tackle future hazards by employing risk-sensitive land-use planning, building regulations tailored to different geographical

[1] *http://bis.org.in/sf/nbc.htm*

regions rather than one uniform set of regulations, and the development and implementation of long-term risk mitigation plans for all hazards.

The Pre-Disaster Context

Overview of Housing, Land, and Settlements

For the Housing Sector Recovery Strategy, the following key data is relevant.

- **High population density and degree of urbanisation:** Kerala is one of the most densely populated states in India (860 inhabitants per km^2 as compared to all India figure of 324 people per km^2) and 47.2% of its population lives in urban areas (31.1 % for all-India).[2]
- **Comparatively high standard and average size of houses:** 83.5% of households live in permanent structures with concrete roofs, 57.3% have two or three rooms (all-India: 46.2%); 95.2% have toilet facilities available within the building. As per the Census 2011, about 94.4% of the houses in Kerala have electricity and 92% have safe drinking-water supply.[3]
- **Ownership structure:** 92% households are homeowners, about 7% live in rented accommodations, and less than 1% have an unauthorised legal status.[4]
- **Scarcity of housing:** As on 31 March 2015, the state's housing shortage was around 3.5 lakh units (inclusive of landless, houseless households) as per the Economic Review 2017.[5] However, about 10% census houses were unoccupied before the flooding.[6]
- It has also been seen that in Kerala, a number of houses of high quality with large living spaces are being occupied by a single elderly person or a couple, while their families live elsewhere in the country or abroad.

Housing Stock in Kerala by Type

According to the 2011 Housing Census, there were 336 houses for every 1,000 persons in Kerala (all-India 273 houses per 1,000 persons). The settlement pattern of Kerala is of a rural and urban continuum with different varieties of housing typologies—vernacular, traditional and modern reinforced cement concrete (RCC) roof housing.

Though there are particular typologies based on regions, some common typologies can be found across the state with a few exceptions. The common materials used for walls are burnt bricks, cement concrete (CC) blocks, laterite (where it is available), and mud in the tribal areas. The common materials used for roofing are RCC, Mangalore tiles, galvanised iron (GI) sheets, and thatch in some tribal areas. Multi-storeyed high-rise buildings are numerous in urban centres, though often not adequately planned.

The prevailing settlement pattern consists of independent houses on individual plots scattered across the habitable areas, creating much pressure on the land. Along the main roads, big RCC-framed-structures, high-end bungalows—again on individual plots—prevail. Most of the smaller buildings have random rubble (RR) masonry foundation in cement mortar with walls made of brick or CC blocks, while the larger houses may be RCC-framed structures. As mentioned earlier only a small number of houses are made of mud, and these exist mainly in the tribal areas.

In general, few of the small houses have plinth and lintel bands, which make them very vulnerable to the effects of hazardous events. Figure 1 shows the distribution of buildings by types of walls and roofs across districts.

[2] *ORGI (2011), Census of India 2011, Office of the Registrar General & Census Commissioner of India, Ministry of Home Affairs, Government of India, New Delhi.*

[3] *Ibid.*

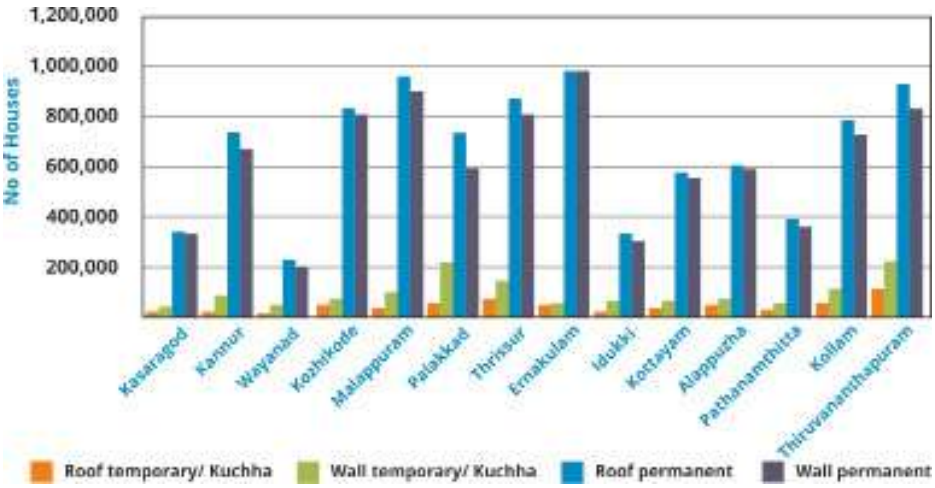
[4] *Ibid.*

[5] *State Planning Board, Economic Review, 2017, Government of Kerala, Thiruvananthapuram.*

[6] *Drawn from discussions with government officials*

Figure 1

District-wise pattern of Kuchha and Pucca roofing and walling material in Kerala (CENSUS 2011)



Source: ORGI (2011), Census of India 2011, Office of the Registrar General & Census Commissioner of India, Ministry of Home Affairs, Government of India, New Delhi.

Housing Policy, Building Code, Building Rules, and Enforcement

The Kerala Housing Policy provides the framework for the sector. The NBC provides guidelines for regulating building construction activities across the country. It is recommendatory in nature and becomes mandatory only when adopted into the Building Rules.

The two building rules established in Kerala are the **Kerala Municipality Building Rules** and the **Kerala Panchayat Buildings Rules**, 2011. However, there are issues with the existing building rules regarding the different types of hazards. The Building Rules: (i) do not differentiate between the distinct climatic and geologic regions across the state; and (ii) require a uniform Floor Area Ratio (FAR) of 4, for the whole state. An FAR of 4 is comparatively high, and to have it applied uniformly across regions is an unsafe practice. The departmental capacity for the enforcement of the Building Rules at local levels is frequently weak.

Government Social Housing Programmes

The Housing Department of the Government of Kerala implements and coordinates various social housing schemes for the Economically Weaker Sections (EWS) and those in the Low Income Group (LIG). The state government started the Livelihood Inclusion and Financial Empowerment (LIFE) programme in February 2018 to provide safe housing to nearly 4.30 lakh homeless people and households below the poverty line (BPL) within a period of five years. Among other programmes, Pradhan Mantri Awas Yojana (PMAY) and the EMS Housing Scheme are operating under LIFE.

Capacities: Engineers, Building Materials, Masons, Labour

Kerala has a large number of technically qualified people in the field of construction. As of November 2017, the LSGD has a technical strength of 2,920 overseers and 1,393 engineers. However, LSGD's technical capacities would be vastly improved with the introduction of a design wing, the induction of a team of geologists, and capacity-building programmes for staff members.

Skilled and unskilled labour are almost exclusively migrant workers from the eastern states of India, many of whom left in the aftermath of the flood, but have started returning. There is a scarcity of building material and sand; the majority of the material has to be imported from other states (e.g. Tamil Nadu). There is almost no quarrying in Kerala at the moment, and construction materials such as aggregates and crusher sand are being imported from Tamil Nadu, often at prohibitive rates. The Department of Geology and Mines, Government of Kerala, regulates quarrying for laterite through quarrying permits.

In the post-flood scenario, the government has an opportunity to examine the regulations that govern the extraction of the base building materials—such as river/reservoir sand, rubble/stone from quarries, laterite etc.

Post-disaster Context

Housing damage during the flooding and landslides in Kerala in June–August 2018 was caused by the scouring of foundations, settlement of soil, and inundation for several days. Houses in low-lying areas with low plinth heights were damaged much more than houses with high plinths and disaster-resistant features such as plinth and lintel bands. Masonry walls built with cement blocks without plinth bands weakened when water seeped up due to capillary action and collapsed.

Many houses were completely destroyed in landslides, mostly in Idukki, Wayanad, etc. These houses would have been destroyed regardless of building typology or construction technology, as they were located on unstable slopes. The remains of many of these structures may never be found as the huge landslides swept houses across roads and into the rivers in spate below. In some places, houses were affected by subsidence and suffered due to differential settlement of the foundation. Siting buildings on such slopes could have been avoided had there been regulations that mandated geologic inspection before excavation and construction on such slopes, and if the services of a geologist had been available.

The scale of destruction of dwellings could have been minimised, had the provisions for disaster resistance in the National Building Codes of India (NBC)[7] been incorporated into the building rules of Kerala, properly enforced, and in turn followed by the people across the state.

Flood Damage Analysis of Buildings and Settlements

Many buildings in the flooded areas were either damaged or they collapsed because they were constructed without adequate disaster-resistant features such as plinth and lintel bands, as recommended in the NBC. The lack of horizontal bands to hold the walls together resulted in wall collapses, eventually leading to damage to the roof and further collapse. In many buildings, the random rubble stone foundations in cement mortar had inadequate depth, resulting in scouring of the foundation and damage to the walls. Many of the flood-damaged buildings had low plinth heights resulting in inundation for days.

The main reasons for housing collapses were: (i) high current of the floodwater; (ii) the inundation of the buildings for several days, causing differential settlement of the foundations; and (iii) flash floods, especially where the buildings were too close to rivers and canals.

Many buildings that adhered to the NBC did not collapse or sustain structural damage even though they were inundated up to the lintel/roof for several days, and only had to undergo minor repairs. However, most of the household assets in these buildings were totally damaged.

[7] *Codified by the Bureau of Indian Standards and last updated in 2016; http://bis.org.in/sf/nbc.htm.*

Some of the settlements in Kuttanad are below the mean sea level (msl); though these areas are exposed to low-level flooding almost every year, it is common practice here to build houses on low plinth and foundations that are not deep enough. During the 2018 floods, such buildings suffered much more than those built on stilts in the same area (which were hardly damaged). Given the fact that parts of Kuttanad are below sea level, the requirements of safe building construction here are very different from other parts of the state and, therefore, the Kuttanad region should have separate building regulations that reflect this.

The causes of building collapse and what can be done differently in the future is summarised in Table 1.

Analysis of Damage due to Landslides

Whether or not a building is safe in a landslide prone location is decided by the siting of the plot and the soil conditions. Due to the low bearing capacity of soil and subsidence induced by soil piping, many buildings in the mountainous parts of Kerala suffered differential foundation settlement in the wake of the incessant

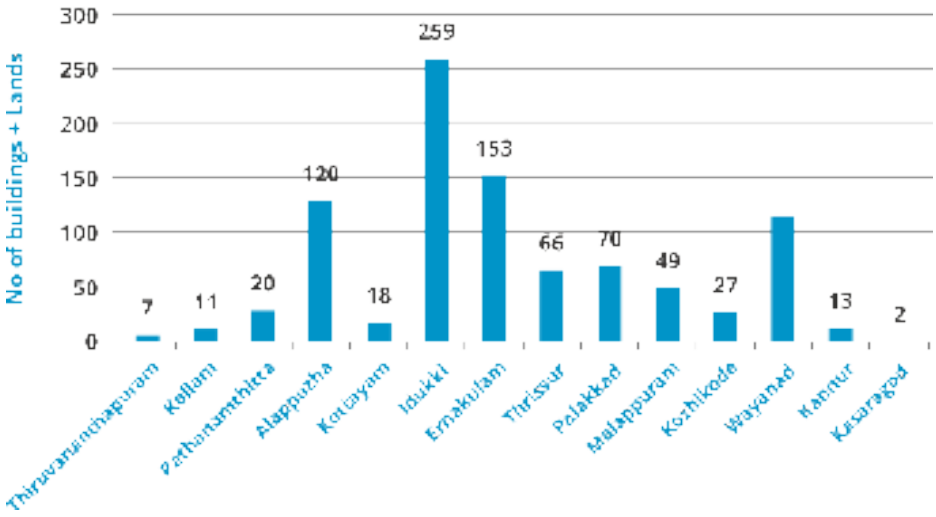
Table 1
Summary of Failure in Flood and Recommendations

TYPE OF FAILURE: FLOODS	RECOMMENDATIONS
Low plinth height (less than 600 mm) in flood-prone areas	In building rules, specify the safe plinth height for flood-prone areas as demarcated on state hazard maps.
Buildings damaged due to poor construction, missing features prescribed in the NBC.	• Include NBC provisions in local building regulations and enforce these. • Ensure strict construction quality control with adequate technical support. • Generate awareness on minimum codal provisions and technology options for construction including rattrap-bonded wall with plinth and lintel bands. • Roll out masons' training programmes
Buildings on soft soil with inadequate foundation, leading to differential settlement and damage to walls and roof	• In building regulations, define location-specific minimum depth of foundation. • Develop and disseminate foundation guidelines for deep stub (e.g., coconut wood) piles, well foundation with precast RCC rings, and other suitable foundations with plinth and lintel bands.
Failure of walls and consequential failure of roofs due to inundation	Recommend the use of plinth bands to stop the capillary rise of moisture through the foundation wall to the superstructure walls made of CC Blocks, resulting in dampness in building and weakening of structures
Houses below canal/river water level, especially in Kuttanad and along river/canal banks	Ensure adequate plinth height and the use of stilts (stub or arched foundation) to allow the water to flow under the buildings. separate building regulations for Kuttanad with adequate attention to specifications of building the foundation

rains and landslide. In hilly districts, most of the damage was caused by 'shallow landslides'. These occur when the soil on the hillside is saturated due to continuous rainfall. The lost buildings were buried under the saturated soil or in some cases slipped over a distance of up to 20 meters to a lower position. The risk of landslides was the highest along mountain slopes that were at an incline of more than 45 degrees and where a large number of buildings and roads had been cut into the sides.

Many of the landslides that occurred during the first two weeks of August 2018 brought down a considerable portion of the mountainside. However, these slides will continue to creep upslope as the precipitation and instability of the slopes continue. Houses located near the side and top margins of the landslide are likely to be affected if the rainfall persists. These slopes need to be examined by geologists and communities relocated, if warranted. In general, constructions along the unstable slopes have to be regulated with the help of landslide hazard zonation maps of at least 1:5,000 scale. Hillside construction is very different from construction in plains demands a separate set of rules and regulations. New guidelines should be

Figure 2
District-wise pattern: Complete loss of Land with Buildings



Source: 'Rebuild Kerala' mobile app., data accessed: 4 October 2018

developed for hillside construction, as even the NBC is not thorough enough in this regard.

Idukki district had the highest number of cases where both land and buildings were lost due to the large scale landslides (Figure 2). In Alappuzha district, the losses were not due to landslides, but floodwaters. In Ernakulam district, the Periyar river washed away several buildings and tracts of land along its banks. Land was also lost in the small islands (thuruthu) due to the floods in the same district.

Debris

The disposal of debris in the aftermath of any disastrous event can be a major challenge for local governments. The environmental impact of the debris has to be managed by the concerned local bodies, which must not permit the dumping of this waste in an unscientific manner on hill slopes and riverbeds. Much of the

Table 2
Summary of Building Failure in Landslide and Recommendations

TYPE OF FAILURE: LANDSLIDE	RECOMMENDATIONS
Building on very steep slope, next to the edge of the previous landslides	Make landslide hazard zonation maps available at a scale appropriate for local planning (1:5,000 to 1:2,000) in all municipalities and panchayats in hilly areas
Building on the path of a stream on a very steep slope	Initiate major shift in land-use policies demarcating certain areas as 'no development' zones and 'construction restricted' zones including the relevant Hon High Court of Kerala Order (2017)
Buildings damaged due to man-made landslides initiated by cutting slopes for road construction or for new buildings	Introduce slope modification regulations against human interference and activity that can affect the stability of slopes
Houses damaged due to differential settlement caused by soil piping and subsidence	Ensure that the stability of slopes is established by geological investigations before construction or slope modification activities are initiated. All panchayats and municipalities in hilly areas should appoint geologists. Local self governments should consult the geologists of the Mining and Geology Department or the Ground Water Department before implementing infrastructure development projects

construction debris can be recycled to produce walling materials. The local body shall design appropriate measures in consultation with expert institutions for management of debris (including a processing facility) and optimal utilisation of recycled products.

Temporary Shelters

Currently, temporary shelters are being constructed in various districts by private organisations or NGOs to cater to the immediate needs of the affected house-owners (while they wait for government support to rebuild their home. Such construction is being undertaken without any systematic coordination. All these house-owners should be registered in a district database and then allocated houses. The shelters, even if transient, should take into consideration, the basic comfort of the occupants.

It should be clearly understood by the users that the shelter is temporary and will have to be handed back to the government to be used in future emergencies. For instance, these shelters could be modified and used as: (i) bathing or toilet spaces in schools which serve as relief camps; (ii) emergency medicine storage spaces for hospitals and health clinics as part of their emergency management plans; or (iii) Emergency operations centres in government offices.

Impact Assessment

Impact on the People

The impact of the floods and landslides on the people, due to the destruction and damage of buildings and lands has been considerable. Due to the lack of safe housing before the disaster, post-disaster the people are living in poorer conditions—in damaged and unsafe buildings or with friends and relatives or in rented accommodation. Their livelihoods have been affected. Women and children

are especially burdened due to the lack of civic amenities and poor access to schools.

There is an immediate need to restore the citizenry to their pre-disaster socio-economic condition. As the first step, a damage and needs assessment has been carried out by the Local Self Government Department (LSGD) engineering wing, using the Rebuild Kerala mobile app., which will be the basis for recovery planning in housing. The LSGD data on building damage have been acquired for all 14 districts.

The damage has been categorised as follows: (i) land and the building destroyed; (ii) only the building is destroyed; and, (iii) buildings are partially damaged. The partially damaged buildings were subdivided into buildings with a concrete roof and those with a non-concrete roof. Each category has been further subdivided based on extent of damage: (i) up to 15%; (ii) 16%–29%; (iii) 30%–59%; (iv) 60%–74%; and (v) greater than 75%. It was decided that all houses with over 75% damage would be rebuilt from scratch. This report is based on the database received from mobile app. 'Rebuild Kerala' accessed on 4 October 2018, 4:35 p.m.

A total 2.34 lakh houses across Kerala were damaged by the floods and landslides. Additionally, 1.20 lakh households (whose houses may have remained intact) lost their possessions and had their wells and homes filled with mud and debris that needs to be cleaned (Table 3). The total number of houses to be rebuilt is currently estimated at 17,316. However, this figure is likely to increase as the Information Kerala Mission data gets consolidated. Field visits have revealed that in places with massive landslides, some houses on the upper or lateral edges of slopes that may be intact at present are still vulnerable as landslides may advance upslope in the future. Many families may have to be relocated once these sites are assessed by competent geologists.

While Figure 3 shows that Ernakulam has the highest number of affected buildings, most of these have up to 15% damage and their repair cost would not be very high. Buildings that have incurred 16%–29% damage will obviously cost more and Ernakulum has a significant share of those. The repair need of Alappuzha is also

Table 3
District-wise Damage Assessment (Number of Cases by Extent of Damage)

District	Both land & building lost	Only building lost	Building damage >75% : needs re-building	Buildings to be re-built (cols 2+3+4)	Partially damaged buildings with concrete roof	Partially damaged buildings with non-concrete roof	No. of households that lost goods and wells, and have to clean their homes	Total no. of buildings affected by flood/ landslide (columns 5+6+7)
Thiruvananthapuram	7	374	31	412	745	1,415	1,675	2,572
Kollam	11	321	38	370	956	2,058	1,809	3,384

District	Both land & building lost	Only building lost	Building damage >75% : needs re-building	Buildings to be re-built (cols 2+3+4)	Partially damaged buildings with concrete roof	Partially damaged buildings with non-concrete roof	No. of households that lost goods and wells, and have to clean their homes	Total no. of buildings affected by flood/ landslide (columns 5+6+7)
Pathanamthitta	28	856	118	1,002	10,143	6,660	10,877	17,805
Alappuzha	128	1,653	114	1,895	21,054	17,973	21,497	40,922
Kottayam	18	566	128	712	7,007	9,389	8,999	17,108
Idukki	259	1,530	83	1,872	2,019	4,605	6,150	8,496
Ernakulam	153	2,523	293	2,969	73,866	11,836	35,488	88,671
Thrissur	66	3,610	369	4,045	12,286	8,122	16,044	24,453
Palakkad	70	1,622	127	1,819	1,282	4,972	5,730	8,073
Malappuram	49	679	59	787	3,332	3,511	3,831	7,630
Kozhikode	27	314	42	383	2,784	2,171	2,756	5,338
Wayanad	116	629	68	813	3,356	3,544	3,760	7,713
Kannur	13	147	19	179	347	1,209	926	1,735
Kasaragod	2	53	3	58	33	242	223	333
Total	**947**	**14,877**	**1,492**	**17,316**	**1,39,210**	**77,707**	**1,19,765**	**2,34,233**

Source: Rebuild Kerala' mobile app. accessed on 4 October 2018, 4:35 p.m.

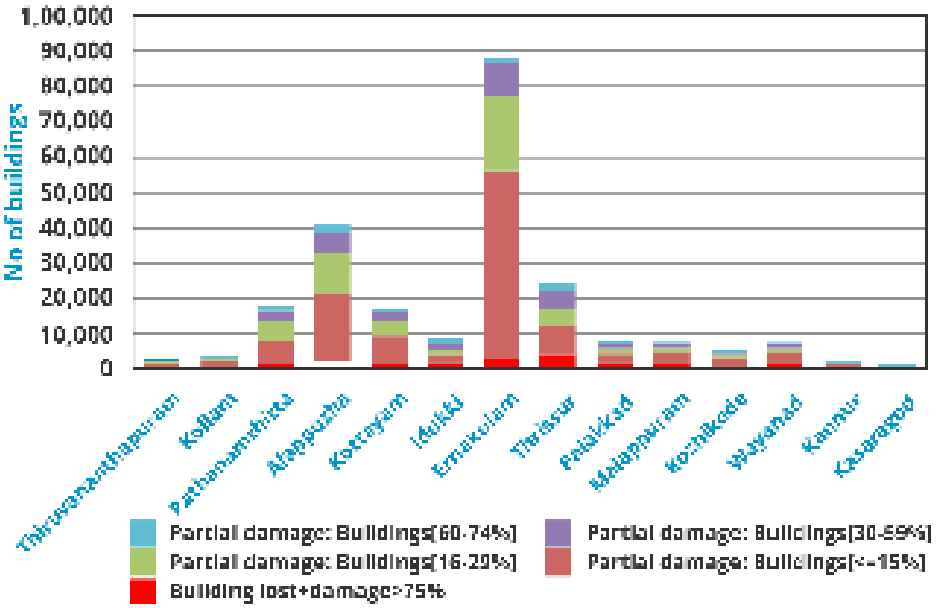
high. The number of buildings to be rebuilt from scratch is the highest in Thrissur followed by Ernakulam and Alappuzha.

Loss of Household Goods, Cleaning of Mud and Debris from House and Well Cleaning

Many households in Kerala, regardless of their socio-economic class, used open wells for drinking water. Almost all these wells were contaminated during the floods—almost 10,000 wells were ruined in Alappuzha District alone. Many toilets were damaged due to scouring of the foundation and roof collapse. Electrical systems and drinking water facilities were destroyed in numerous buildings inundated by floodwaters.

Figure 3

District-wise pattern of recovery needs: Rebuilding and repair of damaged buildings pf four categories



Source: 'Rebuild Kerala' mobile app. accessed on 4 October 2018, 4:35 p.m.

The value of lost household goods and the cost of cleaning homes and wells run over by mud and debris was available only for Alappuzha district because LSGD carried out an assessment survey. Since, such data was not available for all the districts and given the fact that the quantity and quality of household goods lost largely depends upon the affluence of the families, these components were excluded from the recovery cost. However, in the section on loss, the cost of household goods lost and cleaning cost were included in the calculations.

Damage and Loss

The assessment of damage, loss, and reconstruction needs has been conducted based on data from the Rebuild Kerala Mobile App (4 October 2018, 4:35 p.m.) along with field missions, interviews with local representatives of LSGD, and the affected communities. The data has been the basis for all calculations in this report and is reflected in more detail in Annexure 3. The methodology for calculating the costs of recovery has been based on the following assumptions.

Table 4

Cost of Building Services, Value of Household Goods Lost, and the Cost of Cleaning Houses and Wells

Item description	Cost per house (INR)
Cost of electrical repairs in a 500 ft² house	68,750
Value of household goods lost plus the cost of clearing the house and its well of mud	1,15,000

Note:

1. *On an average, electrical repair cost is 25% of the total cost of wiring and appliances in a new building*
2. *Serial number 2 includes INR 24,000 for cleaning mud from houses and well cleaning.*

Source: From the Alappuzha, Idukki and Pathanamthitta, Executive Engineer, LSGD office.

- Rebuilding of all the completely damaged buildings (including buildings with over 75% damage) and the repair and retrofitting of damaged buildings (up to 74% damage), are proposed to be in compliance with the BBB and eco-sensitive principles.
- Houses with more than 75% damage are to be rebuilt.
- The repair and reconstruction cost of housing has been calculated based on the unit rate provided by LSGD (detailed in the next paragraph).
- The state government will provide INR 6 lakh as relief to households that have lost their land due to floodwaters/landslides, and INR 4 lakh as relief for those whose houses have been destroyed.

The LSGD engineers arrived at a unit cost of INR 1,912 per ft^2 for a new building, by applying the cost index of 44.12% on the Delhi Schedule of Rates 2016 (as is the current practice for new constructions by LSGD). The cost includes the provision of a concrete roof, random rubble foundation, CC block walling, plinth and lintel bands, standard finishing etc. The cost also includes electric wiring and a toilet, though it does not include a septic tank or leach pit, a water tank and other plumbing fixtures. Likewise, the unit cost for a new building with tile roofing is INR 1,434 per ft^2.

Based on the field visits and in consultation with the Engineering wing of the LSGD, the Public Relations (PR) department, and the field-level staff members, it is assumed that the minimum covered area required for a household is 500 ft^2. However, in many cases, people's aspirations were higher (about 750 ft^2) and hence, it would be reasonable to assume that people would start putting their lives together with a 500 ft^2 house and expand the building incrementally.

As far as the cost of repair is concerned, based on discussions with various government engineering departments, the range of the repair cost was fixed between 5%–30% of a building's current replacement (new house) cost (i.e. 5% of the replacement cost for damage category less than 15% and 30% of the replacement cost for damage category 60%–74%). Therefore, an average of (5%+30%)/2 = 17.5% of the current replacement cost of a building has been considered as the basis of costing repair works.

The LSGD's data (provided on its mobile app.) on the number of buildings destroyed and buildings destroyed along with land, has not been segregated in terms of their roofing types. Therefore, in loss calculation, the average cost of INR 8.37 lakh per unit (item no. 3 in Table 5 below) has been adopted. However, while calculating the reconstruction cost, the unit cost of RCC roof type (INR 9.56 lakh) has been considered for all rebuilding. Table 5 shows the assumed cost of repair and rebuilding.

Cost of Housing Damage and Loss

The cost of damage and loss due to the flood and landslides include the: (i) cost of land lost; (ii) cost of houses that were completely lost; (iii) houses that suffered over 75% damage (which are being considered as totally damaged); and, (iv) houses that suffered up to 74% damage. Added to this is the cost of household goods lost in the

Table 5
Basis of Costing

Item Description	Calculation	Cost per house (INR lakh)	
1. Cost of new construction with RCC roof for 500 ft²	500 ft² x INR 1,912 per ft2	9.56	Additional amount in excess of INR 4 lakh= INR 5.56 lakh
2. Cost of new construction with non-RCC roof for 500 ft²	500 ft²x 1,434 per ft²	7.17	Additional amount in excess of INR 4 lakh = INR 3.17 lakh
3. Average cost of new construction per building (with RCC or non-RCC roof) (for calculation of loss only)	(9.56+7.17)/2	8.37	
4. Average repair cost per damaged building (<=74% damage) with RCC roof (17.5% of INR 9.56 lakh)	9.56 x 0.175	1.673	
5. Average repair cost of damaged buildings (<=74%) with non-RCC roof (17.5% of INR 7.17. lakh)	7.17 x 0.175	1.255	

flood/landslides and the cost of cleaning the houses and wells after the flood. Table 6 below provides a summary of the total cost of damage and loss.

Figure 4 shows that Ernakulam district suffered most damage and loss, followed by Alappuzha, and Thrissur.

Table 6
Total Cost of Damage and Loss due to Flood and Landslides

Items	INR lakh
Land + new building	13,604
New construction: totally damaged buildings+ buildings with damage >75%	1,35,820
Repair and retrofitting of buildings with concrete roof	2,32,898
Repair and retrofitting of buildings with non-concrete roof	97,503
Electrical	22,876
Loss of household goods + cleaning wells and houses	1,38,329
Grand Total	**6,41,030**

Note: Water supply and sanitation costs are under the Water, Sanitation, and Hygiene Sector (WASH); hence, they are excluded here

Figure 4

Cost: Loss of land+ building, loss of building, loss due to damaged building and HH goods lost+Cleaning of HH and Wells

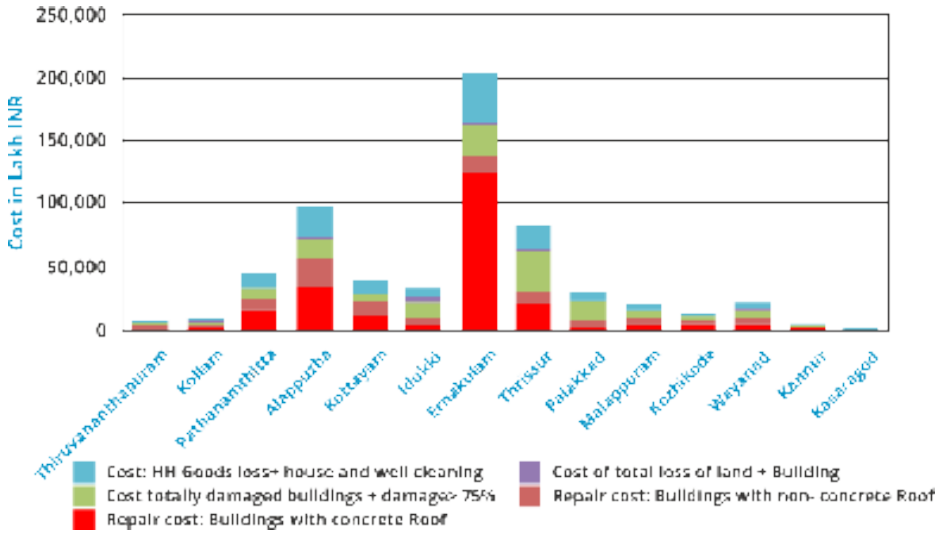


Table 7

Cost of Recovery: Buildings and Land Lost, Building Totally Damaged or Partially Damaged

District	Repair cost: Houses with concrete roof	Repair cost: Houses with non-concrete roof	Cost of rebuilding demolished and destroyed houses	Value of land + building loss	District Total in INRlakh =(Col. 2+3+4+5)
Thiruvananthapuram	12.5	17.8	38.7	1.1	70.0
Kollam	16.0	25.8	34.3	1.7	77.8
Pathanamthitta	169.7	83.6	93.1	4.4	350.7
Alappuzha	352.2	225.5	168.9	19.9	766.6
Kottayam	117.2	117.8	66.3	2.8	304.2
Idukki	33.8	57.8	154.2	40.3	286.1
Ernakulam	1,235.8	148.5	269.2	23.8	1,677.3
Thrissur	205.5	101.9	380.4	10.3	698.1
Palakkad	21.4	62.4	167.2	10.9	261.9
Malappuram	55.7	44.1	70.6	7.6	178.0
Kozhikode	46.6	27.2	34.0	4.2	112.1
Wayanad	56.1	44.5	66.6	18.0	185.3
Kannur	5.8	15.2	15.9	2.0	38.9
Kasaragod	0.6	3.0	5.4	0.3	9.3
TOTAL COST	**2,329.0**	**975.0**	**1,564.9**	**147.4**	**5,016.2**

Cost of Recovery

- **Cost of services:** As mentioned before, only the cost of electrical wiring and appliances has been considered in the recovery, since water and sanitation is included in WASH. For calculating the cost of lost electric wiring and appliances, the unit cost obtained from LSGD field engineers has been adopted. Table 7 shows the summary of recovery cost of new construction, cost of land, repair and retrofitting of damaged buildings.
- **Human resource capacity:** Practising and experienced masons need to undergo fresh training to ensure that all houses are indeed built back better. The cost of the training programmes has been included in the recovery cost.
- **Local entrepreneurship:** The reconstruction phase could generate local entrepreneurship if alternative building materials are produced using local materials and skills. The costing for this has been done (see Table 9). Similarly, the cost of establishing production yards for innovative technologies with industry partnership has also been considered. Local Kudumbashree units could play a prominent role in this phase.
- **Housing Facilitation Centre:** It is proposed that each district should have at least five HFCs to support the recovery programme. These would be supported by the district-level executive engineers, LSGD, and others. Each HFC would be staffed by three engineers/architects and three technical assistants to provide technical support to house-owners. The main purpose of HFCs is to bring the social and techno-managerial support to the doorsteps of the affected households for rebuilding activities. The HFCs will ensure that retrofitting in line with BBB objectives is integral in the repair works to make the buildings resilient against all future hazards. The architects/engineers would prepare case-by-case estimates, working drawings etc., for repair and retrofitting.

To ensure that HFC interventions are technically sound and comply with Bureau of Indian Standards (BIS) codes, there would a need for monthly peer review of the interventions by empanelled experts. The HFC architects/engineers would regularly supervise the house construction, help people in procuring materials, and provide specially trained masons who would ensure that BBB principles were followed in repair and reconstruction.

The presence of qualified and trained staff members would ensure that all construction is disaster resistant so that the Chief Minister's vision of a 'Nava Keralam', resilient to future hazards is achieved. It will also bring in elements of sustainability and generate thousands of 'green jobs' in the process. Table 8 shows the cost of running an HFC for the first 18 months of the recovery period.

The Impact of Recovery

Impact of Building Materials Used

Reconstruction while offering a great opportunity for local employment generation could also have a significant negative impact on the environment; there is a strong need, therefore, to use alternative construction technologies and local materials. **The state must prepare a procurement plan for each district to enable reconstruction work to start at the earliest.**

It may be noted that the Honourable Governor of Kerala in his Republic Day addresses in 2017 and 2018, emphasised on the use of appropriate construction technologies and green design concepts in Kerala. The working group on the housing sector for

Table 8

Expenditure of the Housing Facilitation Centre (HFC)

Expenditure for setting up and running a Housing Facilitation Centre for 18 months	INR lakh
3 architects/ engineers @ (INR 75,000 salary + INR 7,000 for transport, communications) x 18 months x 14 districts x 5 blocks	3,100
3 technical assistants @ (INR 40,000 salary + INR 7,000 for transport, communications) x 18 months x 14 districts x 5 blocks	1,777
INR 2 lakh capital cost per HFC	140
Awareness campaign, workshops, peer review, evaluation, etc., and overheads (30%)	1,505
Total	**6,522**

Table 9

Cost of Recovery and Other Developmental Activities: Summary

	INR crore
Land + New building	147
New construction: totally damaged buildings+ buildings with damage >75%	1,565
Repair and retrofitting buildings with concrete roof	2,329
Repair and retrofitting buildings with non-concrete roof	975
Electrical repair + complete electrification of new building	229
Training cost: 5 training sessions x 40 masonsx14 districts x INR 20,000/person +25% management cost	7
Small entrepreneurship: 140 units of MCT, CSEB production, precast element, etc.@ INR 50 lakh per unit including leased land	70
Industry partnership: Production yards 112 @ INR 50 lakh per unit, industry will pay for this since they will have business profit	56
Housing Facilitation Centre	65
GRAND TOTAL	**5,443**
Loss of household goods plus cost of cleaning wells and homes (not costed in the above table)	1,383
Special note: For new construction cost of electrical appliances is added as the rest is inbuilt in building cost	

Table 10

Value of Damage, Loss, and Recovery: Summary (INR crore)

	Damage	Loss	Damage plus loss	Total recovery cost
Housing, land and settlement	5,027	1,383	6,410	5,443
Note: Damage + loss is more than recovery, since the latter excluded the loss of household items and cleaning				

the 13th Five Year plan also recommended the propagation of 'cost effective and environment friendly approaches through the use of local building materials and appropriate alternate technologies'.[8] It is thus imperative that the recovery process takes these messages forward to make it a model for other states to follow.

Impact on Livelihood and Employment

Housing reconstruction will create numerous livelihood opportunities—approximately 35 lakh days of work for skilled masons and about 171 lakh days of work for unskilled workers will be created (Annexure III). Alongside, there will be opportunities for skill upgrading through BBB training programmes.

If women and women's organisations, such as Kudumbashree, were to come forward to avail these opportunities, the reconstruction activities could translate into immense gender gains. For instance, painting of reconstructed houses can be easily done by women construction workers with appropriate training—this alone could generate 9 lakh working days for them (Table 11). Women's organisations could also manage building supplies alongside the HFCs, creating numerous employment opportunities in every district.

Environmental Impact

In face of this urgent reconstruction need, it is important to minimise the environmental impact by selecting technologies carefully. The focus of the reconstruction would be the use of green design and appropriate technologies, to mitigate the negative impact on the environment. The reconstruction will embody 1,529 mega watt hour (MWh) of non-renewable energy and emit 718 thousand tonnes of CO2 (Annexure III) at the building materials production yard (Table 12). As an option, if rat-trap bonded brick walls are used, a considerable amount of non-renewable energy and emission could be saved. Micro concrete tiles (MCTs) would be an environment-friendly option, where stone is available. In Kerala, compressed stabilised earth blocks (CSEBs) and bamboo are good green technologies provided they are discussed and made acceptable to the people.

Gender, Social Inclusion and Disaster Risk Reduction

In Kerala, 23% of the households are headed by women, who should be given high priority in the recovery strategy framework. It is seen that women bear a disproportionate burden of employment loss after disastrous events, as small businesses close down. Often the impact is aggravated by the loss of homes, kitchen gardens, and farm animals. The special challenges of households with elderly

[8] *Box 4.3.15 in State Planning Board, Economic Review, 2017, Government of Kerala, Thiruvananthapuram*

Table 11
Employment Potential of Major Building Components

	Complete loss: buildings + damage >75% (no. of days)	Partially damaged building: concrete roof (no. of days)	Partially damaged building: non-concrete roof (no. of days)	Total (no. of days)
Skilled	10.89	15.32	8.65	34.86
Unskilled	55.91	78.66	36.58	171.15
Women's employment: painting	2.86	4.03	2.25	9.14

people, people with physical and mental disabilities, people of the third gender (a sector that is almost invisible, suffering from social isolation), and households from other marginalised groups, must be taken into consideration. Since a large proportion of Kerala's working population routinely migrates from the state, the number of elderly living alone is high in Kerala[9]. All these groups will need enhanced technical assistance from the government for rebuilding their houses.

Sector Recovery Strategy

In order to ensure that the reconstruction happens smoothly and the window of opportunity for BBB is utilised, the LSGD and the LIFE mission will have to strengthen the technical teams in each district. This is required to ensure that housing reconstruction is carried forward in mission-mode and the routine activities of LSGD and LIFE mission are not affected. It is important that additional technical capacities are built in the team to ensure the use of appropriate disaster resistant green construction technologies.

[9] There were 24 lakh elderly people living alone in Kerala in 2014, according to the Kerala Migration Survey (KMS 2014) conducted by the Centre for Development Studies, Thiruvananthapuram.

Table 12
Embodied Non-renewable Energy and CO2 Emission

	Complete loss of buildings+ damage >75%	Partially damaged building with concrete roof	Partially damaged building with non-concrete roof	Total
Embodied non-renewable energy (MWh)	532.45	749.10	247.36	1,528.90
CO2 emission (thousand tonnes)	291.47	300.08	126.48	718.03

Role of Line Ministry and the LSGD

The Department of Housing, Government of Kerala and the Kerala State Disaster Management Authority (KSDMA) at the state level and the LSGD at the local level would play an important role in the reconstruction process. It is important that the district LSGD engineering teams participate in an awareness programme on DRR in housing and the teams are strengthened with adequate designated technical staff members. However, their role in supervision is likely to be limited due to high workload and the reconstruction is likely to be managed by an additional team of technical staff designated for housing reconstruction.

These technical team members will be part of the HFCs and will assist local house owners in developing designs, sourcing materials, and in ensuring quality control.

Green Kerala

Based on its tradition in alternative construction, Kerala could integrate environment-friendly reconstruction and planning into all aspects of life, including disaster-resistant cost-effective and energy-efficient architecture, appropriate waste management (including recycling of waste water), maximising efficiency of water use, adopting alternative energy resources, and rainwater harvesting. Recycling

debris during reconstruction would decrease the adverse environmental effects of recovery activities.

Barring buildings that have minor-or medium-level damage, the recovery would have an output of 64,000 new, repaired, and retrofitted green buildings as shining examples of green development for the rest of India to emulate.

Principle of Building Back Better

Non-compliance with safety standards in construction was a major reason for the massive damage to buildings in Kerala. Therefore, in line with the principles of BBB (Priority 4 of the Sendai Framework), to increase the resilience of the state and its communities to future disasters, the recovery process should integrate DRR measures into it. Reconstructed buildings should be retrofitted against multi-hazards and be adherent to the latest BIS standards of building safety.

Financial Support for Reconstruction

While the impact of the floods was felt in nearly all the districts, the 10 central districts took the worst blow (excluding Kasargod, Kannur, Kollam, and Thiruvananthapuram). As already mentioned, a total of 17,316 houses have to be rebuilt in the state (status as on 4 October 2018). The state government has already announced a relief of INR 4 lakh per household for those families who have to rebuild their homes from scratch. This includes INR 1 lakh per household from the National Disaster Relief Fund (NDRF). Furthermore, assistance of INR 6 lakh per household has also been announced for those who have lost their land in the disaster.

To build a 500 ft^2 house with an RCC roof is estimated to cost INR 9.56 lakh and one with a non-RCC roof, INR 7.17 lakh. With the INR 4 lakh assistance from the state government, a household could build a semi-finished dwelling (within an INR 4 lakh budget) in the short run and upgrade it over time. Alternatively, it could avail of a housing loan (from government designated banks) of INR 5.56 lakh (for RCC roof)[10] or INR 3.15 lakh (for non-RCC roof)[11] and rebuild completely. Local materials-based alternative technologies could cut costs significantly, reducing the loan burden while building a green and resilient Kerala.[12]

Proposed Economic and Technical Arrangements for Reconstruction

- All reconstruction effort will be planned, designed and executed through the LSGD and LIFE missions, which will regulate all post-flood construction regardless of the funding mechanism, governmental agencies, non-governmental agencies, or private funding.
- Each of the 17,316 households will get the same support (technical, financial, same covered area, etc.) to avoid social disparity.
- A separate top-up fund will be created to assist all beneficiaries to complete a 500 ft^2 house, with contributions from private donors, corporate donors, NGOs, and through crowd-funding. The total budget only for construction for the top-up fund could reach INR 963 crore.
- The LSGD will have adequate additional technical staff at the state and district levels along the lines of the LIFE Mission including an experienced geologist in each landslide-prone district.
- The LSGD will run 70 HFCs across about 140 blocks of Kerala, focusing on those blocks that have the greatest reconstruction burden in the wake of the disaster. It will facilitate the convergence of various governmental programmes for

[10] INR 9.56 lakh cost minus INR 4 lakh assistance

[11] INR 7.15 lakh cost minus INR 4 lakh assistance

[12] https://pmayg.nic.in/netiay/Pahal.pdf

the house-owner, bringing in assistance for toilet construction, solar lighting, wind power, etc. Each HFC, staffed with three architects/engineers and three technical assistants, will provide technical and coordination support to home-owners in reconstruction.

Design Assistance to Affected House Owners

Reconstruction should take into account the cultural heritage of Kerala and the people's views and aspirations. Therefore, as the cornerstone of BBB, it is suggested that the home designs be developed through a participatory process where the architects of Kerala can act as catalysts in giving shape to the aspirations of the people.

Design

A basket of design options with minimum 500 ft^2 covered area with a toilet and roof access facility will be developed through participatory workshops in each district with all listed house-owners. In the workshops, the HFC staff members and socio-engineering experts will endeavour to understand the needs and aspirations of the people. Flexibility of design and technology for housing transformation is very important.

The house-owner will choose one of the designs for construction at her/his site. The details of the materials required, costs thereof, and the available suppliers selling at government-approved rates will be provided at the HFC.

The house design and access to common facilities will be barrier free, to prioritise the needs of persons with disabilities (both temporary and permanent), the elderly, pregnant women, and children, especially during emergencies. The comfort and well-being of the occupants should be the basis of the design.

The design options should be evaluated for thermal and visual comfort and daylight requirements. They should include lofts and ledges where people can store their assets before evacuation in future disaster events.

In several districts, especially the tribal areas, the design could incorporate spaces that facilitate home-based income generating activities. Design should consider convenience and safety of child-care. There could be need for sheds for livestock and storage in specific areas. There should be proper staircases to grant assisted roof access in emergencies.

Since initially only the core house is being reconstructed that can be developed incrementally, designs should have provision for the house-owner to add more rooms (without jeopardising the structural integrity of the house) if and when the owner is able to arrange additional finances.

Materials, technologies, and costs

The designs should maximise the use of locally available material while ensuring that construction technologies are durable and tried and tested for fire safety. No 'experiments' with untested technologies or materials will be allowed under the HFC.

Local material suppliers and labour contractors are also registered with the government and may be chosen by the house-owner for the reconstruction. As the rates have been negotiated by the government for the reconstruction, it reduces the chances of pilferage or corruption. Another option is to encourage local Kudumbashree units to run the material banks. It should be possible for homeowners to place a materials order directly, with virtual fund transfer to the

supplier from their bank accounts.

Estimates, models, and construction details of the designs so developed will be worked out by the HFC staff members and displayed in the HFCs.

Building capacity

All personnel involved in the reconstruction programme will have to develop their skills in construction management, building-in appropriate technologies, disaster-resistant construction etc. There is a need for training programmes for masons to ensure that all houses are indeed built back better. The trainees must be practicing masons only. It has been anticipated that conducting five training programmes in each district (40 masons per batch), will train 2,800 master masons (10-day training module). Each of these trained masons will work with five helpers. This comes to 16,800 masons and helpers across the state to support recovery.

The HFC staff members will train masons on retrofitting and encourage the community to retrofit their houses. Training of masons should be implemented with the help of appropriate training providers. Students of Civil Engineering/Architecture or postgraduate students of Geology from institutes within the districts (if any), will be encouraged to take part in the process. They may be provided training and assigned to assist specific homeowners during construction. They could be awarded appropriate academic credits for this activity.

Once all the destroyed houses have been rebuilt in a district, the HFC will continue to provide technical services to the LIFE mission, PMAY (G) etc., so that the state makes rapid progress towards achieving its goal of total housing.

Implementation method

Reconstruction and repair could be owner-driven, with technical support of the HFC. People with physical or mental disabilities, the elderly, women-headed households, etc., would need government support.

It is proposed, therefore, that the HFC provide additional technical assistance to women-headed households, families with special needs persons, elderly etc.. All hands-on mason training programmes conducted by the HFC will be at such building sites so that additional technical guidance and manpower can be provided to the house-owner.

Monitoring and Quality Control

The LSGD will develop a mobile application for coordination of the construction work in each district with beneficiaries, the HFC, the material suppliers, and contractors. The progress of the construction can then be monitored remotely and various tranches of payments transferred to the house-owner's bank account directly.

Key Policy Recommendations

In order to support the building of a New Kerala, as envisioned by the government, and to help life return to normal, without the past or existing risks, or creating new ones, the following initial policy recommendations may be considered.

Land-use, multi-hazard zoning

- Clearly demarcate the state into three zones: Western Coastal (coastal zone), Central Midlands (plains zone), and Eastern Highlands (hill zone) at the panchayat-level for focused land-use planning efforts. Kuttanad should be demarcated as a special zone for land-use planning.

- Prepare flood-, wind-and earthquake-hazard zonation maps for all zones. Update the existing land-use maps with respect to the multi-hazard map.
- Make landslide-hazard zonation maps available in a scale appropriate for planning at the local level (1:5,000 at least) for all municipalities and panchayats in the hill zone.
- Initiate a major shift in land-use policies demarcating certain areas as 'no development zone' and 'construction restricted zone'. These could be directly linked with the hazard-zonation maps.
- In flood-prone areas, the district administration should identify the location for flood shelters depending on the settlement pattern.

Building Rules and Enforcement

- The review and revision of the building rules for urban and rural areas needs to be prioritised. Separate chapters should be included in the Kerala Municipal Building Rules and the Kerala Panchayat Building rules for enhancing disaster-resilience of constructions in various zones.
- Develop awareness materials on safe construction practices for different zones and make them available at HFCs at the municipal and panchayat levels.
- Strengthen enforcement mechanisms in all zones, with adequate staffing of regulatory agencies and capacity-building of regulatory staff members.

- Discourage the construction of boundary walls using energy intensive materials and encourage the use of bio-fences, in all new constructions. Prototypes and models can be displayed in government offices to encourage the public to adapt to this change.

Suggested Recovery Interventions to 'Build back Better' and Integrate Disaster-Risk Reduction and Environment Safety Considerations

To help increase the resilience of housing and settlements in the face of future hydro-meteorological and other hazards, the following recovery interventions could be considered.

- Establish an enhanced techno-legal regime that stems from the development of the hazard-zonation maps at adequate scales, revision of building rules, and capacity development of regulatory authorities.
- Appoint geologists in all municipalities and panchayats in the hilly regions to ensure adequate technical support to the regulatory authorities for enforcement of the building rules.
- Constitute a 'Landslide Policy Committee' with engineers, geologists, architects, planners, and utility services experts from the government and private sector to draw up policies and develop a long-term landslide risk reduction plan for the hilly regions. In Mizoram, the Aizawl Municipal Corporation (AMC) has taken several policy measures to reduce landslide risk within its area including the constitution of a Landslide Policy Committee that formulated a landslide risk reduction plan called the 'Roadmap to Stability'.[13]
- Introduce slope modification regulations human activity that can jeopardise stability of hill slopes, e.g. slope cutting, filling, increasing the amount of groundwater penetrating into slopes, and disposing of sewage onto slopes, etc.

[13] *https://amcmizoram.com/uploads/files/road-map-to-stability_18102018121358.pdf*

- Build capacities in the local building fraternity—including engineers, architects and masons in all municipalities and panchayats—in the construction of multi-hazard resilient buildings.
- Constitute an expert committee to develop guidelines for hillside construction. This will be a first for the country, as even the NBC does not address the issue adequately.
- Every household in a hazard-zone should be insured. The insurance agencies should train their inspectors to carry out multi-hazard risk assessment of buildings and calculate premiums accordingly. The premium for the low-income households could be subsidised or be paid for by the government.

Relocation and Resettlement Planning

- Community members who have lost land and home or are living in highly vulnerable locations, have to be relocated within the same panchayat so that social linkages and livelihoods are not disturbed further.
- People may be incentivised to move from hazardous zones to safety. Disincentives could be in terms higher taxes or ineligibility for any relief or compensation in the event of future natural hazards.
- If 'safe' land is not available for separate homesteads, a cluster housing approach may have to be considered. In Kerala high-density living is inevitable. Thus, for possible relocation of households following the floods and landslides, as well as for vulnerable groups, two- to three-storeyed houses should be taken into consideration. Each unit should have a balcony or assigned space to allow the residents to continue some of their small livelihood activities. As an added benefit, the plot of the complex may also include a multi-functional open space. Convergence with the various governmental programmes for WASH, access roads, solar lighting etc may be ensured.
- Where resettlement is needed, the government should also explore the transfer of development rights (TDRs), with the government acquiring lost/hazard-prone land, at market rates to ensure that the vulnerable locations are not encroached upon in future.
- Resettlement compensations can be adapted from the existing Rehabilitation and Resettlement (Kerala) Rules 2015, LIFE mission norms or as per directions of the State Tribal Resettlement and Development Mission.

Culture of Alternative Environment-friendly Design and Technologies Inspired by Laurie Baker

Kerala has a distinctive traditional architectural style evolved holistically over time. Continuing from this tradition, Laurie Baker introduced the culture of environment-friendly and cost-effective construction based on local materials and skills, thereby, creating a distinctive 'Baker style'.

Influenced by Baker various institutions are promoting alternative building practices. The Nirmithi Kendra, Centre of Science and Technology for Rural Development (COSTFORD), Habitat Technology Group, and People's Movement for Sustainable Architecture give technological assistance to people in appropriate disaster-resistant building technologies. Such institutes and individuals can contribute significantly to reconstruction programmes, towards achieving a Green and resilient Kerala.

Implementation Plan

The following implementation plan has been suggested to achieve a resilient and green recovery in Kerala.

Table 13

Implementation Timeline: Short-, Medium-and Long-term Interventions for Recovery

Period and Task	Who Does it	Expenditure on Recovery
SHORT TERM 0–12 MONTHS		
Damage assessment complete	Local Self Government Department (LSGD), Rebuild Kerala	Cost of establishing a Housing Facilitation Centre (HFC) at 14 districts x 5 locations = INR 2 lakh x 70 = INR 1.40 crore
Control room at LSGD		
Establish HFC at 70 locations in 14 districts	LSGD, Panchayati Raj Department,	
Identification of land for resettlement/ relocation (government and private land) and transfer of development rights	state government and the people- participatory	Salary + transportation of housing facilitators + HFC's other expenditure =INR 43.473 crore
Resource mapping exercise to identify materials and multi-hazard zone-specific technologies	state- and district-level architects and engineers	
Participatory design and preparation of zone-specific designs (prepare a menu of options)	The people, LSGD and the state government and private architects	All construction activities including repair =INR 3,496.79 crore
Preparation of region-specific designs and technology options along with the estimates	LSGD	
Capacity building: Preparation of the course content and study materials as per the guidelines of the National Skill Development Council (NSDC) and Construction Skill Development Council of India (CSDCI)	Government of Kerala, Kerala State Disaster Management Authority (KSDMA), private architects and engineers	2,800 master masons' training on BBB=INR 7 crore
'Build Back Better' training of the affected community, masons, contractors, government and private architects, and engineers including building inspectors	Government of Kerala, KSDMA, Private architects and engineers and other training providers	Small-scale building material production centre 140 units in 14 districts=INR 70 crore
In collaboration with the Construction Skill Development Council of India, examination and certification of the trained people could be done	Government of Kerala, KSDMA, NSDC, Construction Industry Development Council, and CSDCI	Establish 112 production centre–industry partnerships = INR 56 crore

Period and Task	Who Does it	Expenditure on Recovery
MEDIUM TERM 0–36 months		
Review the existing building rules and update them to be in line with the multi-hazards in Kerala. Review the impact of the present floor area ratio (FAR) (4 for the whole state), and rationalise it to suit the existing urban and rural services, roads, etc.	Department of Urban Development, Panchayat Raj Department, KSDMA	Salary + transportation expenses of the facilitators + HFC's administrative costs = INR 21.74 crore All construction activities including repair = INR 1,748 crore Total recovery expenditure in 18 months = INR 5,443 crore
Review planning approval of buildings – additional guidelines for 'Build back Better'	Panchayati Raj Directorate	
Set up small production units for pre-cast alternative building components based on local materials	KSDMA	
Partnership with the industries for innovative building materials and high quality products at affordable prices, setup district level centres; industry to pay for this	Multi-departmental activity: Government of Kerala	
Preparation of a contour map with zone-wise soil depth and bearing capacity	Multi departmental activity: Government of Kerala + KSDMA	

Period and Task	Who Does it	Expenditure on Recovery
LONG TERM 0–60 months		
Micro zonation of the state identifying landslide (Geological Survey of India), flash flood, flood (Central Water Commission or CWC), seismic and wind zoning (Indian Meteorological Department or IMD), preparation of the multi-hazard maps at a scale appropriate for planning.	Government of Kerala, CWC, IMD with local support of KSDMA	
Update land use map for municipality, corporations, and panchayat areas	Land-use Board, Town Planning Department, Government of Kerala, Panchayat Raj Department	
Inclusion of appropriate technologies in the schedule of rates		

The process of recovery for the flood- and landslide-affected Kerala is not just a one-time intervention. On exit of the recovery support, the New Kerala ('Nava Keralam') should emerge as a green and resilient society, with full preparedness to face all future hazards. This could happen only if the interventions are socially appropriate and the affected people are involved in every step of the suggested strategies.

Priorities

- *Establish HFCs at the earliest and make them operational at block level under LSGD.*
- *Conduct an audit of how many skilled masons and labourers exist in Kerala and where they are located (migratory and local). Carry out skill-gap analysis. Implement training (BBB) in all 14 districts.*
- *Prepare a procurement plan of the construction materials which are available in the state and assess how much is to be acquired from the neighbouring states. Conduct resource-mapping exercise in all the districts through the HFC.*
- *Prepare a detailed construction management plan of the reconstruction work, along with human resources requirement and a mechanism for monitoring and quality control.*
- *Immediately establish a control room at LSGD, networked with HFCs at district-level for tight supervision and technical support to the HFC. The control room should be led by a professional Project Manager with computerised planning, scheduling, monitoring and control skills.*
- *Document the entire process as a model for other states to formulate recovery projects.*

Health and Nutrition

Health and Nutrition

Summary

The Post-Disaster Needs Assessment (PDNA) for the health and nutrition sector, was led by the Department of Health and Family Welfare (DHFW), Government of Kerala, and supported by United Nations (UN) agencies. The World Health Organization (WHO) was the lead agency, with contribution from other UN agencies—the United Nations Children's Fund (UNICEF), the World Food Programme (WFP), the United Nations Population Fund (UNFPA) and the United Nations Development Programme (UNDP). Consultations were held with the Department of Women and Child Development (DWCD), to address the nutrition aspects.

The PDNA reviewed damage and losses in the allopathic system, Indian systems of medicine (AYUSH—Ayurveda, Yoga, Unani, Siddha, and Homoeopathy) as well as the private sector. A total of 41 allopathic healthcare institutions have been damaged and 441 partially damaged in the health sector and AYUSH. The private sector, which delivers a substantive proportion of healthcare in Kerala, has suffered damage worth around INR 34 crore to assets and equipment.

The total damage to the health and nutrition sector is estimated at INR 499 crore (INR 273 crore for health, which is mostly of health facilities and INR 226 crore for nutrition, which is mostly damages to anganwadi centres). The total loss of the sector is estimated at INR 28 crore including INR 26 crore for health and INR 2 crore for nutrition. The total recovery cost of health and nutrition would come to INR 600 crore including INR 447 crore for health and INR 153 crore for nutrition.

Overall response to the disaster has been prompt, rolled out with immense supportive supervision and regular monitoring of the affected districts. Local private practitioners, doctors (including the Indian Medical Association and other

Figure 1
Safe and Green Hospitals to Build Back Better

professional organizations), voluntary organisations, volunteers and neighbouring state governments have ably supported the prompt and efficient response mounted by the state.

To build back better (BBB), Kerala is encouraged to transition to a 'safe and green hospital' concept through the allocation of adequate resources to health facilities that are most at risk (Figure 1). Multiple gains are possible by integrating disaster-risk reduction with low carbon energy use, water conservation, sustainable consumption, and environmental protection.

Robust health-sector planning and preparedness, together with investment in emergency operation centres (EOCs) will ensure strategic management of public health emergencies.

Given the vulnerabilities of the state to both natural disasters and high threat pathogens, continued focus on strengthening surveillance will be required. Gains made by strengthening linkages with the private sector for disease surveillance with support of surveillance medical officers from WHO, must be further strengthened and utilised within the Integrated Disease Surveillance Programme (IDSP) system. Investments in district health laboratories to detect flood-related diseases like leptospirosis, and health systems planning for acute events should be enhanced. Similarly, building capacity of healthcare professionals for early clinical suspicion of diseases like leptospirosis and starting prophylaxis if required.

Kerala is encouraged to strengthen the electronic integrated health information system to mitigate and rapidly respond to health emergencies. Innovative, real-time, web-enabled, and mobile-based information systems such as the Integrated Health Information Platform (IHIP), developed by the Government of India, should be implemented to augment existing health information systems in the state. The IHIP supports real-time monitoring and managing of IDSP data. In addition, IHIP includes all health facilities (private and public sector), all ports of entry (airports, seaports, and land-border crossings), as well as remote sensing and satellite imagery data with all applicable standards of the Government of India related to e-Governance, information technology (IT), data and metadata—all essential for responding to public health emergencies such as that which occurred in Kerala.

To build resilient health systems and communities there is a need to focus on the long-term psycho-social needs of survivors, including vulnerable groups such as the elderly, individuals with chronic ailments, the mental ill, persons with disabilities in the affected districts.

The State Mission of 'Aardram', a step in the right direction, should be implemented as part of the Nava Keralam initiative. It envisages the transformation of primary health centres into family health centres, standardisation of facilities in district and taluk (sub-divisional) hospitals with super-specialty and patient-friendly outpatient transformation, and ensuring protocol-based case management at all healthcare institutions.

Pre-Disaster Context

Health Sector Overview and Baseline Information

Kerala, with the lowest decadal population growth rate in India (4.9%),has a population density of 860 people per km^2,a literacy rate of 93.19%, the highest life expectancy (almost 75 years), and the highest sex ratio (1,084 women per 1,000 men), across all Indian states.[1]

The Secretary to the Government of Kerala heads the Health Department. Under the Health Department is a Director of Health Services, whose mandate is designed for the preservation and improvement of public health by preventive, promotional, curative, and rehabilitative methods. The Director of Homeopathy, the Director of the Indian System of Medicine and all medical colleges come under the Health Department. Analytical laboratories, public health laboratories and hospitals—ranging from medical college hospitals to primary health centres—fall under this department.[2]

The 1280 allopathic healthcare institutions in Kerala include 18 government hospitals, 18 district hospitals, 81 taluk hospitals, 232 community health centres, 848 primary health centres, and 5,408 sub-centres, besides other specialty hospitals. The state has 10 government medical colleges and 22 owned by the private sector, besides several dental, nursing, and pharmacy colleges both in the private and government sectors.

The Indian Systems of Medicine(ISM), especially ayurveda and homeopathy play an important role in the healthcare delivery system in Kerala. There are 1226 hospitals and dispensaries under the ISM Department with 946 of them under the regular government system and the rest, including ayurveda, unani and siddha, under the National Health Mission (NHM). There are 1083 institutions, 34 hospitals, and 659 homeopathy dispensaries, under the Homeopathy Department, with 693 under the state government and 390 from NHM. The state has homeopathy medical colleges, both in the government and private sector.

Risks

Kerala is prone to a host of natural hazards such as coastal erosion, flood, drought, lightening, landslide and earthquake. Almost all districts of the state are multi-

[1] *ORGI (2011), Census of India 2011, Office of the Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India.*

[2] *Website of Directorate of Health Services, Kerala. http://www.dhs.kerala.gov.in/*

Table 1
Health Indicators of Kerala

Indicator	Kerala	India	Data source
Life Expectancy at Birth (in years) for 2011–15	73.2 (Male) 77.6 (Female)	67.3 (Male) 69.6 (Female)	Census, 2011
Birth Rate (per 1000 living persons)	14.3	20.4	Sample Registration System, 2016
Maternal Mortality Ratio (MMR) (per 100,000 registered live births)	46	130	Sample Registration System , 2014–16
Infant Mortality Rate (IMR) (per 1,000 live births)	10	34	Sample Registration System, 2016
Under-5 Mortality Rate (per 1000 live births)	14	39	Sample Registration System, 2016.

hazard prone. Rapid urbanisation, environmental degradation, growing population, and climate change have compounded the disaster risks in the state.

Table 2
Nutrition indicators for Kerala and India

Indicators (percentage)	Kerala	India
Under-5 children stunted (height-for-age <-2SD)	19.7	38.4
Under-5 children wasted (weight-for-height <-2SD)	15.7	21.0
Under-5 children severely wasted (weight-for-height <-3SD)	6.5	7.5
Under-5 children underweight (weight-for-age <-2SD)	16.1	35.7
Children 6–59 months anaemic (Hb<11.0g/dl)	35.5	58.4
All women 15–49 years who are anaemic(Hb<11.0g/dl)	34.3	53
All women 15–49 years who have low BMI < 18.5 (Women)	9.7	22.9
Source: National Family Health Survey (NFHS-4), 2015–16		

Kerala has made significant advances in all the three components of health transition—demographic, epidemiological, and healthcare. The state is already in an advanced epidemiological transition as reflected in its morbidity profile. The prevalence of non-communicable diseases (NCDs), especially cardiac problems, diabetes, all forms of cancer, and chronic respiratory diseases are very high in Kerala.[3]

The state has succeeded in increasing life expectancy as well as reducing infant and maternal mortality. The effective implementation of the public distribution of food played an important role in improving nutritional status.

Overall, there have been impressive improvements in nutrition outcomes in Kerala between 2006 and 2016 (Table 2). Stunting declined from 24.5%[4] to 19.7%[5] and needs to be further reduced to less than 12% by 2025 (WHO) target on stunting. The prevalence of wasting remained stagnant with a negligible decline of 0.2% (from 15.9%[6] to 15.7%[7]).The prevalence of iron-deficit anaemia was also high among children and women, as can be seen in Table2. The floods may have impacted the nutritional status of women and children.

Non-Communicable Diseases

In Kerala, NCDs account for more than 50% of total deaths occurring in the 30–60 age group.[8] Kerala is considered to be the diabetes capital of India, with 27% men and 19% women being diabetic. The percentage of people with hypertension, cardiovascular diseases, and cancer is also very high across all sections of society. Though Kerala has a good healthcare system, 11.36% of the total population is affected by mental disorders, including schizophrenia and other depressive disorders. A study by the National Institute of Mental Health and Neuro Sciences (NIMHANS), Bengaluru, puts the prevalence of severe mental disorders in the state at 0.44%.[9]

[3] *Public Health Foundation of India (PHFI) (2017),'Kerala: Disease Burden Profile, 1990 to 2016',India: Health of the Nation's States—The India State-Level Disease Burden Initiative, PHFI, New Delhi.*

[4] *National Family Health Survey (NFHS-3), 2005–06*

[5] *National Family Health Survey (NFHS-4), 2015–16*

[6] *National Family Health Survey (NFHS-3), 2005–06*

[7] *National Family Health Survey (NFHS-4), 2015–16*

[8] *Indian Council of Medical Research (ICMR), PHFI, and Institute for Health Metrics and Evaluation (IHME) (2017), 'Kerala: Disease Burden Profile, 1990 to 2016',inIndia: Health of the Nation's States—The India State-Level Disease Burden Initiative, pp. 1–2, ICMR, New Delhi.*

[9] *National Institute of Mental Health & Neuro Sciences (2016), Prevalence of disorders, National Mental Health Survey 2015–16 Prevalence, Patterns and Outcomes, NIMHANS, Bengaluru, p.90.*

Sustainable Development Goals

As of now 70% of Kerala's healthcare is privately provided, making it expensive. Sustainable Development Goals (SDGs) of universal access to quality healthcare, medicines, sexual and reproductive healthcare, safe drinking water and sanitation, and the promotion of mental health are tough to achieve if public healthcare provisioning is not deep and wide enough. The Union government is committed to advancing the agenda of Universal Health Coverage (UHC) in the country and is taking concrete steps to reduce out-of-pocket (OOP) expenditure. The OOP medical expenses constitute about 62% of all healthcare costs in India (Insurance Regulatory and Development Authority of India IRDAI).

Nutritional Status

The state has a very good network of food and nutrition security related services. The Department of Women and Child Development (DWCD) provides nutrition-related services to children and women through 14 district Integrated Child Development Services (ICDS) offices, 258 project offices and 33,115 AWCs. Amrutham (Nutri-mix) is produced through 241 plants run by the Kudumbashree Neighbourhood Group. Further, the Food and Civil Supplies Department has a network of 180 godowns (under the National Food Security Act or NFSA), run by the Kerala State Civil Supplies Corporation (better known as SupplyCo) and 1445 authorised retail dealers (ARDs) for the distribution of subsidised foodgrain through the public distribution system (PDS).

Post-Disaster Effects

Response

Given the magnitude of the floods, the health sector's response was remarkable. Control rooms were set up at the state and district levels with dedicated e-mail Ids and landline numbers. District and zonal control rooms had nodal officers assigned for overall management and coordination, including the management of human resources, transport, pharmacy, and public health.

The communication network was affected during 14–16 August (the worst spell of rains), but was quickly restored. A state-level call centre was also setup with a toll-free number and two WhatsApp numbers. Disaster control room activities were managed by public health teams with strategic planning for medical aid management, logistics support, ensuring continuation of services for immunisation, NCDs, dialysis, palliative care training, media surveillance, and documentation. Rapid response teams were mobilised in each district.

Information from the control rooms and reports from the districts were collated twice daily. The Minister for Health & Social Justice, Additional Chief Secretary (Health & Family Welfare), Mission Director (NHM), Director of Health Services, and Director of Medical Education reviewed the situation and guided action on ground.

One key observation was that the health workforce, which promptly responded to the situation, was not guided by standard operating protocols, including alerts for evacuation of health facilities. This resulted in damage to equipment and supplies and need for emergency evacuation of inpatients, doctors, and paramedics as water started flooding the health facilities.

Effect on Health and Nutrition Infrastructure and Physical Assets

Overall damage and loss to the health sector is estimated to be INR 298 crore approximately. About 41 institutions were completely destroyed and about 411

partially damaged (including those in the AYUSH sector). The value of infrastructural damage to the health sector (including AYUSH) is estimated to be INR 273 crore (Table 3). Medicines worth INR 14 crore were lost across allopathic and AYUSH. Damage assessment and calculations have been conducted by the Engineering Department and estimates prepared in all the affected districts.

The total damage to institutions and assets caused to the food and nutrition security sector is estimated at INR 228 crore. A total of 1219 AWC buildings were affected, of which 114 were completely destroyed. In the PDS network, 900 ARDs were affected. Losses were incurred by 62 maveli (local grocery) stores, 23 super stores, 6 medical stores and 14 PDS depots, mainly on account of loss of grains, inventory, food items, and medicines. Asset losses at the nutri-mix plants were huge, especially owed to the damage to raw materials and take-home ration (THR) stocks produced for distribution for the months of August and September 2018.

Effect on Health Service Delivery and Access to Services and Goods

Interaction with health functionaries, community volunteers, local self-government, and administration, revealed that service delivery was quickly restored and maintained by the Health Department through inter-sector coordination. The loss to the health services sector in terms of the cost of demolition and cleaning rubble, disinfection, hiring of personnel, vehicles, and transportation charges in health facilities is estimated at INR 0.57 crore. The expenses incurred for relief camps such as logistics, manpower, transportation, and local purchase of drugs was INR 2.39 crore, and operational cost for setting up temporary health facilities (supported by UNICEF) was INR 1.28 crore.

Health services costs of prophylaxis, increased number of NCD patients, referral and transport of patients, medicines, consumables and supplies, district-level training, accommodation and local transport for health workers, mental health interventions and revenue loss was estimated at INR 5.2 crore. The cost of additional coordination and disaster management needs was estimated at INR 13.09 crore. Risk-reduction expenses—related to increasing immunisation coverage, health and nutrition promotion and information, education, and communication (IEC) expenses, screening for malnutrition projected for the next three to six months, water quality testing and chlorination (wells and other sources in health sector),vector control and monitoring, disinfection polluted areas, saving animals, and medical waste management—stood at INR 2.9 crore.

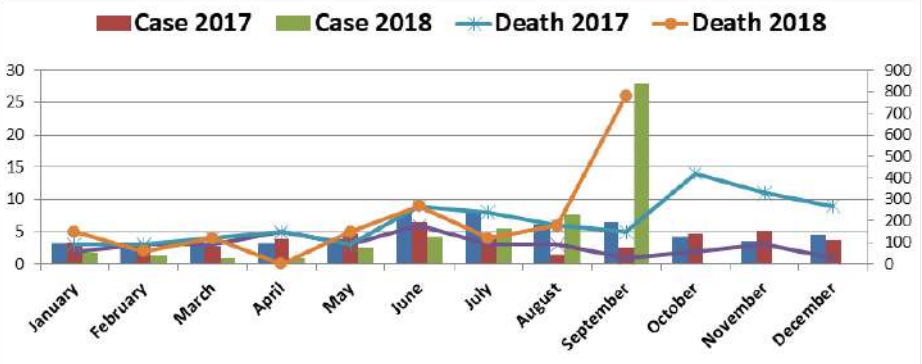
Communicable diseases

Toward post-disaster disease surveillance, WHO staff in Kerala was repurposed including consultants involved in the National Polio Surveillance Project [NPSP], tuberculosis, and cardiovascular disease prevention. The WHO field team helped in sensitising private health facilities as part of enhanced surveillance activity, including dissemination of the surveillance application to peripheral private hospitals to ensure efficient real-time electronic transfer of data.

Teams of epidemiologists and entomologists from Tamil Nadu also supported the state and districts in disease surveillance. There was a surge in cases of leptospirosis and dengue, and money was spent from the planned budgets on purchase of diagnostic kits, doxycycline prophylaxis and IEC. Community volunteers including anganwadi workers, accredited social health activists (ASHA) workers, Kudumbashree members etc. were engaged in public health interventions. Rapid response team meetings were convened and protocols for doxycycline prophylaxis, leptospirosis management, and dengue treatment were developed and disseminated. This helped in rapidly controlling the situation. Though leptospirosis cases increased in

Figure 2

Change in Leptospirosis Cases and Deaths in 2018 over 2017 (by month)



number initially, fatalities were reduced as a result of this aggressive response and management (Figure 2).

Further, a State Technical Advisory Group on Immunisation (STAGI) meeting was convened and advisories on Measles Rubella (MR) vaccination and Tetanus Toxoid (TT) vaccination were implemented.

Training and meetings

The IEC materials were developed for public dissemination, and trainings were conducted for call centre staff. District coordination meetings were conducted for the implementation of the Comprehensive Programme for Tribal and Affected Villages on water, sanitation and hygiene; disaster management; and health and nutrition. The Departments of Health, Local-self Government (LSG), ICDS, Social Security, Education and Water Authority participated in these meetings.

Logistics

Support from the state in terms of medicines, supplies, human resource, and guidelines, was prompt and extensive. Further, treatment protocols issued from the state on real-term basis, based on situational and surveillance data analysis, was quite helpful. The district collectors responded by closely monitoring and directing relief activities and mobilising other support systems. The elected LSG representatives were also at the forefront of logistic support. The state logistics team along with Additional Directorate of Health Services–Medical (ADHS–M) and Kerala Medical Services Corporation Limited (KMSCL) monitored drug stocks on a daily basis, with the help of district drug monitoring core teams and mobilised drugs and consumables to needy institutions. Materials worth INR 5.59 crore including 2 lakh kg of bleaching powder, chlorine tablets, clotrimazole cream, and doxycycline tablets were procured and supplied to affected districts through KMSCL.

Temporary health facilities

Temporary health facilities were set up at 244 flood-affected panchayats, which worked for 15 days and catered to 72,754 outpatients. Each additional health facility was manned by a medical postgraduate student and a staff nurse. Six junior health inspectors (JHIs) were also posted to these panchayats. Overall, 1200 JHIs were hired by the state for a month to support public health activities in flood-affected panchayats. In addition, 257 staff nurses were posted to strengthen the facilities to handle higher patient load due to floods.

Mental health

The Mental Health Disaster Management team conducted 1.23 lakh house visits and 706 camp visits using 122 intervention teams in the flood-affected districts. They provided psycho-social intervention to 2.04 lakh patients and pharmacotherapy to 1543 patients. This response was built upon the existing District Mental Health Programme with support from a team of experts from NIMHANS Bengaluru.

Non-communicable diseases

A total of 80,945 NCD patients were reinitiated on treatment using alternate NCD primary care guidelines for post-flood situation prepared by the state advisory group. Around 900 cancer patients were reinitiated on chemotherapy. An epidemiological surveillance of NCDs was initiated with the support of the National Institute of Epidemiology (NIE), Chennai and WHO.

Maternal and child health

High priority was assigned to pregnant and lactating women and young children during rescue and relief operations across flood-affected districts. Many pregnant and lactating women were shifted to safer locations, within and outside the state. Most women at full-term pregnancy were hospitalised for observation. There have been no reports of deliveries at camp sites across the state, but pregnant women had to be rescued and moved to safer locations at the peak of flooding. Most pregnant women in the state prefer to deliver at tertiary (medical college hospitals) and secondary care (district hospitals) facilities or at private hospitals. This trend continued during the floods. There were no reports of any major disruption to emergency obstetric and newborn care services. The ASHAs and junior public health nurses (JPHNs) contacted and tracked pregnant and lactating women over mobile phones.

Patient records have been lost in flooded health facilities. Most pregnant women lost their 'Mother and Child Protection' cards and other reports. There has also been extensive damage to equipment and medical supplies in these facilities. However, medicines and essential commodities were mobilised and services restored through temporary health facilities. Women health functionaries were actively involved in extending clinical and public health services. The frontline functionaries were the leading force in reaching out to the communities, particularly to women and children.

Effect on Nutrition Service Delivery and Access to Services and Goods

Integrated Child Development Services

Interaction in the field with senior government officials and functionaries as well as community leaders, spokespersons, and well-informed people in the village, suggested that dearth of food security and nutrition has not been a major issue during the floods. However, discussions with frontline workers in severely affected areas revealed that AWCs, which provide the ICDS, were closed for 1–4 weeks. Floodwaters damaged assets such as weighing machines (for growth monitoring of children), all paper-based records, toys, medicines, communication materials, and the pre-schools kits. As a result, pre-school activities as well as the distribution of iron–folic acid (IFA) tablets are not yet fully operational at the AWCs. Also, the vitamin-A supplementation under NHM has been disrupted due to loss and damage of the supplements inventory.

The THR distribution among pregnant and lactating women was interrupted. Interactions with mothers revealed that they could not prepare any special food supplementation for children during the flood and as a result, the very young children consumed the common food prepared at home for everyone. Mothers also reported that they were unable to take as much care as they normally would to maintain hygiene while caring and feeding the children, due to the shortage of hygiene products such as soap and sanitary napkins. Though some of the anganwadi workers (AWWs) were themselves affected by the flood, they did their best to support the affected children and mothers. The AWWs expressed the need for training on responding to nutritional needs of children and women during emergencies.

Public distribution

SupplyCo suffered heavy damage to its retail chain as well as its PDS depots. Loss, to the tune of INR 112.9 crore, was incurred due to the destruction of custom milled rice (CMR) and paddy procured under the minimum support price procurement plan and stored in various godowns and rice mills. However, these stocks were insured and the losses therefore should be reimbursed.

Estimates of Damage and Loss

The damage and loss to infrastructure and physical assets was reviewed, both in

Table 3

Damage/Loss/Total Recovery Needs (INR crore)

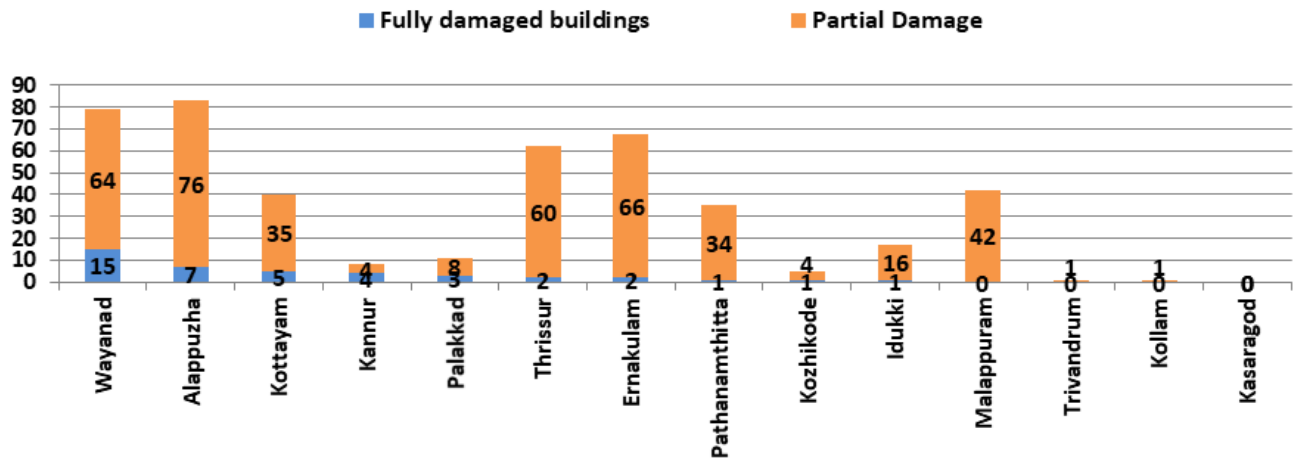
Health

	Damage	Loss	Damage + loss	Public	Private	Recovery needs
Infrastructure	272.62	4.25	276.87	276.87	33.68	421.29
Service delivery	0	5.21	5.21	5.21	0	6.25
Governance	0	13.09	13.09	13.09	0	15.71
Risks	0	2.95	2.95	2.95	0	3.55
Total	**272.62**	**25.50**	**298.12**	**298.12**	**33.68**	**446.80**

Nutrition

	Damage	Loss	Damage + loss	Public	Private	Recovery needs
ICDS	88.03	0	88.03	88.03	0	126.12
Food and civil supplies	5.26	2.11	7.37	7.37	0	7.37
SupplyCo: National Food Security Act	112.94	0	112.94	112.94	0	0
SupplyCo retail chain	20.15	0	20.15	20.15	0	20.15
Total	**226.38**	**2.11**	**228.49**	**228.49**	0	**153.64**
Grand total	**499.00**	**27.61**	**526.61**	**526.61**	**33.68**	**600.44**

Figure 3
Partially and Fully Damaged Buildings



public and private health facilities, including the AYUSH sector. Other institutions included laboratories, blood banks, and warehouses. Damages were calculated for furniture, equipment, medicines, loss of drugs and consumables (allopathy and AYUSH), disruption of ambulance services, and also disruption in nutrition services at AWCs, ICDS centres and the PDS.

Recovery Strategy and Build Back Better[10]

The priorities for recovery and reconstruction are to restore service delivery, address increased risks and actively seek to minimise interrupted treatment for chronic illnesses, resilience to invest in disaster-risk reduction and disaster-risk management capacities, and build back better (BBB) for infrastructure and services. The recovery process needs to strengthen the provision of basic health services with specific attention to gender and vulnerable groups.[11] Priorities for early recovery include restoring the functionality of the health system and building the capacity for effective service delivery.[12] When restoring health functions in the disaster-affected area, opportunities to build back better should be considered, including reconstructing or renovating health infrastructure for resilience to disaster, improving access to health services (compared to pre-disaster access), strengthening disaster-risk management capacities of government and communities, and reducing risks and vulnerabilities to future disasters.

Recovery and reconstruction needs as given in Table 3 and as detailed out in the section on recovery strategy would come to INR 600.44 crore including INR 446. 80 crore for health and INR 153.64 for nutrition.

Given the ongoing risks arising from the impact of the disaster, support to health services should pay particular attention to: (i) epidemiological surveillance of the population; (ii) infectious disease prevention and control (including adequate supplies and mobile response capacity); and, (iii) health promotion through community outreach among vulnerable groups, especially for vector- and waterborne disease prevention and treatment.

To ensure a coordinated approach to the provision of health services, district and sub-district coordination mechanisms will be developed. These will ensure that the different health sector partners agree on the key outcomes expected, and that

[10] The World Bank (2012), Recovery and Reconstruction Strategy, Thai Flood 2011 - Overview, Rapid Assessment for Resilient Recovery and Reconstruction Planning, World Bank Group, Washington, DC,p.7

[11] World Bank. 2015. Myanmar - Post-disaster needs assessment of floods and landslides: July–September 2015 (English), World Bank Group, Washington, DC. http://documents.worldbank.org/curated/en/646661467990966084/Myanmar-Post-disaster-needs-assessment-of-floods-and-landslides-July-September-2015

[12] Australian Government AusAID (2009), Investing in a Safer Future: A Disaster Risk Reduction policy for the Australian aid Program, Australian Agency for International Development (AusAID), Canberra. p. 5

resources from different institutions are allocated efficiently. Risk insurance needs to be provided for public health facilities and pharmaceutical supplies.

Short-term (12 months)

The short-term recovery plan will target life-saving interventions through curative and preventive approaches.

Infrastructure

- The reconstruction and repair to health institutions in Kerala in the BBB plan must include the 'Safe and Green Hospital' initiative, which is more than just protecting buildings. 'It's about ensuring that health facilities are accessible and functional, at maximum capacity, immediately after a disaster strikes'.[13] Making hospitals and health facilities safe from disasters is not just an economic requirement, but also a social, moral, and ethical necessity.

- Building location, design specifications, and resilience of the materials used, all contribute to a hospital's ability to withstand natural hazards. Protection is ensured in the designing of hospital beds, protection to health workforce, equipment, and basic lifelines and services: such as electrical power, water and sanitation, and waste management and disposal. Architectural spaces need to be properly designed for laboratories and operating theatres, medical records, medical and support services, and administrative processes.

- All steps including contingency planning, improved organisation and staff training are necessary to prevent a functional collapse. While this requires a significantly lower financial investment, it nonetheless remains a major challenge.

- A 'check consultant' is an independent consultant who, on behalf of a client, ensures that norms and building standards are in place. Check consultants can be contracted to oversee the construction of any building, but their thorough knowledge of building codes and natural hazard mitigation measures are particularly important to ensure the disaster safety of critical facilities such as hospitals. During the reconstruction of damaged health facilities, especially in areas prone to periodic flooding, situational assessment and selection of competent and qualified contractors must be backed by the stringent implementation of building controls and guidelines. For example, building codes may require certain floors to be located above an established minimum flood level (the flood hazard level).

- The reconstruction of health facilities in flood-affected areas under the 'safe green hospital' practice would include:

    1. planning the service area and warehouse based on the maximum height reached by the floodwaters;
    2. reinforcing roofs and windows to resist hurricane-force winds;
    3. using energy-efficient LED light bulbs;
    4. replacing old air conditioners with newer, more energy-efficient models;
    5. making the premises mobility-friendly for the disabled and the geriatric patients;
    6. ensuring piped water supply;

[13] Quote by Dr Bruce Aylward, Assistant Director-General for Emergencies at the World Health Organization (WHO); http://www.who.int/mediacentre/news/releases/2015/disaster-risk-reduction/en/

7. setting up hybrid solarisation; and,

8. installing rainwater harvesting structures.

- The number and types of essential equipment should be identified and acquired with adequate buffer for emergencies.
- A policy for discarding/destroying equipment affected by the flood should be developed.
- The anganwadi centres, which are damaged during floods, should be rebuilt at appropriate locations with design to withstand disasters.

Health and nutrition services

- The state and district command system at all levels will be enhanced to ensure effective and efficient healthcare response. The EOCs at the state and district levels must be enhanced with state-of-the-art health control rooms to coordinate and manage emergencies, including natural disasters.
- The focus must continue on strengthening surveillance of communicable diseases and prompt action to prevent any outbreaks.
- Any disruption of the management of NCDs, palliative care services, and national and state health initiatives must be addressed and services restored, particularly in worst-affected geographies.
- Continue focus on psycho-social support through outreach services in the community and through schools and other institutions. Psycho-social support is also a necessity for the frontline workforce to prevent burnout.
- Emergency transport system of patients to be established, including air ambulances in case of extreme emergency.
- Mission Aardram under implementation as part of the Nava Keralam initiative to be supported. It includes transformation of primary health centres into family health centres, standardisation of the facilities of district and taluk (sub-divisional) hospitals with super-specialty and patient-friendly outpatient transformation, and ensuring protocol-based case management at all healthcare institutions.
- Similarly ICDS should also have a district-specific plan for preparedness and management of emergency situation.
- Recognise the exemplary work done by health and ICDS workforce and identify champions.
- At the AWCs, there is an immediate need for the restoration of THR (Amrutham) production and supply chain. This warrants repair and replacement of machines at the Amrutham production plants and restoration of buildings, especially storage space.
- The weighing scales for growth monitoring, pre-school learning kits, medicine kits, toys and other pre-school materials need to be supplied to the AWCs immediately for resumption of full ICDS services. Immediate resumption in the distribution of vitamin-A and IFA tablets will be critical.
- There is a need for continuous psycho-social counselling and treatment for children and mothers who are traumatised in the wake of the disaster.

Disaster risk reduction

- Disease surveillance protocols must be reviewed and greater participation and engagement of private sector encouraged.
- Gains made by strengthening linkages through surveillance medical officers of WHO, must be leveraged by the IDSP system.
- There should be protocols to manage pregnant and lactating mothers—particularly mothers nearing expected delivery date and those with high risk pregnancies.
- Adequate electrical and non-electrical cold chain equipment's should be made available to ensure vaccination during emergencies.
- There should be a system to support tribal districts. Most of the tribal hamlets are remote and difficult to reach.
- Information to the tribal communities should be translated to languages they can understand and communicate in. The IEC materials, as well as communication methods, should be designed according to their needs.
- There should be at least one referral centre in every district. Existing district referral centres need to be strengthened because these were found to be inadequate in handling the enormous number of patients who thronged the healthcare facilities post the floods, hence taluk-level hospitals had to be roped in to take care of the huge numbers. The referral centres should build incapacity buffer to accommodate the additional requirement during emergency.
- Disaster management plan should include health-facility planning with standard operating procedures. Action-oriented district disaster management plans with response roles to health and allied sectors depending on type of disaster should be drawn up.
- Drug supplies received from various sources need to be inventoried for reallocation and use before expiry.
- There should be a coordination mechanism between ICDS, Health Department, Scheduled Tribes Development Department, and LSGs at the district level for improving health and nutrition of the tribal population.
- There should be a formal system of engaging with private service providers who contribute 70% of the sector provisioning in Kerala.
- The resumption of food grain distribution under the National Food Security Act warrants disposal of the damaged grain and other waste at the Supply Co's NFSA (PDS) godowns as also the refurbishment of these warehouses. The disposal of damaged stocks, replenishment of fresh stocks, replacement of electronic grain weighing scales and e-PoS machines—all need to be done urgently at the affected ARDs.
- The re-issuance of PDS ration cards to beneficiaries who have lost their cards has already begun and needs to be completed soon.
- It is also critical to conduct immediate nutrition surveillance at AWC level to understand the scenario, especially among the tribal population and special programmes. Establishment of nutrition monitoring committees at panchayat and district levels and extensive IEC campaign through them will be useful.

- Mechanisms for better utilisation of untied funds to meet the needs of medical emergencies should be set up. A contingency fund is required at the level of taluk and community health facilities for immediate action, and special contingency funds at every level for immediate response.
- Periodic capacity-building of manpower and mock drills is required.
- Mapping of disaster-prone facilities, risk assessment, and upgrading are an immediate need.
- It is advisable to also have at least a 72-hour supply of fuel available to power generators.

Medium Term (12–36 months)

The medium-term recovery plan will emphasise improving healthcare access by restoring health facilities, improving capacities of the health workforce, and promoting disaster-risk reduction.

Infrastructure

- Continue reconstruction of health facilities considering the geographical location with respect to disaster proneness and rebuild at another site or make suitable engineering modification to avoid such issues in the future.
- Strengthen laboratories in all district hospitals for detecting leptospirosis and other communicable diseases. This should include state-of-the-art laboratories including RT-PCR .

Health service delivery

- Departments with standard protocols with trained personnel at all levels and rapid response teams will be established under the Department of Public Health. Emergency operation centres will be established in the districts, and the EOC at state-level enhanced.
- Exclusive plans for Disaster Preparedness and Response of the Health Sector should be updated annually. This should include plans to handle all types of disasters that the region is vulnerable to, including mass causality incidents and disaster management plans for hospitals, both government and private.
- Training and capacity-building programmes for health functionaries at various levels should include mock drills with clearly specified roles and responsibilities to ensure a prompt and systematic response to all kinds of emergencies and disasters.
- Legislative framework to ensure prompt response from the private sector including reporting and engagement with public health measures should be created.
- State-of-the-art health control rooms may be established to coordinate and manage emergencies, including natural disasters.
- Safety of health infrastructure may be assessed with regard to various kinds of disasters and appropriate investments made for disaster-resistant infrastructure.
- Epidemiological studies and investments for vector control measures, including introduction of technology for monitoring and prompt reporting will help

reduce the risk of outbreaks after disasters.

- Contingency funds for emergencies should be set up, especially at lower level health facilities for immediate response.
- Develop Standard Operating Protocols related to disaster response and action such as evacuation and follow-up of pregnant and lactating women and children, NCD management, and palliative care of patients; rolling out public health measures at alert and post-disaster phases; coordination of external medical teams, management of medicines and supplies received from various sources and such other issues.

Disaster risk reduction

- Conduct periodic training and capacity-building programmes tailor-made to the roles and responsibilities of the health-sector workforce.
- Distribute fortified packaged mix suitable for mothers as THR. The fortified mix could be produced at the same production plants run by the Kudumbashree for Amrutham Nutri-mix (distributed among children) for cost optimisation at scale. The inclusion of milk and eggs in hot-cooked food for pre-school children should be considered.
- Conduct disaster-risk reduction training on emergency nutrition for the AWWs.
- Innovative health technologies and digital health approaches should be used at all levels to benefit and maximise the building of the health systems.
- Utilise the new IHIP for managing data for IDSP for all 14 districts of Kerala. The IHIP is a web-enabled near-real-time electronic information system for managing IDSP data. The IHIP is embedded with all applicable Government of India's eGovernance standards, IT, data and metadata standards.
- Install siren systems for early alerts in the state and the districts.
- The paperless monitoring and reporting system through the Electronic Common Application Software (eCAS) is being implemented in four districts, viz. Kannur, Kasaragod, Malappuram and Wayanad, under the National Nutrition Mission (NNM).Scale-up the same to other districts as well.
- Set up of counselling centres in state and districts to address psycho-social issues.

Long Term (36–60 months)

The long-term plan should be in line with other development plans at various levels and aim to promote ongoing health sector reforms, strengthen health facilities, and the health information system.

Infrastructure

- Roads and access to healthcare facilities need to be designed to provide safe access and possibly multiple routes of evacuation.
- The Government of Kerala is in the process of implementing a 3-G model building for ICDS facilities and the norms of multi-hazard proofing could be integrated in the recovery plan.

Health service delivery

- The IDSP could further strengthen the disease surveillance linkages established with the private sector.

Disaster risk reduction

- Continue supporting, setting up, and operating psycho-social counselling centres in the state and districts.
- Kerala's Department of Health & Family Welfare will take this opportunity to review and assess the health system's response to emergencies and disasters, and identify health system-wide as well as cross-sectoral improvements. Furthermore, national, regional/state, and township disaster-risk management and disaster response plans will be developed. Prevention, mitigation, and coping measures will be integrated in this plan. The capacity of the state's Health & Family Welfare Department workforce will be developed in disaster-risk reduction and disaster-risk management.
- The public health system has to review the number, staffing pattern and district specific requirements, and revise staff structure accordingly with buffer to handle emergencies.
- Decentralise warehouses for drugs and medical equipment to the regional level; suggested districts are Ernakulum, Idukki, Wayanad and Malappuram.
- A disaster management body can be established at the district level to act and mount swift response during emergencies.

Box 1: Best Practices in Kerala

1. *In the immediate aftermath of floods, when connectivity to different districts from state capital was compromised, the Kerala Health Department mobilised support from adjoining states like Karnataka and Tamil Nadu.*
2. *The supply of oxygen cylinders, doxycycline capsules, saline infusions, bleaching powder and other lifesaving drugs from across the border, helped continuation of critical care and saved lives.*
3. *Government efforts to strengthen disease surveillance by roping in partners quickly and generating early warning signals also helped save lives.*
4. *Feedback from field visits highlighted the robust support the districts received from the state in the initial days after the flood. One of the District Medical Officer (DMO) mentioned that the level of, 'support was exemplary and exceptional, be it medicines, consumables, manpower or moral support.'*

Implementation Strategy for Recovery

Short-, medium-, and long-term recovery programmes will all need to be accompanied by strong mechanisms that track aid, coordinate programmes, and monitor progress. Existing monitoring and evaluation systems will also need to be enhanced at all levels. Effective progress monitoring and aid tracking will be

critical for ensuring that the government, international partners, and the private sector achieve the sector objectives. It would be equally important to ensure regular reporting on progress toward recovery targets, challenges faced during recovery, and the impact of assistance provided. Finally, the recovery programmes must include a mechanism for feedback from communities on the support provided and then adjust priorities according to their needs.

Assessment Methodology

The PDNA for the health and nutrition sector (public and private) followed the standard PDNA methodology, which includes analytical tools and methods for a consistent application of basic concepts of damage and loss assessment and post-disaster recovery and reconstruction needs assessment for the health sector. Conducted through the health-sector team led by the Department of Health and Family Welfare, Government of Kerala, the PDNA methodology included the analysis of pre-disaster baseline data to compare with post-disaster conditions in order to assess the disaster impact and to determine the overall recovery strategy. It combined quantitative data with qualitative information to analyse and assess the social and economic impact of the disaster from the community level to the national level.

The PDNA team for the health and nutrition sector was led by the Department of Health and Family Welfare, Government of Kerala, under the overall leadership of Rajeev Sadanandan, Additional Chief Secretary, Ministry of Health; Keshavendra Kumar (MD), NHM, and Dr L. Sarita, Director Health Services, Kerala. The team was also supported by officers of women and child development department.

The process was supported by public health and nutrition experts from UN agencies—WHO, United Nations Children's Fund (UNICEF), World Food Programme (WFP), United Nations Population Fund (UNFPA)—with the overall guidance of the UNDP. The following persons and departments are acknowledged for providing technical inputs: State Mission Director; Director Health Services; Additional Director Planning; Additional Director, Medical and Hospital Administration; Deputy Director Health Services Planning; Deputy Director Health Services(Family Welfare); Material and Drug Management, KMSCL; Human Resources Planning; 24/7 Call Centre management; Quality Assurance; Media Surveillance, Training and IEC; NCD; Mental Health; AYUSH, Medical Equipment Quality; IDSP; Women and Child Department; SupplyCo, Indian Medical Association; Indian Academy of Paediatrics.

The specific objectives of the health and nutrition sector PDNA included:

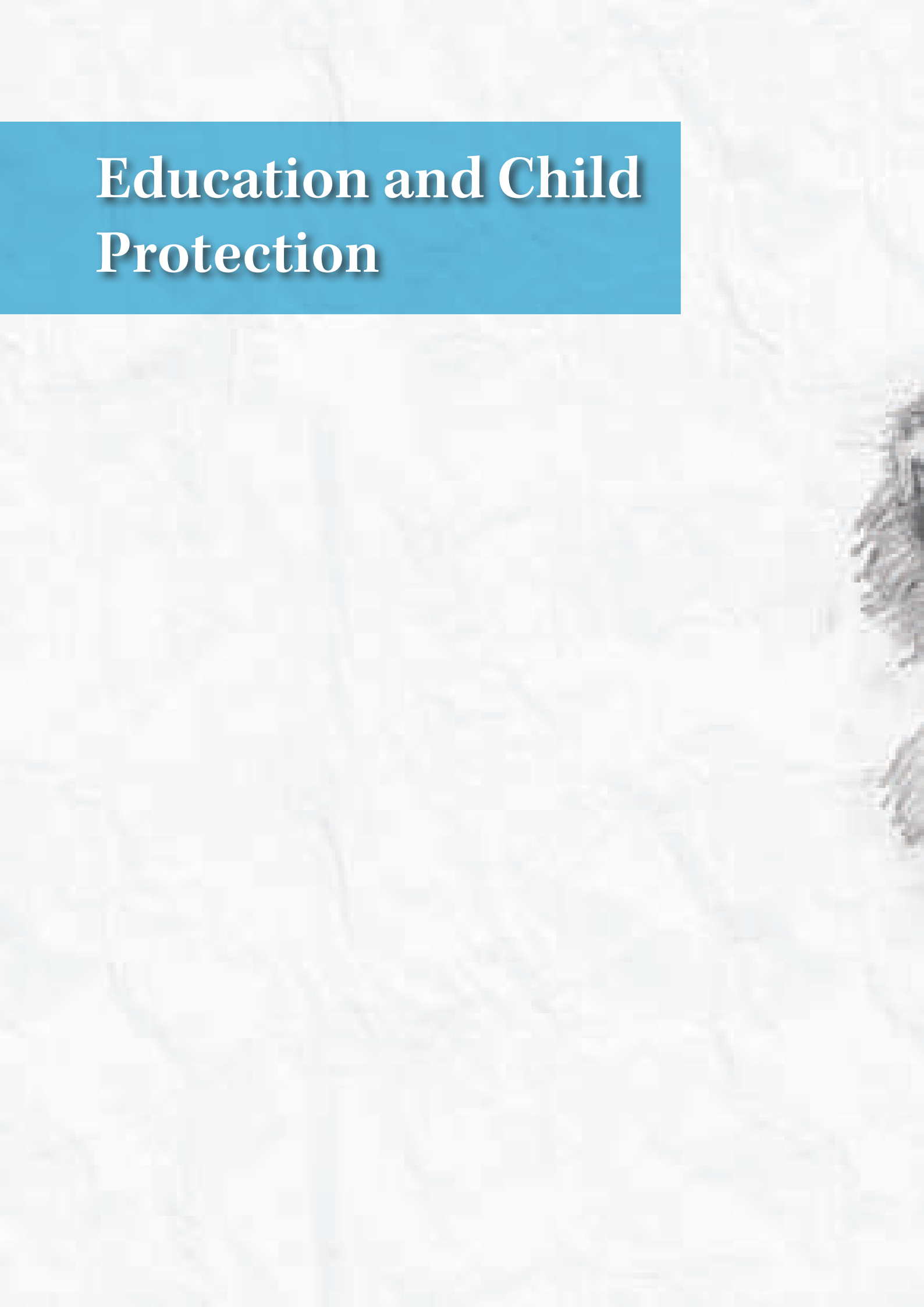
- assessing health sector-wise effects and impact of the floods in the state;
- assessing the overall socio-economic impact of the floods on the people and economy;
- identifying priority needs for affected households and the health and nutrition sector, with a particular focus on resilient recovery and reconstruction;
- recommending institutional mechanisms and policy measures to be undertaken in support of the recovery, reconstruction and infrastructure development; and
- reviewing current disaster risk management and putting disaster risk reduction policies and measures in place to deal with disasters and recommend measures to improve prevention and mitigation, as well as preparedness and response.

The assessment focused on the disaster-affected areas and examined the damage to physical assets and the immediate repair and rehabilitation/reconstruction

needs, investments required to restore service delivery to address increased health needs and mitigate health risks, as well as social and economic needs of the affected communities. Uniform parameters for assessment within the health sector were set, standard units for cost estimation applied and included in the cost of improved specifications and better resilience. Where possible, it also considered how the response to the current situation can improve the natural and built environment for citizens as well as the health infrastructure network, and how the impact of future natural disasters can be minimised. The road map for long-term disaster mitigation can also commence in parallel with the PDNA exercise, building on progress made in the Ministry on Health Disaster Risk Management, including the International Health Regulations.

The assessment built upon the initial and detailed sector damage assessment undertaken by state government and the data collected by other agencies like Indian Medical Association. The health sector assessment made use of existing data from district and state-level health authorities, and from the assessments as done for the emergency response. Field visits and key stakeholder interviews at multiple levels in the affected areas were also considered.

Education and Child Protection



Education and Child Protection

Summary

The Post-Disaster Needs Assessment (PDNA) for the education and child protection sector is a joint exercise of the Government of Kerala (GOK) which was led by the Department of Education and supported by United Nations agencies (with UNICEF[1] as the lead agency and contributions from UNESCO[2]). Consultations were also held with the Department of Women and Child Development (WCD) to discuss on pre-school education and child protection.

This assessment covers pre-school education in anganwadi centres (AWCs), general school education (Grades 1–12), higher education, vocational education, and non-formal adult education. The entire spectrum of education services from the age of 3 years to lifelong learning suffered damages and losses due to floods. The chapter also provides estimates and strategies for recovery and reconstruction, using the principle 'Build Back Better'.

The total damage and losses to education and child protection is estimated at INR 179.48 crore, which includes damages of INR 174.98 crore and loss of INR 4.50 crore. The total recovery and reconstruction needs for the education sector for the next 3–5 years are estimated at INR 214 crore. The major costs for recovery are related to reconstruction of damaged or destroyed schools, AWCs, and continuing education centres (CECs).

The major recovery strategies and innovations suggested include:

- adopting the approach of green school that creates a healthy environment conducive to learning and environmental protection;
- strengthening existing biodiversity parks in all schools;
- designing schools and educational centres based on topography, climate, local conditions, and principles of green building;
- strengthening the child-friendly police initiative and Our Responsibility to Children (ORC) programme in all schools;
- strengthening mental health programmes (through psycho-social support and school counselling) and integrating it to the school curriculum for both students and teachers;
- initiating comprehensive school safety planning (safe physical environment, nature clubs, child protection, and disaster risk reduction [DRR]); and
- integrating DRR in the curriculum, which has already been initiated by the State Council of Educational Research and Training (SCERT).

[1] *United Nations Children's Fund*

[2] *United Nations Educational, Scientific and Cultural Organization*

The Pre-Disaster Context

Kerala has the highest total literacy rate (94%) and female literacy rate (92%) in the country (Table 1).[3] In January 2016, it became the first Indian state to achieve 100% primary education. [4] The Gross Enrolment Ratio (GER) of the state is 95 at the elementary and 102 at the secondary level; the drop-out rate at the primary level is zero and the transition rate from elementary to secondary level is 99.8% (U-DISE 2016–17). The National Achievement Survey 2017 (NAS 2017) places Kerala among the top 10states in the performance of grades 3 and 4.[5] The accomplishments of the state in education can be attributed to an impetus on education since the 19thcentury, which has been consolidated by successive state governments since 1956. By the 1980s, Kerala was spending 6% of its gross state domestic product (GSDP) on education. Kerala was also the first state to become fully literate in April 1991.

Table 1
Key Education Indicators

Indicators	Kerala	India	Data source
Total literacy rate/female literacy rate (%)	94/92	73/65	Census, 2011
Literacy rate-Scheduled Caste/Scheduled Tribe (%)	89/76	66/59	Census, 2011
Annual average dropout rates at primary level (%)	0	6.3	U-DISE, 2016–17
Transition rate from elementary to secondary (%)	100	90	U-DISE, 2016–17
Gross enrolment ratioat elementary/secondary/higher secondary	95/102/78	97/80/56	U-DISE, 2015–16
Percentage of 3–6 year olds attending pre-school/school	91.2	80.2	ASER, 2016

Sources:

1. *Census, 2011: ORGI (2011),Census of India 2011, Office of the Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India.*
2. *U-DISE: https://data.gov.in/dataset-group-name/u-dise*
3. *ASER 2016: http://img.asercentre.org/docs/Publications/ASER%20Reports/ASER%202016/aser_2016.pdf*

General education is structured into kindergarten (lower and upper), lower primary (grades 1–4), upper primary (grades 5–7), high school (grades 8–10), and higher secondary (grades 11–12). There are over 33,000 government run anganwadi centres (AWCs) in the state for 3–6 year olds.[6] Kerala has good access to school education with 16,466 elementary schools (grades 1–8), 4770 secondary schools, and 3000 higher secondary schools (Table 2).[7] In higher education (beyond grade 12), there are 13 state universities, 1 central university, 2 deemed universities with 73 government colleges, 3 aided colleges,[8] 182 private aided and affiliated colleges, 150 self-financing engineering colleges , and nearly 1100 private colleges. The Kerala State Literacy Mission Authority (KSLMA) mostly carries out non-formal adult education and lifelong learning programmes. There are 654 CECs with over 100,000 adult learners in Kerala.

Schools are modelled to be safe spaces for children, providing a protection net from abuse and violence. The ORC programme under the Integrated Child

[3] ORGI (2011), Census of India 2011, Office of the Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India.

[4] https://indianexpress.com/article/explained/kerala-primary-education-literacy-rate/

[5] National Achievement Survey 2017, Ministry of Human Resource Development, Government of India. http://mhrd.gov.in/NAS

[6] Data submitted by ICDS on request dated 23 September 2018.

[7] U-DISE https://data.gov.in/dataset-group-name/u-dise

[8] Rashtriya Uchchatar Shiksha Abhiyan (RUSA), 2014, Department of Higher Education, Ministry of Human Resource Development, Government of India.

Protection Scheme (ICPS) focuses on child protection.[9] Through teacher training and student empowerment, the state curriculum enhances the understanding of the importance of child protection in child development. During January–August 2018, the Kerala Police recorded 2031 cases under the Protection of Children from Sexual Offences (POCSO) Act, 2012.[10] An analysis of POCSO cases in 2017–18 by the ChildLine India Foundation showed that neighbours and relatives are the major child abusers.[11] There are 872 child care institutions (CCIs) in the state, mostly run by non-governmental organisations (NGOs), with about 25,000 children. Almost all of them attend school.

All schools are mandated to prepare a school safety action plan and form school safety clubs, following the guidelines of the Supreme Court on school safety.

Table 2.
Education and Child Protection Sector at a Glance

Sub-sector	Learner age (in years)	No.of students/ learners (in lakh)	No of institutions	No of institutions
Anganwadi centres	3–6	3.2	33,115	Data submitted by ICDS on request dated 23 September 2018.
Elementary schools	6–14	39.8	16,466	U-DISE https://data.gov.in/dataset-group-name/u-dise
Secondary schools	15–16	10.7	4770	U-DISE https://data.gov.in/dataset-group-name/u-dise
Higher secondary	17–18	8.2	3000	U-DISE https://data.gov.in/dataset-group-name/u-dise
Technical and Vocational Education and Training	15+	3.7	654	Data submitted by Department of Higher Education on request dated 28 September 2018
Adult literacy	15+	1.4	2010	Data submitted by KSLMA on 27 September 2018.
Child care institutions	0–21	0.25	872	Data submitted by WCD on request dated 23 September 2018.

Based on the above baseline data and information, the assessment team evaluated the effects of the recent Kerala floods and landslides on education in the state in terms of physical infrastructure, service delivery, governance mechanisms, the teaching and learning process, and personnel. The key findings are presented in the sections below.

The Post-Disaster Context

Kerala received unprecedented rainfall during June–August 2018, leading to floods and landslides, the worst since 1924.In all, 1779 schools and some colleges were used for the displaced people as relief camps. The state government issued guidelines on running the camps under camp managers. Each camp had a separate women's toilet, safe place for children, and separate room for lactating mothers. Cultural and play activities were held in all the camps.

[9] *http://www.orcindia.org/*

[10] *http://keralapolice.gov.in/public-information/crime-statistics/pocso (accessed on 4 October 2018).*

[11] *ChildLine India Foundation – Kerala State Advocacy Plan 2018-2019 by ChildLine India Foundation South Regional Resource Centre (CIF SRRC).*

Immediately after the floods, the government issued detailed instructions on clearing debris and cleaning schools and almost all schools re-opened on 29 August 2018, within 10 days of the floods. Teachers and education department officials were involved in cleaning the schools and also volunteered in the camps. Camps operating from schools and AWCs were shifted to other locations.

Damage to Infrastructure and Physical Assets

Based on the quantitative and qualitative records, the team assessed the varying degrees of impact of the recent floods and landslides on the infrastructure and physical assets of institutions ranging from AWCs to CECs and colleges.

The floods left 1219 anganwadi centres (AWCs) fully and partially damaged.[12] Loss of kitchen items like gas stoves, food grains, and utensils led to the disruption of the regular services of the centres. They were unsafe for the children to stay in, as there was damage to the walls, floors and roofs. They lacked in supplements and safe drinking water; sanitation facilities too were damaged and disrupted. This deprived women and children of regular nutrition supplements, health check-ups and services, besides affecting the pre-school education of children aged 3–6 years.

In all, 1613 schools were affected by the floods. In addition, 1148 toilets and 842 urinal facilities and about 34,251 m of compound walls were damaged. School midday meals were disrupted due to loss of kitchen infrastructure, noon plates etc. The worst affected were the districts of Alappuzha, Ernakulam, Pathanamthitta, Thrissur, Wayanad, Idukki, and Kottayam. The situation poses a threat to children, especially girls, who might stop attending school and ultimately drop out in case the toilets remain unusable for long.

In the context of adult literacy and continuing education, 52 CECs were fully destroyed and 100 were partially damaged including loss of learning materials, application forms and certificates, examination papers, furniture, and information and communication technology and equipment. The greatest damage was observed in 18 centres each in Wayanad and Alappuzha districts.

In institutions of higher education, furniture, laboratory equipment, chemicals, books, documents, computers, electrical wirings, plumbing lines, sanitation facility, floor tiles, walls, and allied objects were completely damaged. In addition, toxic pollution hazard was posed by seeping chemicals and physical security threatened by damaged and exposed electrical wiring and weakened building structures.

Out of 31 CCIs managed by the state, two homes suffered infrastructure damage.[13] The toilet in the girls' home in Alappuzha was waterlogged due to floods and the boys' home in Wayanad faced damages to its compound wall. The CCIs managed by NGOs have suffered damages too.

Impact on Teaching and Learning

In all, 1219 pre-school kits were either washed away or destroyed in the AWCs affecting the regular activities of about 25,000 children. The children in many of the centres were afraid to come back to the AWCs and anganwadi workers and helpers went on regular home visits to encourage them to return. In North Paravur in Ernakulam, where 136 out of the 179 AWCs were damaged, the ICDS team garnered support from individuals, corporates, and charity organisations fund an AWC facelift initiative, to make them bright and welcoming for the children.

Teaching and learning were adversely affected in almost all schools and higher education institutions across districts with some closing down for up to 23 days.[14]

[12] Data submitted by ICDS on request dated 23 September 2018.

[13] Data received from State Child Protection Society on request dated 28 September 2018.

[14] Data received from the Directorate of Public Instruction (DPI).

Many schools, especially in Alappuzha, were closed for more than a month. Even when the schools re-opened, attendance was as low as 20% in many schools. To make up for the lost instructional days, all the schools are now open on Saturdays and many teachers teach for two extra hours daily. Although the learning loss of children due to the long absence from school cannot be quantified, the adverse impact of such absence on their overall academic performance and increased risk of dropping out if the child is unable to cope with the missed lessons in inevitable.

It is estimated that 71,927 school students lost their uniforms and 86,634 students lost their textbooks, notebooks, school bags, noon-meal plates and tumblers.[15] The education department has almost completely replaced the textbooks and many voluntary organisations and individuals provided new notebooks and geometry boxes to the children. Uniforms, library books, and laboratory equipment still await replacement. Students, who will be taking their board examinations in grades 10 and 12 in the current academic year, may need to rewrite their notes as they have lost them.

In non-formal adult education, literacy and equivalency classes were suspended for periods ranging from a week to a month. Almost all examination dates were rescheduled to allow learners to have enough time to prepare for tests. Even in the cases when literacy classes resumed within a week after the disaster, many preraks[16] reported that their learners required counselling and psycho-social support. Although it was difficult to confirm, anecdotal records indicate that participation became intermittent and discontinuous as many adult learners dropped out of equivalency and basic literacy classes to revive their livelihoods and rebuild their houses.

While there were no casualties reported among teachers and non-teaching staff, many teachers and preraks from the affected areas lost their homes, properties, and farmlands and were forced to live in the relief camps. The KSLMA mobilised the preraks in relief and recovery activities. Several newspapers carried stories on the active participation of the KSLMA members in the cleaning of roads, hospitals, schools, and private houses of the affected community members.

Impact on Service Delivery and Governance Mechanisms

No major damages were reported to the physical infrastructure of state-level institutions like Kerala State Council of Educational Research and Training(SCERT), Directorate of Public Instruction (DPI), etc., during the floods. Hence, the functioning of key state-level agencies remained more or less normal. However, of the 14 district project offices (DPOs) of the Samagra Shiksha Abhiyan in Kerala, the DPO of Malappuram was badly hit by the floods. Out of 168 block resource centres (BRCs) in the state, 14 have been severely affected and are operating from alternative buildings.

Estimating Financial Value of Damage and Loss

Data on infrastructure damage to AWCs is reported in Chapter 8, Health and Nutrition. Therefore, the loss pertaining to AWCs in this section is only relating to loss and damages to the pre-school education kits, which was worth about INR 60 lakh. Data on damages for Technical and Vocational Education and Training (TVET) was not available until the time the report was prepared. Losses were estimated in terms of instructional days, midday meals, access to drinking water and toilets (Table 3).

[15] Samagra Shiksha Abhiyan (SSA) report sent to the Ministry of Human Resource Development post floods, September 2018.

[16] Preraks are facilitators who lead the non-formal education programmes

Increased Risks and Vulnerabilities

Disasters create new threats or conditions of vulnerability that can be aggravated, if not attended to immediately. The area covering Kuttanad taluk in Alappuzha is a low-lying area, where the schools and AWCs were inundated for almost one month

Table 3
Estimation of Damages and Losses to Infrastructure and Physical Assets

Damage to infrastructure and assets	Description	Public damage (in INR crore)
Classrooms and office rooms	1420 classrooms, 193 office rooms in school, and 152 classrooms in CECs damaged.	128.28
Administrative offices	1 DPO office and 14 BRCs damaged.	0.89
Uniforms	71,927 m of uniform damaged.	0.93
Teaching and Learning Materials (TLM)	Pre-school education materials, TLM, lesson plans, notebooks	1.94
Computer laboratories	1256 desktop, 597 laptops, 203 LCD projectors, 50 printers, 337 printers, 775 Uninterruptible Power Sources (UPS), 313 batteries, 256 network switches and 927 computer tables were damaged in schools	13.61
Science laboratories and chemicals	2653 school laboratories were damaged; a detailed assessment needs to be undertaken to assess the extent of damage	0.26
Sports and game equipment	33,171 sports kits and play materials damaged	0.35
Other equipment	Weighing machines, generators, microphones, fans, electrical wiring, etc.	4.71
Furniture	Almirahs, desks, benches, chairs and tables damaged.	7.38
Playground and boundary wall	3,68,731 m2of playground and 34,251 m of boundary wall damaged	12.17
Kitchen materials	13,978 m2 of school kitchen, 5542 m2of dining hall along with utensils, food grains, and gas cylinders damaged	4.46
Sub Total		**174.98**
Water, sanitation, and hygiene facilities	1148 school toilets were damaged. 842 school urinals were damaged. Toilets in CECs and CCIs were damaged.	4.50
Sub Total		**4.50**
Grand Total		**179.48**

Notes:

1. Loss in terms of number of schooling days and learning outcomes/reduction of students has not been quantified.
2. Privately-run educational institutions (35%) have not been included in this assessment.

and the buildings were unsafe for the children. In many cases, people lost their livelihoods, which had a direct impact on the education of children. It created a possibility of children being kept back home or forced to join the labour force to compensate for the loss of family income.

Damp walls and floors exposed children to shelter/building-related diseases including the potentially fatal threat of mould growth. Lack of proper drinking water and toilet facilities posed further hygiene and sanitation issues. Some of the schools that were visited during the assessment were deemed unfit for use. Children studying in these schools were either attached to a nearby school or relocated just outside the school building. At least two schools in both the visited districts had to resort to multi-grade teaching due to lack of space, even though all teachers were present on duty. In remote tribal villages such as Idamalakkudy in Idukki, children stayed away from school for fear of more flooding and had to be coaxed back by the teachers. Anecdotal evidence suggests high absenteeism among students in tribal pockets, which could lead to dropouts.

Programmes run by the KSLMA enrol participants from the most disadvantaged social groups—elderly people, women, disabled persons, members of Scheduled Tribes and Scheduled Castes, coastal communities, farmers, and migrant workers. The recent disaster has sharpened the vulnerabilities of these communities due to loss of livelihoods, poor health and nutrition, and deprived them of free lifelong learning opportunities.

This disaster destroyed or damaged about two lakh houses.[17] This is expected to force around a lakh families to take shelter with relatives and acquaintances, increasing the risk of child abuse and violence, disruption of schooling and drop out.

Impact Analysis of Development Goals

Schools and colleges play a major role in providing children and students with a routine and a semblance of normalcy. Hundreds of schools and colleges were used as camps during the floods and many such buildings were damaged. Besides, educational institutions were closed for several days due to heavy rain, floods and landslides. This led to the disruption of schooling and learning for many days resulting in loss of instructional hours. In addition, the schools incurred losses of schoolbooks, notebooks, uniforms and even modes of transportation (cycles, scooters), etc. The children living in camps had no privacy or quiet spaces to study. Girls found it difficult to meet their menstrual hygiene needs. Apart from the low attendance rates during the early post-disaster period, destruction of TLMs and disruption of services, it remains to be seen if there are any dropouts, especially amongst the most marginalised social groups.

Deterioration of mental health of students and teachers due to the trauma and stress could lead to poor school performance, decrease in attendance, school dropouts, depression and other psychological challenges which could persist for many years and even carry forward into the adult life of the children.

Recovery Needs and Strategy

The recovery strategy for education and child protection will be based on the well-established principle of Build Back Better. The overall vision of the sector is to 'place all children in school and ensure learning in a protected and safe environment'. The focus is on ensuring uninterrupted and quality education service delivery in a safe and learner-friendly environment for both young and adult learners.

In addition, the sector is envisaged to play the critical role of building stronger and

[17] *Data sourced from the Rebuild Kerala Mobile App.*

more resilient communities and individuals. For instance, Education for Sustainable Development (ESD), including environmental sustainability, could provide a comprehensive framework through which policymakers and practitioners bring about change in the knowledge, skills, attitudes and behaviour of individuals and communities, in addition to improved infrastructural resilience of educational institutions to future disasters.

School buildings need to be constructed or refurbished keeping in mind the concept of safe schools and DRR norms as relevant to the Kerala context. There is a need for on-going and in-depth risk assessment of educational infrastructure in the state, which needs to be updated regularly with the measures required to reduce or withstand future risks. Finding a safe piece of land for the school/ anganwadi would be a critical factor in ensuring infrastructure safety. It is expected that appropriate site planning will be undertaken to ensure safety of the built environment including the access roads and play grounds. Building reconstruction should also entail adoption of building technology that promotes the use of local construction materials to reduce carbon footprint. The design should endeavour to include principles of green building by deliberately including greening elements in the educational building design. The rebuilding should ensure proper protected drinking water and toilet facilities that are child-friendly and cater to children and people with special needs while allowing for effective waste and water management, including rainwater harvesting, where applicable and possible.

This will also be an opportunity to embed principles of child-friendly learning spaces by integrating the needs of children/learners in building design. This may include but need not be restricted to spaces for indoor and outdoor activities, appropriate display and storage spaces, integration of pedagogical elements in the design, environmentally sustainable construction specifications, displays for early warning, and evacuation arrangements. Some of these can begin to emerge as model school buildings, which have the potential for replication. The above will be true for all sub-sector buildings—AWCs, schools, TVET institutions, colleges, District Institute of Education and Training (DIETs), CECs, and CCIs. Geology-specific construction norms should be adopted, for instance, for construction in wetlands.

The roadmap to recovery for the education sector is divided into three phases—short-term, medium-term and long-term. The given roadmap should be part of the state and district level Master Plan that the Education Department has initiated. The plan seeks to address both short- and long-term needs, which include academic and infrastructure components.

Short-term Needs (up to 12 months)

Education

Institutional/structural reforms

- Strengthen coordination and inter-department convergence amongst various institutional structures at the district and state levels to promote effective child rights governance in disaster situations.
- Construct 'Green Schools' based on principles of 'Build Back Better', including disaster resilience technology, greening elements, better learning environments and quality services for all children/learners including children with special needs. The main pillars of these schools are good sanitation, waste management, water and energy conservation.

Box 1: Green School

A green school is about more than the curriculum, more than programming and more than bricks and mortar. It is a school that supports global sustainability in every way. A green school begins with the future in mind, designing a learning experience for students that will prepare them to lead the world toward a healthier, cleaner, more sustainable future.

A green school is identified with those elements and practices that inculcate environment sensitivity and promote environment sustainability through various environment-friendly means that encourage the judicious use of resources. It also caters to the physical, mental, and emotional needs of a child by ensuring a school environment that is physically safe, emotionally secure and psychologically enabling.

Infrastructure:

- Design infrastructure based on the topography, climate, and local conditions, which should also include principles of green building by including greening elements in the AWC, school, CEC, and college designs.
- Conduct detailed structural assessment of damaged buildings and soil testing to ascertain the damages and losses as well as well as feasibility of reconstruction/ retrofitting in the existing sites.
- Replace or upgrade TLM, sports equipment, lab equipment and other supplementary instructional material in all the education centres.

Teaching–learning and curriculum reforms

- Planning, developing and providing counselling and psycho-social support for learners, teachers/educators/preraks, and other relevant stakeholders.
- Promoting and strengthening the skill development programme for transgender persons under the KSLMA and creating a safe environment for their existence.

Child Protection

Rollout and monitoring of child protection strategies along with risk-informed/ resilience strategies in sector planning

- Strengthening of child-friendly police initiatives and Our Responsibility to Children (ORC) for bringing the protection net closer to children.

Institutional/structural reforms

- Promote capacity building of staff from the District Child Protection Unit (DCPU), paralegal volunteers and ChildLine on DRR, psycho-social support, and group therapy.
- Develop, train, and display evacuation plan in all the CCIs with updated information for rescue and rehabilitation in case of any kind of emergency.

Medium-term Needs (1–2 years)

In the medium-term, the reconstruction of damaged buildings and allied services

will take precedence. This will require reviewing and revising the existing legal and oversight mechanisms for strengthening and ensuring safety in all types of educational facilities.

Education

Institutional/structural reforms

- Promote convergent action by Kerala State Disaster Management Authority (KSDMA) and the Education Department at the state and district levels to ensure the safety of children.
- Strengthen the school task force committees on school/community-based disaster risk management (DRM) wherein early warning systems can be established in education institutions.
- Review the School Management Committee (SMC)/Parent–Teacher Association (PTA) module and incorporate DRR resilience principles and approaches, and accordingly develop the School Disaster Management Plan. Simulation exercises and mock drills to be part of the school routine and practised periodically.
- Promote parenting skills through different means such as counselling, especially in hard spots such as among the tribal populations and the most excluded groups.

Rollout and monitoring strategies along with risk-informed/resilience strategies

- Conduct a social audit of schools by SMC/PTA on all school-related indicators including DRR and emergency preparedness.
- Strengthen the Educational Management Information System (EMIS) to include indicators on DRR and school safety.
- Establish a children's parliament in schools, which serves as the official voice of the children's body and encourages them to express their concerns and ideas especially in matters concerning them. Strengthen 'Nature Clubs' eco-warriors for promoting environment conservation.
- Support Kudumbashree and the State Literacy Mission to develop a massive female workforce capable of undertaking disaster mitigation work along with the men.
- Reconnect children and youth to educational programmes focusing on local environmental issues.[18]

Teaching–learning/curriculum reforms

- Revise the curriculum and develop new educational programmes in the area of disaster management and resilience in higher and adult education.
- Strengthen mental health programmes for students and teachers (psycho-social support; school counsellors; integration in the curriculum).
- Promote 21st century skills such as resilience, collaboration, creativity, etc., and entrepreneurial skills among adolescents to introduce them to new avenues such as emergency management and risk assessment, which can play an important role during emergencies.
- Introduce a comprehensive education package for tribal children, migrant children, and communities to ensure that they do not miss out on education.

[18] *Recommendation of the Western Ghats Ecology Expert Panel (Gadgil Commission), 2011.*

Technology-based solutions could also be explored.

Infrastructure

- Set up biodiversity parks and strengthen the existing ones in all the educational institutions to increase environmental awareness among students, promote greening of the state as well as help restore the ecological balance.
- Map AWCs at vulnerable spots and ensure coordination between the Department of Education and WCD for shifting AWCs to schools as per the guidelines of the Ministry of Human Resource Development, Government of India.

Child Protection

Institutional/structural reforms

Establish specially designated medical facilities for children with special needs in community health centres.

Long-term Needs (36–60 months)

Education:

Institutional/structural reforms

- Integrate the Comprehensive School Safety Plan into the District Disaster Management Plan and revisit it regularly for addressing safety needs in schools from time to time.
- Re-establish the existing conveniently located CECs as community learning centres or hubs, which provide innovative lifelong learning programmes, including issues of environmental disasters, ecological awareness, waste management, life skills, ecological and sustainable farming, fishing, and other livelihoods.
- Kerala has a network of around 5000 village libraries functioning under the State Library Council. These should be effectively used to carry out a sustained multimedia educational campaign to create consciousness or sensitise the public about the need for environmental awareness in the context of climate change.

Rollout and monitoring strategies along with risk-informed/resilience strategies

- Follow-up on the task force committees and psycho-social programmes for creating a safe and eco-friendly atmosphere in the school/learning spaces.
- The State Literacy Mission should undertake a long-term continuing education programme on environmental literacy and disaster mitigation, which will slowly build into a major campaign involving all the gram panchayats and gram sabhas in the state.

Child Protection

Institutional/structural reforms

Promote non-institutional care practices like sponsorship, foster care and adoption, as family is the best place for children. This would reduce the number of child care institutions.

Table 4
Recovery Table

Recovery Needs	Assumptions/Comments	Recovery cost (INR crore)		
		Short-term	Medium-term	Long-term
Education				
Assessment of damages in educational institutions	Detailed assessment of the damages including mould remediation.	44.23	0	0
Replacement and upgrading of damaged materials	Labs, kitchen and sports materials will be repaired/replaced with higher quality of equipment/materials and shifted to safer places to avoid future damages/loss.	31.01	0	0
Provision of TLM and uniforms	This includes the replacement of TLM and uniforms in AWCs, schools (other than textbooks), and CECs on a priority basis. There is no inclusion of textbook replacement in schools as 90% of the students received textbooks from the department immediately.	3.45	0	0
Provision for equipment	Upgrading and replacement in continuing education	5.02	0	0
Provision for furniture	Replacement of the damaged furniture in all educational institutions	11.5	0	0
Provision of water, sanitation, and hygiene facilities	Installation of toilets using Build Back Better concepts	4.9	0	0
Prototype model of the school building	Developing prototype designs for various disasters	1	0	0
Construction of destroyed educational institutions and schools along 'green' principles	Repair and reconstruction of institutions under the concept of Build Back Better addressing all children including those with special needs.	80.65	0	0
Capacity building of anganwadi workers/ helpers, teachers, SMC, PTA, and preraks to provide psycho-social support	Developing modules on psycho-social support with a focus on DRR, training of staff, SMC, PTA and master trainers	0.3	0.25	0.8

Implementation Strategy for Recovery

Cost of Recovery

Details of the recovery plan and the associated comments and timelines are delineated in Table 4.

Recovery Needs	Assumptions/Comments	Recovery cost (INR crore)		
Promotion of DRR activities at the state level in all educational institutions	Holding consultation meetings/workshops on developing a comprehensive and inclusive school safety plan	0.15	16.37	0
Disaster preparedness and response through school-based/ community-based DRM	Capacity building workshops/trainings at the state and district levels	0.15	1.09	0
Promote 21st century skills and entrepreneurial skills across the sectors	Strengthening the skill development programme among adolescents as well as excluded communities like transgender people, tribal people, SCs/STs, etc.	3	0.65	0
Revision of curriculum to incorporate DRR, life skills and psycho-social support	Incorporation of the components mentioned in Early Childhood Commission (ECC), higher education, and non-formal education. Already initiated in the school curriculum.	0	0. 24	0
Establishment of monitoring system through social audit	Social audit of schools by the PTA/SMC on all school-related indicators including DRR and emergency preparedness	0	1.6	0
Setting up of biodiversity parks in educational institutions.	Biodiversity parks in educational institutions to promote greenery, which will help in restoring of ecological balance and sensitise children towards nature.	0	4.03	0
Provision for campaign on education and climate	Creation of awareness under long-term continuing education and multimedia campaigning on issues like environmental disasters, ecological awareness, etc.	0	0.28	1.39
Comprehensive education package for children from tribal, migrant, and marginalised communities to ensure that they do not miss out on education.	Specifically, for the children from migrant and tribal communities, those who are affected by disasters, and the most marginalised groups. Technology-based solutions could also be explored.	0	0.3	0
Child Protection				
Capacity building of various stakeholders in CCIs on DRR	Developing evacuation plans at CCIs and capacity building of paralegals, volunteers and other staff in DRR.	0.71	0	0
Provisions for children with special needs	Specially designated medical facilities for children with special needs established at community health centres	0	0.7	0
Promoting non-institutional care	Reducing the burden on CCIs and mainstreaming children in regular life.	0	0.007	0
Sub Total		**186.07**	**25.27**	**2.19**
Grand Total			**213.5**	
Note: 5%–10% inflation has been accounted for.				

Role of Line Departments

Department of General and Higher Education

- Set timelines for educational institutions to complete the reconstruction of basic infrastructure. Any delay will have serious repercussions for the safety of children.
- Develop new disaster preparedness strategies and strengthen the existing ones, including higher education and adult education sub-sectors, which would be included in the teacher/educator training and school curriculum.
- Follow up and design strategies to internalise the psycho-social training extended to teachers as a co-curricular component that could be sustained on a regular basis in the schools and CCIs.

Department of Social Justice

- Ensure that 100% of the CCIs are registered and that children's committees and home committees are established and functioning in order to facilitate the participation of children in the post-disaster rebuilding process.
- Support CCIs in rebuilding their physical and system requirements through training and consultancy for ensuring protection to children with special needs and those in conflict with the law.

Local Self Government

- Draw up timelines with the participation of the community and the children to build back each school as a violence-free space with requisite safeguards.
- Create community-based disaster preparedness plans that include the schools, CECs, and CCIs.

Sector Assessment Methodology

The Education and Child Protection sector's PDNA utilised a combination of qualitative and quantitative assessment tools.

The major component of this assessment is the estimation of damages and losses for the sector—early childhood education (ECE), school education (grades 1–12), TVET, higher education, and non-formal education/lifelong learning. Tools were developed through a consultative process of focus group discussions with children, students pursuing higher education, teachers, faculty members of universities and colleges, community members, PTAs/SMCs, DCPUs, interviews with officials and Panchayat members and an observation tool for educational institution damage assessment. The calculation of damages and losses for the sector are based on the data and information provided by various sub-sectors—Integrated Child Development Services for AWCs, DPI, Samagra Shiksha Abhiyan , SCERT, DPO for general education and higher education, KSLMA for Adult Literacy and Continuing Education (NFE), and State Child Protection Society (SCPS) for CCIs.

For damages and losses, data was obtained through the education departments of all the 14 districts of the state. All the calculations of the school sub-sector are based on the Central Public Works Department (CPWD) method of costing and the district cost price index. A field visit was undertaken by the Education and Child Protection sector team during 23–26 September 2018 in Alappuzha and Ernakulum districts covering AWCs, schools, higher education colleges, vocational education colleges,

CECs and CCIs to understand the local perspective of the damages/losses and also to get additional insights on the:

- access and learning environment,
- teaching and learning environment, and
- education personnel and teachers.

For this purpose, discussions were undertaken with the district officials, teachers, preraks, SMCs, PTAs, children, parents, adult learners, and Panchayat members. Meetings were also held with the Minister of Education, General Education and Higher Education Secretaries, District Coordinator, WCD, DPI, SSA, KSLMA directors and district project coordinators, SCERT faculty, State Child Protection Society, and teachers' associations to understand the impact of the disaster on the education system as well as to solicit their inputs on the potential recovery strategies and interventions.

Assumptions and Limitations

1. Although the number of private schools and colleges is known and has been mentioned in the report earlier, there was no data available regarding the extent of damage suffered by these institutions; hence the data has not been included in the estimations.
2. The damage to the infrastructure and assets of the AWCs has been captured under the health and nutrition sector and therefore not included here. However, damage to the pre-school education kits has been calculated in the education PDNA.
3. Details regarding TVET were not available and therefore the extent of damage and loss could not be estimated.
4. As the timeline was short, the detailed structural assessment initiated in all the 14 districts could not be included (the exercise will take a month to conclude);hence, the Education Department gave the estimated cost for the same.
5. Apart from the 31 CCIs run by the state government, accounting for less than 5% of the total CCIs (841),[19] CCIs managed by NGOs, also suffered damages but this was not assessed.

[19] *As per the data received from State Child Protection Society on 25 September 2018 on request.*

Cultural Heritage

Cultural Heritage

Summary

The devastating floods in Kerala have had a serious impact on the cultural heritage of the state. Working closely with the Department of Cultural Affairs of the Government of Kerala, the United Nations Educational, Scientific and Cultural Organization (UNESCO) led the post-disaster needs assessment (PDNA) of the cultural heritage sector. The assessment includes an analysis of the effects of the floods on tangible heritage—monuments and archaeological sites; intangible heritage—traditional crafts, rituals and traditional performing arts; and movable heritage—museums and manuscripts in the state. It also estimates the economic and human impact of the disaster on the sector and formulates a recovery strategy to address short, medium, and long term needs in the sector.

The economic value of the damage to and loss of cultural heritage is of four types. First, in monetary terms, the damage and loss of tangible heritage, intangible heritage, and museums may be valued at INR 75.01 crore (USD 10.72 million)[1]. Second, indirect costs were incurred in terms of economic loss to the state, and to individual employees of organisations and owners of various firms involved in this sector, who suffered loss of income. This is partially quantifiable and amounts to approximately 48.8% of the total estimated damage and losses. Third, thousands of tourists and pilgrims as well as local residents, whose socioeconomic utility was affected negatively since they could not consume these cultural goods and services, also experienced loss. This is not easily quantifiable for the lack of precise data, and is not represented in this report, although some instances are mentioned explicitly. Fourth, the quantum of damage and loss varied with the location of the heritage site. It is observed that the value of damage and loss is significant in the rural areas, viz.,72% sites in case of tangible and 89% sites in case of intangible heritage. The total recovery cost for the cultural heritage sector over short, medium and long term amounts to INR 79.9 crore (USD 11.43 million).

There are hundreds of disaster victims left homeless. A culturally sensitive approach needs to be adopted for rehabilitating them and ensuring that they are not suddenly exposed to alien building technology, urban planning, and a completely new lifestyle. The vernacular architecture of Kerala addresses various climatic, cultural, and even gender needs. Similarly, the intangible cultural heritage (ICH) elements are largely community-based rituals and practices which cater to the cultural integrity of the society. Revival of the vernacular architecture style and planning, along with ICH elements could be a model for future recovery. This model can contribute to socio-cultural cohesiveness. Communities are inherently resilient but they need to be supported with certain basic, enabling environments to express and manifest their cultural needs, and to reinstate their cultural values and identity in the spaces they inhabit.

Pre-Disaster Context

Kerala is known not only for its natural beauty, with its backwaters, forests, hills and beaches, but also for its numerous and diverse traditional art and architectural forms. Festivals such as Onam are occasions for showcasing the diversity of

[1] *A conversion rate of USD 1 = INR 70 has been assumed throughout the report.*

performance art forms practiced in the state. Two of the performing art traditions of Kerala—Mudiyettu and Koodiyattam—find place in the UNESCO Representative List of Intangible Cultural Heritage of Humanity. Kerala is also home to a number of iconic forts, palaces and other heritage structures that bear testimony to its pre-historic, ancient, medieval and colonial history. The pre-historic rock art in caves, megalithic monuments, mural paintings and inscriptions, forts, palaces, temples, churches, mosques, public buildings etc. scattered across Kerala portray its rich and diverse cultural legacy.

The tangible heritage of Kerala refers to 'built heritage' such as historic monuments, archaeological sites, and temples. It falls under the purview of the Department of Archaeology and Department of Cultural Affairs. Kerala has 179 listed monuments and sites protected by the Department of Archaeology of the state government. They are unique due to their historic importance, constructional significance, and heritage value at the state level. The Archaeological Survey of India (ASI) protects another group of 28 monuments and sites that are important at the national level.

The intangible heritage and crafts come under the purview of the Directorate of Culture of the Department of Cultural Affairs. Performing art forms, social practices, rituals, festive events, and knowledge regarding nature and the universe are found across all districts of Kerala as part of the common cultural vocabulary of the state. The abundance of natural materials such as wood, fibre, coir, bamboo, metal and stone has resulted in a tradition of long established craft practices across districts. However, specific pockets in the state may also be home to certain distinctive traditions of craft and performing arts. Currently 43 forms of performing arts, intangible knowledge and practices from Kerala are listed by the Sangeet Natak Akademy, a national agency for implementing the UNESCO Convention for Safeguarding Intangible Cultural Heritage. Kerala also has 27 unique craft and handloom traditions with the geographical indication (GI) mark, while the other crafts are recognised by the Department of Cultural Affairs of the state.

There are 12 museums under the Department of Archaeology including, Pazhassi Tomb Museum, Kunjali Marakkar Memorial Museum, Pazhassi Raja Museum, Archaeology Museum at Thrissur, Mural Paintings Museum, Chendamangalam Synagogue, Hill Palace Museum, Krishnapuram Palace, Kottarakkara Thampuran Memorial Classical Arts Museum, Velu Thampi Dalawa Museum, Koyikkal Palace, and Padmanabhapuram Palace.

The Zoological Park in Thiruvananthapuram City; the State Museum and Zoo at Thrissur; and the Art Gallery and Krishna Menon Museum at Kozhikode, come under the Department of Museum and Zoos.

Paliyum Museum at the site of Muziris is under the Muziris Project (a Trust established by the Government of Kerala) and houses several thousand manuscripts made of palm leaves dating from 15–16 CE, a great number of which have been affected by the floods.

Table 1
List of Tangible, Intangible, and Movable Heritage

Type of Heritage	Concerned Authority	Number
Tangible Cultural Heritage		
Monuments and sites	Archaeological Survey of India	28
	Department of Archaeology	179
	Muziris Heritage Trust	1
Intangible Cultural heritage		
Traditional Crafts	Directorate of Culture under the Department of Cultural Affairs, Government of Kerala.	27
Performing Arts		42
Oral Traditions		5
Social Practices, Festivals and Rituals		7
Movable		
Museums	Department of Archaeology	12
	Department of Museums & Zoos	3
Manuscripts & Artefacts	Archives Department	More than 10,000
Source: Department of Cultural Affairs, Government of Kerala and Archaeological Survey of India.		

Post-Disaster Effects

Tangible heritage

The monuments and archaeological sites in Kerala have weathered the floods to some extent, and in most cases the extent of damage is moderate. Their geographical location and material protected the monuments and other sites of cultural importance, enabling them to withstand the floods. For instance, the superstructure and plinth of vernacular architecture constructed in laterite stone or sun-dried mud blocks plastered with lime allows them to breathe and drain the water without causing structural damage. In most heritage structures, wood is also used as part of the superstructure in windows, doors, louvers and gabled roofs, most of which has been affected by the inundation. Superior quality seasoned wood used in construction of old buildings is considered as an asset and has been salvaged for reuse.

Despite the far-reaching effects of the floods, the people of Kerala have showed remarkable resilience in recovery and rebuilding, engaging in cleaning and salvaging living spaces and buildings. Many monuments of cultural significance have already been cleaned up and whitewashed. However quick repair works also imply the use of incompatible material, such as cement. Such repairs can both, affect the authenticity of the protected monument and harm the monuments in the long-term.

Ernakulum, Idduki, Pathanamthitta, and Thrissur have been worst hit in terms of damage to tangible heritage. Flood affected buildings of cultural significance in these districts are mainly public ones. The State Archaeology Department through Vastu Vidya Gurukulam is in the process of assessing all the public buildings of cultural

significance. Data has been provided for the district of Pathanamthitta, which will be used to project the losses in other affected districts.

Intangible Heritage and Craft

Performing arts

Some of the performing art practices have been severely affected by the floods and their practitioners have suffered income loss due to cancellation of all events (both special and regular ongoing performances) across the 14 districts. Fortunately, there has been no loss of life or injury to the gurus (masters of performing arts), practitioners and transmitters, or to students. Hence, no long-term loss in skills or transmission of these performing arts is expected. Nevertheless, the impact on the practice and performance aspects of the intangible elements has been severe due to physical damage suffered by materials and equipment that are necessary for practicing various rituals, traditional theatres, and other community-based practices.

Koodiyattam, Chavittunadakam, and Padayani of Pathanamthitta and Ernakulam districts were the most affected among the performing arts. Koodiyattam, a Sanskrit theatre, is one of India's oldest living theatrical traditions and was included in the UNESCO Representative List of the Intangible Cultural Heritage of Humanity in 2008. The loss of infrastructure, materials, and documentation has not only disrupted the teaching, learning, performance, and revenues in the short and medium-term but also compromised the preservation of knowledge related to these art forms. The floods destroyed associated materials like costumes, props, accessories, and musical instruments, as well as equipment for sound and light. In addition, the floods also inflicted some structural damage on the traditional performance space called Koothampalam, including its electrification, besides loss of office equipment. Furthermore, several valuable and rare photographs, books and manuscripts have also been damaged. Training sessions also had to stop.

Chavittunadakam, literally 'the stamping drama', a combination of European opera and the native dance forms of Kerala, dating from the 16th Century CE and reflecting the influence of Jesuit Missionaries, was also affected by the floods. With only a few troupes practising this art form currently, the loss of all their materials/equipment, costumes and accessories, musical instruments, sound and light systems and personal goods is a considerable blow, not to mention the loss of income from August onwards, which is their peak performance period around Onam. Padayani, literally meaning 'military formation' in Malayalam, is an ancient ritual enactment that is performed in honour of the Goddess in the Bhagavati temples. The tangible decorative components required for the Padayani ritual comprise of 1,001 parts including costumes, musical instruments, props, artefacts, accessories and other aspects, most of which were destroyed.

Fortunately, performing art forms such as Modieyettu and others in the UNESCO Representative List for Intangible Cultural Heritage of Humanity have been reported to be intact after the August floods.

Traditional craftsmanship

Aranmulakannadi metal mirror, Chendamangalam handloom weaving and Kuthupally saree weaving in Pathanamthitta, Ernakulam, and Thrissur districts respectively were the worst affected among traditional craft-forms. Aranmulakannadi is the GI tagged form of handcrafted metal mirrors made by generations of a single family of highly skilled goldsmiths in Aranmula of Pathanamthitta district. About 25 such craft-centre units have been destroyed in this district due to the flooding. The

existing moulds and the raw material for making moulds to cast the mirrors were severely damaged and have become unusable. The tools, blowers, clay kiln, half-finished and finished pieces have all been destroyed, besides structural damage to buildings and power loss. At the time of this assessment the craftspeople were yet to resume work as they were still in the process of cleaning up the debris.

Chendamangalam is a village of handloom weavers in the Ernakulam district where cotton textiles are woven by hand on frame looms. All the three cooperative weaving societies operational in the region have suffered severe structural damage to work-sheds. The handlooms, pre-loom and post-loom equipment have all been damaged. Besides, the cotton yarn, semi-finished textiles and finished textiles have also been spoilt beyond repair by the flooding.

Social practices and events

The Aranmula Palliyodam snake boat ritual is a community-based activity in which all villagers along the Pamba River take part. Of the 51 snake boats, 30 have been damaged, among which two are almost completely destroyed. In many cases even their long boat sheds were washed away. Other boats have sustained moderate to heavy damages that require a minimum of three months of repair by a team of 10 expert craftspersons. The raw materials are available in the vicinity but all the tools and processing equipment have been damaged and need immediate replacement. The damage caused to the banks of the river Pamba due to erosion, makes it difficult for large snake boats to access boat sheds or the river.

The major events that were disrupted and cancelled due to the floods are the Paayipattu Jalotsav and Aranmula Uthrattaachi Vallamkali boat races, Maramon Christian Convention and Cherukolpuzha Hindumatha Convention and Mankottuchira Pathi in Kuttanad paddy fields. The famed traditional boat races held during the harvest festival of Onam are part of community managed events that are watched by thousands of people from across Kerala, besides attracting a large number of tourists. All boat races were cancelled due to the flood, including those held in the back-waters (Nehru Trophy and Presidents Trophy) as well as in the river. The cancellation of the boat races is unprecedented in recent history.

Movable Heritage (Museums and Manuscripts)

Most of the museums in the state suffered minor damages or were unharmed. However, in case of Muziris, the traditional artefacts and manuscripts in the museum collection suffered damage. In addition to the quantified damage and loss, there is non-quantifiable damage and loss, as some of the library and museum collections have been completely washed away. This also includes the ancient manuscripts on specially processed palm leaves. Thirty palm leaf manuscripts have suffered heavy damage from the inundation of the museum premises.

Effects on Revenues of the State

The floods, which preceded the festive season, have resulted in huge revenue losses at various monuments, sites and museums. Furthermore, the timing of the floods coincided with the peak period for performances, ritual enactments and other festivities based on communities in rural areas, which means naturally high demand for craft and handloom products from both domestic and international tourists.

In the case of the traditional craft industry, the disaster affected different parts of the value chain and had a major impact on the lives and livelihoods of the artisans (drop in tourism numbers, lack of purchasing power within affected communities, disruption of weekly markets, etc). These trends could be seen across the sector

and were worse for those who have lost their workplaces and houses in the most affected districts of Ernakulam, Pathanamthitta, and Thrissur. The Chendamangalam weavers expect to lose several months' income from August onwards. There are further possibilities of new risks and vulnerabilities as the weavers are all over 40 years of age. Due to lack of other livelihood options most of them have already taken up unskilled, non-weaving work to compensate for the loss of earnings and may not return to their craft. This will make recovery very difficult for the affected handloom cooperatives. The loss of finished goods, combined with limited access to customers and marketing events has also had a heavy impact on the earnings of the cooperative societies as well as the concerned local communities.

Table 2
Assessment of Damage and Losses

Type of heritage	Description of damage	Damage costs (INR crore)	Type of revenue loss/ indirect costs to compensate artisans	Revenue loss (INR crore)
Tangible Heritage				
Pathanamthit-ta District				
Narasimha Swami Temple, Pathanamthitta	Partial damage to the structure and wood and rock carvings	0.04	No quantifiable indirect costs	0.00
Traditional Nalukettu: Vazhuvelli Tharavadu, Pathanamthitta	Partial damage to the structure, affected about 300 inhabitants	1.20	Costs due to relocation of inhabitants	0.48
Alappuzha District				
Buddha statue, Karumaadikut-tan, Alappuzha	Partially damaged, four affected employees, an average of 170 visitors lost per week	0.23	Loss due to lack of visitors and rehabilitation of affected employees	0.02
Idukki District				
Margaret Hanging Bridge, Idukki	Completely damaged, affected 1,000 passengers per day	1.50	No quantifiable revenue loss	0.00
Dolmens Archaeological site, Vellapaara, Idukki	A few completely damaged and others partially damaged; 25 employees were directly affected; on an average, 1,000 visitors lost per week,	0.07	Loss due to lack of visitors and rehabilitation of affected employees	0.03
Ernakulam District				
Ramamangalam temple, Ernakulam	Partial structural damage affected 10 employees, loss of visitors @ 210 per week	0.18	Loss due to lack of visitors and rehabilitation of affected employees	0.02

Type of heritage	Description of damage	Damage costs (INR crore)	Type of revenue loss/ indirect costs to compensate artisans	Revenue loss (INR crore)
Thrissur District				
Chinese fishing nets, Thrissur	9 completely damaged, 11 partially damaged, 80 employees and 500 other workers affected	0.60	Livelihood loss per person for 6 months	6.26
Siva Temple at Pallimannah, Thrissur	Suffered minor damage due to inundation in floods	0.04	No quantifiable indirect costs	0.00
Muzuris Archaeological Heritage Site, Thrissur	Extensive damage to archaeological excavations due to inundation in floods	0.02	No quantifiable revenue loss	0.00
Palakkad District				
Agrahaarams, Kalpathy Heritage Area, Palakkad	Partial structural damage to 50 houses, affected 200 inhabitants	1.20	Costs due to relocation of inhabitants	0.42
Chandrashek-harapuram Shiva Temple, Palakkad	Partial Damage to the structure	0.30	No quantifiable revenue loss	0.00
Chandrashek-harapuram Agrahaarams, Palakkad	Complete damage to 15 houses, affected 75 inhabitants	1.60	Loss due to foregone entry fee of visitors due to closure	0.22
Wayanad District				
Edakkal caves, Wayanad	Partially damaged, affected 40 employees, loss of visitors @ 7,000 visitors per week	0.10	Loss due to foregone entry fee of visitors due to closure	0.02
Total	**7.08**		**7.48**	
Intangible Heritage				
Pathanamthit-ta District				
Aranmula Palliyodams, Pathanamthitta	Completely destroyed: 3 Palliyodams and 4 Palliyodam sheds; partially destroyed: 30 Palliyodams	10.70	Loss due to cancellation of associated activities	8.80

Type of Heritage	Description of Damage	Damage Costs (INR crore)	Type of Revenue Loss/ Indirect Costs to Compensate Artisans	Revenue Loss (INR crore)
AranmulaKannadi, Pathanamthitta	Completely damaged workshop and equipment, raw materials, finished and semi-finished mirrors and partially damaged infrastructure	1.08	Loss of livelihood for 22 artisans for next 6 months	6.83
Padayani Ritual, Pathanamthitta	Complete damage of units in 3 villages, partial damage in 37 units	1.11	Loss of wages of the craftsmen of 40 units throughout the year	1.38
Ernakulam District				
Koodiyattam (Nepathya), Ernakulam	Complete damage to equipment, Partial damage to infrastructure, costumes and supporting instruments	0.26	Revenue loss due to cancellation of performances	0.04
Sree Sankaracharya Sanskrit University Theatre, Kalady, Ernakulam	Completely damaged costumes and supporting instruments and partially damaged theatre	0.38	Revenue loss due to cancellation of performances	0.04
Chendamangalam Traditional Handloom, Ernakulam	Complete damage to 4 handloom workshops and showrooms, household units of 200 weavers	6.00	Loss of livelihood for 200 weavers for next 6 months	7.56
Chavittunadakam Sangham, Ernakulam	Partially damaged infrastructure, theatre sets, equipment, and property	0.34	Revenue loss due to cancelled programmes	0.12
Mangalodayam and Sahithybhooshanam Vayanashala, Eranakulam	Very old library practice, repository of traditional books. Many fully damaged and many washed away.	0.70	Loss of entire library resources	0.02
Thrissur District				
Kuthampalli Traditional Handloom, Thrissur	Complete damage to handloom workshops and showrooms, household units of 100 weavers	9.24	Loss of livelihood for 100 weavers for next 6 months	4.32
Total	**29.80**		**29.10**	

Type of Heritage	Description of Damage	Damage Costs (INR crore)	Type of Revenue Loss/ Indirect Costs to Compensate Artisans	Revenue Loss (INR crore)
Museums				
Ernakulam District				
Paliyum Nalukettu Museums, Ernakulam	Partially and completely damaged artefacts and literature and partially damaged infrastructure	1.00	Was under renovation before flood so no revenue loss	0.00
Hill Palace Museum, Thripunithura, Ernakulam	Partially damaged infrastructure	0.50	Loss due to reduced number of visitors	0.03
Thrissur District				
Kalari in Kodungalloor, Thrissur	Partially damaged palm leaf manuscripts	0.01	Revenue loss due to lack of practice sessions	0.01
Total	**1.51**		**0.04**	
Total economic value of damage & loss (INR crore)	**38.39**		**36.62**	
Total economic value of damage and loss (INR crore)	**75.01**			
Total economic value of damage and loss (USD million) (USD 1 = INR 70)	**10.72**			

Note:

The unit cost for each item varies. For example, for a destroyed Palliyodam, unit cost is INR 2.90 crore, whereas for a partially damaged one, it is INR 0.35 crore. For a cancelled public performance by the performing art organisations, the revenue loss is INR 0.0125 crore. In case of handloom units, the unit cost of damaged cooperative handloom and infrastructure is INR 0.81 crore, whereas the value of damage to an individual weaver is INR 0.03 crore. These values were provided by the respondents and the Department of Cultural Affairs, Government of Kerala.

The assumptions made are as following:

- *Based on the respondents' responses, average values of damage were used. Thus, for example, for each individual weaver, the value of damage and loss may differ, but it averages out to INR 0.03 crore.*
- *Where the number of families was given, an average family size of 4.3 is considered.*
- *In case of temporary relocation, the cost of rental is estimated at 20% of Kerala's per capita income. The value 20% is based on the weight of housing in the composition of urban Consumer Price Index as given by the Reserve Bank of India. The actual weight assigned by the Reserve Bank of India is 21%.*

Impact Analysis

Hundreds of people lost their livelihood for varying time periods, and some have not been able to go back to work because of relocation or incomplete restoration. This resulted in higher rates of unemployment and worsened standards of living in the short term, though it is expected that the situation will get back to normal once the restoration work/or re-equipment of various workshops in case of traditional crafts are completed.

The cancellation of rituals, festivities, traditional observances, public and community events due to the floods have had a significant and dual impact. Besides the economic losses, the flood situation severely affected the sentiments and morale of the community involved.

In addition, destruction of finished goods and damage to the production units have resulted in reduced supply of goods and services from the heritage sector. This will expectedly increase the prices of such goods and services, contributing to higher rates of inflation, especially in the local markets, precipitating a further decline in average standards of living. This will take a longer time to reverse, since prices may not decrease until the restoration work is completed and production gets back to normal, pre-disaster levels.

The human impacts of the disaster on this sector are twofold:

Livelihoods and Poverty

For the crafts sector and the performing arts affected by the flood, the impact on livelihoods and poverty levels has been very high. For many of the artisans and artists these activities constitute their only source of income, and for a variety of reasons the majority have been stranded without an income for several months to come. In a number of cases the impact on poverty levels is particularly high because people lost both their houses and workplaces. These costs are higher for those artisans who no longer have access to raw materials or who have suffered significant damage to infrastructure and tools. The absence of support will seriously undermine the potential to recover in these cases. For those areas where the main loss has been linked to a decline in tourist numbers and lack of access to markets, the impact on livelihoods can be considered temporary.

Loss of Cultural, Historic Value, and Diversity

For a number of cultural practices and the spaces in which they are performed, the loss of potential in cultural value and diversity, though, temporary, should be noted. This is significant in the case of traditional rituals such as Palliyodam or snake boat rituals that take place along the Pamba river.

A number of traditional crafts could lose a part of their cultural value and diversity because artisans are starting to look for cheaper alternatives to produce more and at the lowest price to tide over this phase of economic hardship. They may also choose to leave the trade or be forced to leave their workplace due to the time it might take to recover from the serious damages incurred. Entire families who take up craft and artisanal work may be rendered without incomes or livelihoods in the event of a calamity such as this, having to wait till their workshops fully recover and the market picks up again.

The drop in income for artisans and the need for bank loans to rebuild their houses and workplaces or to restart production puts this part of the population at risk of increased poverty, and this in turn increases the gap of inequality in access to quality education, health services etc.

Recovery Strategy: Build Back Better

In the aftermath of a disaster, it is essential to build back better (BBB), to take the opportunity to develop more sustainable and resilient solutions. This is even more relevant in the case of floods, a recurring event that it is likely to increase in frequency and intensity in the coming decades. With this in mind, this assessment has identified a number of areas, which are essential to consider during the recovery phase.

In general, it is important to acknowledge the recurring nature of floods, and to build on the present experience in compiling data and assessing damage, to better prepare the public institutions for future eventualities. A lot of time and effort went into compiling baseline data and post-disaster data. Development of a database that can store this information—data, photographs, drone footage, media and other reports, maps, etc.—has been recommended, not just as a record of the 2018 Kerala Floods, but also to prepare for future events and assessments.

The following are a few important issues to be taken into account in building back better for tangible, intangible and movable heritage:

1. **Archaeological Sites and Built Heritage:** Preventive measures and risk management plans are strongly recommended to safeguard archaeological sites and built heritage sites from future events. To this end, it may be necessary to conduct in-depth assessment of each site in terms of its hydrology and soil, proximate ravines and rivers, to project technical solutions for risk prevention and management in the event of landslides and floods. Furthermore, it is necessary to incorporate anti-seismic reinforcements during the rehabilitation.

2. **Community Participation and Value Assessment:** The involvement of local communities is strongly recommended in the rebuilding of tangible and ICH.

3. **Authenticity of Materials:** Reconstruction of traditional houses post-disaster often entails dramatic changes in settlement location, morphologies, housing design, etc. Authenticity of reconstruction material is important not just for authentic restoration but also renewing the life of the old structures. Special attention should be paid to avoid short cuts in repair work and to adopt a holistic and material-sensitive approach in dealing with damaged structures.

4. **Learning from the Vernacular:** Traditional architectural principles always respect nature, are climate conscious, user-friendly, based on locally available material, and reflect the culture and tradition of the communities, and hence provide greater resilience. The 2018 Kerala floods fully proved the greater resilience of traditional houses than the modern structures made of concrete. The recovery strategy should fully take into account this aspect.

5. **Establishment of State Inventories for Intangible Cultural Heritage:** A state level inventory of ICH should be built on an urgent basis.

6. **Development of Databases:** Databases storing documentation and research on oral traditions, recordings of masters, events, processes, archival digitisation of recordings, photographs, etc. must be developed as a record for future generations and for formulating safeguarding plans. As recommended earlier, it would be desirable to make use of the data collected during the PDNA process in order to develop databases that can serve to prepare for future events and assessments.

7. **Directory of Practitioners and Transmitters:** A list of all ICH practitioners and transmitters can be maintained online for ease of access and for safeguarding.

8. **Scholarships:** State-level scholarships must be instituted for disciples, apprentices and for youth who wish to train in different aspects across the ICH domain to strengthen and safeguard transmission

9. **Museums and their collections:** There is need to build on the recent experience for developing more systematic and institutionalised approaches, including risk preparedness plans for museums. After the floods, while great recovery and retrieval of inventory and displays was carried out by museum staff all over the state, this was often not part of a well-established risk protocol and management plan. It is essential to use the recent experience to develop such plans for each museum and to identify specific measures that can be put in place to better protect the collections from future disasters. Training of staff and strengthening of prevention programmes are essential.

Policy Recommendations for Sector Recovery

Monetary Support

Employees, artists, artisans of various heritage-related units (museums, monuments, handloom and handicraft units, performers of various art-forms, rituals, etc.) including local communities that are seriously affected by the floods need to be provided monetary support to sustain themselves. Artisanal communities are highly vulnerable when it comes to their livelihood, since they may not have large savings to fall back upon in times of crisis. They need adequate financial support so as not to be tempted to leave their traditional crafts and move to unskilled work. This may result in not only a compromise with their income levels, but also in a gradual loss of their traditional skills. Such support is required in short- to medium-term, depending on the speed of recovery of various craft sectors.

Subsidy and Tax Benefits

Individuals and organisations that require fresh investment to rebuild their production units, in particular in the traditional craft areas, should be provided subsidies and tax benefits as well as priority sector/low interest lending facilities. This will encourage such individuals and organisations to opt for reinvestment in the same sector rather than look for easy, alternative economic activities.

Facilitating Marketing and Promotional Activities

While individuals and organisations rebuild their losses/ damaged heritage goods and services, governmental and non-governmental organisations can help them in marketing of their products in the local, national, and international markets. This can be done by organising exhibitions, sales fairs, special events around cultural activities, announcing tax benefits for the customers who purchase products manufactured by the affected artisans, etc.

Training for Repair and Revival

Training workshops in various traditional crafts including handlooms need to be conducted with a particular focus on the younger generation and women. Entrepreneurial skills and marketing workshops will also be crucial for recovery of the sector.

Memory of Disaster and Future Resilience

It is of the utmost importance to keep the memory of the disaster alive so the future generations take measures to prepare any future disasters seriously. Annual exercises for disaster response and rescue of objects of cultural heritage should be organised state-wide, along with proper Disaster Risk Management Plan (DRMP) implemented on the monuments and sites of cultural significance.

Assessment of Recovery Needs

In the post-disaster scenario after immediate and priority needs have been met, further short-term, medium-term and long-term recovery needs have been categorised and described subsector wise in Tables 3–6.

Table 3
Recovery Needs and Costs for Tangible Heritage (INR lakh)

Region	Short-term needs	Costs	Medium-term needs	Costs	Long-term needs	Costs
Pathanamthitta District						
Narasimha Swami Temple	The wood and rock carvings choked with mud, need extensive cleaning.	4.45	An assessment of structural integrity and stabilisation of ground surface is advised.	1.00	A risk assessment to be undertaken. DRMP should be drafted and implemented at the site level.	0.27
Vazhuvelil Tharavadu	Immediate aid should be extended to the inhabitants of the damaged Nalukettus. A survey should be undertaken to assess the level of damage to the housing. Reversible stabilisation should be adopted, instead of hastening repairs using materials incompatible with the history of these buildings.	167.64	Research and photo documentation should be initiated to document the history of Nalukettus. Community-based workshops with a gender-balanced participation should be organised for effective decision-making regarding future conservation and reconstruction strategies with respect to the Nalukettus that have been destroyed.	37.71	The Nalukettus will require reconstruction and repair policies. A heritage management plan and conservation manuals should be put in place. Risk assessment should be undertaken and a DRMP should be drafted and implemented at the site level.	10.20
Alappuzha District						
The Ancient Buddha Statue known as Karimadikuttan in Kuttanad	The structure will need immediate repair.	25.00	In-depth research needs to be undertaken to ascertain the damage to the statue and arrive at the appropriate response.	5.62	A risk assessment should be undertaken. A DRMP should be drafted and implemented at the site level.	1.52

Region	Short-term needs	Costs	Medium-term needs	Costs	Long-term needs	Costs
Idukki District						
The Margaret Hanging Bridge	Alternative transportation and movement should be put in place and reinforced to avoid disruption of services.	0.00	A value assessment of the bridge should be undertaken Research and photo documentation should be initiated to document its history. An architectural competition should be organised for a new bridge.	150.00	A new bridge commemorating the memory of the victims and the resilience of the people of Kerala during these floods should be constructed.	300
The Dolmens/ Muniyaras in Vellappara	A rescue mission should be initiated for the dolmens that got washed away and repair works for the damaged dolmens should be undertaken.	10.00	Recovered dolmens should be reinstated within their original context and landscape.	2.25	A risk assessment should be undertaken. A DRMP should be drafted and implemented at the site level.	0.61
Ernakulam District						
The Ramamangalam Narasimhaswami Temple	The silt and debris need to be cleared. The wood and rock carvings choked with mud need extensive cleaning.	4.45	An assessment of the structural integrity of the building and stabilisation of the ground on the premises is advised.	1.00	A risk assessment should be undertaken. A DRMP should be drafted and implemented at the site level.	0.27
Thrissur District						
Chinese Fishing Nets	Monetary grants should be extended to repair damaged nets. Wage compensation should be given to those who have lost their livelihood due to the damage	686.40	Monetary grants should be extended for rebuilding the fully damaged Chinese fishing nets	154.42	A strategy needs to be established at the state level to provide strong institutional support that will help the revival and safeguarding of the heritage asset.	41.76

Region	Short-term needs	Costs	Medium-term needs	Costs	Long-term needs	Costs
Siva Temple at Pallimannah	Special attention needs to be paid to the cleaning of the woodwork and mural paintings in the temple.	4.45	The damage caused to the woodwork and mural paintings of the monument must be studied in-depth.	1.00	A risk assessment should be undertaken. A DRMP should be drafted and implemented at the site level.	0.27
The Muziris Archaeological Site	The debris and silt need to be cleared. Insurance needs to be claimed for the insured museum structure and artefacts.	19.75	In-depth analysis of artefacts should be undertaken and the possibilities of using local materials in the future should be explored	4.44	The capacities of local staff members should be built to carry out rescue and restoration of artefacts and manuscripts.	1.20
Palakkad District						
Kalpathy Agrahaarams	Immediate aid should be extended to the inhabitants of the damaged Agrahaarams. Survey assessing the level of damage on the housing should be undertaken. Reversible stabilisation should be adopted, instead of hastening repairs that result in the use of materials incompatible with the history of these buildings.	162.03	Research and photo documentation should be initiated to document the history of Agrahaarams Community-based workshops with gender-balanced participation should be organised for effective decision-making regarding future conservation and reconstruction strategies with respect to the Agrahaarams that have been destroyed.	36.45	In the long term the Agrahaarams will require reconstruction and repair policies. A heritage management plan and conservation manuals should be put in place. A risk assessment should be undertaken. A DRMP should be drafted and implemented at the site level.	9.86
Chandrashek-hara Shiva Temple	The silt and debris need to be cleared. The wood and rock carvings choked with mud need extensive cleaning.	4.45	An assessment of the structural integrity of the building and stabilisation of the ground in the premises is advised.	1.00	A risk assessment should be undertaken. A DRMP should be drafted and implemented at the site level.	0.27

Region	Short-term needs	Costs	Medium-term needs	Costs	Long-term needs	Costs
Chandrashek-harapuram Agrahaarams	Immediate aid should be extended to the inhabitants of the damaged Agrahaarams. Survey assessing the level of damage on the housing should be undertaken. Reversible stabilisation should be adopted, instead of hastening repairs that result in the use of materials incompatible with the history of these buildings.	162.03	Research and photo documentation should be initiated to document the history of Agrahaarams. Community-based workshops with gender-balanced participation should be organised for effective decision-making regarding future conservation and reconstruction strategies with respect to the Agrahaarams that have been destroyed.	36.45	In the long-term the agrahaarams will require reconstruction and repair policies. A heritage management plan and conservation manuals should be put in place. A risk assessment should be undertaken. A DRMP should be drafted and implemented at the site level.	9.86
Wayanad District						
Edakkal Caves	Scaffolding that aids structural stability of the caves while ensuring minimal obstruction to tourism (the major source of revenue for the local community) needs to be put in place.	10.00	In-depth analysis of the structural stability of the cave and an analysis of the damage to the carvings should be undertaken.	2.25	Tourism facilities if affected should be restored and the structural stabilisation of the caves should be maintained without compromising their authenticity. Detailed documentation of the carvings and their interpretations is advised.	0.61

Table 4

Recovery Needs and Costs for Intangible Heritage (INR lakh)

Region	Short-Term Needs	Costs	Medium -Term Needs	Costs	Long-Term Needs	Costs
Pathanamthitta District						
Performing Arts: Padayani	Access to monetary grants/ schemes/ programmes to replace lost assets such as costumes, masks, equipment, musical instruments like the Tholthappu, Chenda, Maddalam, Thudi, Para, Kanthala; besides those to cover costs of anjili and areca nut wooden parts to help resume ritual performances that have been disrupted.	129.00	Access to monetary grants/ scheme/ programmes should be ensured to rebuild Padayani centres.	29.02	A strategy needs to be established at the state level to provide strong institutional support that will boost the revival and conservation of Padayani.	7.85
Traditional Crafts: Aranmula Kannadi	Programmes and schemes need to be instituted for priority recovery of tools, blowers, equipment and kiln replacement. Access to raw material should be ensured to resume production. Funds should be provided as working capital and to repair structural damages to work sheds.	108.00	Access to insurance schemes and ex-gratia grants should be ensured to compensate for the loss of half-finished and finished pieces.	69.90	Access to customers, exhibitions, marketing events both in Kerala and other parts of India will be needed to promote the product once the production cycle has resumed.	6.57
Traditional Crafts: Palliyodam	Monetary grants are needed for priority repair of damaged boats. Working capital grants should be provided to crafts-persons/ carpenters for replacement of tools and purchase of materials for boat repair.	1050.0	A programme to celebrate recovery can be planned when the necessary number of boats are restored by holding boat races along the river to boost the psyche of local communities affected by the floods	890.00		63.87

Region	Short-Term Needs	Costs	Medium -Term Needs	Costs	Long-Term Needs	Costs
Ernakulam District						
Performing Arts: Koodiyattam	Monetary grants/ schemes/ programmes to help replace lost assets and resume performance must be extended to Koodiyattam centres and practitioners.	6.00	Nepathya, the Koodiyattam training and performance centre should have access to monetary grants for repair works.	19.50	A strategy needs to be established at the state level to provide strong institutional support so that this outstanding ancient form of theatre can be promoted. Promotion at the international level will give a boost to its revival and conservation.	0.36
Performing Arts: Chavittun-adakam	Monetary grants/ schemes/ programmes to replace sets, properties and entire costumes for daily rehearsals must be extended to the art form.	8.50	Access to monetary grants/schemes/ programmes to resume performance by peak season during Christmas and New Year must be ensured for both centres and artists.	25.50	Chavittunada-kam appears to be a fast-dis-appearing art form and hence needs special atten-tion. Support from the state government is necessary for conservation and revitalisa-tion of this art.	0.52

Region	Short-Term Needs	Costs	Medium -Term Needs	Costs	Long-Term Needs	Costs
Traditional Crafts: Chendamangalam Weaving	Monetary grants from government schemes and programmes can restore the functioning of the cooperative. They should cover working-capital grants for salary payments to weavers and purchase of cotton yarn. Additionally loans/grants for infrastructure including new hand looms, tools and equipment will be required. Wage compensation is needed to prevent weavers from taking up other jobs till recovery.	1356.0	Grants/loans should be extended to the cooperative to address structural damage to work-sheds. The average age of currently working women in these cooperatives is above 40–45 years and the younger generation has little interest in this traditional craft. Support and training must be extended to the younger generation ensure the sustainability of the craft.	207.87	A well-thought-out strategy needs to be established to attract the younger generation to continue this traditional craft in Kerala. The failure to do so will endanger Kerala's traditional handloom craft in the long-term. Support to the handloom industry should be extended in the form of special exhibition-cum-sales events organised by the Government of Kerala along with other stake holders in Kerala and in the rest of India.	82.49
Sree Sankaracharya Sanskrit University Theatre, Kalady	Monetary grants should be extended to the institute to immediately replace lost assets, and thereby, resume performance.	6.00	Grants/loans should be extended to build back better the theatre which is the main performance centre in the campus.	19.50	A well thought out strategy needs to be established at the state level to provide strong institutional support to this outstanding theatre to promote its revival and safeguarding.	0.36

Region	Short-Term Needs	Costs	Medium -Term Needs	Costs	Long-Term Needs	Costs
Mangalodayam and Sahithy-bhooshanam Vayanashala	Monetary grants/ schemes should be extended to the old library to replace lost assets, to do repair work for the structure and to replace the damaged furniture	10.00	In-depth research needs to be done for documenting the contents of the lost books and a detailed inventory should be prepared for the remaining books for appropriate response in future.	2.25	A risk assessment should be undertaken. A DRMP should be drafted and implemented at the site level for future resilience.	0.61
Thrissur District						
Traditional Crafts: Kutha-palli Saree Weaving	Monetary support from government schemes and programmes can restore the functioning of the cooperative. They should cover working-capital grants for salary payments to weavers and purchase of cotton yarn. Additionally, loans/grants for infrastructure including new hand looms, tools and equipment will be required. Wage compensation is needed to prevent weavers from taking up other less skilled occupations till recovery is completed.	1356.0	Grants/loans should be extended to the cooperative to address structural damage to work-sheds. The average age of currently working women in these cooperatives is above 40–45 years and the younger generation has little interest in this traditional craft. Support and training must be extended to the younger generation ensure the sustainability of the craft.	207.87	A well-thought out strategy needs to be established to attract the younger generation to continue this traditional craft in Kerala. The failure to do so will endanger Kerala's tradi-tional hand-loom craft in the long-term. Support to the handloom in-dustry should be extended in the form of special exhibi-tion-cum-sales events organ-ised by the Government of Kerala along with other stake holders in Kerala and in the rest of India.	82.49

Table 5

Recovery Needs and Costs for Museums (INR Lakh)

Region	Short-Term Needs	Costs	Medium -Term Needs	Costs	Long-Term Needs	Costs
Ernakulam District						
The Paliamnaa-lukettu	The debris and silt need to be cleared. Insurance needs to be claimed for the insured museum structure and artefacts. The IT Unit and control room has suffered losses which must be restored with basic laptop and internet services for communication	80.69	In-depth analysis of artefacts should be undertaken and the use of local materials for future usage should be explored.	18.15	The capacities of local staff members should be built to carry out rescue and restoration of artefacts and manuscripts. A material research centre which explores vernacular materials and restoration techniques for the Muziris region should be set up.	4.91
The Thripunthira Hill Palace, Kochi	The restoration activities undertaken so far have relied on materials incompatible with the historical structure. Older trees in the premises should be assessed for their stability in and around built structures, to avoid further damage.	25.00	The stability of roofs covering the steps leading to the step-wells should be assessed since high water levels in the step-wells had resulted in inundation of the iron beams of the roof of access stairs to water.	25.00	A proper understanding of the water linkages on the site through a study of water channels will be necessary to guide future repair works. Lost species of trees should be restored through planting schemes that maintain the historical landscape of the hill palace.	1.52

Region	Short-Term Needs	Costs	Medium -Term Needs	Costs	Long-Term Needs	Costs
Thrissur District						
Kalari in Kodungalloor	Clearing and scientific restoration should be done for rescue of damaged manuscripts and artefacts	6.00	In depth scientific analysis of artefacts and manuscripts for further restoration and preservation.	19.50	Capacity building programmes should be organised for the local staff to educate them to carry out rescue and restoration in a scientific way.	0.36
Total cost (INR crore)	54.02			19.68		6.29
Total costs (USD million)		7.72		2.81		0.90
Total recovery cost						**INR 79.9 crore (USD 11.43 million)**

Refer Annexe Table1 for district-wise recovery needs and strategy over short-, medium- and long-term.

Implementation Strategy for Recovery

Developing comprehensive, multifaceted strategies is crucial for both mitigation measures as well as recovery. To this end the following issues can be considered:

Internal partnerships

Built heritage and archaeological sites, ICH and movable heritage, all come under different departments of the Ministry of Cultural Affairs. Therefore, it would be important to formulate a cross-departmental team which can be named as a task force or disaster recovery team. This will allow the Ministry of Cultural Affairs not only to undertake mitigation measures and to implement a set of actions for recovery in a coordinated manner across tangible, intangible, and movable heritage, but also bring synergy between various actions in different areas of heritage.

This special team can also build its own capacity in dealing with disaster-related issues as well as in addressing the recovery strategy, and will thus become an important government entity in dealing with emergency situations as well as in the disaster preparedness strategy.

External Partnerships

It would also be important to involve local communities in support of recovery efforts at various stages, particularly in the area of intangible cultural heritage, which is mostly embedded in the life of local communities. This will ensure that the recovery measures are culturally relevant and heritage-sensitive.

In parallel, various civil society bodies can also be mobilised in order to organise activities such as exhibitions and performances which can bring the various stakeholders together. This will boost the morale of the population affected by the floods and also raise awareness about various aspects of the floods including loss

and damage, while fostering a sense of solidarity across different communities, which is important at a time of disaster.

Priority Needs

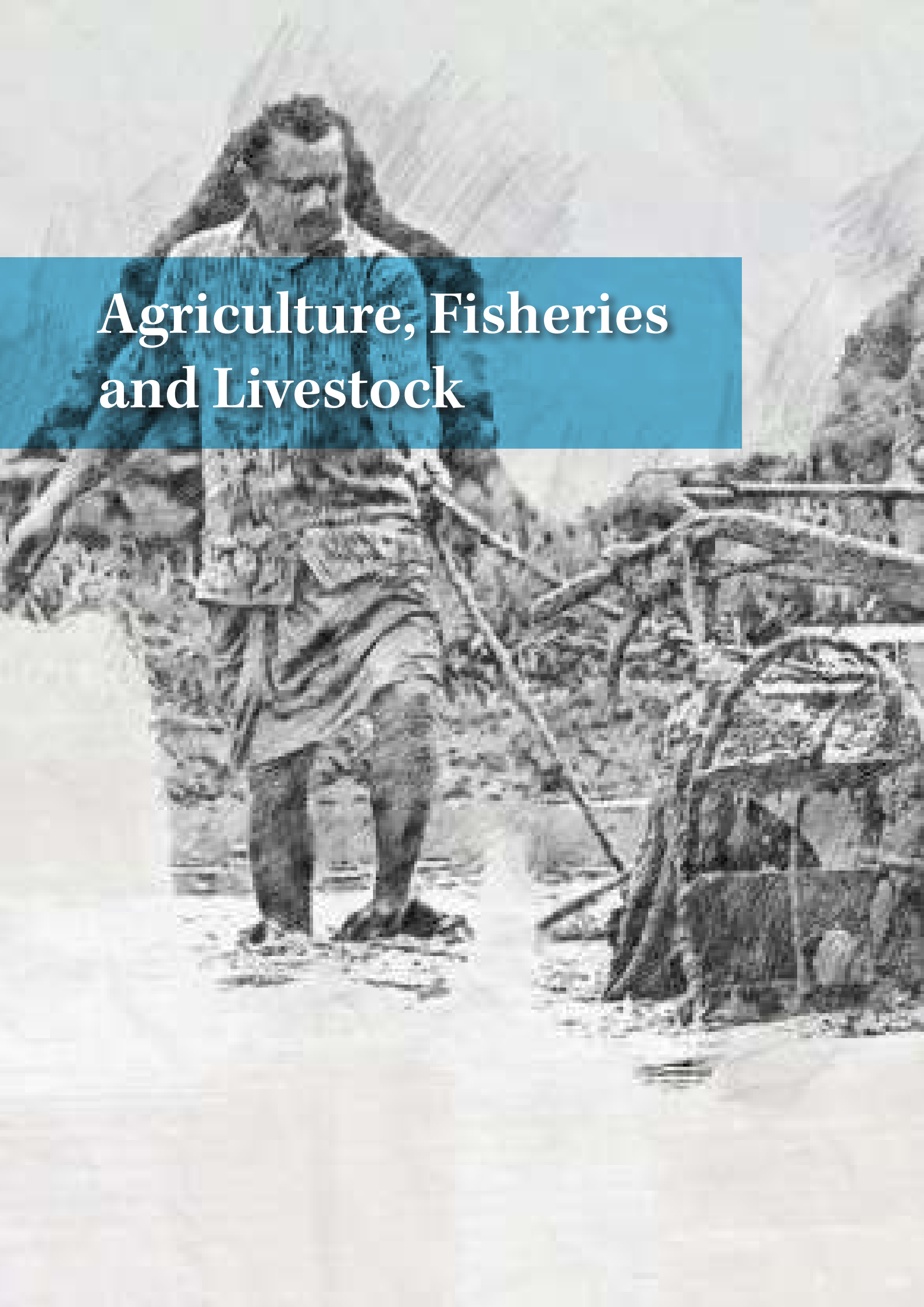
It is important to prioritise the diversity of recovery needs and take up the most urgent need first, since both financial and human resources are limited.

Sector Assessment Methodology

The post-disaster situation was assessed through a combination of secondary and primary data. The former was collected from the government, key partner organisations on-site, media, and geo-referenced data. Secondary data so obtained was further corroborated and qualified through field visits to collect primary data from the key affected areas in the state. The initial plan to synthesise data collected by NGOs such as International Council of Monuments and Sites (ICOMOS) could not be executed since the data received only contained the list of artefacts rescued from the Paliyum Palace complex in Ernakulam, and was hence unusable. Therefore, the current report is based on data provided by the Government of Kerala (Department of Cultural Affairs), and primary data collected through field visits undertaken by the UNESCO team along with representatives from the Government of Kerala.

The economic valuation of the damage to and loss of cultural heritage is based on primary data collected by a team of researchers. The owners of various firms and organisations, inhabitants of the damaged houses and officials from various government and non-governmental organisations were contacted for the data. It is difficult to separate the value of loss from the value of damage in many cases. Also, it is difficult to project an exact amount required to reach the pre-disaster level for each affected unit, since the exact process of restoration itself is unknown. Hence, the amounts are given in terms of expected value of damage and loss as an aggregate figure in all cases, barring a couple of exceptions.

Agriculture, Fisheries and Livestock



Agriculture, Fisheries and Livestock

Summary

Nearly 52% of Kerala's population lives in rural areas, and 17.15% of the population depends on the agricultural sector (including crops, livestock and fisheries) for its livelihood.[1] The sector contributes to 11% of the total gross state value addition (GSVA) at current prices (crops 5.42%, livestock 3.84%, and fisheries 1.78%).[2]

All three subsectors (crops, livestock, and aquaculture/fisheries) have suffered losses and damages in the flooding and landslides of 2018. Crops were most heavily affected, contributing to 88% of the total loss and damage to the sector, followed by livestock (10%) and fishery/aquaculture (2%). Subsistence agriculture (across all three subsectors) is an important source of income for rural communities. The effects of the floods are expected to impact the state's economy and a large number of sector-dependent rural households, most of which are involved in subsistence agriculture.

The total effect of the Kerala floods on the sector is INR 7,154 crore, that includes INR 2,975 crore of damages plus INR 4,179 crore of loss. Total recovery and reconstruction needs are estimated at INR 4,498 crore (Table 1).

Table 1
Damages, losses and recovery needs

Subsector	Damage	Loss	Total effects	Ownership		Recovery needs
				Private	Public	
Crops						
Damage, loss & recovery	2,722.5	3,558.2	6,280.7	5,156	1,124.7	4,193.5
Livestock						
Damage, loss & recovery	167.8	519.7	687.5	660.9	26.7	125.8
Fisheries						
Damage, loss & recovery	84. 5	101.3	185.8	166.8	19	179
TOTAL	**2,974.8**	**4,179.2**	**7,154**	**5,983.7**	**1,170.4**	**4,498.4**

Sector impact

The destruction of crops, livestock and fisheries infrastructure, assets, and stocks has resulted in temporary deterioration of livelihoods, employment and agriculture-related income, decline of exports and increase of post-disaster government expenditure (including compensation or other support to paddy and damaged

[1] *Agriculture Census 2011, Department of Economics and Statistics, Government of Kerala, www.ecostat.kerala.gov.in , 2013.*

[2] *Economic Review 2016, Volume One, State Planning Board, Thiruvananthapuram, Kerala, India, March 2017*

trees). Production losses are expected to last several years and rural household income is expected to remain depressed over a long period of time.

The extensive damage sustained and projected reductions in agricultural output will not only impact the economic performance of the state but will also have welfare implications on a large number of rural households. The incidence of diseases, the appearance of weeds like Parthenium, and damage to soil structure will lead to continued reduction in crop production, unless urgently attended to. Ambitious government programmes such as Janakeeya Matsya Krishi and Blue Revolution, under which most new aquaculture ventures had been supported, have suffered serious setbacks due to the floods. All aquaculture ventures have lost at least one crop implying employment loss of INR 21 crore. The fishing units lost translate to loss in employment of over INR 7 crore.

Environmental concerns are posed by the escape of many exotic species of fish from aquaculture farms to the open system including ornamental fish, fish stocked with proper bio-security measures such as the genetically improved farmed Tilapia (GIFT), and illegal stocks of fish like the pacu (Piaractus brachypomu). The impact of such accidental release needs to be studied and countermeasures developed to safeguard the natural fauna against it. Separately, the floods also caused an accumulation of plastic waste from the upstream areas in the lower-end Vembanad Lake.

Sector Recovery Strategy

The recovery vision for the sector is to develop sustainable, responsible, integrated, inclusive, eco-friendly, and resilient agriculture (crop, livestock, and aquaculture/ fisheries) in line with the policies of Government of Kerala and Government of India. Implementation of an inclusive recovery strategy will promote the participation and well-being of women and other vulnerable groups in agriculture, fisheries, livestock, and allied activities. The aim of reconstruction efforts in the agriculture, fisheries, and livestock is primarily to increase economic activity and sector resilience to disaster events, in accordance with the principles of 'Build Back Better (BBB)'.

Short term recovery will focus on provision of inputs and restocking, replacement or repair of assets and infrastructure, and finding alternative income sources for the population. Medium and long term activities will focus on building resilience of each subsector through environmentally sustainable integrated farming systems, community-based management of water resources, promotion of traditional indigenous livestock breeds (resilient to local conditions), improvements in value chain, setting up of early warning systems, and effective communication with enhanced GIS/technology backed capabilities.

The important recovery strategies in the fisheries sector are an ecosystem approach to fisheries and aquaculture management, based on a strong foundation of co-management and integrated development of the Vembanad Lake. Other major interventions include the revision of the Kerala Inland Fisheries and Aquaculture Act, 2010, in tune with the above strategy, and building a strong fisheries and aquaculture database.

Implementation of the Recovery Strategy

Kerala state departments of agriculture, soil, livestock, and fisheries, will coordinate the recovery strategy with the local self-government system and the local-level crop, livestock, and fish-farming community, represented by cooperatives and associations, as grassroots partners. Other government agencies like the Kerala State Cooperative Federation for Fisheries Development Ltd. (MATSYAFED) and

Agency for Development of Aquaculture, Keralal (ADAK) will support the Fisheries department in recovery and reconstruction activities. Technical support may be provided by institutes under the Indian Council of Agriculture Research (ICAR) and the Food and Agriculture Organisation (FAO) of the United Nations. Relevant non-government organisations may also play facilitating roles.

The Crop Subsector

The agriculture sector suffered heavy damages in 1.54 % of the net cropped area; Wayanad and Idukki were worst affected. Losses to crops have been estimated at INR 3,558 crore across 89.6 thousand hectares (4.44 % of the net cropped area). About 36.74% of the net cropped area of Wayanad and 17.59% of that in Alappuzha was damaged. Infrastructure worth INR 457 crore has been damaged. Perennial and annual crops, such as bananas, coconuts, areca nut, pepper, and coffee were the most impacted. Seasonal crops, such as rice, vegetable, tapioca, and other tuber crops also suffered significant losses. The recovery needs for the crop sector are estimated at INR 4193.5 crore.

Pre-Disaster Context

The crop sector represents 5.42% of the total GSVA and the net sown area of the state is 51.86%. Marginal farmers constituted 96.32% of the total operational holding and accounted for 58.62% of the area.[3] About 6.70 lakh persons in Kerala are involved in crop cultivation and small farmers operate 18.69 % of the area.[4] Female cultivators and agriculture workers account for 14.57% of cultivators and 35% of total workers engaged in agriculture respectively.[5] Dominant subsistence crops include paddy, banana, tapioca, and leafy vegetables. Coconuts, banana, cashew, rubber, pepper, and areca nuts are major cash crops and an important source of income for many rural households.[6]

The total cropped area and major crops by area under cultivation in each district is given in Table 3. In the two hill districts, the major crops are pepper, cardamom, tea, coconut, and coffee (accounting for 52% to total cropped area in Idukki and 40% in Wayanad).

[3] Economic Review 2016, Volume One, State Planning Board, Thiruvananthapuram, Kerala, India, March 2017

[4] Agriculture Statistics 2016–2017, Department of Economics and Statistics, Government of Kerala.

[5] Agriculture Census 2011, Department of Economics and Statistics Government of Kerala www.ecostat.kerala.gov.in, 2013

[6] 'Shrinking Rice Cultivation', in Kerala Shiji.O Ph.D Research Scholar, Department of Economics, Dr.John Matthai Centre, University Of Calicut, Aranattukara, Thrissur-680618

Table 2
Area and Production of Important Crops in Kerala, 2016–17

Crop	Area (thousand hectares)			Production (thousand tonnes)		
	2001-02	2016-17	% Variation	2001-02	2016-17	% Variation
Paddy	322.37	171.4	-47	703.5 (as rice)	436.5 (as rice)	-38
Tapioca	111.19	68.66	-38	2,455.9	2,529.7	3
Coconut	905.72	781.5	-14	5,479 (million)	5,384 (million)	-2
Pepper	203.96	85.21	-58	58.3	34.1	-42
Cashew	89.72	41.66	-54	65.9	27.9	-58
Rubber	475.04	551.05	16	580.4	540.4	-7
Pulses	8.19	1.74	-79	6.3	1.7	-73
Ginger (dry)	10.71	5.15	-52	40.2	20.5	-49
Turmeric	3.56	2.63	-26	7.9	6.5	-18
Banana	50.87	57.16	12	345.9	489.3	41

Crop	Area (thousand hectares)			Production (thousand tonnes)		
Total cereals	329.87	171.65	-48	708.6	436.7	-38
Areca nut	93.19	97.7	5	84.7	116.8	38
Coffee	84.79	84.98	0	66.7	63.5	-5
Tea	36.9	30.2	-18	66.1	61.5	-7

Table 3

Percentage of Area under Major Crops to Total Crop Area, 2016–2017 Season (thousand hectares)

District	Paddy	Coconut	Rubber	Total major crops (thousand hectares)	Total cropped area	Major crop area to total crop area %
Thiruvanan-thapuram	1.39	70.47	32.20	104.06	158.98	65
Kollam	1.30	50.94	37.26	89.50	147.94	60
Pathana-mthitta	2.64	15.88	50.90	69.42	103.97	67
Alappuzha	32.45	33.67	4.50	70.62	102.62	69
Kottayam	17.22	25.61	114.41	157.24	204.34	77
Idukki	0.7	16.12	40.59	57.41	270.36	21
Ernakulam	4.73	43.08	60.17	107.98	166.09	65
Thrissur	21.10	80.50	15.66	117.26	170.98	69
Palakkad	65.51	59.55	37.87	162.93	278.46	59
Malappuram	7.14	102.84	42.77	152.75	237.86	64
Kozhikode	1.99	119.06	21.93	142.98	198.39	72
Wayanad	7.82	10.32	10.80	28.94	166.87	17
Kannur	4.67	88.22	48.07	140.96	221.37	64
Kasaragod	2.74	65.24	33.92	101.90	155.79	65
State Total	**171.4**	**781.5**	**551.05**	**1,503.94**	**2,584.01**	**58**

Source: Agricultural Statistics 2016–17, Department of Economics & Statistics, Government of Kerala, hiruvananthapuram, December 2017

Post-Disaster Effects

Damages to the crops sector have been estimated at INR 2,722.5 crore, representing 91.5% of total damage to the agriculture sector (including all subsectors). The major damage includes destruction of irrigation systems and structures amounting to INR 1,065.3 crore (39%), destruction of crops worth INR 880.6 crore (32%), agriculture buildings and assets (hand tractors, tools, stored seeds, etc.) worth INR 456.6 crore (17%), and soil degradation estimated at INR 320.2 crore (12%).

Across all districts, south-west monsoons damaged irrigation systems including flood protection bunds (1,533 km damaged), irrigation distributaries, regulators, water storage tanks, canals (425 km damaged), and access roads. Damages to other agriculture infrastructure and assets included motor sheds, storage facilities, power tillers, hand tractors, threshers, weeders, plows, seeds/seedlings, stored fertilisers, petty and para-irrigation systems, pumpsets, etc.

About 30,945 Ha of perennial crops were destroyed, with pepper, areca nuts, banana and coconut being worst affected. Over 109 million trees/plants were completely damaged. The damages in Idukki and Wayanad are particularly severe. Both are ecologically sensitive uplands requiring special attention and policy support for ecological and environmental conservation. Damages to perennial crops will result in loss of income, ranging from a year's earnings in banana to over seven years' earnings in rubber.

Soil was also adversely affected by rains and debris slides in Wayanad, Idukki, Kozhikode, and Kannur. Topsoil erosion caused due to rains and overflowing dams and deposition of silt/sand in paddy fields, has resulted in changes to its physical and chemical properties, waterlogging, and anaerobic conditions. The damage to soil is estimated at INR 320.2 crore, with Wayanad district being the worst off due to landslides. The damage to the soil structure, advent of crop diseases, and the proliferation of weeds like Parthenium can have long term effects.

Estimated production losses in the crop subsector were INR 3,558.2 crore, representing 85% of total agriculture losses. About 89,610 ha of crops suffered, which is 4.44 % of the net cropped area (Figure 1). The south-west monsoon caused significant losses to cash crops such as banana, accounting for 40% of total crop losses, followed by pepper (19%), paddy (14 %), vegetables and tapioca. Kozhikode and Wayanad accounted for 47% of total crop loss value.

Recovery Strategy

Short-term activities will address immediate needs by restoring crop production through land clearance, preparing the land and sowing, bailing out water and planting, distribution of agro-inputs, clearing existing drainage systems, and restoring farm machinery and equipment (Table 6).

Table 4
Damages to permanent crops

Permanent crops	Total area pre-disaster (2016–17) (thousand hectares)	Affected area (thousand thousand hectares)	Trees destroyed (units)	Total damages (INR crore)
Coconut	716.78	7.03	14,06,876	272
Pineapple	66	0.1	43,47,500	2
Banana	57.16	8.68	2,15,96,675	337
Rubber	551.05	0.3	1,12,362	10
Pepper	85.21	14.65	8,15,99,868	259
Total	**1,476.18**	**30.94**	**10,90,63,281**	**881**

Source: Agricultural Statistics 2016–17, Department of Economics & Statistics, Government of Kerala, Thiruvananthapuram, December 2017

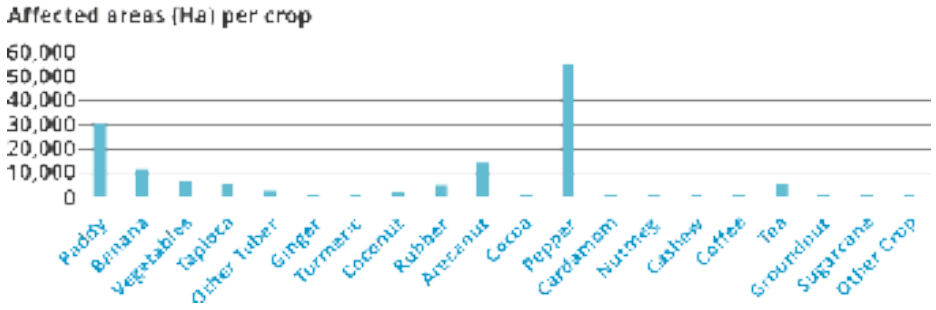
Table 5

Total Crop Sector Damage by District and Ownership (INR crore)

District	Private	Public	Total
Thiruvananthapuram	35.6	77.8	113.4
Kollam	35.9	18.7	54.6
Pathanamthitta	112.2	106.7	218.9
Alappuzha	61.7	292.1	353.8
Kottayam	54.4	16.7	71.0
Idukki	536.7	52.0	588.8
Ernakulam	23.7	105.6	129.3
Thrissur	48.7	148.7	197.4
Palakkad	33.4	75.2	108.6
Malappuram	108.9	52.5	161.3
Kozhikode	34.4	86.4	120.8
Wayanad	463.8	36.8	500.6
Kannur	52.1	37.8	89.9
Kasaragod	3.9	10.3	14.2
Total	**1,605.2**	**1,117.4**	**2,722.5**

Figure 1

Safe and Green Hospitals to Build Back Better



In the medium to long term, further resources would be required for restoring the crop economy, soil health, and plant protection monitoring (Table 6). The soil environment has been modified in large areas and there is a need for comprehensive study and management to restore fertility. Long-term risk mitigation such as support to eco-friendly and healthy soil preservation agriculture (e.g. permaculture, multilayer cropping, multi-cropping) is recommended. It is also proposed to put up check dams in high ranges to enhance percolation and the availability of water, as well as the maintenance of the natural flow of rivers. Additionally, establishing eco-friendly rain water harvesting structures and improving soil health with organic matter, microbiome, and rhizosphere organisms is recommended. It is proposed to invest in management of flood-related diseases using forewarning systems (e.g. prevention of invasive pest/pathogens and weeds), location-specific soil treatment, etc. The major strategies for recovery are detailed below.

Integrated flood resilient approach: Increasing disaster resilience will be achieved by improving land resource management and establishing new drainage systems where required. Resilient crops like bamboo, lemon grass, and fodder crops to prevent run-off of water and adding organic matter to the soil may be promoted. Introducing new technology and promoting climate-smart and resilient farming techniques and systems are other priorities. In order to rebuild soil microbiomes and enrich the soil, novel technology may be deployed to deliver microbes in capsule form (which is one-hundredth in volume). The Kerala Government has surveyed and analysed the soil in 2013[7], and the data available may be taken as a baseline for another survey of present conditions. The data may be digitised and archived to inform appropriate correction methods in farmer's fields.

Community-based water resource management: The upland areas require special attention for drought proofing as well as for flood control and landslide reduction. Comprehensive policy and legislation framework may be needed to ensure people's participation in watershed development and management on a sustainable basis and appropriate land utilisation techniques (e.g. vegetative covers) to reduce landslides. It is important to bring controls to prevent/reduce adoption of root harvesting crops on the slopes.

Early warning systems and effective communication with enhanced GIS/ tech backed capabilities: It is important to strengthen the early warning capacity of Agriculture Department personnel in terms of GIS system, tools to monitor, detecting and forecasting risks and when necessary, issuing alerts on impending hazards. Effective and immediate communication to the community in locally understood language has to be ensured. Innovative management of flood-related diseases using forewarning systems (e.g. prevention of invasive pest/pathogens and weeds), location-specific soil treatment etc. also may be ensured.

Protect and develop traditional drainage systems: Urgent attention is needed to clear, revive, develop, and protect traditional and natural drainage in all the watersheds/drainage systems in the state. Stringent implementation of the Kerala Conservation of Paddy Land and Wetland Act, 2008 with modifications, if required, is necessary to ensure that the buffering capacity of land is not further reduced. In this context, it is important to administer ecosystem services across geographical continuums from high to midlands and coastal plains. The clearing of natural drainage systems in contiguous geographies may be taken up. The Meenachil–Meenanthara–Kodoor river rejoining project in Kottayam with peoples' participation is a relevant case. Two such geographical continuums to prioritise are Wayanad–Kozhikode–Malappuram and Idukki–Kottayam–Alappuzha. Inter-district planning and coordination mechanisms will be needed to achieve floods and drought related 'risk reduction outcomes' for each such zone/district type.

Enhance and reinforce integrated farming systems: It is recommended to encourage multi-cropping, fish farming cum rice cultivation, build on existing farming models (e.g. coconut based high density multi-cropping system in Kasaragod (Central Plantation Crops Research Institute) and in Maharashtra (Krishi Vigyan Kendra, Dapoli), or inter-cropping pepper, banana, nutmeg, clove, heliconia, and pineapple in coconut/areca nut plantations to enhance the unit productivity of land.

Ecologically and environmentally sustainable integrated agriculture: The sector may adopt an integrated farming model initiative by the European Initiative for Sustainable Development in Agriculture that recommends sustainable development of agriculture involving crops, animal husbandry, fisheries, soil health, water management, human and social capital building. This approach also focuses on energy efficiency, landscape and nature conservation, etc. Growing cover

[7] *Rajasekharan, P., Nair, K. M., Rajasree, G., Sureshkumar, P. and Narayanan Kutty, M. C. (eds) (2013), Soil Fertility Assessment and Information Management for Enhancing Crop Productivity in Kerala, Kerala State Planning Board, Thiruvananthapuram, pp. 1–514.*

crops like velvet bean (Mucuna pruriens), a legume that fixes nitrogen, and seeds that have medicinal properties may be promoted. It is important to encourage and support further research on ecologically and environmentally sustainable integrated agriculture in collaboration with reputed international universities/ institutes/agencies. Environment friendly approaches like biofumigation using cruciferous vegetable crop residues may be adopted to manage soil-borne plant diseases. Organic farming depends on animal waste for maintaining soil health; growing fodder crops for livestock and in turn recycling their waste for crops is a sustainable option. Wayanad and Idukki are also suitable for growing seasonal cruciferous vegetables like cabbage and cauliflower which after harvesting, provide crop residues as biofumigants for managing soil borne diseases of ginger. This suits the organic production system and is a source of additional income for farmers. Some areas like Wayanad and Idukki are suitable for growing herbal spices as inter-crops for additional income.

The crop insurance scheme of the Government of India and Government of Kerala may be reviewed and steps taken to modify the eligibility criteria to include all marginal farmers under it. In the case of Vembanad Lake, where breaches of bunds are common, a comprehensive survey to assess the strength of the bunds and identify weak points may be urgently undertaken with people's participation. Action plans to strengthen the bunds at identified points may be undertaken annually to reduce the recurrence of breaches.

Recovery Needs

Table 6

Meeting Short, Medium, and Long Term Recovery Needs

Activity	Responsible Agency	Cost in INR crore
Short term (up to 12 months)		**3,663.5**
Provision of seeds, seedlings, and other agricultural inputs for replanting of seasonal and annual crops. Soil amendments with fertilisers (both organic and inorganic) and liming materials	State Department of Agriculture; State Horticulture Mission in collaboration with local self-governments like gram, block and district panchayats	350
Reconstruction of breached bunds and repair of infrastructure	Department of Agriculture (DOA); Kerala Land Development Corporation (KLDC)	1,047.6
Replacement and repairs of pumps, equipment, machinery etc.	DOA	1,065.3
De-silting, soil amendments, deep ploughing, dewatering	DOA	320.2
Replanting of perennial crops	State Horticulture Mission; line departments of the agriculture and allied departments	880.6
Medium term (12–36 months)		**350**
Soil testing for land areas damaged by the floods (bleaching, soil erosion, landslides)	Department of Soil Survey and Soil Conservation, Kerala Agricultural University and other central government institutions	100
Provision of disaster resilient crops	Kerala Agricultural University, Department of Agriculture Development and Farmers' Welfare	100

Activity	Responsible Agency	Cost in INR crore
Support sustainable disaster mitigation oriented land management, such as preventing soil erosion on slopes, silting of canals; providing soil conservation methods, constructing low cost check dams and growing cover crops like velvet bean, fodder crops, and herbal spices	Department of Agriculture Development and Farmers' Welfare and Department of Soil Survey and Soil Conservation	50
Promotion of small-scale income generating organic and backyard farming systems	Department of Agriculture Development and Farmers' Welfare	50
Setting up a reliable disaster communication system (satellite phones, solar power sources) for interdepartmental communication mainly between SDMA and the agriculture department	Kerala State Disaster Management Authority (KSDMA), Kerala National Disaster Management Authority (NDMA)	50
Long term (36–60 months)		**180**
Awareness and capacity building on sustainable and viable farming	Krishi Vigyan Kendra (KVKs) at district level; Krishi Bhavans at block level	80
Research and extension work for agro-economic sub-systems and ecological zones	Agriculture and allied departments of Government of Kerala; Kerala Agricultural University and research institutes under Indian Council of Agricultural Research, New Delhi	100
Total recovery and reconstruction needs		**4,193.5**

Subsector Assessment Methodology

Data collection process and sources:

- The damage and loss data was sourced from the departments of agriculture, soil survey and conservation and irrigation. Information was also collected from the Spices Board, the Indian Institute of Spices Research and the Department of Economics and Statistics. Gaps in data were discussed with state and district officials.
- A comprehensive data collection sheet was circulated to all the 14 districts through the Director of Agriculture, Director of Soil Survey and Conservation, Chief Engineer, Irrigation and the Additional Director, Economics and Statistics. District-wise, ownership-wise updated data on crop losses, crop damages, damages to physical infrastructure, farm equipment, machinery, damages to irrigation structures, canals, pumps, damages and degradation of soils, flood control bunds etc. were obtained. The departments deputed officers on a full time basis to facilitate the work of the PDNA Team.
- Field visits were undertaken in four of the worst hit districts of Wayanad, Idukki, Kottayam, and Alappuzha. Valuable inputs were received from district

collectors, principal agricultural officers, agricultural officers, soil survey and soil conservation officers, irrigation engineers, NGOs, local self-government elected representatives, farmers, scientists, research institutions, producers, company representatives, and civil society.

Assumptions made for estimating costs

- Immediate losses in perennial crops were calculated by multiplying productivity (kilograms per hectare) for each crop (provided by the Department of Agriculture for each district) with farm gate price and hectares damaged. The long- term loss was calculated assuming that production would be lost for five years, using the same criteria.
- Damage to perennial crops (Table 7) and cost for replanting was calculated as follows:

unit cost for replanting per hectare (including inputs, labour, seedlings) multiplied by the total number of units damaged

Table 7
Damage to Permanent crops

Permanent crops	Unit Cost (INR lakh per hectare)	Trees per hectare	Source
Cocoa	1.2		NABARD Unit Cost 2017–2018
Coconut	3.6	200	NABARD Unit Cost 2017–2018
Pineapple	2.2	40,400	Scale of Finance
Banana	3.9	2,500	Pradhan Mantri Fasal Bima Yojana (PMFBY) 2016–2017, Department of Financial Services
Rubber	3.4	450	NABARD Unit Cost 2017–2018
Pepper	1.8	1,100	NABARD Unit Cost 2017–2018
Banana	Unit cost (INR lakh per hectare)		
Thiruvananthapuram	5.0		PMFBY 2016–17
Kollam	2.6		PMFBY 2016–17
Pathinamthitta	4.3		PMFBY 2016–17
Alappuzha	3.0		PMFBY 2016–17
Kottayam	3.0		PMFBY 2016–17
Idukki	3.4		PMFBY 2016–17
Ernakulam	3.5		PMFBY 2016–17
Thrissur	4.1		PMFBY 2016–17

Permanent crops	Unit Cost (INR lakh per hectare)	Trees per hectare	Source
Palakkad	3.0		PMFBY 2016–17
Malappuram	3.5		PMFBY 2016–17
Kozhikode	3.8		PMFBY 2016–17
Wayanad	3.5		PMFBY 2016–17
Kannur	3.8		PMFBY 2016–17
Kasaragod	2.9		PMFBY 2016–17

For banana, cost varied per district as indicated in Table 7.

- The damage to perennial crops has been calculated based on unit cost from the National Bank for Agriculture and Rural Development (NABARD) for the year 2016–17 except in the case of banana, where the scale of finance used by PMKBY has been applied. The losses have been computed using the farm gate prices reported by the Department of Agriculture from each district. Unit costs were derived from unit cost and scale of finance fixed by the technical committees convened by NABARD. In the case of banana, the scale of finance fixed by PMKBY was taken.

The Livestock Subsector

The floods resulted in loss of income through animal products and damage to infrastructure and livestock assets, including deaths of more than 5,000 cows, over a million chickens, and 0.5 million ducks. The total damage and loss for the livestock sector is calculated at INR 687.5 crore. The worst affected districts were Thrissur, Alappuzha, and Ernakulam. The recovery needs for this subsector is estimated at INR 125.8 crore.

Pre-Disaster Context

The share of livestock in Kerala's GSVA is 3.84%.[8] Animal husbandry plays an important role in the economy of the state. Around 8.8 million households in Kerala are involved in animal husbandry and nearly 94% of the livestock population is concentrated in rural areas.[9] Approximately 80% of the livestock farmers are estimated to be small or marginal or agricultural labourers, with 60% being women. Animal husbandry includes the rearing of 27.35 lakh[10] cattle, buffaloes, sheep, goats, pigs, poultry, ducks, and quails. The total number of cattle is 1.32 million, 94 % of

[8] *19th Livestock Census 2012, Ministry of Agriculture Department Of Animal Husbandry, Dairying and Fisheries Krishi Bhawan, New Delhi*

[10] *Ibid*

Table 8
Livestock in Kerala

Species	Number of Animals Reared in Kerala (in lakh)		Number of Animals Reared in India (in lakh)	
	18th Census (2007)	19th Census (2012)	18th Census (2007)	19th Census (2012)
Cattle	17.40	13.29	1,990.75	1,909.04
Buffaloes	0.58	1.02	1,053.42	1,087.02

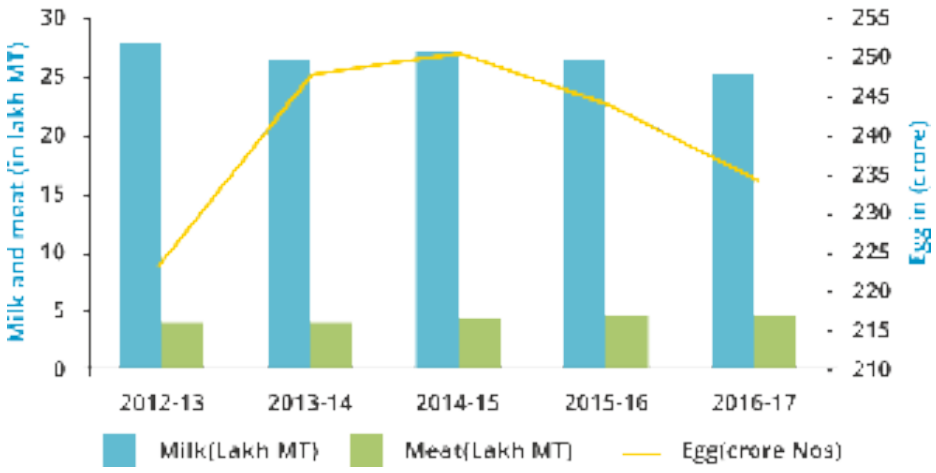
Species	Number of Animals Reared in Kerala (in lakh)		Number of Animals Reared in India (in lakh)	
Sheep	0.01	0.02	715.58	650.69
Goats	17.29	12.46	1,405.37	1,351.73
Pigs	0.59	0.56	111.33	102.93
Others			20.48	19.88
Total (Live-stock)	35.87	27.35	5,296.93	5,121.29
Total (Poultry)	**156.85**	**242.82**	**6,488.29**	**7,292.09**

Source: 18th Livestock Census 2007 and 19th Livestock Census 2012, Ministry of Agriculture Department of Animal Husbandry, Dairying and Fisheries, Krishi Bhawan, New Delhi

which are crossbred. The poultry population of the state is 242.82 lakh (Table 8).

The Government of India operates an insurance scheme for productive animals but its contribution to Kerala is marginal and covered only 21,000 animals during 2016–

Figure 2
Production of Milk, Egg, and Meat during the 12th Plan Period.



Sources:

1. *Animal Husbandry Department*
2. *Economic Review 2017, State Planning Board, Thiruvananthapuram, Kerala, India.*

17. The state took initiative and insured 65,000 cows during 2017–18.

About 25.20 lakh metric tonnes (MT) of milk was produced in the state in 2016–17, mainly by cross bred cows (23,94 lakh MT) and 1.26 lakh MT by goats (Figure 2) . During 2016–17, 5,940 lakh litres of milk were procured by the dairy cooperative societies in the state.[11]

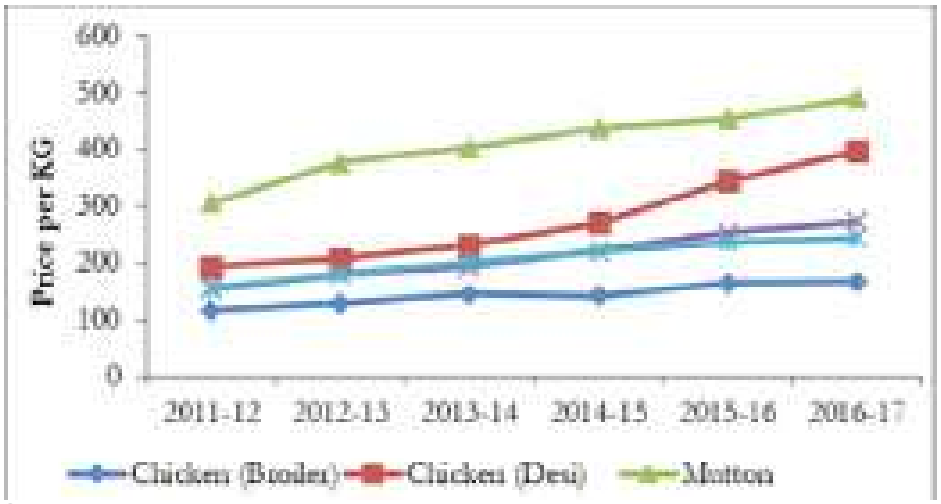
Kerala is ranked 9th amongst the states of India in egg production. Per capita availability of eggs was above the national average during the first four years of

[11] *Animal Husbandry Department and Economic Review 2017, State Planning Board, Thiruvananthapuram, Kerala, India.*

the 12th Plan. About 69% of eggs are from improved fowl and 25% from desi fowl. Nearly all the eggs produced in Kerala come from backyard poultry. Kerala is the 7th largest meat producing state in the country, contributing 6.3% of the meat produced in India. Of the total tonnage of meat produced in Kerala, 40.26% is poultry meat, 31.15% is from cattle, and 22.6% is from buffalo. Meat production in Kerala stands at 4.66 lakh MT in 2015–16.

Under the Dairy Development Department, emphasis is given to production and conservation of fodder in fields, and through dairy cooperatives, commercial fodder

Figure 3
Trend in average prices of livestock products from 2011-12 to 2016-17



Sources:

1. *Animal Husbandry Department*
2. *Economic Review 2017, State Planning Board, Thiruvananthapuram, Kerala, India.*

production in barren lands and wastelands has been initiated. Veterinary services are provided through a network of veterinary institutions and services including emergency night veterinary services established in 85 blocks in 2017–18.[12]

Post-Disaster Effects

The estimated damage to the livestock subsector was INR 167.8 crore, representing 6% of the total damage to the agriculture sector including damage to infrastructure and assets worth INR 82.8 crore in stored animal produce and feed, 19,531 cattle and poultry infrastructural assets including 215 dairy cooperatives and 95 veterinary centres.

Over 16.5 lakh livestock died, valued at INR 85 crore. The maximum loss was among poultry birds (11 lakh; 8% of the population) and ducks (4.6 lakh). The number of households affected by the loss of livestock is still being assessed, calculations based on livestock losses indicate that at least one lakh households were affected, with significant short-term impact on household incomes. Table 9 below shows the district wise break up of lost livestock.

Estimated income losses to the livestock subsector were INR 519.73 crore, representing around 12% of the total losses to the sector, including production losses and decline in eggs and milk production. Alappuzha, Kottayam, Pathanamthitta, Ernakulam, and Thrissur districts suffered the most.

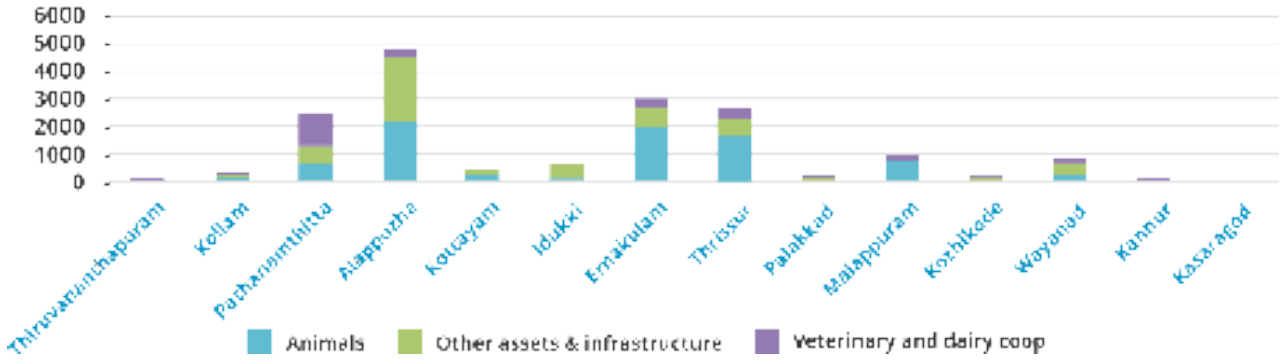
[12] *Animal Husbandry Department, Government of Kerala.*

Table 9
Loss of Livestock

District	Cows	Buffaloes	Calves	Heifers	Sheep/ Goats	Poultry	Ducks	Pigs	Quails
Thiruvananthapuram	10	0	50	0	5	10,345	200	52	0
Kollam	147	2	138	47	43	5,378	0	0	0
Pathanamthitta	606	7	357	353	198	27,457	70,339	0	0
Kottayam	267	4	233	50	120	34,270	5,000	0	0
Idukki	134	14	128	32	79	9,078	67	28	0
Alappuzha	472	32	3,502	146	2,994	1,33,163	3,67,629	0	0
Ernakulam	1,536	421	454	313	2,000	2,16,313	13,621	0	0
Thrissur	1,573	10	185	203	651	2,53,642	0	854	0
Palakkad	89	3	23	19	0	10,983	0	0	0
Malappuram	100	0	60	18	167	3,84,387	7,238	1	0
Kozhikode	40	0	10	9	20	31,503	0	0	0
Kannur	42	0	7	13	5	2,000	500	0	2,000
Wayanad	141	48	19	25	98	25,215	178	118	18,000
Kasaragod	6	0	0	0	0	0	0	0	0
Total	**5,163**	**541**	**5,166**	**1,228**	**6,380**	**11,43,734**	**4,64,772**	**1,053**	**20,000**

Source: Kerala State Animal Husbandry Department (2018)

Figure 4
Livestock Sector Damage by District (INR lakh)



Recovery Strategy

Short-term activities will include the provision of feeds and fodder and veterinary drugs. In the medium to long term, further resources would be required for restoring the livestock economy and promoting hardy traditional breeds in select zones. It is also important to develop area-specific action plans for natural calamities including rescue, rehabilitation, and designer sheds. A key strategy will be to strengthen the value chain, develop veterinary healthcare centres (with night services), bulk coolers, milk collection centres, and fodder banks to improve access to inputs. The sector should also promote better animal management techniques including disease prevention and containment. To support the immediate recovery, farmer self-help groups can be provided with working capital, special revival package for flood affected commercial farms (government and private) and milk societies. In the long term, farmers could be supported to improve awareness of livestock insurance, conduct disease mapping in a GIS framework, assess and map fodder requirements and develop block level fodder development plans and develop drug delivery protocols. Promotion of indigenous breeds maybe considered. About 94% of the cattle in Kerala are crossbred varieties. Indigenous cattle breeds that are more disease-resistant can be promoted to improve the resilience of household's dependent on animal husbandry. Branding and promotion of A2 milk can expand the market for this product and improve profit margins.

Reconstruction needs include rebuilding of assets such as cattle and poultry sheds and restoration and repair of damaged equipment, as well as restocking of livestock and poultry units. Animal sheds must be rebuilt with modern design and better aeration. All veterinary institutions and other community units must be reconstructed with improved disaster-resistant techniques. Traditional breeds can be promoted in select zones due to their inherent resistance.

In the animal husbandry sector, the government plays a significant role through

Table 10
Meeting Short, Medium, and Long Term Recovery Needs

Activity	Responsible agency	Cost (INR lakh)
Short term (up to 12 months)		**11,284**
Distribution of veterinary drugs and feeds	Department of Animal Husbandry, local self government, Kerala Veterinary and Animal Sciences University	125
Provision of feeds and clean water	Department of Animal Husbandry and local self-government	600
Restocking of livestock and poultry	Department of Animal Husbandry	8,497
Repair or replacement of assets and infrastructure with BBB measures, including veterinary and dairy cooperatives	Kerala Poultry Development Corporation (KEPCO); Department of Animal Husbandry	2,062
Medium term (12–36 months)		**600**
Mechanisation support programme for commercial dairy farms	Department of Animal Husbandry and local self-government	200
Development of a disaster assessment system for livestock	Department of Animal Husbandry and local self-government	100

Support integration of backyard poultry rearing system	Department of Animal Husbandry and local self-government	300
Long term (36–60 months)		**700**
Establishing common lairage facility	Department of Animal Husbandry , local self government, Kerala State veterinary and Animal Sciences University (KVASU)	700
Total recovery and reconstruction needs		**12,584**

different state/centrally sponsored schemes implemented by the Department of Animal Husbandry and Dairy Development through local self government i.e. panchayats. Self-help groups like dairy cooperative societies play a vital role in milk marketing.

Recovery Needs

Subsector Assessment Methodology

1. Data collection process and sources:
    - Pre-disaster data was taken from the Economic Review 2017, Planning, Government of Kerala and the Report on Integrated Sample Survey (2014–15), Animal Husbandry Department.
    - The post-disaster data on damage to livestock and losses in production was taken from the Animal Husbandry Department and the Dairy Development Department.
    - Field visits were conducted to discuss issues with farmers and self-help groups in villages.
2. Assumptions made for estimating costs with regard to cows and buffaloes:
    - Replacement/restocking of animals will take 180 days.
    - Regaining production loss of the surviving animals will take 60 days.
    - About 70% of the cows that died were in milk.
    - Production loss of the surviving cows was 30%.
    - Average daily milk production for cows is 10.2 litres and buffaloes is 8 litres.
3. Unit Cost: Based on NABARD cost for livestock/poultry
    - Chicken
        - On an average each bird lays 260 eggs in a year
        - Of the total layers, 70% are laying daily.
        - Cost of each egg is INR 5.
        - Restocking will take 180 days.
    - Ducks
        - Restocking will take 180 days.

- On an average each bird lays 180 eggs in a year
- Out of the total layers, only 30% laying daily.

The Fisheries Subsector

Inland capture fisheries and the aquaculture activities were badly affected. The combined loss for aquaculture and inland capture fisheries was INR 103 crore and damage, INR 84.5 crore. The loss for aquaculture was INR 88.7 crore and damages were INR 65.8 crore. The loss in inland capture fisheries was INR 10.6 crore and damage was INR 3.5 crore. Government-owned hatcheries, fish farms and field offices suffered losses worth INR 3.8 crore and damages worth INR 15.2 crore. The worst affected districts were Thrissur, Alappuzha, and Ernakulam. Most damages and loss were a result of breaches of bund, overflow, and damage to pumps and other farm equipment. The total recovery needs for the fisheries and aquaculture sector is INR 179 crore.

Pre-Disaster Context

The share of fisheries and aquaculture in Kerala's GSVA is 1.78%. Kerala stands fourth among Indian states in fish production. An estimated 11.03 lakh people depend on fisheries for livelihood of which, 2.36 lakh are active fishermen. There are 222 marine and 113 inland fishing villages. Aquaculture systems range from fish in fresh water and brackish ponds, cages, re-circulatory systems and reservoirs, ornamental fish, brackish water shrimp, and fish seed rearing across 14 districts.[13] The inland capture fisheries are in the Vembanad and Ashtamudi lakes, other lakes and rivers. Table 11 presents the annual fish production in Kerala during 2012–2017:

Table 11
Annual Fish Production in Kerala (tonnes)

Year	Marine	Inland	Total
2012–13	5.13	1.49	6.62
2013–14	5.22	1.86	7.08
2014–15	5.24	2.02	7.26
2015–16	5.17	2.1	7.27
2016–17	4.88	1.88	6.76

Source: Government of Kerala, Economic Analysis Report, 2017

The state contributed 14% (of volume) and 13% (of value) of India's total seafood exports during 2016–17.The state is endowed with a total freshwater area of 3,320 km^2 consisting of reservoirs, 44 rivers, and numerous ponds and tanks. Many new private investments by small farmers are in shrimp farming, cage culture, and ornamental fish. There is an estimated 1,260 km^2 of brackish water resources. The 125 km^2 of Pokkali fields distributed in Ernakulam, Thrissur, Alappuzha and Kannur districts are traditionally used for prawn filtration when the water is saline (November–May).[14] In the inland water bodies such as the Vembanad and Ashtamudi lakes, other lakes and rivers, different types of nets like stationary stake and Chinese dip nets, gill nets, dragnets, and cast nets are used for fishing. Dugout and plank

[13] *Department of Fisheries, Kerala*

[14] *Department of Fisheries, Kerala*

Table 12

Aquaculture in Kerala by District and Fish Type

Districts	Carp culture (ha)	Pangasius and air breathing fish culture (ha)	GIF tilapia in pond (ha)	Re-circulatory aquaculture system (units)	Shrimp culture (ha)	Brackish water fish in pond (ha)	Fish cage culture (units)	Crab culture (ha)	One paddy one fish (ha)	Reservoir fisheries (ha)	Ornamental fish (unit)	Fish seed rearing (units)
Thiruvananthapuram	350	5	2	25	20	5.0	5		0		30.00	3
Kollam	400	5	3	11	180	10.0	15		400		40.00	1
Ernakulam	460	30	7	222	900	250.0	376	9	0		250.00	1
Thrissur	680	40	12	150	290	190.0	57	6	2,800	1520	275.00	12
Malappuram	470	30	10	9	0	10.0	8		320		10.00	6
Kozhikode	250	20	5	8	25	25.0	19		0		15.00	1
Kannur	180	5	2	0	230	3.0	3		0		15.00	1
Kasaragod	164	5	2	1	20	2.0	0		0		12.00	0
Kottayam	480	25	5	6	35	35.0	0		1,500		25.00	2
Pathanamthitta	280	5	10	2	0	0.0	0		0		4.00	1
Idukki	380	5	7	7	0	0.0	0		0	5,452	2.00	0
Palakkad	920	20	10	1	0	0.0	0		0	4,258	5.00	0
Wayanad	220	5	9	6	0	0.0	0		0	900	2.00	1
Total	**6,414**	**260**	**90.00**	**450**	**3,000**	**950**	**545**	**15**	**6,500**	**12,130**	**800**	**30**

Note: ha = hectare

Source: Department of Fisheries, Government of Kerala 2018

built boats, and Fibre Reinforced Plastic (FRP) versions are used as fishing crafts. Some of them are motorised.

Aquaculture is a major emerging area of inland fisheries (Table 12). Kerala is known for its traditional paddy and shrimp culture in coastal areas. Other forms of aquaculture are promoted through the Department of Fisheries, fish farmers' development agencies, Agency for Development of Aquaculture, and the Kerala State Cooperative Federation for Fisheries cooperatives. Carp culture is picked up in freshwater tanks and ponds, as well as stocked in large inundated paddy fields and in reservoirs. The extensive fish culture under 'one fish one paddy' is promoted in a big way in Thrissur, Alappuzha and Kottayam. The GIFT is being cultured in ponds under bio-secure measures. Approximately 30 km^2 of brackish water area is now under scientific shrimp farming, mostly tiger prawn (Penaeus monodon)[15]. The exotic shrimp vennami (Litopenaeus vannamei) is being stocked by some farmers, procuring seed from Tamil Nadu and Pondicherry using Specific Pathogen Free (SPF) seeds as specified by the Coastal Aquaculture Authority (CAA). Culture of brackish water fishes in ponds is also emerging. Seed availability and disease problem especially in tiger prawn is a problem.

With guidance from the Central Marine Fisheries Research Institute, Central Institute of Brackish Water Aquaculture, and the state government, cage culture of brackish water fishes is being undertaken in many of the coastal districts. Ornamental fish culture has recently increased substantially. This is mostly due to the promotional activities of a newly formed public company, Kerala Aqua Ventures International Limited (KAVIL) where seeds or brooders are procured and supplied to 800 homestead units in different districts. Many of the ornamental fish culture units are at homestead level where women play a major role.

Post-Disaster Effects

Damage to the fisheries subsector is valued at over INR 84.5 crore (Table 13). The damage assessment covered inland fisheries and aquaculture infrastructure including boats, engines, fishing crafts and gear, damage to bunds, pumps, tanks, fences, cages, and farm equipment as well as loss to government-owned hatcheries, fish farms, and field offices. Aquaculture sustained damage amounting to INR 81.02

[15] *Department of Fisheries (DoF 2018)*

Table 13
Total Fisheries Sector Damage by District and Ownership (INR lakh)

Total damage	Aquaculture		Fisheries assets		Total
Districts	**Public**	**Private**	**Public**	**Private**	
Thiruvananthapuram	100	23		19	143
Kollam	30	92		30	152
Alappuzha	0	1,146		7	1,153
Ernakulam	450	770		124	1,344
Thrissur	354	3,575		28	3,956
Malappuram	30	242		1	274
Kozhikode	14	75		13	102
Kannur	43	7		0	50

Total damage	Aquaculture		Fisheries assets	Total
Kasaragod	0	1	0	1
Kottayam	114	418	75	607
Pathanamthitta	192	55	30	277
Idukki	0	106	17	123
Palakkad	62	7	4	73
Wayanad	129	68	0	197
Total	1,518	6,584	348	1,059
Total aquaculture and fisheries	**8,102**		**348**	**8,450**

crore (96 %), while damage to inland fisheries was valued at INR 3.5 crore. The worst-affected districts had been Thrissur, Alappuzha, and Ernakulam.

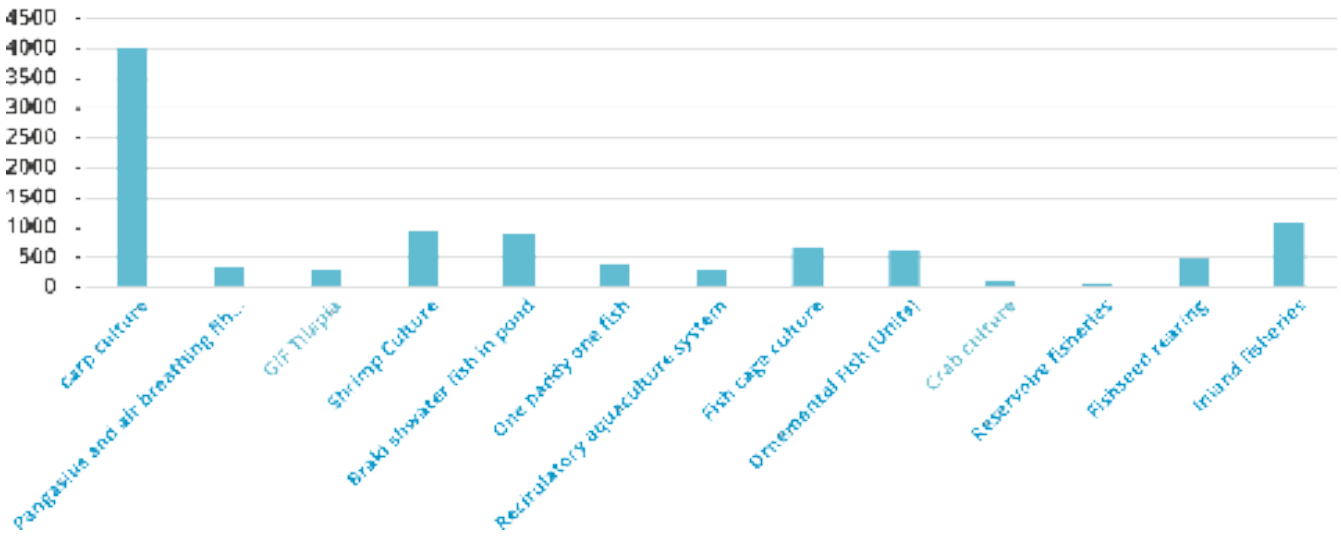
A total of 1,208 fishing crafts are reported to be damaged or lost. Most of the new small private aquaculture investments were badly hit by floodwaters up to 6-12 feet. Carp culture suffered the most losses and damage, followed by shrimp, brackish water fish, one paddy one fish culture, and cage culture.

The fisheries subsector sustained production losses amounting to INR 101.3 crore, with Kollam and Kottayam being worst affected. A substantial part of the losses is attributed to aquaculture, valued at INR 96.8 crore (90%), followed by inland fisheries at INR 10.6 crore (10%), mainly in Thrissur, Alappuzha, and Kottayam.

There is not much information on the loss of inland fishery resource base. The only study on loss of fishery resources available is the assessment by the Central Marine Fisheries Research Institute (CMFRI) of clam fishery in Ashtamudi Lake. It estimates a loss of INR 7 crore because the annual income from clam fishery in the

Figure 5

Loss in the Aquaculture and Inland Fisheries Sector (INR lakh)



lake is estimated at INR 14 crore. The fisheries institutes under the Indian Council of Agricultural Research are undertaking further assessments which may throw more light in this direction.

Recovery strategy

Immediate short-term recovery measures include revival of aquaculture and fisheries system, immediate mitigation measures, and cleaning of the water bodies. It also includes material and services for repair or replacement of boats, motors, pumps, aerators, fence, fishing gear, bunds, and ponds. Lost crafts and gear must be replaced with more eco-friendly gear, and replacement of crafts should be done in accordance with the actual carrying capacity of the fishing vessel to discourage over fishing.

Mid-term measures would include strengthening the Kerala Inland Fisheries and Aquaculture Act, which includes review of the Act with stakeholders including fisherfolk, farmers, and experts and bringing in more practical and applicable regulations in consensus with the stakeholders and amending the Act accordingly. Promotion of fisheries co-management and systematic management of aquafarms are important measures. Strengthening insurance compliance measures by making aquafarms follow standard operational practices and maintaining data on the business for the confidence building of insurance companies is an important measure for better resilience. De-siltation of water bodies is to be taken up in a phased manner.

Long term measures include capacity building on the ecosystem approach to fisheries and aquaculture management, developing and implementing management

Box 1 : Chilika Development Authority—A Model to Follow

Chilika Development Authority (a Government of Odisha agency) has been created under Forest & Environment Department, Government of Odisha in the year 1991 for the conservation of the ecology of the Chilika lagoon in Odisha. It also aims at the all round development of the area around the lagoon through multidimensional and multidisciplinary development activities. The broad objectives of Chilika Development Authority include:

- *protection of the lake ecosystem with all its genetic diversity,*
- *execution of various multidimensional developmental activities to enhance the economic condition of the community,*
- *integrated resource management for all-round development in and around the lake,*
- *establishment of a management information system for the lake,*
- *promotion of long term multidisciplinary research,*
- *preparation of environment status report, and*
- *establishment of an education centre for the lake.*

The hydrological interventions made for the restoration of the lagoon have resulted in considerable improvement of its fishery resources, water quality, positive impact on the biodiversity, and an overall improvement of the ecosystem of the lagoon. This has significantly contributed towards the increase in the per capita income of the community that depends on the lagoon for its livelihood.

plans. These plans incorporate disaster vulnerability reduction as well. Integrated management of the Vembanad Lake through a Vembanad Lake Development Authority is strongly recommended. The model set up by the Chilika Development Authority is a good model to follow (Box 1). Please see box.

Fisherfolk also need to be supported to go up in the value chain of fisheries or to take up most appropriate alternative livelihoods. Strict quarantine and bio-security measures for any exotic species brought to the state must be ensured and the Department of Fisheries should take stringent action against those growing exotic species illegally. Studies to understand the effect of floods on the inland fishery ecosystem and the impact of exotic fish species that have escaped from aquaculture systems to open water bodies need to be taken up and corrective measures implemented.

Strategies to promote increased visibility of inland capture fisheries in fisheries management and disaster response through systematic data collection on fishing operations, catch, and value chains and their contribution to economy, livelihoods, and food security need to be taken up. Existing government schemes like Janakiya Matsya Krishi and 'one paddy one fish' culture programmes should be further promoted and upgraded.

Table 15
Meeting Short, Medium, and Long-Term Recovery Needs

Activity	Responsible agency	Cost (INR lakh)
Short term (up to 12 months)		**13,901**
Revival of aquaculture and fisheries system to pre-flood situation by provision of essential inputs of seed and fish feed to revive the aquaculture crop	Agency for Development of Aquaculture in Kerala (ADAK); Kerala State Fisheries Resources Management Agency (FIRMA)	3,000
Distribution of material for repair or replacement of boats, motors, pumps, aerators, fence, fishing gear, bunds, and ponds	Department of Fisheries (DoF)	9,718
Immediate mitigation measures such as reviving of water bodies including lakes through removing of silt and strengthening bunds wherever applicable	Harbour Engineering Department (HED) under Fisheries Department; Kerala University of Fisheries and Ocean Studies (KUFOS)	1,000
Cleaning the water bodies of litter	Department of Environment	183
Medium term (12–36 months)		**1,000**
Support registry mechanism for aquaculture and inland fishing activities (for boats and major gears)	Department of Fisheries and other fishery institutions	40

Activity	Responsible agency	Cost (INR lakh)
Promote aquaculture calendar and early warning of floods so the farmers have an opportunity of emergency harvest and sale of stock.	Department of Fisheries, Local Self Government Department	40
Support development of data and economics systems	Department of Fisheries, Local Self Government Department and fisher/ farmer institutions	40
Making the Kerala Inland Fisheries and Aquaculture Act work, which includes review of the Act with stakeholders including fisherfolk, farmers and experts and bringing in more practical and applicable regulations in consensus with the stakeholders and amending the Act accordingly	Department of Fisheries, Kerala State Fisheries Resources Management Agency (FIRMA) and Non Governmental Organisations (NGOs)	40
Systematic management of aquafarms. Insurance compliance making aquafarms follow standard operational practices and maintaining data on the economics for insurance companies to get confidence	Department of Fisheries and Agency for Development of Aquaculture in Kerala (ADAK);	40
Distillation of larger common water bodies	Department of Irrigation	800
Long term (36–60 months)		**3,000**
Support creation of a Vembanad Lake Development Authority along the lines of the Chilika Lake Development Authority taking care of the whole ecosystem including fisheries	Multiple government departments of fisheries, environment, irrigation, etc.	1,000
Capacity building of senior, middle level and grassroots officers, civil society, LSGDs and fisher/farmer cooperatives on Ecosystem Approach to Fisheries Management (EAFM)	Department of Fisheries with support from FAO	100
Develop ecosystem approach to fisheries management plans for each fishery ecosystem involving all stakeholders and start implementing and monitoring a co-management framework	Department of Fisheries with facilitation of FAO	100

Activity	Responsible agency	Cost (INR lakh)
Develop master plan based aquaculture system on a co-management platform specific to each aquaculture ecosystem/zone (micro ecological or geographical zones for convenience of planning and management)	Department of Fisheries, Fish Farmer Development Agency (FFFDA) and Agency for Development of Aquaculture in Kerala (ADAK);	200
Strategies to increase visibility of inland capture fisheries sector in fisheries management and disaster response through systematic data on fishing operations, catch and value chains and their contribution to economy, livelihoods and food security.	Department of Fisheries and Kerala State Fisheries Resources Management Agency (FIRMA)	300
Support revival of Janakiya Matsya Krishi and Blue Revolution programmes	Department of Fisheries, Fish Farmer Development Agency (FFFDA) and Agency for Development of Aquaculture in Kerala (ADAK);	750
Initiate a study on impact of the exotic fishes released to the open water system from the aquaculture farms due to the floods	Appropriate Fisheries Research Institute	50
Promote wider dissemination of the 'one fish one paddy' culture system	Department of Fisheries	500
Total recovery and reconstruction needs		**17,901**

Subsector Assessment Methodology

1. Data collection process and sources

   - Data for fisheries and aquaculture was sourced from the Department of Fisheries, Government of Kerala. Gaps in the data were discussed with the Department of Fisheries (DOF) and details collected to satisfy PDNA requirements. Additional data was obtained from the Central Marine Fisheries Institute.

   - The basis of the data collection was discussed with the DOF officers and gaps filled in by directly contacting the district officers. In other gap areas, such as loss in captured fisheries and labour loss in fisheries and aquaculture, convincing formulas for extrapolation were discussed.

   - Visits were made to the Ernakulum and Thrissur districts, among the worst affected in the fishery and aquaculture sector. Apart from meeting the district collectors, the team visited the worst affected villages and talked to aquaculture farmers and fisherfolk. Direct interactions were held with scientists, academicians, development workers, farmers, and fishers. Within the PDNA team, discussions were held with sectoral experts to better understand cross-cutting areas.

2. Assumptions made for estimating costs: The value of aquaculture loss was worked out by the DOF based on the unit cost calculations. For each aquaculture activity the unit operational costs are as follows:

    - Carp culture per hectare = INR 1,50,000
    - Air breathing fish culture per hectare = INR 12,50,000
    - GIFT Tilapia culture per hectare = INR 9,00,000
    - Recirculatory Aquaculture System per unit = INR 1,40,000
    - One paddy one fish per 100 hectare = INR 8,00,000
    - Shrimp farming per hectare = INR 2,40,000 to INR 11,00,000 as per species cultured
    - Brackish water fish culture per hectare = INR 2,00,000
    - Cage culture of fish per unit = INR 1,80,000
    - Crab culture per hectare = INR 6,00,000
    - Ornamental fish culture per unit = INR 40,000
    - Fish seed rearing per unit = INR 25,000

Mechanisms are not adequate to calculate the actual loss of fishing or the damage to the fishery resources in a short time. Therefore, the loss of fishing was calculated, based on the assumed loss of fishing for six months, for each lost fishing craft/ Chinese dip net. Replacement cost is given, not per unit, but for the total area of the affected asset. It is calculated for total area of affected assets based on the cumulative figure of damage from each district, based on damage reported by the individual farmer or fisherperson.

Water, Sanitation, and Hygiene

Water, Sanitation, and Hygiene

Summary

Kerala achieved Open Defecation Free (ODF) status in 2016, but faecal sludge is not yet safely managed with regard to most households. In addition, the majority of people (62%) use shallow wells for drinking water, and only 29% have access to piped water supply. Floodwaters affected drinking water sources and sanitation facilities, putting citizens at serious health risk.

The estimated damage in the water, sanitation and hygiene (WASH) sector stands at INR 890 crore (water subsector: INR 492 crore; sanitation: INR 147 crore; and, solid waste damage: INR 251 crore). Losses in the WASH sector are estimated at INR 471 crore (water-supply loss: INR 349 crore; sanitation loss: INR 48 crore; and solid waste management (SWM) loss: INR 74 crore).

The total cost for immediate and short-term recovery and reconstruction in the WASH sector is INR 1,331 crore (INR 766 crore for water supply, INR 289 crore for sanitation and INR 276 crore for SWM).

While no waterborne disease outbreak was reported initially, post the floods, damages and losses are high and the risk of disease outbreak continues to remain significant. The following recommendations are given to reduce future risk of flood-related damage, loss, and disease outbreak.

- Establish a WASH multi-stakeholder coordination platform positioned under the Water Resources or Local Self Government Department (LSGD).
- Conduct a bottleneck analysis of the WASH sector on policy, strategy, governance systems and the preferred range of technologies in water supply and sanitation, notably to inform a long-term WASH strategy for a 'Green Kerala'.
- Develop disaster and emergency preparedness plans for WASH and its subsectors defining specific roles and responsibilities for WASH stakeholders in the state.
- Rehabilitate/improve shallow wells (raised, covered, lined) and raise awareness on the need to upgrade wells to: (i) reduce risk of floods; (ii) improve water quality; and, (iii) promote alternative sustainable water supply options (rainwater harvesting, piped water supply, etc.).
- Strengthen the water quality surveillance system, including feedback mechanisms and timely follow-up to improve drinking water safety.
- Design and build flood-resilient latrines in flood-prone areas, with realistic financing options.
- Strengthen decentralised solid and liquid waste management, including faecal sludge management to ensure treatment and safe disposal of sludge from septic tanks, based on relevant public–private partnership models, and legally enforce to ensure adherence to a regulatory framework/protocol.

Pre-Disaster Context

Flood and landslide disaster impact on WASH has been substantially high, as the hazard event caused significant damage to water resources, infrastructure services, and supply systems. In this assessment WASH is divided into three main subsectors: water supply, sanitation, and SWM. While hygiene is a major WASH component, it is not quantitatively assessed due to unavailability of segregated data, but has been integrated under other subsectors qualitatively where appropriate.

Water Supply

Assessment of the water supply subsector is mainly confined to human consumption, including drinking water and use of water for sanitation. According to Census 2011,[1] the majority of people (62%) use wells as their main drinking water source, while 29% of the population has access to piped water supply. In terms of accessibility, 78% households have a water source within the premises and 14% households use water sources near the premises. Kerala is perceived to have higher water demand than the national average due to established social norms and demand for better hygiene and sanitation. High water demand could be explained by the fact that 67% households have a flush toilet.[2]

This assessment focuses on piped systems and shallow wells because of their coverage, functionality, and data availability. The Kerala Water Authority (KWA) covers urban and rural piped water supply schemes. As per KWA's inputs in the World Bank's Joint Rapid Disaster Needs Assessment (JRDNA) conducted in September 2018, KWA-managed piped water supply systems have 41% coverage, while Jalanidhi managed schemes have 4% coverage.[3]

The service quality of piped water schemes differs mainly in treatment options and service time. Other than schemes under the direct management of the KWA and Jalanidhi, some small piped-water schemes are managed by gram panchayats under the purview of the LSGD. The KWA holds the capacity of water quality testing with 3 regional and 14 district laboratories, and laboratory facilities at each water treatment plant. The KWA has established protocols for testing water as per the national standards.

Sanitation

Prior to the floods, Kerala was doing well in terms of sanitation, having achieved ODF status in 2016. State sanitation coverage, based on Census 2011 showed that 67% households had water-sealed toilets, and 95% had a toilet facility within the premises.[4] While 50% of households had a septic tank, it is not clear if these were watertight septic tanks or soakage (leach) pits. There was no institutionalised faecal sludge management system in place to manage the sludge after emptying of the septic tanks.

Suchitwa Mission, the technical arm under the LSGD, is the key stakeholder driving sanitation strategies focused on the community and individual households. Centralised piped sewerage systems with treatment plants are under the purview of the KWA, but these only cover Kochi and Thiruvananthapuram towns and have a low coverage across the state. Overall, only 12% of latrines were connected to piped sewerage systems as per the 2011 Census.[5]

Solid Waste Management

Administratively, SWM is decentralised in Kerala. High political will towards a clean state has recently led to the integration of waste management, organic farming, and

[1] *Office of the Registrar General & Census Commissioner, India, Census of India 2011, Ministry of Home Affairs, Government of India, New Delhi.*

[2] *Ibid.*

[3] *These figures were derived directly from JRDNA data sheets provided by KWA to World Bank.*

[4] *Office of the Registrar General & Census Commissioner, India, Census of India 2011, Ministry of Home Affairs, Government of India, New Delhi.*

[5] *Ibid.*

water resource management under the umbrella mission called 'Haritha Keralam'. The mission aims to provide a holistic approach towards a state free of garbage and water pollution. Suchitwa Mission has been very active since 2008 with regard to household- and panchayat-level SWM.

The state installed the Kerala Pollution Control Board (KPCB) as the authority to prepare and implement pollution control measures on all types of wastes, targeting larger waste producing entities in order to prevent pollution of water bodies, air, and the environment. Furthermore, a limited liability company 'Clean Kerala' has been formed under the LSGD. Its primary objective is to formulate innovative and scientific strategies and technological methodologies to secure appropriate industrial waste management across the state.

Total daily municipal solid waste production in Kerala has been estimated at 10,044 tonnes under three broad areas—corporations, municipalities, and gram panchayats. Households contribute 50.1% of the municipal solid waste (MSW), followed by street sweeping (12.2%), commercial centres (9.9%) and hotels (7.8%). Nearly 80% of waste is estimated to be compostable.[6]

Hygiene

Suchitwa Mission is running a comprehensive programme on hygiene, leading to greater awareness and some improvement in environmental hygiene. However, contamination of soil and water still occurs on a large scale and is partially unknown to the general public.

Since people construct their wells close to homes and toilets, the leachate from the toilets, pit latrines, and septic tanks contaminates the wells. Having no resources to check the quality of their well water, many people boil it before drinking, but chemically it still could contain high concentrations of nitrite and nitrate. Secondly, the sludge from latrines and septic tanks is often not treated due to lack of capacity in the state, and ends up in the environment. Water for various purposes is taken from those same water bodies and pumped back into the soil, or runs back into shallow wells.

Disaster Preparedness in the WASH Sector

The Kerala State Disaster Management Authority's (KSDMA's) Plan Profile has acknowledged the formation of thematic sectors in disaster management. It further directs state departments to develop departmental disaster management plans as a routine responsibility, while identifying specific responsibilities, policy, and capacity needs. Health, infrastructure development, agriculture etc., have been identified as examples of thematic areas where WASH is not reflected as a standalone sector and yet the interconnectedness is deep and wide.

Post-disaster observations show that WASH stakeholders in Kerala did not have adequate emergency supplies and human resources to respond unprecedented disaster. However, mandated stakeholders such as KWA, the Jalanidhi Project, and the Suchitwa Mission had the institutional framework and technical knowledge to initiate a WASH response, even with limited emergency preparedness. At the same time, stakeholder coordination within the WASH sector in the pre-disaster context has not been strong enough to roll out a coordinated response. Gram panchayats were the first to respond at the grassroots and technical WASH capacity should be strengthened at this level.

[6] *Kerala Economic Review, 2017, State Planning Board, Thiruvananthapuram. http://spb.kerala.gov.in/ER2017/web_e/ch71.php?id=7&ch=71*

Institutional/Governance Capacities of the WASH Sector

It appears that KWA has a much larger water production capacity than it is able to supply through its distribution schemes. Its ability to reach the unreached by constructing more distribution pipelines should be evaluated, because in most cases the site of the overcapacity is different from location of the need. The KWA's 2016–2017 budget shows that salary costs comprise 75% of its Revenue Account, while operation and maintenance (O&M) takes up 5%. On the income side, 58% comes from paid customer bills, and over 32% from a government grant. Reasons given for the high state subsidy are that tariffs are not high enough for cost-recovery, leakage losses are high, and water to local self government bodies (LSGBs), is not paid for.

Rural water supply schemes were designed with a participative approach to technology, design, and O&M. Unfortunately, many of these schemes suffer from neglect due to lack of technical support, insufficient demand, and low recovery of costs. The more successful ones did so because of prolonged donor assistance, but after withdrawal of this assistance these systems witnessed performance deterioration as well.

There is a well-instituted set of actors in sanitation and SWM. They work in line with state policy, at the panchayat/corporation/municipality level, backed by adequate funds to subsidise all measures recommended. However, sustainability of this strategy should be looked into, as the subsidies may eat into the state's budget and stunt people's own initiative or sense of ownership.

Post-Disaster Context

The post-disaster context was assessed with respect to the following four dimensions.

1. Damage to infrastructure and physical assets
2. Disruption of access to goods and services
3. Disruption of the governance and decision-making process
4. Increased risks and vulnerabilities

Assessments are supported with quantified evidence based on data and qualitative statements.

Water Supply

Piped water schemes

Damage has been reported in 108 urban and 372 rural schemes under KWA, and 583 rural schemes under the Jalanidhi Project.[7] The KWA estimates 58% reduction in daily production, indicating that approximately 50% to 60% of piped water users (20% of the state's population or 6.7 million people), have been affected.

Repair varies from replacement of electrical appliances to reconstruction of structures. Structural damage on retaining walls, intake wells, pump houses, distribution lines, electrical installations, and control systems has been significant. Submerged infrastructure and appliances have been damaged beyond recovery. As a result, most piped water schemes either stopped operating or operated with compromised capacity for many days. The KWA's peak production loss of 58% was reported on 18 August 2018, but was brought down to 5% within a week.

[7] *Kerala Water Authority (2018)complete, KWA Rapid Disaster Needs Assessment summary, 19 September 2018*

Decisions related to piped water supply production and distribution were interrupted during the floods and remained in hiatus until the damage to infrastructure and control systems was assessed. The situation also delayed ongoing water supply projects while compromising planning initiatives for the sector due to the newly emerged challenges. Damage to existing water supply schemes could stretch the current capacity of KWA and the Jalanidhi Project during recovery, thus affecting services and planned improvements.

Shallow wells

It is estimated that 3.17 lakh shallow wells have been damaged in the six worst affected districts,[8] directly affecting 1.4 million persons; the structural damage occurred to the inner linings, parapet walls and aprons of these wells. Shallow wells constructed with concrete rings withstood the floods.

Water in many shallow wells was contaminated. Some of the wells have since collapsed during the cleaning process, due to over-pumping whilst emptying the well. Amid disruptions to routine operations, the LSGD was able to issue cleaning guidelines for wells, as well as certifications for cleaned wells, in support of restoring services. The wells are still subject to increased risk of contamination from flood-carried debris, human waste, carcasses, industrial waste, e-waste etc. Even cleaned wells will take time to stabilise their physical water qualities, which means people relying on these wells would need to look for other water sources. This could create additional demand on piped water systems already damaged and with compromised capacity, or on emergency water supply, which further increases the losses incurred due to the floods.

Sanitation

In the sanitation subsector, household latrines have borne the main brunt of the disaster. Invariably, the septic tanks and leach pits were the most damaged in terms of structural stability and functionality. While de-sludging could remove the debris from these pits, their structural damage can hardly be addressed without extensive repairs.

An estimated total of 95,146 household latrines (of which 83,506 are rural areas) have been substantially damaged.[9] This deprived 4 lakh people of sanitation services.[10] Access to latrines was compromised for several days until the de-sludging process was completed. No damage to piped sewage treatment systems has been reported, but it should be noted that these systems cover only a small proportion of the state population.

The unprecedented damage to latrines is also likely to impact the government's sanitation agenda. The disaster raises the need for resilient superstructure designs and complete septic tanks with customised designs for water-logged areas. Hence the current standard latrine design and subsidies associated with them would need to be revised. This, in turn, would have social and financial implications, as costs of septic tanks or raised latrines with above-ground pits are substantially higher. Furthermore, damaged superstructures pose the risk of injuries and compromise privacy, particularly of women. The impact on septic tanks and leach pits will lead to long-term vulnerabilities in terms of ground water contamination, vector breeding, and release of pathogens into the environment.

Solid Waste Management

The SWM damage includes both flood damage to existing SWM units and solid waste generated by floods. The estimate of the number of damaged SWM units is:

[8] *State Relief Commissioner, Disaster Management (2018), 'Additional Memorandum on Kerala Floods'. Government of Kerala, Thiruvananthapuram, p. 32.*

[9] *Suchitwa Mission (2018), 'Damage Assessment Report, 13 September2018', Government of Kerala, Thiruvananthapuram*

[10] *Suchitwa Mission (2018), 'Proposal for the construction and repair of the Individual Household Latrines 13 September 2018', Government of Kerala, Thiruvananthapuram. p. 2*

2.68 lakh at household level, 349 at community level, and 6,848 at institutional level, across all districts; 2.7 million people have been deprived of SWM services.[11] Debris collection is taking more time than expected and might extend over several months. The SWM situation at household, community, and institutional levels, is dire. Floods have compromised the capacity of waste management, while action remains to be taken to manage flood-generated waste.

While the Haritha Keralam Mission and other actors have created the enabling environment, the decision-making process needs to be revisited to incorporate resilience and improve SWM efficiency. This may temporarily halt current plans related to SWM in the state. Disturbed systems and excessive waste could lead to vector breeding and many related diseases such as dengue. Hygiene management could face a serious threat with the increase of vectors carrying pathogens into the food and water cycles.

Estimation of Damage and Loss

The total estimated cost of damage to the WASH sector is INR 890 crore (water supply: 55%; sanitation: 16%; and SWM: 28%) (Table 1). The sector is reported to have also suffered flood-related losses of INR 471.4 crore, with water-supply related losses alone accounting for 74%.

Water Supply

Total damage to the water supply subsector is estimated at INR 492.3 crore, 77% of which is to shallow dug household wells, 11% to KWA rural schemes, and 6% each to KWA urban schemes and Jalanidhi schemes. The greatest damage was in rural areas with 3.17 lakh dug wells reported to be damaged in the six worst affected districts—Pathanamthitta, Alappuzha, Kottayam, Ernakulam, Thrissur, and Wayanad. The KWA reports damage to 108 urban and 372 rural water schemes, while Jalanidhi reports damage to 583 rural water schemes. The most damage to KWA schemes is reported from Kottayam, Ernakulam, Thrissur, and Malappuram.

As mentioned earlier, both KWA and Jalanidhi reported loss of daily production as well as demand, the lowest ebb (58%) being reached on 18 August 2018. Operational data shows that on an average production recovered within one week. The KWA schemes had an estimated water production loss of 8,706.46 million litres, and the Jalanidhi schemes, 196.74 million litres. The cost of repairing the total estimated losses stands at INR 349.5 crore (91% for cleaning wells, and 8% on emergency water services).

Sanitation

Estimated damage to sanitation (INR 146.5 crore) is entirely owed to the destruction of household latrines in 12 districts, with 88% being in rural areas. The cost of the preliminary cleaning of 95,146 affected toilets is estimated at INR 47.6 crore. Costs incurred in providing temporary sanitation in camps and de-sludging of septic tanks were not estimated due to lack of data.

Solid Waste Management

Value of damage in the SWM subsector is estimated at INR 251.13 crore, about three-quarters of which is due to the destruction of household-level SWM units.

The total loss in the SWM subsector is estimated at INR 74.4 crore, of which 45% is attributed to household-level cleaning, another 31% to disposing of animal carcasses, and the remaining 24% spent by urban and rural administrative bodies

[11] *Kerala Suchitwa mission, 13 September 2018*

on cleaning public areas. The loss of revenue due to interruption of specific waste management services such as recycling, composting etc. was not counted due to lack of data.

Table 1
Damage to Water Supply, Sanitation and Solid Waste Management

	Number	Cost of Damage (INR in Crore)	Cost of Damage (INR in Crore)
KWA schemes	480	81.63	KWA
Jalanidhi water scheme	583	30.24	KWA Rapid Disaster Needs Assessment Summary Sheet, 19 September 2018
Damaged shallow wells	3,17,003	380.40	Additional Memorandum on Kerala Floods by State Relief Commissioner, Disaster Management, Government of Kerala, p. 32
Sub-total Water Supply		**492.27**	
Damaged household latrines	95,146	146.52	Proposal for the Construction and Repair of the Individual Household Latrines 13 September 2018, Suchitwa Mission, Government of Kerala, Thiruvananthapuram. p.2
Sub-total Sanitation		**146.52**	
Damaged SWM units at household level	2,68,088	188.54	
Damaged SWM units at community level	349	28.35	
Damaged SWM units at institutional level	6,848	34.24	Proposal for the Construction and Repair of the Individual Household Latrines, 13 September 2018, Suchitwa Mission, Government of Kerala, Thiruvananthapuram. pp2-4
Sub-total SWM		**251.13**	
WASH Damage Total		**890**	

Table 2
Losses in Water Supply, Sanitation, and Solid Waste Management

	Unit	Loss (INR crore)	Data source
Water production loss for KWA Schemes	8,706 million litres	5.22	
Water production loss for Jalanidhi schemes	196 million litres	0.11	KWA Rapid Disaster Needs Assessment Summary Sheet, 19 September 2018
Cost of cleaning wells		**317.00**	**Additional Memorandum on Kerala Floods by State Relief Commissioner, Disaster Management, Government of Kerala, p. 32**
Cost of emergency response (restoration of water schemes and water supply provision)		27.13	Additional Memorandum on Kerala Floods by State Relief Commissioner, Disaster Management, Government of Kerala, p. 32
Sub-total Water Supply		**349.46**	
Cleaning household latrines	95,146	47.57	Proposal for the Construction and Repair of the Individual Household Latrines, 13 September 2018, Suchitwa Mission, Government of Kerala, Thiruvananthapuram. p. 2
Sub-total Sanitation		**47.57**	
Cleaning houses	1,11,007	33.30	Suchitwa Mission Damage Assessment Data Sheet, 15 September 2018
Cleaning public places (wards)	6,090	17.95	Additional Memorandum on Kerala Floods by State Relief Commissioner, Disaster Management, Government of Kerala, p. 24
Disposing animal carcasses	7,99,256	23.12	Additional Memorandum on Kerala Floods by State Relief Commissioner, Disaster Management, Government of Kerala, p. 27
Sub-total Solid Waste Management		**74.37**	
Total WASH losses		471.40	

WASH Impact Analysis

The WASH sector has been directly impacted by the floods due to linkages with water resources and the environment.

Water Supply

Though floods brought an excessive quantity of water, the environmental damage and pollution associated with the floods limited the quantity of water available for drinking and for people's water security. Physical and microbiological contaminants in well and river water—such as increased turbidity, odour, colour, pathogens etc.—may have the short-term impact of discouraging people from consuming water directly from these sources. As mentioned earlier, some wells are reported to have

suffered structural damage (parapet wells, platforms or aprons, and well lining), making the users vulnerable to injury. Well water, generally safely consumed after boiling, may now contain contaminants not removable by boiling alone.

These elevated contaminant parameters in rivers and streams—increase in turbidity and faecal contamination being two classic examples—will burden existing water treatment plants, demanding increased maintenance. Damage to existing water schemes will lead to a medium-term deterioration of service quality and level. Existing treatment plants may not be equipped to treat some types of hazardous waste, such as industrial effluents, imposing a serious health impact on consumers. Consumers may lose their trust in piped water, decreasing their willingness to pay the water tariff. On the other hand, there could be an increased demand for safe water which could be leveraged to improve the willingness to pay and positively impact sustainability of services.

Sanitation

Damage to latrines and septic tanks may induce communities and households to switch back to unsafe sanitation options and open defecation, putting health of the citizenry at risk and stripping Kerala of its ODF tag. People with damaged toilets may not prioritise reconstruction. Dedicated stakeholders, such as the Suchitwa Mission, will have to prioritise recovery of sanitary facilities for households and institutions, over other regular activities. There is substantial interest in the topic of safe faecal sludge management at policy level, which has led the Government of Kerala to announce plans to construct many more faecal sludge treatment plants across the state.

Solid Waste Management

Based on Kerala's strong political leadership towards a sustainable environment, solid waste management units were established at the household, community, and institutional levels. Damage to these systems and facilities (as mentioned in previous chapters), and the associated cost of recovery may affect the momentum in communities taking forward the good practices of the past. Hence the authorities may need to make additional efforts to maintain the momentum towards SWM.

The floods have exposed and exacerbated the management challenges of solid wastes in Kerala. With tens of thousands of houses and industrial establishments being flooded, some for extended periods, large quantities of disaster debris were generated. Typical wastes generated from households included beddings, furniture made of plywood or pressed wood, electronic waste (computers, televisions, etc.), white goods (fridges, washing machines), clothes, paper (books, newspapers), etc. In addition, where buildings collapsed fully or partially, construction debris also added to the piles of disaster waste. On top of all the waste produced from the fallen buildings, the mud and silt that got deposited during the floods became an added waste to be dealt with, especially in urban areas where it simply could not be cleaned out and dumped in the neighbouring yard.

An immediate challenge to SWM is balancing routine waste management with flood-generated waste. At many places, people have joined together to clean up public spaces and collect waste. A substantial amount of resources will be needed to continue collection, transportation, storage, and disposal of this waste. Existing waste recycling facilities and dumps are affected and it will be necessary to find new sites and disposal mechanisms for each category of waste. Water pollution increased vector breeding and associated diseases make the waste burden complicated. The state will need to allocate substantial financial and human resources to manage this situation.

Hygiene

The aftermath of the floods provides a good opportunity to raise awareness at community level on good WASH practices. A rapid survey conducted by Sphere showed that people's awareness on safe water, sanitation, and hygiene had not been washed away by the floods.[12] However, people admitted to temporarily resorting to open defecation for lack of facilities. Another evidence of people's good practices is the fact that there was no outbreak of diarrhoea or cholera reported after the floods. The resilience of the people, reconstruction of sanitary facilities, and support by local government and state institutions will prevent health deterioration. Hygiene kits have been distributed, but exact figures are not known. Hygiene promoters must continue to promote good WASH practices related to household water treatment, washing hands with soap, and latrine maintenance to withstand the newly emerged risks.

WASH Recovery and Reconstruction Needs

The recovery and reconstruction needs were assessed in consultation with mandated WASH stakeholders and experts. Attention was given to assess their 'build back better' and/or disaster risk management compliance. The total recovery and reconstruction cost for the WASH sector for the first year (short-term) is estimated at INR 1,331 crore, where a clear majority of INR 766 crore (58% of the total) is for the water supply subsector. Sanitation claims INR 289 crore (22%), while the remaining INR 276 crore is allocated for SWM.

The major focus in the water supply subsector is on the recovery of piped water supply systems with a resilience component, at an estimated cost of INR 96.98 crore out of the subsector total of INR 765.65 crore. Similarly, recovery of damaged Jalanidhi schemes will account for INR 34.77 crore. A substantial allocation of INR 633.90 crore is earmarked for improving resilience of affected wells in addition to repairing damage. The sanitation subsector requires a total of INR 289.25 crore for the reconstruction of damaged toilets with a resilient design and septic tanks. The budget for recovering SWM services is primarily aimed at replacing the lost equipment and accounts for INR 276.25 crore, and includes an additional 10% for building back better with disaster resilience.

In addition to the short-term recovery and reconstruction needs pertaining to the disaster, the sector requires an additional INR 10,333 crore for its medium- and long-term service coverage and quality improvements with integrated disaster resilience. A substantive proportion, INR 6,710.82 crore or 65%, has been allocated for revamping, utilisation, and augmentation of piped water-supply schemes and making 20% of household wells resilient in eight affected districts. The remaining INR 3,623 crore represents the need to make 30% of the state's household toilets resilient (with septic tanks) in addition to the recovery and resilience of damaged toilets, and includes a component on improved septage management, to ensure that faecal sludge from septic tanks is treated and disposed safely.

While the SWM sub-sector is in need of substantial additional resources for building back better and disaster resilience, lack of data has made it challenging to propose long-term needs. It is recommended that the state prepare a 'long term costs SWM strategy' that goes beyond recovery of the sub-sector. Recommendations to inform the long-term strategy are given in the next section.

Recovery and reconstruction needs of piped water systems, off-site septage management and institutional SWM are under the purview of the government. Household wells, toilets, and SWM units are in the private domain, while the community domain aims to take care of a part of the rural piped water schemes and

[12] *Sphere India (2018), Rapid Needs Assessment Report on Kerala Floods, 2018, Sphere India, New Delhi; https://reliefweb.int/sites/reliefweb.int/files/resources/Collated%20Assessment%20report%20from%20organisation%20level%20assessment%20reports.pdf*

SWM units. It is important that the most appropriate technical solutions are linked to a strengthened governance system.

Table 3
Recovery and Reconstruction Needs and Costs

Description	Estimated Budget (INR crore)
WATER	
Repairing damage to 108 flood-affected KWA urban water schemes in 13 districts	28.69
Repairing damage to 372 flood-affected KWA rural water schemes in 13 districts	52.94
Building resilience in 8 existing KWA urban water schemes in Kottayam, Ernakulam, Palakkad, and Malappuram	4.43
Building resilience in 13 KWA rural water schemes in Kottayam, Ernakulam, Palakkad, Malappuram, and Kozhikode	10.92
Repairing damage to 583 flood-affected Jalanidhi rural water schemes in 10 districts	34.77
Repairing damage to, and building resilience in, 317,003 flood-affected wells in 6 districts: Pathanamthitta, Kottayam, Ernakulam, Thrissur, and Wayanad	633.9
Water subsector total (INR crore)	**765.65**
SANITATION	
Repairing damage to, and building resilience in, septic tanks of 11,640 flood-affected latrines in urban areas	35.39
Repairing damage to, and building resilience in, septic tanks of 83,506 flood-affected latrines in rural areas	253.86
Sanitation subsector total (INR crore)	**289.25**
SOLID WASTE MANAGEMENT	
Replacing 84,439 household pipe-compost systems with new designs with built in resilience for flood-affected households in 14 districts	9.33
Replacing 14,124 household bio-gas units with new designs with built in resilience for flood-affected households in 14 districts	20.97
Replacing 1.7 lakh household compost bins with new designs with built in resilience for flood-affected households in 14 districts	177.11
Replacing 36 community-managed plastic shredding units with new designs with built in resilience for flood-affected communities in 14 districts	3.96
Replacing 36 community-managed RRF units with resilience building for flood-affected communities in 14 districts	1.98
Replacing 95 community-managed aerobic SWM systems with new designs with built in resilience for flood-affected communities in 14 districts	5.23
Replacing 182 community managed bio-gas plants with new designs with built in resilience for flood-affected communities in 14 districts	20.02
Replacing 6,848 institutional SWM units with new designs with built in resilience for flood-affected areas in 14 districts	37.66
SWM subsector total (INR crore)	**276.25**
WASH SECTOR TOTAL (INR crore)	**1,331.15**

Sources:

1. Data on water supply: KWA Rapid Disaster Needs Assessment Summary Sheet, 19 September 2018
2. Data on sanitation: Proposal for the Construction and Repair of the Individual Household Latrines 13 September 2018, Suchitwa Mission, Government of Kerala, Thiruvananthapuram. p. 2
3. Data on SWM: Proposal for the Construction and Repair of the Individual Household Latrines 13 September 2018, Suchitwa Mission, Government of Kerala, Thiruvananthapuram. pp: 2–4

WASH Sector Recovery Strategy

The disaster should be considered as an opportunity for the WASH sector to revisit current policies and strategies to identify strengths, weaknesses, and improvement needs. Observations made during the assessment, feedback from policy makers, service providers, and stakeholders, as well as field notes are all incorporated in the recommendations in this assessment. There appears to be an enabling environment of dedicated missions, active communities, and LSGBs as well as political will. The following recommendations are made based on this.

All proposed recommendations incorporate the four pillars of a sustainable and green Kerala, focusing on integrated water resource management, sustainable and eco-sensitive solutions, inclusive and people-centred approaches, and innovative technologies through partnerships.

Short Term

1. The impact of the flood made it clear that large-scale dependence on shallow wells should be considered high-risk. Building resilience in household dug wells is a priority, especially in flood-prone areas. While this activity is the responsibility of the owner, it is advisable that the departments of water and health, together with LSGD, form a joint mechanism to rehabilitate/improve wells, and also set clear guidelines to ensure that the investment serves the objective. Engagement with the private sector should be considered while training masons, developing prefabrication concrete products to improve well resilience, etc. Awareness campaigns should be considered to communicate the need for the rehabilitation of wells.

2. The KWA, Jalanidhi, and LSGB water-supply systems of that are out of order, or are operating at a reduced capacity, should be repaired and made flood-resilient. The KWA could assist and advise all operators and managers of the schemes at hand.

3. Flood-resilient latrines should be designed for the Kerala context (can be adapted from existing models in the state and other parts of India such as Assam, Gujarat and Bihar). They should include water-sealed septic tanks (in case not connected to sewer system), to avoid contamination of nearby wells. All damaged latrines should be rehabilitated or replaced following this design. The private sector should be trained in the construction and implementation of these toilets. Increased costs may be a challenge for creating demand, and agreements could be reached with suppliers to reduce costs. The government may encourage suppliers with regulatory and financial incentives on their businesses. Increased cost requires increased personal investment and the Suchitwa Mission should hold awareness campaigns for the public on the

importance of the latrine model.

4. The SWM systems that were damaged should be rehabilitated by the Suchitwa Mission and the LSGBs. Extra effort needs to be made to clean up solid waste washed up by the floods. The SWM systems should consider a decentralised approach and follow the principles of reduce, reuse, and recycle where possible.

5. In the absence of a dedicated WASH sector coordination platform, the subsectors need to create an interim coordination mechanism for water supply, sanitation, and SWM. The platform should not only exist as a technical actor, but should take on board civil society actors, international agencies or advisory companies. In the medium term, this should be shifted to a permanent platform/structure.

6. The sector's actors have reacted quickly to the needs that surged during and after the floods. However, there is a need to prepare Disaster and Emergency Preparedness Plans for the sector as a whole and for each actor, water-supply system and treatment plant separately. All WASH operators should therefore prepare their Disaster and Emergency Preparedness Plans within one year, to be ready before the next flood season. The KSDMA could supervise these plans.

Medium Term

1. A range of sustainable and disaster-resilient (flood, drought, landslide) technical options should be explored to improve people's access to safely managed water supply. These should be eco-sensitive and built upon the principles of integrated water-resource management, incorporating a water safety and security component. Technical options could be: (i) further sanitising shallow wells (covering, lining, raising platform, and wall); (ii) promotion of rainwater harvesting at household level (can also be used to recharge wells); (iii) utilising unutilised capacity of (solar powered) piped water supply systems with treatment; and, (iv) other alternatives such as spring development, where appropriate.

Mazhapolima: Art of harvesting rainwater

Mazhapolima ('bounty of rain') is a community-based dug well recharge programme initiated by the Thrissur District Administration in 2008. It aimed to address the issue of intense ground water depletion in the district through large scale replenishment of unconfined aquifers from where open dug wells make avail water. The programme is aimed to recharge about 4.5 lakh dug wells, the source of drinking water to more than 65% of the total 31 lakhs population in the district, through community awareness and action. So far 30,000 households in the district have benefitted from the project directly.

The technology adopted for the Mazhapolima programme is roof rain water harvesting for open well recharging. The roof top rain water is led through pipes with a sand and charcoal filter at the end, filtered rain water is led to open dug wells to replenish the aquifers. The roof top is cleaned before the first rain and the first rain is flushed out along with impurities. In such recharged wells, even in scorching summers availability of adequate water is a proven fact. Wells in the coastal areas with poor water quality can be improved and recovered by backwashing it with rainwater. It reduces the salinity, turbidity and color of water from the wells in coastal areas and provide clear water.

Recently, it received the prestigious Global WAFA (Water Air and Food) awards committed to the UN Global Compact corporate responsibility initiative and its principles in the areas of clean water, hunger, sustainability, and the environment.

2. Specifically, for systems managed by water utilities, LSGBs or communities, there should be a critical check of the required capacity in the location vis-à-vis supply opportunities, to avoid unnecessary excessive costs for overcapacity and unsustainable over-pumping of water, while in other areas water supply remains insufficient. Sufficient revenue collection and technical capacity is required to ensure sustainability of the system through preventative operation and maintenance.

3. A water-quality surveillance system should be set up and led by the WASH coordination platform, but should include private and institutional water quality laboratories as well. Data on water quality should be stored in an accessible digital system and a feedback mechanism should ensure that results are shared with the relevant authorities and other stakeholders (consider the good practices of app-based systems developed in West Bengal and Maharashtra). Based on the results, appropriate actions should be taken by the responsible authorities, which requires them to be informed, to have the technical capacity and to have budget available to take action. Follow up of actions should be monitored regularly. The community should be engaged in the system (e.g. through sample collectors, water committees, social audits, etc.) and the system could be incentivised to ensure that water quality is regularly checked, including at household level.

4. Suchitwa Mission, together with LSGBs, should lead a campaign on retrofitting of latrines, with the aim to replace all leach pits with septic tanks that are resilient to floods and ground water contamination risks. This campaign should follow the approach for private sector and community engagement as mentioned in the short-term recommendations. Financial compensation should be considered for at-risk and low-income households who will require retrofitting of latrines.

5. Establishing off-site and decentralised faecal sludge management is a high priority due to the substantial number of household toilets with septic tanks and the limited capacity of sewer systems in the state. Decentralised faecal sludge management systems should be established and managed by the most appropriate department (could be the Water Resources Department (WRD) or the LSGD). Off-site septage management facilities need to be designed, planned, implemented and managed at district level, and district government bodies need to be involved in planning and execution, including the allocation of land, to sustain the system. Strict implementation of a regulatory framework is required, which will require awareness campaigns for households and sludge truck owners. A system that only allows payment once sludge is disposed of at the treatment site, could be considered as part of the framework.

6. Setting up decentralised SWM systems should be taken up as part of the building back better strategy for a green and eco-resilient Kerala. Systems should consider public–private partnership models and should be accompanied by strict adherence to a regulatory framework/protocol. Good international practices following the 'waste to resource' and 'waste to energy' principles from The Netherlands and Singapore should be considered.

7. A WASH sector coordination platform should be established under the WRD or LSGD. All actors and stakeholders should be represented, including the United Nations (UN), non-governmental organisations (NGOs) and civil society organisations (CSOs). Once operational, similar district-level platforms should be established.

8. The WASH platform should conduct a bottleneck analysis aiming at long-standing and regular improvement of governance, cooperation, task division, and sharing of technical knowledge and resources at all administrative levels, including consumer groups, with the goals of improving water supply and sanitation coverage, sustainability in the sector and consumer participation. The bottleneck analysis should be driven by the four pillars of a sustainable and green Kerala. The results should inform revision of the current State Water Policy and provide the foundation of a long-term water, sanitation and hygiene strategy and vision aiming for a green and new Kerala.

Long Term

1. The bottleneck analysis should deliver a set of recommendations for rearrangement of responsibilities, capacities, and stakeholder involvement under a clear and concise set of water governance rules, built upon the principles of integrated water resource management and eco-sensitive and sustainable solutions. Recommendations should prepare the way for decisions on a water and sanitation policy and strategy that should lead to a higher coverage of safe drinking water supply (including but not exclusive to piped water supply) under equitable sharing of costs, safe sanitation at affordable costs to households and environmentally safe SWM systems.

2. Potential to expand piped water supply should be explored, but this should be based on sustainability criteria for the supplier, counting not only cost-recovery but also an appropriate O&M budget, raising of awareness, demand creation, and disaster resilience. Plans to activate unutilised water treatment capacity should be complemented with service improvement of existing systems in terms of water quality, service time, and water pressure.

3. Adequate governance models and technical capacity needs to be in place, and specialised knowledge on water-supply technology should be harnessed at an appropriate level where full-time specialists can be permanently employed and subsequently deployed to assist in the service and management of small water-supply systems. Existing water authorities could be transformed into specialised bulk water suppliers to a range of user-groups or other entities or into service providers for technical knowledge and capacity, as well as installing institutional and technical knowledge structures to sustainably support decentralised water-supply distribution networks and administrative entities.

4. Solid and liquid waste management systems should be expanded from decentralised structures to include a centralised state-level strategy and system. They need to continue building upon the principles of 'waste to resources' and 'waste to energy'.

WASH Sector Assessment Methodology

The sector analysis is based on the data sourced from the WRD, KWA, Suchitwa Mission, Ground Water Authority (GWA), KSDMA, LSGD, the Kerala Economic Review, 2017,[13] National Census 2011,[14] and the World Bank.

The WASH sector team received a bulk data package dated 19 September 2018 on various aspects related to PDNA and WASH. Part of the quantitative data had already been formatted to support the World Bank's JRDNA, while another part was accessed through flood updates issued under each sourcing institution.

Based on the data available, the scope of the assessment was decided and further detailed data analysis was then conducted. This was followed by meetings with the

[13] *State Planning Board, Economic Review, 2017, Government of Kerala, Thiruvananthapuram.*

[14] *Office of the Registrar General & Census Commissioner, India, Census of India 2011, Ministry of Home Affairs, Government of India, New Delhi.*

respective mandated stakeholders who, in most cases, were the custodians of data shared. The team met representatives from the World Bank, GWA and KWA on 22 September, followed by meetings with representatives from the Suchitwa Mission and WRD on 24 September, and with representatives from LSGD on 27 September.

All meetings were with the higher management of the respective institutions, with participation of operational level managers. The highest-ranking official met was the Secretary of the Department of Water Resources. The discussions were productive and informative and the team was able to get firsthand information on the views of the authorities on the current situation and the way forward, and data gaps could also be (partially) addressed.

The team visited two districts (Alappuzha and Ernakulam) on 25 September, which allowed direct interaction with the affected communities, local government, NGOs in the field, district officials of the key sector stakeholders (KWA, LSGD, and Suchitwa Mission), as well as the district administration and the collector.

Assumptions were based on data received from government stakeholders, including scenarios and average unit rates.

Table 4
Assumptions Made/Rates Used

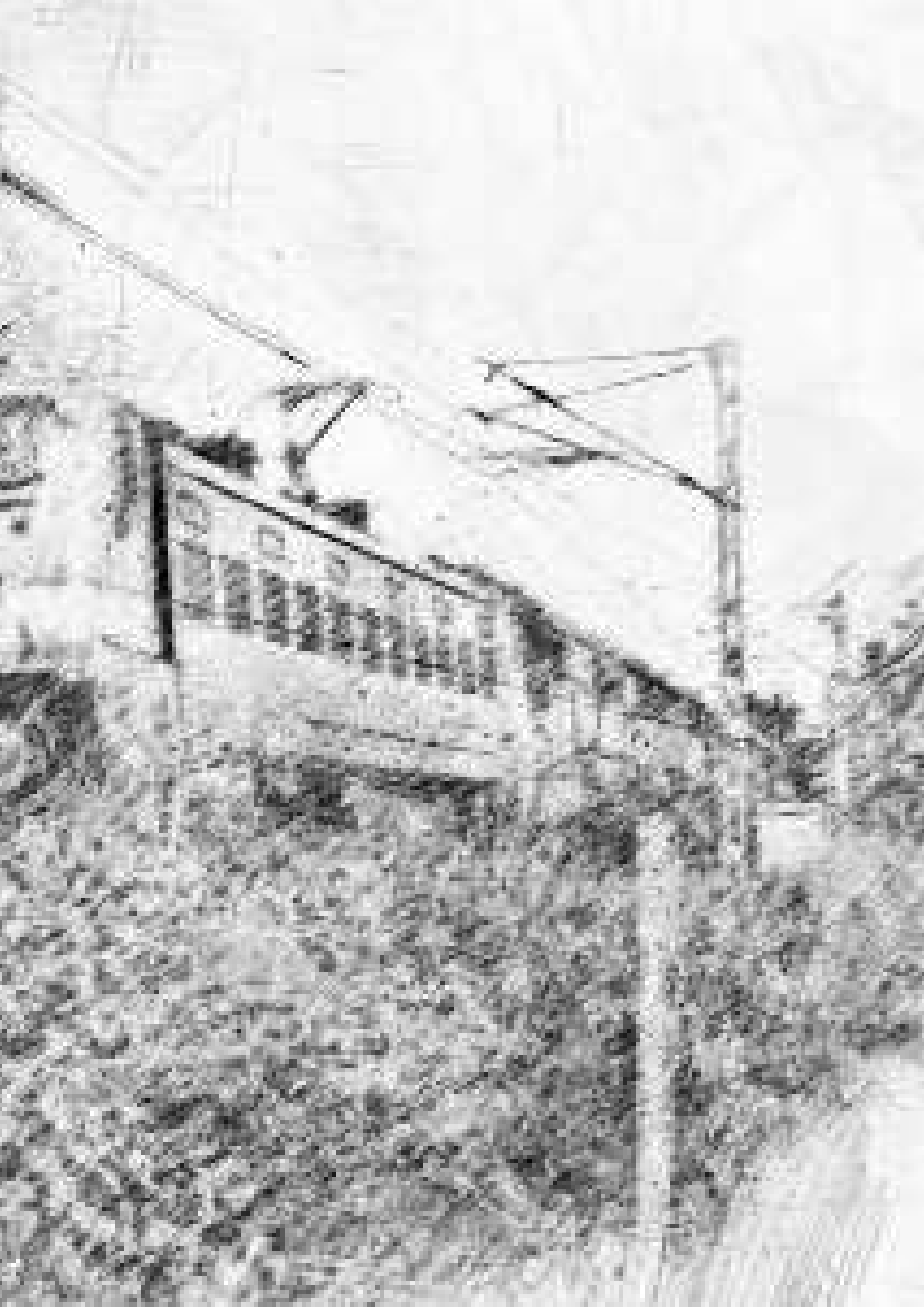
Water	Sanitation
• No. of persons per household: 4.3 (informed by Census 2011) • Damage per well: INR 12,000 • Duration of water production loss: 7 days • Tariff of lost water: INR 6 per kilo litre (according to Kerala Water Authority) • Cleaning cost per well: INR 10,000 (according to the Disaster Management Authority) • No. of wells needing resilience to be built in: 20% of unaffected wells • Resilience building cost per well: INR 5,000	• Damage per latrine: INR 15,400 • Cleaning cost per latrine: INR 5,000 • No. of latrines that need resilience built-in: 30% in all districts • Resilience building cost per latrine: INR 15,000 (additional to construction of latrine)

Solid Waste Management

- Cost per house cleaning: INR 3,000
- Cost allocated per urban ward: INR 50,000 (according to the Disaster Management Authority)
- Cost allocated per rural ward: INR 25,000 (according to the Disaster Management Authority)

Note: Other than the data drawn from the Census 2011, the Disaster Management Authority, the Suchitwa Mission, and the Kerala Water Authority, all the assumptions are made by the PDNA WASH team with their expert knowledge and validated by respective government departments.

Transport



Transport

Sector Context

The roads/highways are the dominant mode of transport in Kerala with about 75% of freight and 85% of passenger share. Kerala has a dense road network, roughly three times the national average. Of the 1.52 lakh km of road network in the state, the primary road network, which carries about 80% of road traffic and the mainstay of economic activities, includes about 1,500 km of national highways (NH), about 4,300 km of state highways (SH) and 28,300 km of major district roads (MDR). The SH and MDR networks are primarily managed by the Roads and Buildings (R&BD) wings of the Public Works Department, while the NHs are managed jointly by National Highways Authority of India (NHAI) and Ministry of Road Transport Highways (MORTH) through the NH unit of the R&BD.

Flood Impact

Based on the primary and secondary data collected by the R&BD, about 2,004 km of SH and 13,246 km of MDR across 14 districts have suffered varying degrees of damage during the recent floods. The NH wing has also estimated damage of about 580 km. The post-flood impact analysis indicates heavy damage due to land slide/slips in the roads in four hill districts of Idukki, Wayanad, Pathanamthitta, and Palakkad, whereas roads in the seven districts of Alappuzha, Thrissur, Ernakulam, Kozhikode, Malappuram, Kollam, and Kottayam have sustained flash floods, erosion, water stagnation, and other flood induced damages. The roads in Thiruvananthapuram, Kasaragod, and Kannur districts have sustained minimal damage.

About 1,090 km of SHs and 6,527 km of MDRs have sustained light damage (Table 1) and would largely require pavement rehabilitation through patching, shoulder repairs, and limited debris clearance. About 734 km of SHs and 6,463 km of MDRs have sustained medium to heavy pavement damage (Table 2) and would require re-laying of surfacing and limited repair of drainage, cross drainage, and protection works. Approximately 179 km of SH and 256 km of MDR have been fully damaged (Table 2) and would require full depth pavement reconstruction, significant repair/ reconstruction of drainage, cross drainage and slope protection works and limited road raising, and new cross drainage works.

Need Analysis

The needs analysis was carried out individually for all 14 districts across three criteria of lightly damaged, severely damaged and fully damaged. The overall cumulative damages for SH and MDR are estimated to be INR 7,647 crore (USD 1.092 billion). For the national highways managed by the NH wing of the state, an additional need of INR 911 crore (USD 130 million) has been estimated, which is proposed to be met out of the MORTH central funds.

Immediate response

Government of Kerala, using its own resources, has started providing for immediate short-term repair of pavements and cross drainage structures, clearance of debris and temporary protection works to restore the access and keep the roads trafficable. The major repair works can only be undertaken starting November

2018, post North-East monsoon. It is estimated that about INR 898 crore (USD 128 million) would be required for immediate needs. The state government should also continue rehabilitation of the lightly damaged roads, largely through measures like pothole patching, to keep the roads trafficable.

Table 1
Lightly Damaged State Highways and Major District Roads

District	Road length affected (km)		Total cost	
	Major District Roads	State Highways	INR lakh	USD million
Alappuzha	173.51	13.05	1,993	2.85
Ernakulam	1,167.83	120.78	10,902	15.57
Idukki	401.44	469.56	23,755	33.94
Kannur	783.58	13.7	4,000	5.71
Kasaragod	320.62	42	1,864	2.66
Kollam	413.61	5.3	2,576	3.68
Kottayam	528.22	62.63	3,897	5.57
Kozhikode	495	0	2,475	3.54
Malappuram	427.16	192.76	15,859	22.66
Palakkad	691.79	137.77	11,072	15.82
Pathanamthitta	299.67	0	1,543	2.2
Thiruvananthapuram	274.48	14	1,536	2.19
Thrissur	505	18.6	7,163	10.23
Wayanad	44.74	0	1,154	1.65
Total	**6,526.66**	**1,090.15**	**89,788**	**128.27**

Recovery, Reconstruction and Resilience building needs

The need analysis was carried out using the current (2016) schedule of rates, suitably adjusted with district wise indices issued by Government of Kerala during October 2017. The individual item and block rates were also calibrated with current market rates operating in ongoing World Bank funded Second Kerala State Transport Project. To enhance disaster resilience, measures such as replacement of all damaged pipe culverts with box/slab culverts with larger waterway, additional slope protection, lined drainage, downstream erosion protection of CD structures, batter slope correction, and limited raising of road stretches were included in the needs assessment.

Recovery Needs (immediate to short term):

The needs assessment indicates that 7,197 km of roads (734 km of SH and 6,463 km of MDR) are severely damaged but recoverable. About 36 major and 178 minor bridges, 362 culverts, 43 km length of retaining wall and 169 km of road side drainage works are severely damaged. It is estimated that about INR 4,146 crore (USD 592 million) would be required for recovering severely damaged SH and MDRs.

Table 2
Severely Damaged State Highways and Major District Roads

District	Road length affected (km)		Total cost	
	Major District Roads	State Highways	INR lakh	USD million
Alappuzha	260.26	0	12,385	17.69
Ernakulam	780.85	71.43	35,545	50.78
Idukki	1,798.28	158.78	122,973	175.68
Kannur	126.75	45.92	11,157	15.94
Kasaragod	92.75	48.14	9,247	13.21
Kollam	285.05	8.3	18,018	25.74
Kottayam	571.97	65.63	25,886	36.98
Kozhikode	486.98	16.02	23,339	33.34
Malappuram	299.41	28.04	12,850	18.36
Palakkad	466.32	4.5	22,060	31.51
Pathanamthitta	227.17	8.2	57,717	82.45
Thiruvananthapuram	355.3	33.7	16,884	24.12
Thrissur	227	171.35	24,411	34.87
Wayanad	485.39	74.33	22,156	31.65
Total	**6,463.48**	**734.33**	**41,462.7**	**592.32**

Reconstruction and Resilience Needs (short-medium term)

The needs assessment indicates that, overall 435 km of roads (179 km of SH and 256 km of MDR) are fully damaged and need to be reconstructed. Two major and 28 minor bridges, 208 culverts, 20 km length of retaining wall and 39 km of road side drainage works are fully damaged. It is estimated that about INR 2,603 crore (USD 372 million) would be required for reconstructing damaged SH & MDRs. This amount also includes the estimates for resilience needs of about INR 1,732 crore (USD 247 million) to enhance disaster resilience works, where additional 62 km of raising of roads, 157 new culverts, 142 km length of new slope stability/protection measures are proposed. Reconstruction of bridges/culverts needs to be assigned priority followed by adequate hill slope protection and flood protection works.

Table 3
Fully Damaged State Highways and Major District Roads: Resilience Building

District	Road length affected (km)		Total cost	
	Major District Roads	State Highways	INR lakh	USD million
Alappuzha	51.61	45.474	62,092	88.7
Ernakulam	0.00*	0.00*	4,239	6.06

District	Road length affected (km)		Total cost	
Idukki	118.7	117.25	66,881	95.54
Kannur	0.00*	0.00*	108	0.15
Kasaragod	0	0	0	0
Kollam	0	0	0	0
Kottayam	21.67	5.5	49,502	70.72
Kozhikode	0.00*	0.00*	3,848	5.5
Malappuram	0.00*	0.00*	8,908	12.73
Palakkad	27.1	0.00*	10,967	15.67
Pathanamthitta	14	0.00*	1,404	2.01
Thiruvananthapu-ram	0	0	0	0
Thrissur	0.3	3	19,876	28.39
Wayanad	22.2	8.2	32,498	46.43
Total	**255.58**	**179.42**	**260,323**	**371.89**

**Note: The cost includes the cost of additional resilience measures.*

Recovery Strategy

Short Term Strategy:

Aimed at restoration of traffic and arresting further asset deterioration

- Patching, shoulder repairs and limited debris clearance

Medium to Long-Term Strategy:

'Building Back Better' with rejigged approach to planning and design with disaster and climate resilience

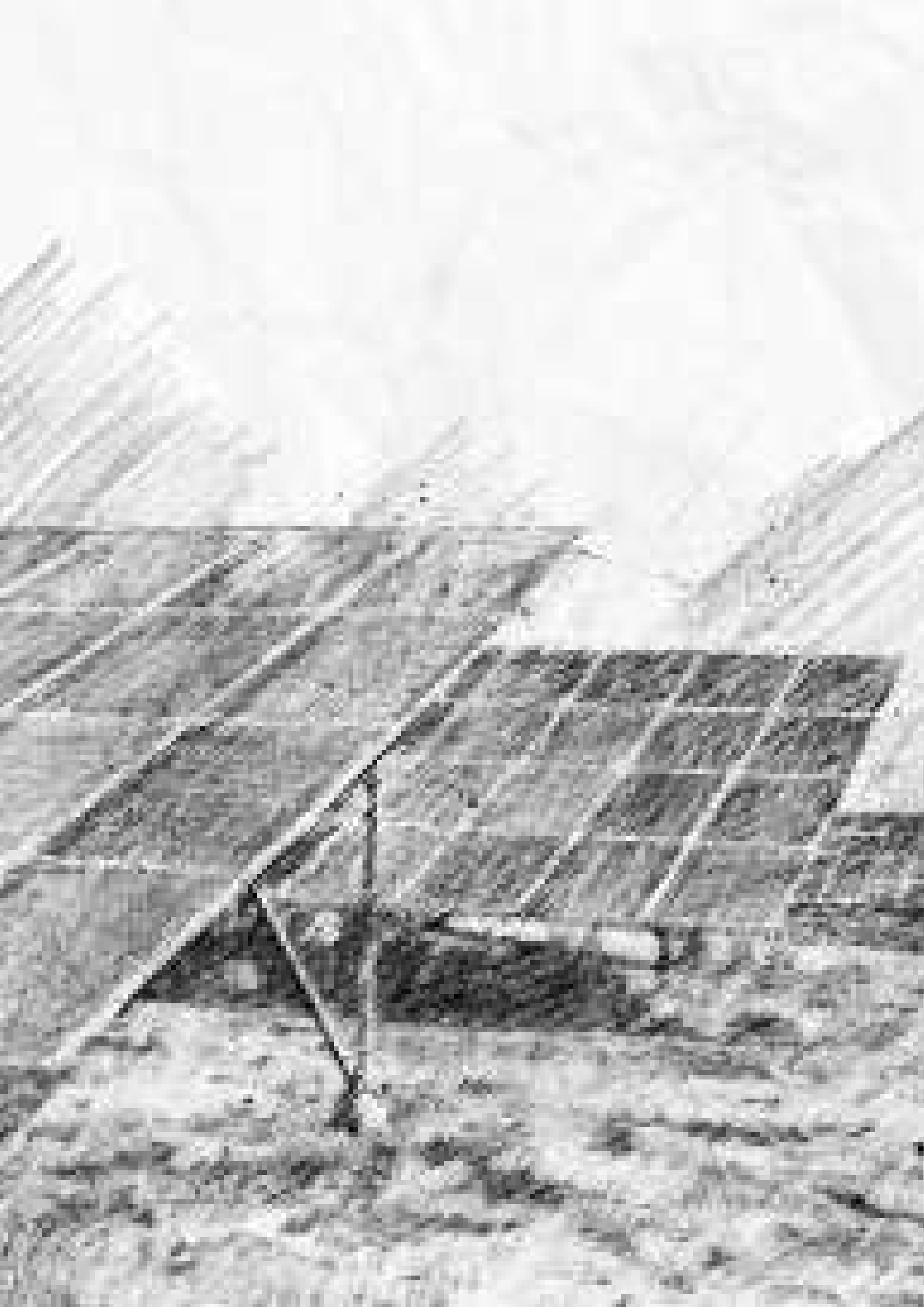
- Site-specific climate adaptations based on flood and landslide hazard vulnerability assessment, i.e., flood maps, landslide zonation based on geological and geomorphological studies, and superimposed micro-climate data.
- Adopting 'life cycle cost' approach and 'environmentally optimised design' measures for rehabilitation and reconstruction of road pavement, i.e., long-life pavement, rigid pavements, semi-rigid pavements, soil stabilization, use of NRMB and other local materials.
- Retrofit CD structures with downstream erosion protection (e.g. aprons).
- Design new CD structures using latest flood and hydrological data with climate projections.
- Packaged landslide protection works—combination of gabions, breast wall, and other slope protection using bio-engineering measures (e.g. geo-grids with grass sodding/rip-raps) and improving coverage of road side plantations.

- Augment contracting capacity in the state with specific capacity building measures, targeted outreach program to contractors in the neighbouring states, setting up an equipment pooling and leasing arrangement.

Technical Assistance

- Road network level vulnerability assessment with specific focus on geo-hazard and flooding risks and development of climate proofing framework (USD 3 million).
- Enhance existing GIS mapping of the highway network with details of the river systems, geo-hazard zones and micro-climates (USD 1.0 million).
- Develop Center of Excellence in PWD for climate and disaster resilience (could be accommodated under KSTP).
- Develop bio-engineering / horticulture cell within PWD (e.g. in Himachal Pradesh) to develop specifications and promote use in slope stability management.

Power



Power

Sector Context

Kerala generates power from four sources— hydro power, thermal power, wind power, and solar power. Of these, hydel and thermal are the dominant modes of power generation. The Kerala State Electricity Board Limited (KSEB Ltd), a government company incorporated on 14 January 2011 under the Companies Act, 1956, which started its operations as an independent company with effect from 1 November 2013, is responsible for generation, transmission and distribution in the state. For administrative convenience, the distribution area of KSEB Ltd is divided in to different regions. Presently, there are four regions viz. South, Central, North, and North Malabar. The Generation Strategic Business Unit under KSEB operates and maintains 37 hydroelectric generating stations, 2 thermal power plants, a wind farm at Kanjikode and few non-conventional stations spread across the state, with a total installed capacity of 2,234 MW. Renovation, modernisation and up-rating of the old hydroelectric projects which have surpassed their useful life are also being carried out by this wing.

Flood Impact

KSEB Ltd sustained losses in all fronts viz. generation, transmission, distribution and by way of loss of revenue due to loss of load. Five major hydropower generation stations and 14 small hydel stations were affected due to the flood and subsequent landslide. About 22 substations were flooded, damaging the control system; 10 Power Transformers were submerged; many transmission towers were toppled; 10 major transmission corridors became dysfunctional due to the flooding. Massive flood has hit the distribution infra badly. Power distribution in 300 odd electrical sections in seven districts were shattered. More than 1,700 distribution transformers were either submerged or damaged. More than 10,000 distribution substations were switched off to avoid mishaps. Feeding from 16,158 distribution transformers was affected. Service to 25.60 Lakh consumers was disrupted in the calamity.

Damage Analysis and Immediate Response

It is estimated that to restore normalcy in power distribution, over 1,700 distribution transformer stations and about 5,300 km distribution lines will have to be reconstructed. More than 10 lakh damaged poles also require replacement. It is estimated that 3 lakh single phase energy meters and about 50,000 three phase energy meters are damaged due to submergence and need replacement. In addition, new governor, excitation system, SCADA, control panel, excitation system, relay and control panels also need replacement.

Government of Kerala, using its own resources, has started providing immediate short-term repair of energy access, clearance of debris, temporary connection etc. Most of the restoration works were done with the immediate intent of restoring the supply to the consumers without insisting on standard procedures and practices, as a temporary measure, sometimes by extending supply with the help of weatherproof wire, sometimes without connecting meters and in many cases by bringing in prewired essential supply points. Back-feeding from distant areas have been resorted to in many cases. A major portion of the flooded transformers with

considerably decreased residual life (due to weakened insulation) have been put back into service after reconditioning as a temporary measure. These transformers will have to be replaced at the earliest. Energy meters have been bypassed in many cases and connection restored with the existing faulty meters in others. A large number of transformers and meters will therefore be required. There are a lot of houses where the wiring circuits were damaged and found unsafe, and where essential supply points were given from prewired kits.

Reconstruction, Recovery and Resilience-Building Needs

The needs are based on the lessons learnt from historical experiences of 'building back better' that inform the design of a comprehensive recovery framework in Kerala. The framework would prepare the groundwork to improve the resilience of state infrastructure and its communities to future natural disasters. Needs assessment indicates that overall distribution sector would need to be significantly reconstructed along with major generation and transmission corridors. Additionally, to enhance disaster resilience, technological interventions are suggested. Overall reconstruction cost in generation, transmission and distribution sectors presented in Table 1.

Table 1
Sector Reconstruction/Recovery Needs

Activity	Typology for reconstruction/recovery	Reconstruction/Recovery	
		INR lakh	USD million
Generation	Civil works, Excitation system, SCADA, Control Panel	8,085	11.6
Distribution	Poles, Distribution Transformers, Meters, Weatherproof cables, ELCBs.	24,245.1	34.8
Transmissions	Power Transformers, Conductors, Disc Insulators, Circuit breakers, Lightning Arrestors.	2,977.1	4.3
Total		**35,307.2**	**50.7**

Recovery Needs

Medium to short term recovery strategy should focus on improving the planning, design, construction, and operation and maintenance practices to embrace 'synonymous with technology' principles, particularly in the areas with distribution and flooding risks. The state must start evolving newer transmission technology areas.

Resilience needs

The KSEB Ltd has decided that the rebuilding activity will not be a business as usual but will follow the principle of building back better. Technology solutions such as (i) use of distribution poles higher than maximum flood limits firmly grouted on a solid foundation; (ii) application of SCADA based flood prediction system; (iii) climate proofing of distribution transformers; (iv) use of multi circuit towers; and (v) dam improvement technologies are recommended.

Recovery Road Map

Short to Medium Term (estimated amount USD 50 million, that is INR 350 crore)

- Restoration of supply to consumers on war footing
- Back feeding from distant areas
- Sourcing of equipment for continuity of connections

Medium to Long Term (build back better)

- Long term transmission plan
- Disaster resilient construction to ensure supply redundancy
- Strengthening of power evacuation system with focus on enhancing reliability of power supply blended with loss reduction
- Extending smart meter service to remote areas
- Technology based dam management inter alia silting aspects
- Application of SCADA/climate based flood prediction system

Irrigation and Water Resources

Irrigation and Water Resources

Sector Context

Kerala receives average rainfall of 3,070 mm annually, 70% of which falls during the south-west monsoon (June–September). The state has 44 rivers with a total length of 3,132 km and average annual river flow of 57.6 billion cubic meters (BCM), among which, only three rivers flow east and the rest flow west into the Arabian Sea. The Periyar is the longest river (244 km), and the Bharatapuzha, Pamba, Chaliyar are other major rivers. The state has developed important water resources and irrigation systems to support various uses of water, including for agriculture, domestic use, fisheries, and river transport. The state has 76 dams (excluding four dams that lie in Kerala but are managed by Tamil Nadu)[1], and over 18,000 ponds, creating a combined storage capacity of 5.8 BCM. Seven of the large dams have a combined storage of 74% of the total live storage. Idukki has the largest dam with 1.46 BCM of storage. Kerala State Electricity Board (KSEB) operates 58 dams with hydropower facilities and the Water Resources Department (WRD) owns 16 dams for irrigating ayacut areas of 5,670 km^2, and 2 dams are owned by Kerala Water Authority.

The Irrigation Department is also in charge of flood protection and maintenance of natural rivers and irrigation canals. Primary and secondary irrigation canals have a total length of over 4,500 km. The total length of river embankments, dyke, and bunds is approximately 12,500 km. The backwaters are made up of a chain of brackish lagoons and lakes that lie parallel to the coast. Vembanad is the largest lake and has canal network with an area of 2,033 km^2. It is a Ramsar wetland and harbours paddy cultivation and fish ponds. The length of the Kerala coastline is 580 km, of which around 350 km is protected with sea walls and groynes.

Flood Impact

The extreme rainfall in early to mid-August 2018 caused severe flooding and landslides across the entire state, severely affecting people's lives and damaging many public and private properties in August 2018. Damage and erosion to river banks occurred, irrigation canals and drains silted up, canal banks collapsed and many structures such as cross drains and gates were damaged. Inspection and approach roads to these irrigation structures were also damaged, in addition to severe damage occurred to coastal protection structures that led to salt water intrusion into the Vembanad Lake area.

Due to the excessive rainfall in the preceding months, years of siltation leading to reduction in the storage volume in reservoirs and lakes, the 'room-for-the-river' hotspot Vembanad lake was able to absorb only 0.6 BCM out of the 1.63 BCM inflow in August 2018.[2] Due to existence of backflow conditions at the river mouths constraining river releases into the ocean, over 480 km^2 of land was inundated—nearly three times the normal magnitude of monsoon flooding. The heavy rainfall also removed the top soil in the hills and upland areas leading to erosion and landslides. As a result, the hills lost much of their natural capacity to absorb rainwater. In several places in Idukki, Wayanad, Kozhikode, Pathinamthitta and Kannur districts, the topography of the land has been altered beyond recognition.

[1] *As defined by ICOLD. CWC, National Register of Large Dams, 2012*

[2] *https://www.thehindu.com/news/national/kerala/severe-storm-occurrences-caused-floods-cwc-report/article24917702.ece*

Damage Analysis

For this analysis, the water infrastructure is divided into three parts: flood protection, irrigation and water resources. Flood protection infrastructure refers to embankments, weirs, sluice gates, and the coastal flood protection of natural channels. Irrigation infrastructure refers to canals, drains and the associated hydraulic infrastructure, pumps and other equipment of artificial channels. Water resources infrastructure refers to dams, barrages, and associated infrastructure.

For flood protection, approximately 886 km of river banks and 103 km of coastal protection and drainage systems were severely eroded, damaged, or heavily deposited with debris. In many cases, roads and buildings adjacent to the flood protection construction, and as associated equipment/structures like weirs, gates and dykes were also damaged. Over 1,640 km of main irrigation canals, over 540 km of canals, and more than 350 hydraulic structures were damaged, affecting the water supply in the command area for irrigation for the oncoming winter season.

With respect to water resources, most damage occurred in smaller storage systems like minor dams and storage ponds. No damage has been reported to large and medium dams. Nearly 200 storage ponds and 70 minor dams were damaged. Several gates are now non-operational or are experiencing severe leakage due to damage to parts of the structures. Approach roads leading to dams, site offices, and residential areas are heavily damaged. The physical damage to flood protection, irrigation and water resources infrastructure is summarised in Table 1.

Table 1

Physical Damage in Irrigation and Water Resources Sector

Sector	Item	Unit	Quantity
Flood Protection	**Bunds**	**km**	**886**
	Regulators etc.	No	42
	Weirs/Check dams	No	142
	Coastal protection, drainage systems	km	103
	Others (e.g., dykes)	No	76
Irrigation	**Canals**	**km**	**1,642**
	Distributaries (distribution channels)	km	543
	Structures (sluice gates, weirs, pump, intake well, etc.)	No	357
	Canal side access/ inspection roads	km	50
	Other (e.g., lift stations)	No	248
Water Resources	**Storage ponds and tanks**	**No**	**192**
	Major dams *	No	0
	Medium dams *	No	0
	Minor dams	No	70
	Operating systems, monitoring, and gauging systems	No	27
	Others (buildings, etc.) nos.	No	75

** May needs further technical investigations*

Reconstruction, Recovery and Resilience Building Needs

Recovery Needs: Investments required in response to the flood emergency have been identified for flood protection, irrigation and water resources. These include repair of damaged and breached: river banks, tank bunds, ponds, coastal protection structures, irrigation and drainage canals; and approach roads to dams and canals; as well as removal of silt/debris deposits. The winter irrigation season is commencing in January therefore, all damaged irrigation and drainage canals and structures should be repaired on priority.

Installation of real-time monitoring of major rivers and water storage structures should also be undertaken on priority. Surveys, designs and studies for remodelling and repairs of water resources infrastructure need to be carried out within a one-two year period to allow commencement of planning of long-term interventions. In addition, the following multi-district efforts are also identified as short- and medium-term needs. The total cost of water sector recovery works is estimated at USD 211.9 million, that is, INR 1,483 crore (Table 2).

Table 2
Irrigation and Water Resources Sector Short- and Mid-Term Recovery Needs

District	Flood Protection (INR crore)	Irrigation (INR crore)	Water Resources (INR crore)	Study and Planning (INR crore)	Short and Mid-Term Total	
					(INR crore)	(USD million)
Alappuzha	325	7	12	0	344	49.1
Ernakulam	61	27	13	0	102	14.6
Idukki	66	5	3	0	74	10.6
Kannur	26	11	0	0	38	5.4
Kasaragod	8	0	0	0	8	1.2
Kollam	16	4	0	0	20	2.9
Kottayam	40	7	3	0	50	7.2
Kozhikode	89	20	0	0	109	15.6
Malappuram	48	1	0	0	49	7
Palakkad	24	41	14	0	79	11.2
Pathana-mthitta	81	20	5	0	107	15.2
Thiruvanan-thapuram	75	3	0	0	78	11.1
Thrissur	85	39	9	0	133	19
Wayanad	18	10	0	0	28	4
Multi-district	200	30	0	35	265	37.9
Total	**1,162**	**226**	**60**	**35**	**1,483**	**211.9**

Hydromet and flood modelling - The 2018 flood event confirmed the importance of flood forecasting with the use of real time water resources monitoring information for generating warnings, planning evacuations, and other related decisions. In addition, flood modelling (impact forecasting) should be conducted to prepare inundation mapping, flood zoning, and flood contour maps to avoid settlement in flood zones. Conducting bathymetry and river cross sections surveys is also critical for developing accurate modelling, to understand river conveyance/carriage capacity for high flow conditions, especially with dam discharges during the August 2018. The verified flood modelling should be further used to plan, evaluate, and design flood protection measures. This activity should be done in close coordination with the ongoing interventions under National Hydrology Project (NHP).

Mechanical works – The 2018 flood event caused significant damages to the mechanical equipment and structures. The mechanical wing of the department needs additional budgetary allocations to manage the increased number of services, operations and maintenance requirements.

Technical studies and master planning – There are several potential flood protection, irrigation, and water resources projects that would strengthen flood resiliency in the flood affected areas across the state and they are listed in the following section. To better cost, verify the importance and proper sizing of projects, technical studies and master planning need to be conducted in short to mid-term period.

Resilience needs: Three areas are identified to strengthen long-term resilience of the water resources and irrigation sector based on the site visits and discussion with district and state governments. These include, but are not limited to: (i) canal erosion and sedimentation management; (ii) dam and barrage operations; and (iii) coastal zone management, among others.

The state developed the following activities that are aligned with the identified long-term needs. Pricing for each activity is not provided as approximate cost can only be identified after proper technical studies and master planning are completed during in the short to mid-term period.

- ***Additional flood protection and coastal zone management*** Upon completion of flood modelling, verification and generation of flood maps, the flood models can be used to identify and design necessary flood protection measures such as additional storages, river training, embankments, etc. Major types of work that the state identified include river and thodu[3] rejuvenation, storages including ponds and dams, lift stations, regulators, and flood bunds. Coastal zone erosion management is another long-term activity required, considering the severity and extent of the coastal damages caused by the August 2018 floods. Similarly, the Pampa area development plan prepared by Travancore Devasom Board should be updated considering the impacts of the floods before commencement of any reconstruction in the area.

- ***Irrigation Project to Strengthening Flood Resiliency:*** The August 2018 flood revealed that canal banks and cross-drainage systems including regulators, weirs, and lift stations need additional strengthening to resist high-flow conditions, as any canal breach can slow down dewatering after flooding and increase damages in agriculture and fisheries. There was a case where barrage gates were too old to open during high-flood conditions. Therefore, dams and barrages also need technical investigations to identify upgrading needs of gating structures and other instrumentation, in coordination with the ongoing Dam Rehabilitation and Improvement Project (DRIP) programme.

[3] *Small water channels*

- ***Kuttanadu Flood Control Works:*** To strengthen flood resilience in Kuttanadu region, renovation and extension of Alappuzha–Chenganassery Canal and modernisation of Thottappally Spillway were identified as long-term priorities. Master planning of the Kuttanadu region needs to be initiated and feasibility of multi-sector interventions prepared to guide systematic planning and implementation of development activities in the area.

Most of the identified areas have been included under NHP or DRIP Project, so close coordination with these national level projects is critical when preparing these long-term activities.

Environment

Environment

Summary

Kerala is a large and environmentally diverse state, stretching over more than 500 km N-S, sandwiched between the Lakshadweep Sea and the southern end of the Western Ghats. It has three natural regions: coastal lowlands, midlands, and highlands; and four major rock formations—crystalline, sedimentary, laterite, and recent and subrecent sediments forming the low-lying areas and river valleys. There are 10 soil types derived from the laterite base and 12 distinct agro climatic zones.[1]

Kerala has 44 river basins, 1,750 sub-basins and 4,452 mini watersheds. While none of the rivers is nationally considered 'major', there are four 'medium' rivers 150 km–250 km long: Chaliyar, Bharathapuzha, Periyar, and Pamba rivers.[2] Many rivers do not have a continuous floodplain. The coast is characterised by a chain of back waters, mostly interconnected by natural or manmade canals. There are 53 backwaters and 7 lagoons listed in Kerala. There are more than 150 wetland areas greater than 0.5 km^2, two-thirds of which are coastal and one-third, inland. Three wetlands are registered under the Ramsar Convention: Ashtamudi and Vembanad–Kole wetlands and Sasthamkotta Lake.[3] There are 33 Important Bird Areas (IBAs).[4]

The forests of the Western Ghats are among the finest non-equatorial tropical wet evergreen forests in the world and one of the richest centres of endemism owing to their isolation from other moist areas. In 2012, a cluster of seven areas was included in the World Heritage List, including four clusters in Kerala—the Periyar, Anamalai, Nilgiri, and the Agasthyamalai sub-clusters. The latter two are also the core areas of the Nilgiri and Agasthyamalai Biosphere Reserves. The range comprises the major portion of the Western Ghats and Sri Lanka hotspot, which is one of the 34 global biodiversity hotspots for conservation identified by the Critical Ecosystem Partnership (CEPF) and one of the eight 'hottest hotspots'. The state has also identified 5,790 sacred groves in five districts,[5] though there were reported to be as many as 15,000 long back.[6]

The state has significant mineral deposits, but large-scale mining activities are confined to a few minerals.

Recent disasters have demonstrated multiple linkages between environment and disaster risk. Several environmental sectors were visibly and severely impacted by the floods and landslides. But on the other hand, it also demonstrated that wherever the environment remained undisturbed or less disturbed, damage to human life and property was less.

The impact on forest ecosystems is marked by soil erosion, loss of humus, and widespread destruction of the riverine vegetation. There were limited losses of certain larger animals like tigers and elephants from the forests. Post-disaster observations on birds, amphibians, reptiles and fishes indicate losses, which will be reflected in the population in future. Experts expect heavy damage to the habitat and a number of indicator species, which will have long-lasting effects on the services provided to humanity by ecosystems. At the same time, the number of landslides in the forests was much less compared to areas in the high ranges, which were open to forests and other human activities. In particular, road construction is seen as a prime reason behind hundreds of landslides.

[1] *KSCSTE (2007), State of Environment Report: Kerala, Kerala State Council for Science, Technology, and Environment, Thiruvananthapuram, Kerala. http://www.moef.nic.in/soer/Kerala_SoE2007-V1.pdf;*

[2] *Ibid.*

[3] *Ibid.*

[4] *Rahmani, A.R., Islam, M.Z. and Kasambe, R.M. (2016), Important Bird and Biodiversity Areas in India: Priority Sites for Conservation (Revised and updated), Bombay Natural History Society, Indian Bird Conservation Network, Royal Society for the Protection of Birds and Bird Life International (U.K.). pp. 1992 + xii*

[5] *Institution of Foresters Kerala (2013), A Comprehensive Study on the Socio-economic & Cultural Aspects of Sacred Groves in Kerala – Report No. 1, Thiruvananthapuram District, report submitted to Kerala Forest and Wildlife Department, Trivandrum.*

Institution of Foresters Kerala (2015), A Comprehensive Study on Sacred Groves in Kerala – Report No. 2, Kollam District, report submitted to Kerala Forest and Wildlife Department, Trivandrum.

Institution of Foresters Kerala (2016a), A Comprehensive Study on the Socio-economic & Cultural Aspects of Sacred Groves in Kerala – Report No. 3, Kozhikode District, report submitted to Kerala Forest and Wildlife Department, Trivandrum.

Institution of Foresters Kerala (2016b), A Comprehensive Study on the Socio-economic & Cultural Aspects of Sacred Groves in Kerala – Report No. 4, Thrissur District, report submitted to Kerala Forest and Wildlife Department, Trivandrum.

[6] *Ward and Conner (1827), Memoirs of the survey of Travancore and Cochin State. Cited from Pushpangadan et. al., 1998.*

The recovery strategies should be site specific, eco-friendly and based on a landscape and ecosystem approach for disaster risk reduction. It is suggested that native vegetation be used for riverine area protection and slope stabilization. The existing roads increase the risk of landslides; hence a review of road systems by geologists and hydrologists is suggested so that an eco-safe road construction methodology is applied. Road construction and other human intervention in slopes above 22 degrees should be avoided. Approaches such as "room for the river" and "making space for water" should be the basis for addressing flood protection. Removal of sand deposited as a result of floods should be based on site specific studies and suggestions by the experts. The present practice of protecting landslide and coastal erosion prone areas with concrete structures, granite rocks etc. may be replaced with natural methods like vegetating with suitable plant species. Priority should be given to such identified areas and actions taken. The affected villages, harbouring very rich biodiversity and agro-biodiversity, should be monitored for various parameters including biodiversity, soil and water resources based on which an Action Plan is prepared, discussed and implemented.

So far, no systematic studies have been undertaken with respect to contamination or chemical pollution due to the flooding of major industrial areas such as Udyogamandal and Edayar in Ernakulam district. International experience shows that contamination of land, groundwater as well as riverine sediments is inevitable under the circumstances. Industrial facilities and surrounding areas should be presumed to be contaminated and a comprehensive soil and groundwater assessment should be initiated.

The disaster produced large quantities of debris, as most contents within households, offices and commercial facilities turned into waste when exposed to water for extended periods. The floods also damaged household and community level facilities for composting and waste management. In addition, solid waste was also produced in the tens of thousands temporary rescue and relief camps, which were operated during the disaster period. Assets and infrastructure worth INR 26.4 crore were estimated to have been lost in the forestry sector. INR 147.85 crore is estimated as required for recovery programmes in the environment sector.

Recent disasters cannot be exclusively attributed to the impact of climate change. However, climate change scientists have indeed forecast increased rainfall intensity in the state. A number of coastal cities in Kerala are prone to waterlogging and periodic flooding will become routine due to increased inflow as well as sea level rise. Agriculture and related activities in Kuttanad, which is below sea level, will also be severely affected by climate change. Regardless of whether the present event is linked to climate change, the flooding and the preceding tropical cyclone Ockhi, may portend the extreme events that may be expected in the future. Hence, activities for assessing vulnerability to climate change and building mitigation and adaptation strategies should be an integral part of the 'New Kerala' being envisaged in the post-disaster setting.

Pre-Disaster Context

Scope of the assessment

Environmental issues are of particular significance in Kerala, given the environmental diversity in the state and its close ties with livelihoods. In the context of the disaster, this chapter covers:

1. Forests and biodiversity
2. Water pollution

3. Land contamination

4. Climate change

In addition to the entire landmass of Kerala, where heavy rain caused direct or indirect environmental impact, this assessment also refers to the potential impact along Kerala's coastline, where sediments and waste washed off from the upper terrains were deposited.

Forests and Biodiversity

Kerala is wedged between the sea and the Western Ghats along coastal plains no more than 120 km wide at any point. The highest point in Kerala is 2,695 m and it receives more than 3,000 mm of rain per annum. As many as 44 rivers run through Kerala and drain into the sea.

Kerala, because of its location in Western Ghats and geographical peculiarities, is blessed with diverse ecosystems—tropical wet evergreen, deciduous, high altitude montane grassland (shola forests), fresh and brackish water aquatic systems, wetlands, mangroves and the sea coast. Kerala is traditionally classified into three distinct geographical zones: Malanad (high ranges), Idanad (plains), and Theerapradesham (coastal areas).

The high ranges are a part of the Western Ghats, which is an internationally acclaimed biodiversity hotspot and recognised as a World Heritage site, contributing to the cultural and natural heritage of the state. The Western Ghats region of Kerala covers nearly 21,856 km^2 (56% of the total geographical area of the state) of which 11,524 km^2 is forested area.[7] The entire Western Ghats region is a treasure trove of ecosystems rich in biodiversity. The Western Ghats is also the source of 44 rivers, of which 41 flow westwards to the Lakshadweep Sea and three rivers flow east.[8]

Riparian areas are transitional zones found along the stream banks, lake shores, and wetlands and these unique ecosystems have specific adaptations for living in repeatedly flooded environments. Riparian areas provide critical habitats for wildlife, especially fishes. Riparian areas ensure that the sediments are settled before they reach the watercourse. This helps reduce stream bank erosion and also maintains stable stream channel geomorphology. In addition, they provide shade, stabilising the temperature sheltering smaller fishes.

The importance of riparian ecosystems to protect the integrity of the river was not fully understood by experts or communities in Kerala. In the past, when there were no dams, all rivers in Kerala used to have annual flooding events in which the banks were inundated. Once dams were constructed in the upstream area, there were no annual flooding events and building houses along water bodies became a matter of prestige due to the water-front views that they allowed. Riparian forests were cut down and other engineering structures were built to stabilise and beautify the river banks. All these might turn out to be causes of major damages during the floods.

Protected Areas form about 28.4% of the forest areas.[9] There are two tiger reserves, five national parks, three bird sanctuaries, one community reserve and 12 wildlife sanctuaries in Kerala. In addition, the state also has two biosphere reserves: the Nilgiris and the Agasthyamalai Biosphere Reserve (covering 3,283 km^2), and four elephant reserves viz. Wayanad, Nilambur, Anamudi and Periyar. The Kerala Forest Department has also identified high value biodiversity areas.

The forests of the Western Ghats are among the finest non-equatorial tropical evergreen forests in the world and one of the richest centres of endemism owing to their isolation from other moist areas. In 2012, a cluster of seven areas was

[7] Institute for Climate Change Studies (2018), State Action Plan on Climate Change: Kerala (Revised), submitted to Department of Environment and Climate Change, Government of Kerala.

[8] KSCSTE (2007), State of Environment Report: Kerala, Kerala State Council for Science, Technology, and Environment, Thiruvananthapuram, Kerala. http://www.moef.nic.in/soer/Kerala_SoE2007-V1.pdf;

[9] Government of Kerala (2018), Administration Report 2016-2017, Kerala Forest Department.

included in the UNESCO World Heritage list, including five sub- clusters in Kerala; the Thalakkavery, Nilgiri, Anamalai, Periyar and Agasthyamalai sub-clusters.[10] The baseline situation of the Western Ghats is stated to be one of 'significant concern' by World Conservation Union (IUCN). High threats identified in the IUCN World Heritage Outlook are livestock farming/grazing and agriculture/aquaculture within the property; unsustainable extraction of fuel wood, non-timber forest products and freshwater biodiversity; tourism beyond the carrying capacity, including massive pilgrimage tourism within the property; renewable energy infrastructure including hydropower and potentially wind power; intense hunting pressure, and increasing human–wildlife conflict; impacts of freshwater pollution including from mining or polluting industries; avalanches/ landslides, storms/flooding caused by more extreme events and changes in land-use and tree cutting, invasive non-native/ alien species, hyper-abundant species; risk of encroachment due to economic development, population growth and rising demand for power, agricultural commodities, and minerals. The IUCN also lists the potential cascade effect of increased degradation on the monsoon processes. The changes in microclimate could be exacerbated by local changes in the regulation of the microclimate by the Western Ghats.

The state has three Ramsar sites. Though Vembanad and Kole are considered one, they are kilometres apart and in two districts. The Kole wetlands alone cover about 136.32 km^2, spread over Thrissur and Malappuram districts, extending from the northern banks of Chalakudy River in the south to the southern banks of Bharathapuzha River in the north.[11] The Vembanad and Kole wetlands are the rice bowls of Kerala and are rich in biodiversity. The Ashtamudi wetland is 1,860 km^2 and Sasthamkottalake is 11.3 km^2. [12]

Kerala has a coastal line of about 590 km,[13] constituted by a long stretch of backwaters and a series of lagoons running parallel to the sea.[14] There are also estuaries and river deltas, including the Kuttanad area which is below sea level and reclaimed for farming. Though mangroves form one of the best ecosystems along the coastal areas, proper assessment of their extent is not available and figures vary. The remnants of the erstwhile vegetation, mostly in the coastal area and midlands, are conserved as a part of social belief. A recent survey resulted in the identification of 5,790 sacred groves in five districts alone, covering an area of about 5km^2.[15]

Pollution due to Waste

Administratively, solid waste management is decentralised in Kerala with local panchayats, municipalities and corporations responsible for handling waste generated within their respective administrative boundaries. However, with local bodies not being able to follow this mandate appropriately in the wake of the floods, a number of initiatives have been formed to address these issues in a centralised manner and offer support to the local bodies to handle waste. These include the Haritha Keralam Mission, which aims to integrate waste management with organic farming and water resource management, and the Suchitwa Mission, whose mandate is to create guidelines, provide technical assistance and build capacity in local bodies to handle waste. In addition to this, a limited liability company 'Clean Kerala' has been formed under the Local Self Government Department (LSGD) to formulate innovative and scientific strategies and technological methodologies to secure hygiene across the state. One of its key interventional areas is 'Hazardous and E-waste Management'.

The total daily municipal solid waste production in Kerala is estimated to be 10,044 tonnes across corporations, municipalities and gram panchayats. In addition to municipal solid waste, the state also generates industrial waste from hundreds of

[10] http://www.forest.kerala.gov.in/index.php/wildlife/world-heritage-site

[11] Jeena T. Srinivasan (2011), Agriculture – wetland interactions: A case study of the Kole land, Kerala, Centre for Economic and Social Studies, Hyderabad.

[12] KSCSTE (2007), State of Environment Report: Kerala, Kerala State Council for Science, Technology, and Environment, Thiruvananthapuram, Kerala. http://www.moef.nic.in/soer/Kerala_SoE2007-V1.pdf;

[13] Institute for Climate Change Studies (2018), State Action Plan on Climate Change: Kerala (Revised), submitted to Department of Environment and Climate Change, Government of Kerala.

[14] KSCSTE (2007), State of Environment Report: Kerala, Kerala State Council for Science, Technology, and Environment, Thiruvananthapuram, Kerala. http://www.moef.nic.in/soer/Kerala_SoE2007-V1.pdf;

[15] Institution of Foresters Kerala (2013 to 2018). See Footnote 5.

large, medium and small-scale industries. Reliable estimates of the production of such waste are currently not available, as there is no proper system for management of such wastes. Some major industries, such as Hindustan Insecticides Limited have their own facilities, whereas some others, especially those in Ernakulam district and nearby, dispose waste at the Kerala Environmental Infrastructure Limited (KEIL).

Another major stream of waste in the state is the medical wastes generated from hundreds of hospitals. A number of hospitals in the state have their own incinerators while the Indian Medical Association has also formed a unit to process medical wastes in Palakkad. This facility, known as IMAGE (Indian Medical Association Goes Eco-Friendly), receives wastes from across the state, though the original plan was to create four such facilities across the state.

Asbestos, a carcinogenic substance, is still heavily used in Kerala and there is neither legal control nor community awareness about the same. There is neither any protocol for the handling of asbestos nor are facilities available for their proper disposal.

Water Pollution

Water pollution is a major issue in Kerala due to lack of appropriate systems to address the potential for water contamination. Water is contaminated at the household level through seepage and overflow from septic tanks into drinking water wells. In villages, water is also contaminated by agricultural run-offs. Water is contaminated in urban areas by disposal of waste (both solid and liquid) from urban commercial establishments, offices and apartments. Finally water pollution is also caused by industrial effluents across the state.

While there are legislative provisions dealing with industrial effluents' disposal, no such provisions exist for municipal sewage disposal. A majority of Kerala's municipalities and corporations do not have a proper system for collection and disposal of sewage and urban wastewater is often disposed of into nearby water bodies, be it the wetlands, river or the sea. This problem is compounded by lack of adequate facilities for monitoring of the water quality of the river and other water bodies. Occasional measurements by the Pollution Control Board or research institutions point to a high degree of contamination of the water resources. A study by the Centre for Water Resources Development and Management (CWRDM) indicated that 70% of the wells surveyed had faecal contamination. Another time series study conducted by CWRDM between 2009 and 2017 in the 44 rivers of Kerala, showed that all of them are considered polluted, with Periyar and Pamba being the most heavily polluted.

Kerala's coast has 300 medium-scale industries and 1500 small-scale production enterprises. These discharge effluents directly into marine and freshwater bodies. This is evident especially in industrial cities like Cochin, where even drinking water is polluted. Eloor, situated 17 km north of the city, is an island of 14.21 km^2 and the largest industrial belt in Kerala. There are more than 247 industries including Fertilisers and Chemicals Travancore (FACT), Travancore Cochin Chemicals, Indian Rare Earths Limited, Hindustan Insecticides Limited and many others, manufacturing a range of chemical and petrochemical products, pesticides, rare earth elements, rubber processing chemicals, fertilisers, zinc/chromium compounds and leather products. There are 861 micro and small chemicals based industries.[16]

[16] *DIC (2017), Potential Survey Report for MSME Sector, District Industries Centre, Ernakulam, Department of Industries and Commerce, Government of Kerala. http://industry.kerala.gov.in/images/pdf/Ernakulam.pdf*

Land Contamination

Given its high density of population, Kerala should take every possible measure to minimise land contamination and degradation—an issue which has not received adequate state attention. Land can be contaminated by use of agricultural chemicals, uncontrolled disposal of sewage, warehouses of chemicals and pesticides, fuel storage tanks in fuel stations, generator stations, and industrial facilities.

In addition to land contamination, there is also the issue of land degradation through quarrying activities. Kerala Forest Research Institute identified about 5,924 quarries in the state, with quarry sizes ranging from 0.0002 km^2 to 0.644km^2. The total area under quarries in the state is 71.58 km^2.[17]

Climate Change

The year 2018 has been unusual from a climatic point of view globally. Europe saw high temperatures in most countries and an extended summer. Japan suffered unusual flooding and forest fires were reported from a number of countries. The cyclone season has been very active around the world. These patterns fully fit with the predictions made by scientists. While, in the past, scientists were more circumspect about attributing specific events to climate change, they have started doing so with increasing confidence.

The ecology, livelihood, and economy of Kerala are heavily dependent on the landscape and climate. Recent periods have demonstrated increasing temperatures, occurrences of heat waves, forest fires during dry spells, occurrences of high rainfall intensity and tropical storm formation in the region, all fitting predicted global and local patterns of climate change.

In its first report on 'Impact of Climate Change in Four Regions of the Country' submitted in 2010 to the Government of India by the Indian Network for Climate Change Assessment (INCCA),[18] it was pointed out that reduced rainfall, increased atmospheric temperature, and flooding due to sea level rise are the climate change scenarios for the Western Ghats and Kerala during the next 20 years. Under the projected climate change scenario, it is estimated that the temperature is likely to increase by 2°C by 2050. The minimum surface air temperature in the Western Ghats region may rise by 2°C to 4.5°C. The average temperature in the region bordering Kerala is likely to rise by 1°C to 3°C. Maximum temperature increase can be seen in the southern and central districts of Kerala, while most of the districts in the southern Kerala will typically observe an increase in the temperature between 1.66° C to 1.77°C. The number of rainy days is likely to decrease along the entire western coast, including the Western Ghats. It is now established that the sea level is on the rise due to global warming and the projected sea level Rise (SLR) along the Kerala coast, according to a conservative estimate will be about 100 mm–200 mm over the next 100 years. It is also projected that if the sea level rises by one metre, 169 $km^2$of the coastal region surrounding Kochi will be inundated.[19]

Post-Disaster effects

Effects on Forests

During August–September 2018, Kerala experienced heavy rainfall and 209 landslides were reported from different forest divisions. Official estimates state that there were 342 landslides (debris flow/rock slides and landslips) which occurred in the revenue department marked land extents. A post-disaster study report, prepared by a team consisting of geologists and soil scientists, coordinated by Kerala Forest Research Institute (KFRI), after visiting the landslide areas in Thrissur district,

[17] Sajeev, T. V. and C. J. Alex (2017), 'Mapping of Granite Quarries in Kerala, India: A Critical Mapping Initiative', Kerala Forest Research Institute, Forest Health Division, Paper presented during Erudite Lecture Series of Prof. Madhav Gadgil at School of Legal Studies, Cochin University of Science and Technology.

[18] Ministry of Environment and Forests (2010), Climate Change and India: A 4 X 4 Assessment - A Sectoral and Regional Analysis for the 2030s, INCCA Report #2, INCCA: Indian Network for Climate Change Assessment.

[19] Institute for Climate Change Studies (2018), State Action Plan on Climate Change: Kerala (Revised), submitted to Department of Environment and Climate Change, Government of Kerala.

listed the causative factors for each site17. According to the report, the landslides were in slopes above 22° and most common between 22°–28° slopes. Majority of the landslide sites were in the fringes of forests, indicating that disruption of slop continuity due to forest fragmentation was a major contributing factor to landslides in the district. Adding to the vulnerability was the destabilisation of slopes due to cutting and creation of escarpments more than 3m for construction purposes. Forest fires have degraded trees leading to water percolation through root systems and formation of subsurface water flow. Construction of check dams on steep slopes and formation of lakes (e.g., Karinchola) obstruct the natural flow resulting in debris. Quarrying in vulnerable areas has also contributed to these degradations and is reported as a factor that can accelerate landslides at least in a few locations.

Soil erosion has been reported from most of the forest areas leading to loss of humus and soil nutrients. The problem is largely visible in areas where heavy rainfall has occurred. Areas under the Ranni Forest Division, Shendurney and Aralam Wildlife Sanctuaries, areas bordering the buffers of Silent Valley NP, Mannarkkad, Malayattur and Vazhachal Forests were the most affected. Loss of undergrowth in Wayanad has been reported by a number of naturalists. The Kurichiar Mala (a hill of high value biodiversity) was the most affected in the landslides that happened in forests.

While the cumulative impact on the Western Ghats, a World Heritage site, has not been assessed in detail, three of the seven clusters are known to have been affected—Nilgiri, Anamalai and Periyar. Given the baseline status of 'significant concern' expressed by the technical agency advising the World Heritage Committee, it will be important to assess whether the flood impact could put the site at greater risk. Of the 10 high risks listed by IUCN, at least two will have been aggravated: avalanches and landslides and invasive (opportunistic) alien species benefiting from the clearings. Several other high risks could be affected in the aftermath, such as hunting/poaching, wood extraction, land-use changes (crops) in cleared areas, additional tourism (to make up for losses) etc. This could be related to search for economic alternatives due to losses suffered, opportunism where forests open up due to landslides, or temporary impact on the capacity of the authorities to monitor.

Effects on Riparian Ecosystems

All 44 rivers in the state crossed their banks during the week of 12–19 August 2018. Flooded riparian areas acted as buffers taking the full fury of the fast flowing rivers, especially as a result of the surge that happened when the dams were opened. Reports of riparian forest damage have come in from the Chalakudy main river (2.9 km^2, Orukombankutty–Vazhachal–Athirappilly), Karappara river (1.16 km^2, Nelliyampathy–Orukombankutty), Sholayar river (0.522 km^2, downstream of Sholayar dam) and Parambikulam (0.13 km^2, Kuriyarkutty–Orukombankutty) that were affected. A preliminary assessment in the Chalakudy River by Dr. Sreekumar of KFRI reported damage to entire patches of vegetation in areas with dominant species like Syzigium occidentale, Barringtonia acutangula, Madhuca neriifolia and Ochlandra scriptoria. The fragile and unique Kuruva islands in Kabini River in Wayanad were heavily disturbed and some of the smaller ones are feared to have disappeared. The situation in all other rivers is about the same and they need to be investigated.

Effects on Protected Areas

Protected areas in the state were comparatively the least affected. However, landslides have occurred in Kottiyoor Wildlife Sanctuary and at Karikombu in the

Eravikulam National Park and some private areas in the border of the buffer areas of the Silent Valley National Park. Post-flood observations in the Thattekad Bird Sanctuary, as shared by Dr. Sugathan, a biologist working in the area for a long time, indicate a drastic change in water-bird habitats. The Periyar riverside, which is about 14–15 km in length, has been almost completely destroyed. The water-bird habitat is filled with silt and sand and the feeding canal from the water reservoir is also filled up. Aquatic vegetation has been washed away and or buried under the sand. Feeding grounds have been replaced with sand. About 30–32 species of water birds have been affected due to the loss of food species like bivalves. The grasslands along the river bank have also been eroded. There has been no major adverse effect inside the sanctuary.

Effects on Ramsar sites: Vembanad–Kole wetlands

According to a study in 1983,[20] the area of Vembanad lake has drastically reduced due to anthropogenic activities and only 35% of its area constitutes brackish waters. Water quality studies in Vembanad indicate dramatic changes in alkalinity, hardness, chlorine and sulphate, which were observed to be higher during the dry season. This is attributed to the closure of Thanneermukkomm bund and an increased number of houseboats releasing waste.

According to Dr. Jude Emmanuel, Rahul Ramesh, Toms Augustine and Dr. John C. Mathew of the Department of Environment and Climate Change, damages to the wetlands/coastal resources were noticed in Vembanad, especially Thottappally, Kochi bar mouth and Munambam bar mouth. Decrease in native fish diversity and catch was reported. There have also been observations of fish disease, Epizootic Ulcerative Syndrome and a sudden increase in the number of exotic/cultured fish species in the catch. Solid waste accumulation, especially of plastic, in the spawning and feeding grounds was observed. Mangroves were affected at Mulavukad, Vallarpadam, Vypin, Mangalavanam, Kumbalam, Nettoor-Valanthakad, Pallippuram, Chenganda, Cheranalloor, Vechur north, and Kumarakom due to plastic/other solid waste accumulation. Species like 'Aattuvanchi' (Ochreinauclea missionis) were uprooted along Thottappally and Veeyapuram areas. These observations were supported by fishermen and clam collectors of Muhamma in Vembanad, during the field visit of the PDNA team.

The Forest Department reported the death of two tigers, two elephants and a barking deer in Periyar Tiger Reserve; two elephants in Wayanad, four elephants in Malayattoor Division and one gaur each in Ranni and Kozhikode Forest Divisions. In addition, the death of one porcupine, a peafowl and a king cobra were recorded from the rescue centre of Thattekad.

Effects on Other Plants, Animals, Birds, Insects, and Fish

Discussions with experts on various groups of plants and animals highlight the possible impact of heavy rain and flood. The impacts could be direct, immediate, or indirect depending on habit and habitats. Most of the impacts are due to changes in the habitats, inundation for a longer period, and washing away by torrential waters. Changes have occurred in distribution patterns and species assemblages, all of which will have long term impact on ecological processes.

Aquatic Birds: Weather is an environmental factor that influences nesting and breeding of water birds. Observations in Kozhikode district, as reported by Dr. Muhamed Jafer Palot of Zoological Survey of India, indicate a reduction in heronries from 42 to 22 after the rains. There is also a reduction in their population. Dr. Shaji CP reports increased numbers of the painted stork—not a common species in the Mala-Annamanada area in Thrissur district—after the floods, due to abundance of

[20] *Gopalan, U. K.,Doyil, T. Vengayil, P. Udayavarma and M. Krishnankutty (1983), 'The Shrinking Backwaters of Kerala', Journal of Marine Biological Association, India, 25(1&2): 131–141.*

fish. The purple moorhen disappeared from the paddy fields after the floods. At Thattekad Bird Sanctuary, about 30 water birds have been adversely affected. The number of open-billed storks is almost nil. Water birds are rare now and feeding grounds have been lost due to changes in the habitat.

Ants: Dr. Kalesh Sadasivan of Travancore Natural History Society, who had been monitoring ants in different areas, expects a high impact on the prevalence and activities of these predators and scavengers, which help in biomass cycling, seed dispersal and soil aeration. Most of these are highly specialised and endemic soil-dwelling species. The greatest impact would be on leaf litter ants, followed by hypogenic ants. The washing away and flooding of nest chambers would spell the end for many of them.

Lepidoptera and Odonates: 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 were almost absent after the rains and floods, according to the observations of Dr. Jafer and V.C. Balakrishnan (Malabar Natural History Society), in Kakkayam, Kakkadampoyil, Anakkampoyil and Kakkavayal areas in Kozhikode district. The larval forms of odonates are aquatic and must have been washed away.

Grasshoppers: Post-flood observations in an island in the Banasura reservoir, indicate disappearance of Euparatettixpersonatus (Bolívar, 1887), a grasshopper recorded for the first time in India by Dhaneesh Bhaskar, a Fellow of KFRI.

Spiders: According to Sudhin (Christ College, Irinjalakuda), the spider specialist, the flood would have affected the ground-dwelling, especially of the Lycosid spiders. Deterioration and changes in the habitat structure and complexity due to floods would alter the spider species composition.

Amphibians and Reptiles: The post-flood observations by Sandeep Das and Rajkumar (both ZSL EDGE Fellows) indicate that tadpoles of bicoloured frog (Clinotarsus curtipes) were washed away in several areas including Nelliyampathy, Parambikulam, Periyar, Banasura and several other forest streams to temporary pools, where they later died because of the drying up of these pools. Breeding sites of the endangered purple frog (Nasikabatrachus sahyadrensis) were completely destroyed due to landslides and several tadpoles were found dead in Nelliyampathy (13 sites), Neriamangalam (11 sites) and Vazhchal (12 sites). Large number of caecilians, the limbless amphibians was found dead in several areas. Thousands of reptiles especially snakes, lizards and skinks took refuge in houses during the floods. The burrowing snakes, the Uropeltids were seen either moving on the roads or were dead. Dr. Jafer reports sightings of trinket snakes in Kozhikode city for the first time. Forest Department officials in Thamarassery in Kozhikode and other places in the state have rescued hundreds of snakes from flood-affected areas, indicating definite changes in their distribution patterns.

Fishes: There are very visible changes in the substratum of rivers, in Aralam, Chalakudy, and Periyar near Thattekad and downstream in the plains. The disappearance of native species of fishes is obvious in the catch brought in by the fishermen. The changes in the aquatic habitat would be reflected in the population in future, Dr. Shaji, the ichthyologist said.

Exotic fishes that are reported to have escaped from fish farms, aquaria and other facilities to the natural systems include Pacu, Piaratcus brachypomus (introduced illegally and cultured by fish farmers; a bumper catch of this species was reported after the floods from Alappuzha by fishermen), Pangas, Pangasianodon hypophthalmus (legally introduced and cultured in ponds), Tilapia, Oreochromis nilotiucs (widely

cultured in India, after it was introduced as GIFT, Genetically Improved Farmed Tilapia) and Giant gourami, Osphronemus gorami (cultured as ornamental fish, but some fishermen culture this for food as well) also escaped to the rivers. According to Dr. Basheer of National Bureau of Fish Genetic Resources, very stray sightings/catch Araipama gigas (illegally introduced), Alligator gar, Atractosteus spatula (illegally introduced in ornamental fishery) and goldfish, Carassius auratus and a few other ornamental fishes like mollys, guppies, oscar, and angels also escaped. The stray ones did not heavily impact the natural systems as they were either washed away in the floods or caught.

Invasive species of plants: There is a huge risk of increased episodes of biological invasions in the post-disaster period. The newly exposed land substratum in landslide areas will be favourable for invasive plants such as Lantana camara, Chromolaena odorata, Sphagneticola trilobata, Mikania micrantha, and Mimosa diplotricha. The rivers are high-speed corridors for the spread of invasive exotic plants downstream and these rivers form the major sustained source of propagules of these invasive plant species.

Waste Management

The floods resulted in large quantities of solid wastes in addition to carcasses of a large number of domestic animals. This has posed a major challenge in the already complex waste management system in place. These wastes could be detrimental to the natural system with impact on the ecological processes. A large number of animals, mostly domesticated, died during the flood event. Many chickens also perished in the floods. Their carcasses have contributed to total waste volumes.

Asbestos Hazard

As mentioned earlier, India is one of the countries where asbestos is still legal and can be used, and community awareness about the same is virtually non-existent. During field visits, one could see a number of damaged houses in which asbestos sheets were used for roofs. While staying in houses with asbestos roofs is itself not considered hazardous, broken asbestos pieces release millions of asbestos fibres which are very hazardous. Once inhaled, some of these stick to the lungs, and in due course, lead to a specific cancer named mesothelioma. While no specific estimate of the number of damaged houses with asbestos roofs is available, clearly, asbestos is an issue that needs to be addressed in the post-disaster setting in Kerala.

Water pollution

All water bodies in the flood-hit areas were polluted. The flood waste brought down huge quantities of mud and silt from the upper reaches of the river and this was subsequently deposited in wells and rivers. While this will not cause major chemical pollution, it has certainly increased the turbidity of the water in the wells and rivers. All households which had wells for water supply had to undertake clean up measures, including emptying the well contents and chlorination. Assuming that 62% households in Kerala have a well, one can estimate that about 3.17 lakh shallow wells were contaminated and had to be cleaned up.

The clam collectors in Vembanad reported debris and mud deposits along with plastic waste, affecting their livelihood. There are additional complications with regard to chemical contamination of wells and rivers. The Udyogamandal and Edayar industrial areas were both affected badly by the floods. These areas are home to hundreds of chemical industries, where different types of chemicals are being manufactured and used. The floods have caused these chemicals to be washed into the nearby land, wells, and rivers. While no estimate of the extent of

damage has been arrived at, there is clearly a need for a comprehensive study of the contamination of affected water bodies.

Land Contamination and Degradation

Significant land contamination has been caused by deposition of chemicals when flood waters entered chemical stores and warehouses. The obvious possibilities of contamination are the chemical factories, housed inside Edayar and Eloor industrial areas. However, based on experience, one can also anticipate contamination of land from hydrocarbons, around petrol stations and generator units. Stores of agrochemicals (fertilisers and pesticides) as well as laboratories (of schools and hospitals) etc., are also sources of chemical contamination. Though it is not possible make an estimate of the quantities or the resultant loss, it certainly implies an urgent need to conduct a comprehensive assessment of the chemical contamination of land around industrial areas, warehouses, and stores.

Another issue of importance is land degradation due to quarrying. The recovery needs will generate a significant demand for construction materials and one can expect an increase in quarrying activities in the state. This will, in turn, increase the risk of landslides and landslips, thus going against the spirit of disaster risk reduction. The issue relating to quarrying and environmental damages is a long-term issue and the disaster should be seen as an opportunity to address the problem itself.

Recovery Strategies

Environmental degradation is one of the fundamental causes of large-scale destruction, following the heavy rains of 2018. Therefore, the recovery strategy should address the underlying environmental issues, in addition to those environmental issues created by the disaster itself.

1. It was evident that despite the presence of numerous government institutions and academic institutions with technical competence to undertake a detailed and quantitative assessment of the environmental impacts of such disaster events, it was not done. In most sectors linked to the environment, the data availability is sparse, which downplays the importance of the environmental sector in the PDNA. However, a comprehensive post-disaster environmental impact assessment should be carried out to study and document how environmental degradation has exacerbated the disaster, as well as the environmental damages caused by the disaster itself. This should include satellite image-based analyses of land use as well as field level studies on the impacts of the floods on biodiversity and assessment of water pollution and land contamination by chemicals. The studies should result in precautionary/mitigation strategies.

2. Post-disaster reconstruction is likely to create a massive environmental footprint due to the significant demand for construction materials, formation of new areas to relocate people away from the hazardous spots and the rapid pace of reconstruction. At the same time, to achieve faster implementation of the project, there will be pressure from both government as well as the community to do away with the normal environmental controls. The 'Integrated Strategic Environmental Assessment' approach, developed by UN Environment and implemented during the post-conflict reconstruction of Sri Lanka and post-disaster reconstruction of Nepal could be applied to mitigate the negative effects.

3. Kerala should learn international best practices in managing asbestos. A comprehensive plan to increase capacity within local self-government

Table 1

Infrastructure and Asset Loss due to Heavy Rains and Floods (INR lakh)

Damages	South-ern	High Range	Central	East-ern	North-ern	Agasthyava-nam	Field Director Kotta-yam	Field Director Palakkad	Social Forestry South	Social Forestry Central	Social Forestry North	Total
Buildings	25.00	48.00	110.00	55.00	2.00	2.57	1.64	2.30		78.60		325.11
Roads/ culverts/ track path	151.00	402.00	116.50	149.75	30.00	3.60	4.33	6.20				863.38
Vehicle	0.50		0.65									1.15
Bowl boats/ boat	2.00											2.00
Teak billets/ timber re stacking			30.00									30.00
Plantations	0.50			3.80								4.30
Eco-tourism sites	5.00		40.00	4.00								49.00
Compost	22.00											22.00
Seedlings/ nurseries	5.00		2.00	2.40					62.64	30.84	9.75	112.63
Elephant proof trench/Walls			29.00			0.39	1.86	0.75				32.00
Water supply		12.00										12.00
Compound wall/ retaining wall			88.50	84.50	9.50							182.50

Damages	South-ern	High Range	Central	East-ern	North-ern	Agasthyava-nam	Field Director Kotta-yam	Field Director Palakkad	Social Forestry South	Social Forestry Central	Social Forestry North	Total
Cleaning wells			0.20				0.50					0.70
Office pieces of equipment			3.45				3.78					7.23
Damage due to land slides	185.00	120.00	80.00	200.00	60.00		10.00	10.00				665.00
Private property				27.50								27.50
Solar fencing/ solar units				54.25	62.50							116.75
Cairns				4.80	46.00							50.80
Removal of wind-fallen trees				3.32								3.32
Desilting				13.30								13.30
Wireless				2.50								2.50
Translo-cation of families				2.50			0.50					3.00
Elephant proof wall				39.20	25.00							64.20
Gully plugging					2.00							2.00
Hanging bridges					0.50							0.50

Damages	South-ern	High Range	Central	East-ern	North-ern	Agasthyava-nam	Field Director Kotta-yam	Field Director Palakkad	Social Forestry South	Social Forestry Central	Social Forestry North	Total
Bridges						1.75	1.20	1.10				4.05
Check Dam						0.50	1.50	3.00				5.00
Electrical equipment/ others						0.50		1.46				1.96
Total	**396.00**	**582.00**	**500.30**	**646.82**	**237.50**	**9.31**	**25.31**	**24.81**	**62.64**	**109.44**	**9.75**	**2603.88**

departments to deal with asbestos and awareness programmes about adverse health impacts should be conducted among the population.

4. Kerala should establish a comprehensive plan for regular monitoring of all its water bodies for both quality and quantity. In addition to routine monitoring for water quality parameters (chemicals, dissolved oxygen, and biochemical oxygen demand), the issue of contamination of the soil and ground water, spread of invasive species and contamination of sediments with chemicals should be addressed.

5. Because the villages support a rich biodiversity, including agro-biodiversity, the impact on flood-affected villages has to be monitored for various parameters for corrective measures.

6. The recovery strategy in Kerala should focus on a landscape/ecosystem-based approach to disaster risk reduction. This would involve systematic use of biota for river bank protection and slope stabilisation; all existing roads should be reviewed for their potential to cause landslides, and the 'eco-safe' road methodology should be applied for their stabilisation, involving geologists and hydrologists. Approaches such as 'room for the river' and 'making space for water' should be the basis for addressing flood protection instead of creating dams and embankments. Finally, protecting forests to prevent landslides and treating coastal erosion should be considered as the primary option instead of other measures involving concrete, granite and steel.

7. Removal of sand deposited in rivers and river banks should be done, only after site specific studies and suggestions by experts.

8. Even though Kerala could be extremely adversely affected by climate change and despite the presence of some institutions that are doing relevant work, including the Institute for Climate Change Studies, when it comes to robust quantitative downscaling of climate change scenarios for Kerala, the state was found lacking. The Institute for Climate Change Studies should be tasked with undertaking a comprehensive downscaling of climate change scenarios for the state of Kerala, and the same should be made available to all concerned government departments and also to LSGs, so that they could use it as the basis of their adaptation plans.

9. Given the international value of the Western Ghats as one of the eight global 'hottest hotspots', which could be at risk of joining the list of 'World Heritage in Danger', and given its status as 'significant concern', prior to the floods and the impacts of the floods and possible impacts during recovery, recovery should include an assessment of the cumulative impact on the State of Conservation (SoC) and capacity building of communities and authorities in disaster risk reduction for World Heritage sites, including integrated planning of natural resources management.

Sector Assessment Methodology

Data Collection Process and Sources

The baseline data available with the consultants were compiled. Further details were collected from published literature and notes prepared by experts in the field. Sources of information included the Kerala Forest and Wildlife Department on the loss/damage to infrastructure and biodiversity and estimates for recovery, and discussions with Head of Forest Forces and team. Further telephonic consultations were made with the divisional forest officers for clarifications. Discussions were also

Table 2
Recovery Needs Costing (INR crore)

Recovery activities	Short term	Medium term	Long term	Total
Reconstruction of roads/ bridges/culverts	39.38			39.38
Maintenance/construction of buildings/compound wall/camp sheds/wireless station in forest area	21.51			21.51
Maintenance/construction of conflict mitigation structures in the forest	15.18			15.18
Restoration of landslide and other damaged forest areas		12.00		12.00
Restoration of riparian vegetation		5.50		5.50
Restoration of plantation/establishment of nursery under Forest Department	11.75			11.75
Restoration of critical wildlife habitats		6.00		6.00
Soil and moisture conservation measures@ INR15,000 per brushwood structure in forest areas	10.50			10.50
Maintenance communication equipment/computer/ solar units/boat engine in forest areas	2.87			2.87
Road map and action plan for plastics management in Vembanad Lake	2.00			2.00
Monitoring of biodiversity in flooded villages		7.00		7.00
Restoration of landslide areas in revenue lands in 9 affected districts with 333 incidences @ INR 50,000 per site (according to the memorandum for seeking central assistance submitted by Government of Kerala to Government of India)		1.66		1.66
Restoration of affected wetlands	2.00			2.00
Study on the impact of sand deposits in rivers	1.00			1.00
Soil quality monitoring in flooded villages		1		1.00
Replace plastic with alternate options through Kudumbashree/Women SHG Enterprises		0.7		0.70
Assessment of hard rock availability		0.30		0.30
Carbon stock assessment			0.50	0.50
Restoration of forests around Ramsar sites near Villupuram		2		2.00
Environmental impact assessment studies	5.00			5.00
Total	**111.19**	**36.16**	**0.50**	**147.85**

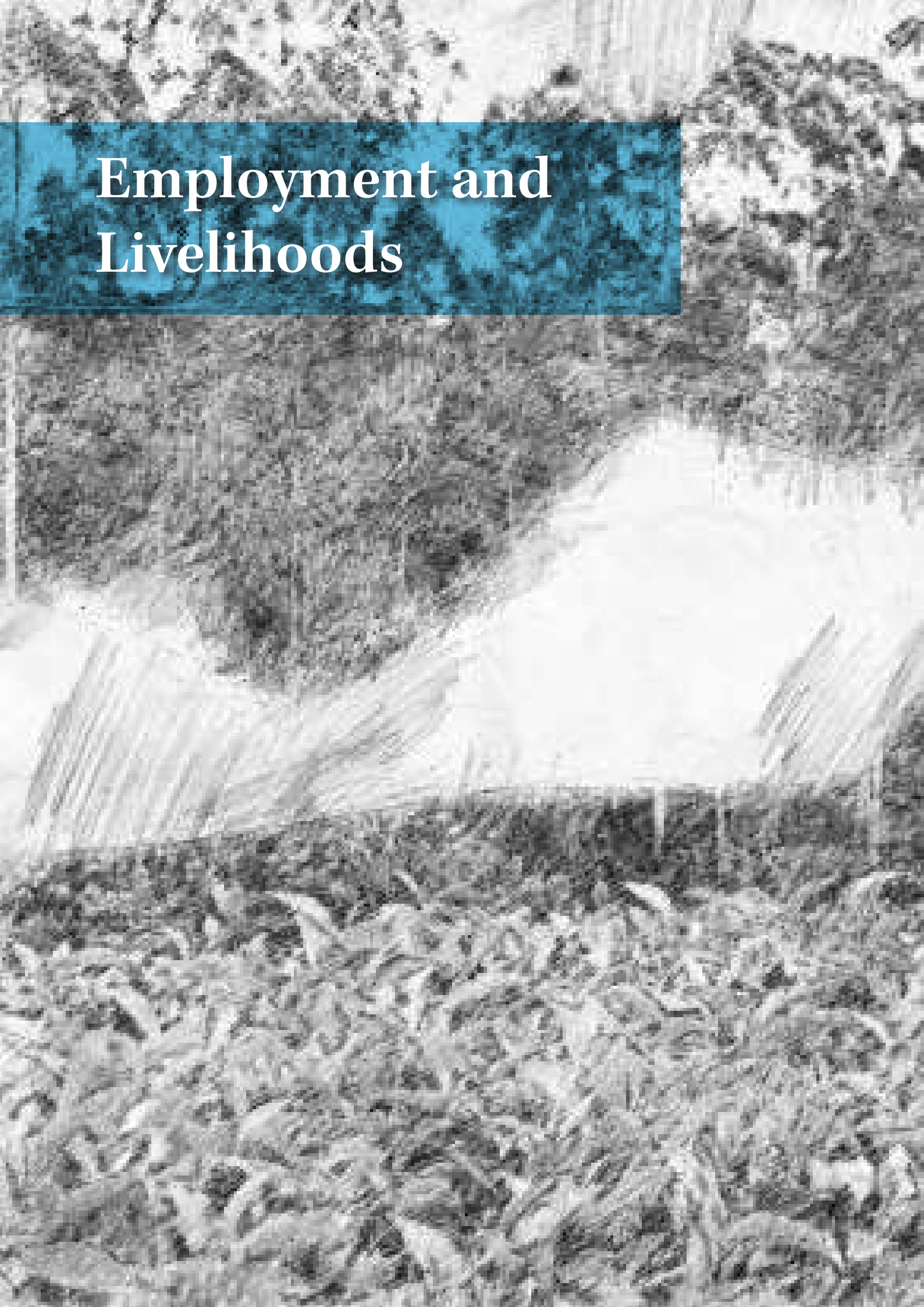
held with experts of Kerala State Council for Science, Technology and Environment (KSCSTE), Zoological Survey of India, Ashoka Trust for Research in Ecology and Environment (ATREE), Cochin University of Science and Technology, National Bureau of Fish Genetic Resources, Integrated Rural Technology Centre, MG University, Travancore Natural History Society, Kerala Forest Research Institute, Ocean Society of India, Centre for Water Resources Development and Management, National Centre for Earth Science Studies, Suchitwa Mission, Green Kerala Mission, Forestry College of Kerala Agricultural University, MS Swaminathan Research Foundation, Thanal, Malabar Natural History Society, Periyar Malineekarana Virudha Samithi and discussions with district collectors of Ernakulam and Thrissur. Harish Vasudevan gave inputs on matters related to environmental law.

Methodology to Extrapolate Data

The Kerala Forest and Wildlife Department directly gave the data on loss/damage on forests. There is no indication of the method used for arriving at the damage or recovery cost. The loss on biodiversity was mostly based on post-disaster observations. A few experts assumed the loss in certain groups based on their knowledge of the distribution, habit and habitat of the animal/plant groups. The loss to the habitat could not be quantified, except the riparian vegetation along Chalakudy River, to some extent, which was also an estimate. Environmental damage to rivers and villages in industrial areas could not be estimated because of obvious reasons. There were no statistics available on chemicals that must have gone with the flood, and there are no figures from soil analysis. There could have been several assumptions based on which some estimates could be arrived at. However, this would be highly unscientific and may lead to gross errors and hence, was not attempted. The loss of land due to landslides was assumed to be about 50 cents per slide on an average. Disaster debris estimates were also made based on international experiences at 300 kg per flooded household.

Field visits were made to Muhamma in Alappuzha district and discussions held with scientists of ATREE, Clam Marketing Society, Lime Shell Co-operative Societies, and people's representatives. Nearby areas were visited. In Cochin, Eloor and Edayar, industrial areas were visited and discussions held with State Pollution Control Board officials and with Purushan Eloor of Periyar Malineekarana Virudha Samithi and Dr. Madhu, a Professor in Chemical Engineering of Cochin University. Discussions were also held with the president and members of Kalady Gram Panchayat. At Perumbavoor, discussions were held with officers from the industries department and the representatives from plywood industry. The Kole Ramsar site was visited and discussions held with Chandran, a former project engineer of Kerala Land Development Corporation and Dr. V. S. Vijayan, former Chairman of Kerala State Biodiversity Board. The views of scientists of Kerala Forest Research Institute were collected in a consultation meeting. Telephonic consultations were made with Divisional Forest Officers and selected people from affected areas all over Kerala.

Employment and Livelihoods



Employment and Livelihoods

Summary

The total damages in the employment and livelihoods have been assessed at INR 881 crore, including INR 509 crore damage in tourism, INR 359 crore in micro, small and medium-sized enterprises (MSMEs) and INR 13 crore in Kudumbashree and coir. Total loss is estimated at INR 9,477 crore including wage loss of INR 7,301 crore and inventory loss of INR 2,176 crore. This puts the total damage and loss of the sector at INR 10,358 crore.

Total person days of employment lost comes to 1,097 lakh along with a wage loss to the workers estimated at INR 7,301 crore. Two-thirds of the migrant workers, estimated at 22.7 lakh also lost their workdays during the floods, amounting to an estimated wage loss of INR 2,033 crore.

While state income loss and wage loss relate to the economy, the real loss of wages was for the casual labourers or the self-employed. A portion of regular workers also stood to lose because of the informal nature of their employment. This has implications for the livelihoods of a major proportion of the workforce.

At the minimum, Kerala's economy lost 2.6% of its annual income (INR 17,462 crore) due to floods, excessive rains and landslides. This estimate would go up to 6.6% (INR 26,850 crore), if the potential damage to the agricultural sector were also considered. However, the Centre for Development Studies (CDS), Thiruvananthapuram, in a conservative estimate, projects reduction of Gross State Domestic Product (GSDP) growth rate of 1.27% in current prices and 1.23% in constant prices in 2018–19 in the state.

Two recovery needs scenarios have been worked out. In the first scenario, the total requirement would be of INR 3,896 crore, is part of the overall recovery needs assessment of this report. In the second scenario, the additional need for an employment-linked eco-restoration plan (for restoring natural capital) would be of INR 23,065 crore. This involves leveraging Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) by adding 53 days to the existing average of 47 days per annum (making it a total of 100 days) of employment for the existing 13 lakh job card holders. This means 73% of the cost will be borne by the central government. Another 3% can be added by leveraging central schemes for skill development. The net impact on the state government would be 24% or INR 5,600 crore for five years, i.e., INR 1,120 crore per annum.

For the self-employed, especially those in the livelihood sector including Kudumbashree, financial assistance in the form of grants and interest-free loans is recommended for replacing capital.

This calls for creating 'green jobs' (with a lower carbon footprint) based on the principles of environmental sustainability and cost effectiveness. Skill development would be a critical component, both in the recovery period and beyond.

Pre-Disaster Context

While the physical damage and income loss received much attention in the public discussions post the Kerala Floods 2018, the employment impact did not receive as much focus as it should have. Employment is the means by which the majority of the people meet their livelihood requirements and Kerala is no different in this respect. For the poorer sections of the population, livelihoods are sustained by resorting to a variety of employment and non-employment mechanisms. It is crucial to understand the employment and livelihoods profile of the people of Kerala, to provide a background to the assessment of the impact of floods and the reconstruction programme.

The core principle deployed in the reconstruction plan is based on the concept of 'Build Back Better' (BBB) for a new, environment-friendly Kerala by promoting green jobs. Kerala's ecological endowments along with its habitat pattern provide a solid foundation for much of its economic activities, be it agriculture, livestock, fisheries, agro-processing industries, sourcing construction materials, water transport or the much acclaimed tourism. One is not sure whether there is adequate recognition, let alone conscious incorporation, of the 'natural capital' function of Kerala's environment.

To understand the employment profile we look at the number of workers and the workforce participation rate (employed as a share of total population). While the work force increased from 102 lakh persons from 1983 to 131 lakh in 2005, it declined to 127 lakh in 2012.[1] This is mainly due to the increased enrolment in education of women in age group 15–24 years. Part of it was also caused by the withdrawal of women from the labour market due to the migration of their spouses to Gulf countries. There could also be a proportion of 'discouraged persons', especially women who opted out of the labour market due to lack of opportunities. Given this trend and the negative rate of growth of persons in age group 15–19 years as a result of demographic transition, it is unlikely that Kerala has added to its work force in 2018.[2] This is borne out by the continuing growth in migrant labour from outside which shall be examined separately.

Kerala is a state which reports a high rate of unemployment. At the same time it has a migrant workforce of 34.85 lakh from other states that is equivalent to 25% of its labour force![3] On the other hand it has an emigrant workforce (mostly in Gulf countries) of 22–24 lakh that is equivalent to 16%–18% of its labour force.[4] This may look paradoxical, but would make sense, viewed from a larger developmental point of view.

Kerala's younger generation has higher educational attainments: so much so that the proportion of those who have at least a secondary school pass in age group 15–40 years in the labour force is 51% for males and 69% for females as against the national average of 39% and 24% respectively (as of 2012).[5] This has led to a shift in preference in the kind of work sought, leading to a situation of educated unemployment. It is this phenomenon that has given rise to in-migration of labour (mainly young men) from outside the state, predominantly for casual manual work. There is no reason to believe that this scenario has changed. However, there could be a segment of 'discouraged women' who are not seeking work, and hence, are not counted in the labour force.

In addition, there are women who combine domestic work with economic activities but describe themselves as 'housewives', and hence, are not counted in the labour force. This was evident in a study on Kudumbashree where 54% of women Kudumbashree members reported as 'engaged in economic activity' but their

[1] *Figures from 38th Round of NSS for 1983, 61st Round of NSS for 2004-05 and 68th Round of NSS for 2011–12.*

[2] *See age-group wise labour force projections for states in NCEUS (2009: 59–60). National Commission for Enterprises in the Unorganised Sector (2009), The Challenge of Employment in India: An Informal Economy Perspective, Vol. II, Annexures, (p.59–60), Government of India, New Delhi.*

[3] *A study by Gulati Institute of Finance and Taxation estimated a stock of migrant workforce in Kerala of 25 lakh in 2012 with an estimated annual growth rate of 6.8%. For details see, Narayana, D. and C.S. Venkiteswaran (2013), Domestic Migrant Labour in Kerala, Gulati Institute of Finance and Taxation, Thiruvananthapuram.*

[4] *Labour force here is defined as the proportion of workers plus those seeking work out of the total population. According to the Kerala Migration Surveys carried out by the Centre for Development Studies, Trivandrum there were an estimated 18 lakh Keralites working outside India in 1998 that went up to 24 lakh in 2011 and then declined to 22 lakh in 2018.*

[5] *For the entire labour force of '15 years and above' these percentages are 43 for males in Kerala (34 for India) and 53 for females (18 for India). The lower percentage for Kerala males compared to its females could be due to the emigration of educated men to other parts of India and abroad.*

average hours of work per day varied between only 3 to 5 hours.[6] This is roughly 14 percentage points above the work participation rate for a similar age group as per NSS 68th Round (2011–12).[7] But the percentage engaged in 'any economic activity' among the Scheduled Castes and Scheduled Tribes was 69% and 64% respectively, indicating a comparatively poorer economic condition.[8]

Persons in these three categories—the unemployed + the discouraged workers + those available for part-time work—may be reckoned as a reserve army that could be usefully deployed in the reconstruction of Kerala, especially at the local level, with adequate training for skill development and investment in appropriate technology to create what we call 'green jobs' (Box 1).

A summary of the employment–unemployment profile as per official definitions is given in Table 1.

[6] 99% of Kudumbashree members were found to be in the age group of 25 years and above. Kannan, K.P. and G. Raveendran (2017), Poverty, Women and Capability: A Study of the Impact of Kerala's Kudumbashree System on its Members and their Families, Laurie Baker Centre for Habitat Studies, Thiruvananthapuram (unpublished manuscript), October.[Study sent to the Kudumbashree Mission and the Department of Local Self Government, Government of Kerala. Also shared with National Rural Livelihood Mission which funded the study.]

[7] This gives us a rough idea of the percentage of women working for some part of the day but not netted in the official surveys due to self-reporting and/or low average work hours.

Table 1
Labour and Employment Profile of Kerala, 2011–12

Category	Men	Women	Total
Total Labour Force (lakh)	93.4	42.3	135.7
Total Workforce (lakh)	90.7	36.4	127.1
Total Unemployed (lakh)	2.7	5.9	8.6
Labour Force (LF) Participation Rate (%)	57.5	24.0	40.1
Workforce Participation Rate (%)	54.6	21.4	38.1
Unemployment Rate (%)	2.9	14.1	6.4
% of persons with at least secondary level education among the unemployed	82.2	87.3	85.7
LF with at least Secondary level education (%)	42.5*	53.1	45.8
Younger LF (15–40 years) with at least Secondary level education (%)	51.0	69.4	57.2
LF with at least Graduate level education (%)	11.9*	20.8	14.7
Younger LF (15–40 years) with at least Graduate level education (%)	13.2	29.5	18.7

*Note: *The lower percentage of men compared to women in these educational groups could be due to the emigration of a large number of educated workers to foreign countries (especially to Gulf countries).*
Source: Computed from unit level data of National Sample Survey 68th Round.

Post-Disaster Effects

From a state level macroeconomic perspective, the economic impact of a disaster like the Kerala Floods 2018 can be broadly divided into (i) asset damage/loss, and (ii) income loss. While the asset loss (either due to damage or loss or both) refers to the depletion in stock of capital, income loss refers to a flow that occurs in a given period. These two have different employment implications. In the case of asset loss future employment is adversely affected based on the time needed to replace the stock. In the case of income loss there is the loss of current employment. In some situations, especially in restoring the natural capital (land and water bodies), there is the opportunity to create new employment. Given Kerala's imperative to move

[8] Kannan, K.P. and G. Raveendran (2017), Poverty, Women and Capability: A Study of the Impact of Kerala's Kudumbashree System on its Members and their Families, Laurie Baker Centre for Habitat Studies, Thiruvananthapuram (unpublished manuscript), October.[Study sent to the Kudumbashree Mission and the Department of Local Self Government, Government of Kerala. Also shared with National Rural Livelihood Mission which funded the study.]

Box 1: Green Jobs

Green jobs are those that not only contribute to the production of goods and services that are less environmentally harmful (e.g. low carbon footprint or local environmental damage) but also use processes that are more environment friendly. For example, a building is often called 'green' if it uses solar energy and more energy efficient equipment for its function. But it can be called 'green' only if it is also built from materials with a lower carbon footprint and without adverse environmental consequences for the local surroundings.

According to the International Labour Organisation (ILO) green jobs help (i) limit greenhouse gas emissions, (ii) protect and restore ecosystems, (iii) minimise waste and pollution, (iv) improve energy and raw materials efficiency, and (v) support adaptation to the effects of climate change. The ILO advocates increasing efforts to maximise what it calls 'green jobs' based on decent employment, along with green processes resulting in green products and services. Its 2018 World Employment Social Outlook Report concludes that while the 'transition to a green economy will inevitably cause job losses in certain sectors as carbon- and resource-intensive industries are scaled down, but they will be more than offset by new job opportunities'. It has estimated that globally 6 million jobs are likely to be lost in the transition while creating 24 million new green jobs, i.e., a net increase of 18 million jobs across the world.

Source:

1. *International Labour Organisation (2018), World Employment and Social Outlook 2018: Greening with Jobs, International Labour Office, Geneva.*
2. *International Labour Organisation (2016), What is a Green Job? https://www.ilo.org/global/topics/green-jobs/news/WCMS_220248/lang--en/index.htm (13 April 2016).*

towards an environmentally sustainable path (green economy) the new employment should be transformed into 'green jobs'.

The asset loss is usually valued on the basis of replacement costs and applied to manufactured capital equipment and land under economic activity. While the latter would represent 'natural capital', it should be remembered from an environmental sustainability point of view that it constitutes only a part of the total. There is the wider base of natural capital consisting of all land and water and related natural resources that provide an important environmental function for sustainable living. Any damage beyond a certain threshold level would have serious economic implications, including employment. There may not be an easy solution to the valuation of this environmental function but the costs involved in their restoration (e.g. strengthening embankments of water bodies such as rivers, lakes, and canals or landslide areas) need to be recognised as an important investment cost for the medium and long term.[9]

For income loss, an indirect assessment has been made by taking the proportion of population in the affected villages as declared by the Government of Kerala (Table 2). Table 2 reveals that INR 17,462 crore or 2.6% of Kerala's income (GSDP) got washed away due to the floods and the resulting disruption of the economy for 15 days. This may be reckoned as the lower limit. The upper limit would be determined by the loss of income, especially in agriculture, for the next, say, four months, i.e., the time required to restart cultivation of seasonal crops and repair and restoration of perennial crops. If we take the entire primary sector in the state, this would mean a loss of income of one-third of GSDP from this sector.[10] This would add INR 26,850 crore to the estimate. That would mean loss in state income rising by another 3.96%, taking the total loss to the economy to 6.56% of state income.

[9] Asset damage/ loss have been estimated by the respective sector groups and reported elsewhere in this report.

[10] This implies damages to crops not only in flood hit areas but also in other areas due to incessant rains followed by high temperature leading to drying up or decay of much of seasonal crops and yields in tree crops. This is equivalent to INR 24,408 crore in 2016–17, adjusted to INR 26,850 crore for 2017–18. The period taken is after the immediate impact of the floods and the loss in overall GSDP as per the calculation in the lower limit. A loss of output equivalent to one-third of the GSDP in agriculture and related activities does not seem to be an unrealistic one. However a realistic picture will emerge only when the GSDP is estimated for 2018–19.

Table 2
Estimated Income Loss during Floods 2018 , Kerala

District	Total population (Projected) 2016–17	Affected popula-tion %	No. of affected popula-tion	Per capita GSDP 2016– 17 (INR)	GSDP per capita per day (INR)	No. of days lost	Total Income (GSDP) Loss
Thiruvanantha-puram	33,38,907	0	0	1,66,736	457	0	0
Kollam	26,63,381	45.96	12,24,090	1,86,988	512	15	940
Pathanamthitta	11,77,745	100	11,77,745	1,35,850	372	15	657
Alappuzha	21,38,105	100	21,38,105	1,85,171	507	15	1,626
Kottayam	19,86,144	100	19,86,144	1,64,840	452	15	1,347
Idukki	10,97,993	100	10,97,993	1,87,252	513	15	845
Ernakulam	33,83,757	100	33,83,757	2,04,472	560	15	2,842
Thrissur	32,05,105	100	32,05,105	1,73,514	475	15	2,284
Palakkad	29,21,749	59.91	17,50,420	1,36,840	375	15	985
Malappuram	44,08,415	42.67	18,81,071	1,21,663	333	15	940
Kozhikode	32,06,519	11.22	3,59,771	1,45,993	400	15	216
Wayanad	8,38,395	100	8,38,395	1,32,045	362	15	455
Kannur	25,88,014	19.88	5,14,497	1,49,395	409	15	316
Kasargod	13,67,919	0	0	1,38,161	379	0	0
Kerala	3,43,22,148	56.98	1,95,57,093				13,452
Additional days for Alappuzha, Wayanad and Ernakulam							
Alappuzha (50%) (16 July 2018 –14 August 2018)						30	1,626
Wayanad (50%) (1–15 September 2018)						15	228
Ernakulam (20%) (1–15 September 2018)						15	568
Total (16+17+18)							**2,423**
Grand total (15+19)							**15,875**
Total loss at 2017–18 prices (Estimate I - Lower)							**17,462**
Kerala's GSDP in 2017–18 (6,17,034 x 1.10)							**6,78,737**
Percentage loss in GSDP due the immediate impact of floods							**2.60**
Add 33% loss in primary sector							**26,850**
Additional loss as percentage of GSDP							**3.96**
Total loss at 2017–18 prices (Estimate II - Higher)							**6.56**

Note:

1. *Population for 2016–17 was projected by the Central Statistical Office (CSO), Government of India and reported in Kerala Economic Review 2017, State Planning Board, Government of Kerala, Vol. 2, p. 20.*
2. *Percentage of affected population was worked out based on population in officially declared flood hit areas.*
3. *The GSDP for 2017 is calculated by an increase of 10% in nominal terms based on the growth rate of previous two years.*

Lost Person days and Wage Loss to the Workers

Loss to the workers can be assessed in terms of person days lost as well as wage loss. Macro estimates are based on the assumption that the proportion of workers affected is the same as the percentage of affected population. By estimating the workers in three broad categories from the 68th Round of NSS (Casual, Regular, and Self-Employed Workers) and applying an average current wage rate for casual workers (and projecting to 2018 by applying the ratios from the 68th Round) the person days and wage income lost for men and women have been estimated separately; this has been undertaken for the three labour status categories as well (Table 3 and Annexe Table A14.1).

Table 3
Estimated Person Days and Wages Lost to Workers

Category	No. of workers (lakh)	Person days lost (lakh)	Wages lost (INR crore)
Male	51.68	782.93	5,943.09
Female	20.74	314.22	1,357.90
Total	**72.42**	**1,097.15**	**7,300.99**

Note: Annexe Table 1 provides details on number of days lost, wages, etc.

Migrant Labour

As per Gulati Institute of Finance and Taxation (GIFT) study published in 2013[11] , the stock of migrant labour was 25 lakh comprising men (99%) and within age group 18–35 years (91%). This was equivalent to around 20% of Kerala's workforce then. The study had stated that there is a 6.8% annual net flow of migrant labour that would give an estimate of around 35 lakh, equivalent to 27.5% of Kerala's workforce of 127 lakh in 2018. They work six days a week on an average. About 20% of migrant workers were classified as skilled. While they are present in all sectors of the economy, 60% of them were found to be working in the construction sector. Assuming a loss of 13 work days in 16–30 August 2018, the total wage loss works out to INR 2,032.72 crore implying a loss of 296.01 lakh person days for migrant workers.

[11] Narayana, D. and C.S. Venkiteswaran (2013), Domestic Migrant Labour in Kerala, Gulati Institute of Finance and Taxation, Thiruvananthapuram.

Table 4
Wage Loss to Migrant Workers (INR lakh)

Districts	Total migrants [lakh]	Affected %	Affected persons	Skilled (20%)	Income loss @ INR 802 for 13 days [in lakhs]	Un-skilled (80%)	Income loss @ INR 658 for 13days [in INR	Total wage income loss [in INR lakhs
Thiruva-nantha-puram	1.21	0	0	0	0	0	0	0
Kollam	0.63	45.96	0.29	5,800	605	23,200	1,985	2,589
Pathana-mthitta	1.46	100.00	1.46	29,200	3,044	1,16,800	9,991	13,035
Alappu-zha	1.45	100.00	1.45	29,000	3,024	1,16,000	9,923	12,946
Kottayam	2.6	100.00	2.60	52,000	5,422	2,08,000	17,792	23,214
Idukki	0.76	100.00	0.76	15,200	1,585	60,800	5,201	6,786
Ernaku-lam	6.03	100.00	6.03	1,20,600	12,574	4,82,400	41,264	53,838
Thrissur	2.47	100.00	2.47	49,400	5,150	1,97,600	16,903	22,053
Palakkad	2.11	59.91	1.26	25,200	2,627	1,00,800	8,622	11,250
Malappu-ram	1.68	42.67	0.72	14,400	1,501	57,600	4,927	6,428
Kozhiko-de	3.2	11.22	0.36	7,200	751	28,800	2,464	3,214
Wayanad	4.6	100.00	4.60	92,000	9,592	3,68,000	31,479	41,071
Kannur	3.86	19.88	0.77	15,400	1,606	61,600	5,269	6,875
Kasargod	2.78	0	0	0	0	0	0	0
Kerala	34.85	65.34	22.77		47,480		1,55,819.7	2,03,300

Note: Col.(1): The distribution of migrant workers as per Kerala Economic Review 2017, State Planning Board, Government of Kerala, p. x. Col (2)

Social security provided by or through the state has been a recent development for this segment of workers in Kerala. It covers health and accident, provision of dormitory facilities for stay, teaching of the Malayalam language, and so on. A Migrant Workers' Bill is now pending before the government. More aspects of the migrant labour conditions and social provisioning are dealt with in Chapter 16 on Gender Equality and Social Inclusion.[12]

Workers Affected (as shared by Department of Labour)

While Table 3 (along with Annexe Table A14.1) gives an estimate of all workers affected by the floods, the information supplied by the Labour Commissioner covered 67.11 lakh workers (pertaining to sectors under its jurisdiction), of whom 12.80 lakh workers (19.1%) were affected by the floods. On an average they lost 21 days of

[12] *Information collected from the Office of the Labour Commissioner, Government of Kerala. For details on housing see www.lc.kerala.gov.in. Also see Ramachandran, Shastri (2018), 'Kerala shows the way by embracing migrant workers' in https://www.newsclick.in/kerala-shows-way-embracing-migrant-workers downloaded on 6.10.2018*

work, totalling 269.08 lakh person days lost. The occupational sector-wise details are given in Table 5. Enquiries revealed that the data were collected largely through the various Welfare Fund Boards that come under the administrative jurisdiction of the Labour Department. As such it does not cover sectors and occupations that come under the jurisdiction of other departments. Thus, the universe of workforce covered is 53% of the total workers as estimated from the NSS data.

In an interaction with trade union leaders there was a general consensus that the working people affected by floods as well as those who face the prospect of job loss due to damage to enterprises, farms, and capital assets need to be taken care of. They emphasised the contribution of the workers in rescue and relief operations as well as the contribution of their organisations mobilising finance for the Chief Minister's Disaster Relief Fund (CMDRF). Two types of compensations were suggested: (i) public works for those who demand them under the MGNREGS, and (ii) compensation for loss of household durables and workdays at a rate that should not be less than the MGNREGS wages. Compensation for replacing the capital assets of the self-employed (such as artisans) was also underlined.

Table 5
Person Days Lost Due to Floods, 2018

Sector	Total no. of workers	Flood affected workers	Work- days lost	Person days lost
Building construction	16,93,779	6,10,486	16	97,67,776
Tailoring services	8,20,606	1,54,387	15	23,15,805
Toddy tapping	29, 908	2,273	35	79,555
Shops & commercial establishments	4,49,907	45,167	8	3,61,336
Agricultural activities	16,16,273	4,03,682	33	1,33,21,506
Handloom weaving	6,145	778	42	32,676
Abkari (toddy sales)	3,178	255	6	1,530
Jewellery making	18,611	760	13	9,880
Unorganised Sector (Not specified)	4,17,420	5,522	15	82,830
Small plantations sector	15,091	7,607	6	45,642
Etta kattuvally thazha (bamboo & reeds)	79,442	27,354	18	4,92,372
Motor vehicle workers	8,69,239	14,903	12	1,78,836
Cashew Workers in factories	1,25,274	531	19	10,089
Head-load workers	69,564	6,711	54	3,62,394
Labour welfare fund board	4,87,871	0	0	0
Beedi & cigar workers	9,000	0	0	0
Total	**67,11,308**	**12,80,416**	**21.14**	**2,70,62,227**

Source: Office of the Labour Commissioner, Government of Kerala.

Plantation Sector

The plantation sector in Kerala is an important one from the point of view of employment and livelihoods. According to the Department of Labour, Government of Kerala, the organised sector employs 69,000 persons in around 725 companies and 1.5 lakh persons work in the unorganised sector consisting of small plantations. A majority of workers in the organised sector are women working on a piece rate wage basis and constitute one of the low-paid sections. According to the Department of Labour, 35,107 workers were affected out of the 50,882 workers in the various flood-affected districts.[13] The total person-days lost were 2,45,749. If this incidence of affected workers (69%) is extended to the entire workforce of 2.19 lakh workers, it would work out to 1.51 lakh workers. The district-wise figures are given in Table 6.

[13] *The gender-wise figures were not available from the Department of Labour.*

Table 6
Plantation Labour Affected by Floods, 2018

Name of Office	District	Total no. of registered employees	No. of flood affected employees	No. of days	No. of work days lost
Chief Inspector of Plantations, Kottayam	Thiruvananthapuram	0	0	0	0
	Kollam	2,785	0	0	0
	Pathanamthitta	3,299	348	3	1,044
	Alappuzha	0	0	0	0
	Kottayam	1,383	113	3	339
	Idukki	31,486	25,976	6	1,55,856
	Ernakulam	743	743	5	3,715
	Thrissur	912	912	4	3,648
	Palakkad	2,850	1,754	11	19,294
	Malappuram	671	248	5	1,240
	Kozhikode	1,073	352	6	2,112
	Wayanad	5,128	4,171	10	41,710
	Kannur	389	260	10	2,600
	Kasargode	163	230	10	2,300
Total		**50,882**	**35,107**	**6.66**	**2,33,858**

Source: Labour Commissioner, Government of Kerala.

Livelihoods

As in most states in India, a majority of workers in Kerala are informal (officially known as unorganised) workers who work (i) in the unorganised sector (i.e., proprietary or partnership establishments employing less than 10 workers) as casual workers and some as regular workers, and (ii) in the organised/formal sector (establishments with 10 or more workers). A significant number of workers, especially women, work

as casual workers in large organised sector enterprises such as cashew processing, coir manufacturing, plantation and a number of other sectors. The total workforce may be divided into casual workers (36.3%), regular workers (26.4%) and self-employed (37.3%). This distribution is somewhat different from the all-India scenario where the respective shares are 30%, 18% and 52%, suggesting a higher degree of commoditisation and proletarianisation of the Kerala economy.

Of the three labour status categories, all casual workers are considered as informal workers. The same is the case with the self-employed, except a very small segment of independent professional workers. Among the regular workers more than half are informal workers without any employment and/or social security.[14] By adopting the definition of informal workers as per the National Commission for Enterprises in the Unorganised Sector (NCEUS), the industry-wise informal workers in Kerala were estimated and it was found that 87% of workers in Kerala are informally employed, i.e., without any employment and/or social security provided by the employer.[15] The floods had a major impact on this particular sector and the recovery strategy needs to be cognisant of their vulnerability.

Agricultural and Allied Labourers

Given the extent of devastation of land and water resources, agricultural labourers (who are asset-poor, so that employment is their only means of livelihood) face a dire situation. Agricultural labourers, who constitute around one-fifth of the total workforce[16], have no government departmental agency to look after their needs, unlike farmers (Agricultural Department), coir workers, workers in cashew and other industries and commercial activities (Department of Industries & Commerce) and service sector departments (various departments) except domestic workers, which is another segment of the working poor. Their estimated wage income loss is included in Table 3 (pertaining to all affected workers).

Workers in Traditional Industries

Several worker households in the traditional industries were affected by the floods directly.[17] Coir processing industry is a major traditional industry in Kerala in terms of employment generation. The government is giving more emphasis to the coir industry, with a separate department considering the social features and problems faced by it. Among the states in India, Kerala is the largest producer of coconuts, contributing 45% of the country's total production. This agro-based rural industry provides subsistence to a large number of families in the coastal belt of Kerala. Around 80% of its workers are women.[18] The cooperative sector plays a key role in the coir industry in the state. The private sector too has a large presence in the industry as final product manufacturers and exporters.

Khadi & Village Industries

Khadi & Village Industries Board (KVIB) carries out its activities through cooperative societies, registered institutions, and departmental units. It plays an important role in generating regular employment for women in rural areas with minimum investment. These industries use eco-friendly local resources and generate higher employment opportunities. The workers are mostly women working either from home or in cooperative societies, and their wages are, perhaps, the lowest in the state, given their low productivity. However, they are sustained by the fact that there is regular employment which is accessible to women who are not available for work beyond their neighbourhoods. Then there are the workers engaged in handicrafts of various types, most of them from socially and economically backward classes.

[14] These figures were computed from the unit level data of the 68th Round of National Sample Survey (NSS).

[15] This deficiency has been partially taken care of in Kerala by forming Welfare Fund Boards for several segments of the workers. These boards pay a pension to retired workers and provide other financial assistance to their members. This has been possible due to the unionisation of almost all segments of workers in Kerala, irrespective of the nature of their employment (formal or informal).

[16] Computed from the 68th Round of the NSS for Kerala.

[17] Cashew processing workers in factories were, by and large, unaffected as per the Labour Department (see Table 5).

[18] State Profile of Kerala 2016–17, published by Ministry of MSME, Government of India

Handloom Sector

The handloom sector in Kerala stands second to the coir sector in providing employment among the traditional industries of the state. The handloom industry in the state is mainly concentrated in Thiruvananthapuram and Kannur districts and in some parts of Kozhikode, Palakkad, Thrissur, Ernakulam, Kollam, and Kasaragod district. The industry is dominated by the co-operative sector. The cooperative sector consists of factory type and cottage type societies. There were 600 registered Primary Handloom Weavers Cooperative Societies in the state during the year 2015–16 as against 575 in March 2015. Of this, 167 are factory type and 433 are cottage type societies. Of these 600 societies 402 were in working condition as on October 2016. The number of factory type cooperative societies functioning at present is 84 (14%) and cottage-type societies is 318 (53%).[19]

The case of Chendamangalam Handlooms is unique. These weavers also own their family looms and work from home as well. It is estimated that the cost of restoration of each such smaller loom will be around INR 2 lakh. In addition, while the restoration continues, the weavers are going to lose their livelihood at an average rate of INR 1,200 per day (with two or more working members per household), for at least six months.

Tourism

Kerala tourism has, by and large, been built up over the last three to four decades with an eye on high-end consumers, especially from abroad. However, there are two segments to this sector: one relying on foreign tourist arrivals and the other on domestic tourists. The latest figures (2016–17) show that 10.38 lakh foreign tourists and 13.17 lakh domestic tourists visited Kerala in 2016–17. The earnings were INR 7,749.51 crore and INR 15,348.64 crore respectively. Indirect income generation from tourism has been estimated at INR 6,560.41 crore.[20] That works out to 4.8% of the Kerala's GSDP.

The August 2018 floods disrupted this flow temporarily for the first 15 days, but it has continued for some more time, partly to repair and refurbish the facilities and partly to convey a sense of normalcy. Since the monsoon period has a lower rate of tourist arrival than other seasons, it may not be too far off the mark to assume a 20%–25% decline in revenue (between INR 5,932 crore and INR 7,415 crore). This has consequences for a segment of the workers who are casually employed in hotels and restaurants and in transport sector as well as the self-employed and other workers in small shops and restaurants.

The floods resulted in the cancellation of Onam festivities in all districts, causing tremendous losses in the tourism sector. The disaster affected various parts of the value chain and had a major impact on the lives and livelihoods of the artisans (drop in tourism numbers, lack of purchasing power within affected communities, no more weekly markets, etc.). These trends could be seen across the sector and were worse for those who lost their workplaces and houses in the most affected districts of Ernakulam, Pathanamthitta, and Thrissur. Tourism is one of the modern sectors of the Kerala economy that has benefitted from the ecological endowments (natural capital) of the state. The damage to the natural environment is equivalent to the damage or destruction of the natural capital foundation of this sector that contributes to the income and employment in Kerala's economy.

Micro and Small Industries

Barring a few large industrial units, mostly in the public sector, Kerala's manufacturing sector is dominated by both modern and traditional industries.

[19] State Profile of Kerala 2016–17, Ministry of MSME, Government of India

[20] Kerala Economic Review 2017, State Planning Board, Government of Kerala, Vol.2, p.185

The latter has been on a declining path, although some of them such as coir have been staging a comeback, given the environment-friendly low carbon footprint products such as geo-textiles. New industries that have made their presence felt are food products, rubber products, plywood manufacturing, rice milling, general engineering, pharmaceuticals, printing, Ayurveda and so on. A number of clusters in Aluva in Ernakulam district were severely affected by the floods. So is the case of coir industrial units (including coir cooperatives).

The Department of Industries and Commerce made a quick assessment of the damages and supplied a summary statement of the number of enterprises, number of workers affected and an estimate of loss to plant and equipment. According to this assessment, 3,590 MSMEs (of 1.28 lakh) and 17,413 workers (of 6.6 lakh) were affected by the disaster.

Table 7
MSMEs Affected by the Floods

District	Total enterprises	No. of enterprises	Total estimated losses (INR lakh)	Persons affected
Thiruvananthapuram	9,647	10	192	50
Kollam	7,300	41	510	220
Pathanamthitta	4,509	410	3,101.48	1,500
Alappuzha	7,831	820	5,260.99	3,625
Kottayam	7,979	204	745.62	980
Idukki	4,533	79	879.82	368
Ernakulam	16,547	1,126	39,180.44	6,400
Thrissur	15,250	630	11,857.82	2,910
Palakkad	8,732	59	499.43	300
Malappuram	21,914	97	372.91	504
Kozhikode	10,445	52	410.17	298
Wayanad	3,200	61	377.18	255
Kannur	6,415	1	3.95	3
Kasargod	3,423	0	0	0
Kerala	1,27,725	3,590	63,391.81	17,413

Source: Department of Industries and Commerce.

Assessment of Damages and Losses

The total damage to specific sectors works out to INR 880.96 crore while the loss stands at INR 9,477.19 crore. The total damages and loss work out to INR 10,358.16 crore.

Table 8
Damage to Assets and Income Loss

Sector	Number of workers affected	Damages (INR crore)	Income loss (INR crore)	Total (INR crore)	Data sources
Wage loss to all affected workers **Subtotal (A)**	72,42,000	NA	7,300.99*	7,300.99	Annexe Table A14.1 of this report
Losses for specific segments/sectors as per information from respective departments					
Workers in different welfare funds	12,80,416	NA	NA	NA	Table 5 of this chapter
Plantation (No.)	35,107	NA	NA	NA	Table 2 of this chapter
MSME	17,413	359.00	274.92	633.92	Table 7 of this chapter
Coir (self-employed) (number)	50,553	1.34	0.32	1.66	Department of Coir
Handloom (self-employed) (number)	Assessed in Chapter 10 on Culture and Heritage				Department of Handloom
Tourism (number)	95,500	508.80	1,701.00	2,209.80	Department of Tourism
Kudumbashree (JLGs, micro enterprises, etc) (lakh)	2,58,660	11.82	199.96	211.78	Kudumbashree Mission
Sub-total (B)	**17,20,160**	**880.96**	**2,176.20**	**3,057.18****	
Grand (Total A+B)		**880.96**	**9,477.19**	**10,358.16**	

*Note: * means estimated wage loss.*

*** Includes a significant portion as wage loss given the employment-intensive nature of the sectors.*

For specific segments/sectors loss in column 5 relates to inventory and/or income loss.
NA means Not Available

Department of Coir, Department of Handloom, Department of Tourism, Kudumbashree Mission, are all agencies of the Government of Kerala.

Recovery Needs and Strategy

The idea of 'Build Back Better' (BBB) for a New Kerala has to be rooted in environmental sustainability, cost effective technologies, green job creation, skill development, climate resilient livelihoods via decentralised planning and social-cum-gender inclusion. From an employment and livelihoods point of view, two recovery scenarios have been worked out. The first one, given in Table 9 is part of the main recovery programme, based on meeting the immediate needs in the affected sectors

and people to kick-start recovery (e.g. through emergency employment) while also creating conditions for long-term recovery, resilience to multiple shocks (including sudden climatic events and natural hazards) and sustainable development. The total recovery cost, as given in Table 9, works out to INR 3,895.66 crore for five years.

An additional recovery scenario with a view to addressing livelihood concerns linked to eco-restoration (recovering and strengthening the natural capital foundation) has been worked out and presented in Table 10. This is an additional employment programme leveraging the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) and expanding the state government's urban employment scheme called Ayyankali Employment Guarantee. This works out to INR 23,065.20 crore. Out of this, INR 16,915.63 is to be mobilised by leveraging MGNREGS, i.e., 73% of the total cost. Of the remaining INR 6,149.57 crore, INR 1,098.21 crore is earmarked for skill development. If half of this amount can be leveraged through centrally-sponsored schemes, the state government's burden will reduce to INR 5,600.47 crore or 24% of the total cost for five years.

Short-term Plan (within one year)

Creating emergency employment through cash for work and other quick employment projects: This should address the needs of the 2.05 lakh MGNREGS job card holders out of the 6.4 lakh families who were given a cash relief of INR 10,000. Even as it provides livelihood support it can be linked to the repair of damaged bunds, for debris clearance of land, repair of ponds and lakes used for irrigation and water control measures, strengthening riverine embankments and all such activities that have to do with land and water resource management and development. These can be taken up through the MGNREGS for rural areas and Ayyankali Employment Guarantee Scheme in urban areas.

Special compensation packages for Kudumbashree members: Leased land cultivators (e.g. joint liability groups) and those who set up microenterprises are a very vulnerable group in the post-floods scenario. The massive strides they had made in livelihoods have been completely wiped out by the sudden floods, absence of insurance and a total lack of livelihoods diversification. This group needs special attention in the context of rehabilitation, but more importantly with regard to issues of land ownership, leased land regulations, decent wages and insurance in order to be resilient to future disasters. An appropriate policy framework for leased land cultivation such as by JLGs and similar groups is warranted. While there is an extensive data base of households and individual members, especially those belonging to economically poorer households (e.g. Kudumbashree, panchayats, and the public distribution system), field visits and review reports pointed out problems in accessing benefits to some of the flood-affected poor. This needs to be specially taken care of by creating access points such as the panchayats for their inclusion.

Insurance packages for climate resilient agriculture: The current insurance packages cover paddy, cashew, plantain, sugarcane, tapioca, and mango. Other agricultural products like rubber are also to be brought in. Current insurance packages are weather-based and crop-based. Insurance packages should also cover damages from wind and excess rains.

Capital recovery/subsidy and loans for income loss: These have been provided for sectors with a large number of informal workers such as artisanal households and other such sectors.

Medium-term Plan (one to three years)

Restoration and regeneration of natural capital: This is mostly green-job-creating

activity. Technological choices need to be made that entail lower carbon footprint, e.g., in strengthening and construction of embankments and related works.

Promotion of alternative technologies in building construction: This is an area in which there are a number of demonstrated alternatives practiced in Kerala. There is already a skilled workforce and more workers can be skilled given the low learning curve of the already educated young labour force. Promotion of low carbon footprint materials is another such area. Some of these have been spelt out in detail in other chapters (e.g. Housing) but the employment generation potential should be kept in mind.

Promotion of climate resilient Agriculture: Crop-based seasonality mapping needs to be carried out to identify vulnerabilities to hazards and a menu of options for farmers in vulnerable areas needs to be developed. Integrated farming approach is already being promoted by the Haritha Kerala Mission. This needs to be intensified.

Product innovation and market development: It is very important, especially for the artisanal sectors like coir and handloom, to intensify efforts in developing new products and expanding access to market through innovative methods. These concerns, however, have largely been addressed already.

Entrepreneurship promotion: The Government of Kerala needs to cement the brand on Nava Kerala products through E-commerce platforms in allied areas such as organic agriculture and its products, handicrafts and trade, efforts in waste management, local ecological tourism, arts heritage and culture.

Skills upgrade and technology links for creating green jobs: Skill upgrade and development is a crucial area of concern to which Kerala needs to pay particular attention. It should be dovetailed into the emerging concept of creating green jobs.

Long-term Plan (three to five years)

Disaster, climate risk and livelihoods governance: Kerala's distinct people's participation model on local self government forms the bedrock of the recovery strategy. The initiatives of local governments are essential for community-based disaster risk reduction plans, community-based disaster management, climate risk and livelihoods recovery plans. Capacity building and strengthening of such a model ensures the social, economic, and political decisions that determine exposure and vulnerability to natural disaster/s and also provides integrated solutions for disaster risk reduction, climate adaptation and sustainable livelihoods. This will also be directly aligned with Priority 2 of the Sendai Framework on Disaster Risk Reduction (DRR) on 'Strengthening Risk Governance to Manage Disaster Risk'. These issues have been dealt with in detail in the Chapter 15 on DRR.

Enterprise, product innovation, market development and skill development: These have to be carried on in the long term as well in order to strengthen the emergence of a New Kerala with environmental sustainability as a key characteristic.

Table 9

Recovery and Reconstruction Needs and Costs (INR crore)

Activity	Short - term	Medium – term	Long – term	Total
MGNREGS and cash for work	**956.36**			**956.36**
Estimated households (HH) with active job card among the 6.4 lakh flood affected HHs = 2.05 lakh (1.44 rural + 0.61 urban)				
MGNREGS additional employment for 100 days for 1.44 lakh rural HHs (over and above the current annual average of 47 days) (1.44 lakh x100 x INR 274)	394.56	An additional package for employment, linking it with eco-restoration and green jobs given separately.		394.56
Material cost (wages to materials in the ratio of 60:40)	260.41	An additional package for employment, linking it with eco-restoration and green jobs given separately.		260.41
Ayyankali Employment Guarantee for 0.61 lakh urban HHs (0.61lakh x100 x INR 274)	180.84	An additional package for employment, linking it with eco-restoration and green jobs given separately.		180.84
Wages and material cost in the ratio of 60:40	120.55	An additional package for employment, linking it with eco-restoration and green jobs given separately.		120.55
Micro, small and medium-sized enterprises (MSMEs)	**590.32**	**315.40**	**100.00**	**1,005.72**
Recovery of damage (INR 359 crore + 20% additional cost for BBB)	215.40	215.40		430.80
Recovery of loss (25% of the cost as compensation and remaining as loan)	274.92			274.92
Convergence schemes for strengthening cluster common facilities, technology and marketing (existing central and state level mechanisms)	80.00	80.00	80.00	240.00
Skill development (through industrial training institutes, polytechnics and others)	20.00	20.00	20.00	60.00
Coir	**76.36**	**87.08**	**0**	**163.44**
Recovery of damage (20% additional cost for reconstruction & BBB)	0.81	0.81		1.62
Recovery of loss—product and stock (25% of the cost as compensation and remaining as loan)	0.32			0.32
DRR preparedness, resilience planning and insurance	0.23	0.04	0	0.27
Technical upgrade (123 damaged units @ INR 1 lakh)		1.23		1.23
Market development including e-commerce		10.00		10.00
Promoting coir products for large-scale reconstruction and resilience (geo-textiles for embankment protection, controlling erosion, treated coconut wood for building homes, pith for horticulture and so on)	50.00	50.00		100.00

Activity	Short - term	Medium – term	Long – term	Total
Skills upgrade and diversification for coir workers (to create new products such as geo-textiles) (approximately 50,000 workers to begin with x INR 10 000)	25.00	25.00		50.00
Handloom	Recovery needs provided in Chapter 10 on Culture and Heritage			
Tourism	**405.28**	**405.28**		**810.56**
Recovery of damage (20% additional for reconstruction and BBB with green infrastructure such as solar, water, waste management)	305.28	305.28		610.56
DRR preparedness, resilience planning (including insurance)	50.00	50.00		100.00
Skill development for environmentally sensitive tourism development including capacity building for handling disaster situations	50.00	50.00		100.00
Kudumbashree women's sector	**157.09**	**207.09**	**200.00**	**564.18**
Recovery of damage (20% additional for reconstruction and BBB under a special package from National Rural Livelihoods Mission (NRLM) for damaged assets recovery	7.09	7.09		14.18
Recovery of income loss (50% as grant and remaining as loan without interest)	100.00	100.00		200.00
Capital subsidy for microenterprises and JLGs for strengthening green enterprises/activities (e.g. organic farming, safe food catering, creating green products such as cloth bags, biomaterial-based products, vermicompost and so on)	45.00	90.00	180.00	315.00
Insurance cover for crops and enterprises	5.00	10.00	20.00	35.00
Skill development, digital data storage, information system, etc.	**28.00**	**296.40**	**71.00**	**395.40**
Skill formation and development training based on district-level plans for creating green jobs and green enterprises for Kudumbashree members (14x10)	28.00	56.00	56.00	140.00
Strengthening existing digital data system and MIS at the state and district level of Kudumbashree (INR 1 crore for two years for districts and state level)		15.00	15.00	30.00
Capacity Building of LSG institutions to support Kudumbashree office and organisational systems (941 panchayats x 10 lakh + 93 municipalities x 20 lakh for two years)		225.40		225.40
Grand total	**2,213.41**	**1,311.25**	**371.00**	**3,895.66**

Additional Recovery Plan based on Employment Generation linked to Eco-restoration

As mentioned earlier, the additional recovery plan has been worked out separately since it is solely based on leveraging the MGNREGS and expanding the state government's urban employment guarantee scheme (Table 10). This provides an opportunity for Kerala to provide a smooth transition to a green economy, recognising the foundational environmental function of its natural resources as well as its function as natural capital. As mentioned earlier, much of Kerala's economic functioning depends on the ecological assets as well as the natural resources that emanate from it. In addition, eco-restoration would call for mobilisation of large numbers of workers as was witnessed in the recent and praiseworthy initiatives in rejuvenating blocked or disused rivers and canals (Alappuzha and Varattar in Pathanamthitta). Such mobilisation of labour would certainly provide for livelihood opportunities for the poorer sections, especially women, labour supply from whom will be enhanced through local level activities. In addition such an eco-restoration programme would also provide for leveraging Kerala's justly famous voluntarism that has contributed to Kerala's social transformation.

Table 10

Additional Recovery and Reconstruction Need Assessment for an Employment-oriented Livelihood Protection Linked with Eco-Restoration (Strengthening Natural Capital)

Past five years' performance of MGNREGS (Kerala)*	2018–19 (14 October 2018)	2017–18	2016–17	2015–16	2014–15
Person days generated (lakh)	318.1	619.6	684.6	741.7	588.7
SC person days (%)	16.5	16.3	17.0	17.4	17.5
ST person days (%)	6.0	4.6	4.5	3.9	3.9
Women person days (%)	90.2	90.8	91.1	91.3	92.2
Total households worked (lakh)**	11.6	13.1	14.6	15.1	13.8
Average no. of days/HH	27.5	47.2	47.0	49.3	42.7
Average daily wage rate (INR)	274.1	260.9	243.1	231.8	214.3
Annual growth in money wage (%)	5.1	7.3	4.9	4.8	
Additional employment generation and the required financial resources	**Short Term**	**Medium Term**		**Long Term**	
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Additional employment creation for eco-restoration and related works (households in lakh) (2.05 lakh provided in the main recovery deducted)	10.95	13.0	13.0	13.0	13.0
Additional number of person days per household	53.0	53.0	53.0	53.0	53.0
Total person days of employment to be generated (lakh)	580.35	689.00			
Expected daily wage rate (5% annual increase)	274.1	287.8	302.2	317.3	333.2
Additional financial requirement (INR crore)	1,590.73	1,982.94	2,082.16	2,186.20	2,295.75

Past five years' performance of MGNREGS (Kerala)*	2018–19 (14 October 2018)	2017–18	2016–17	2015–16	2014–15
Materials (based on 60:40 ratio of wage: materials) (INR crore)	1,080.38	1,321.83	1,387.97	1,457.32	1,530.35
Total additional financial requirement for rural areas (INR crore) [INR 16,915 for five years]	**2,671.11**	**3,304.77**	**3,470.13**	**3,643.52**	**3,826.10**
Employment creation for eco-restoration and related works in urban areas (2 lakh persons = 10% of female urban labour force) for 100 days (2 lakh x 100 x wage rate as per MGNREGS) (INR crore)	548.20	575.60	604.40	634.60	666.40
Materials (based on 60:40 wage: materials) (INR crore)	365.43	383.69	402.89	423.02	444.22
Total additional financial requirement for urban areas (INR crore)	**913.63**	**959.29**	**1,007.29**	**1,057.62**	**1,110.62**
Skill upgrade and development (5% of 6+9) (INR crore)	**179.24**	**213.20**	**223.87**	**235.06**	**246.84**
Total (INR crore)	**3,763.98**	**4,477.26**	**4,701.29**	**4,939.20**	**5,183.56**
Grand total for five years in INR crore					**23,065.29**

*Note: *http://nregasp2.nic.in/netnrega/homestciti.aspx?state_code=16&state_name=KERALA*
***No. of active job card holders as of 14 October 2018 was 19.4 lakh.*
Source of data on past performance: Website of Government of India, Ministry of Rural Development

Implementation Strategy

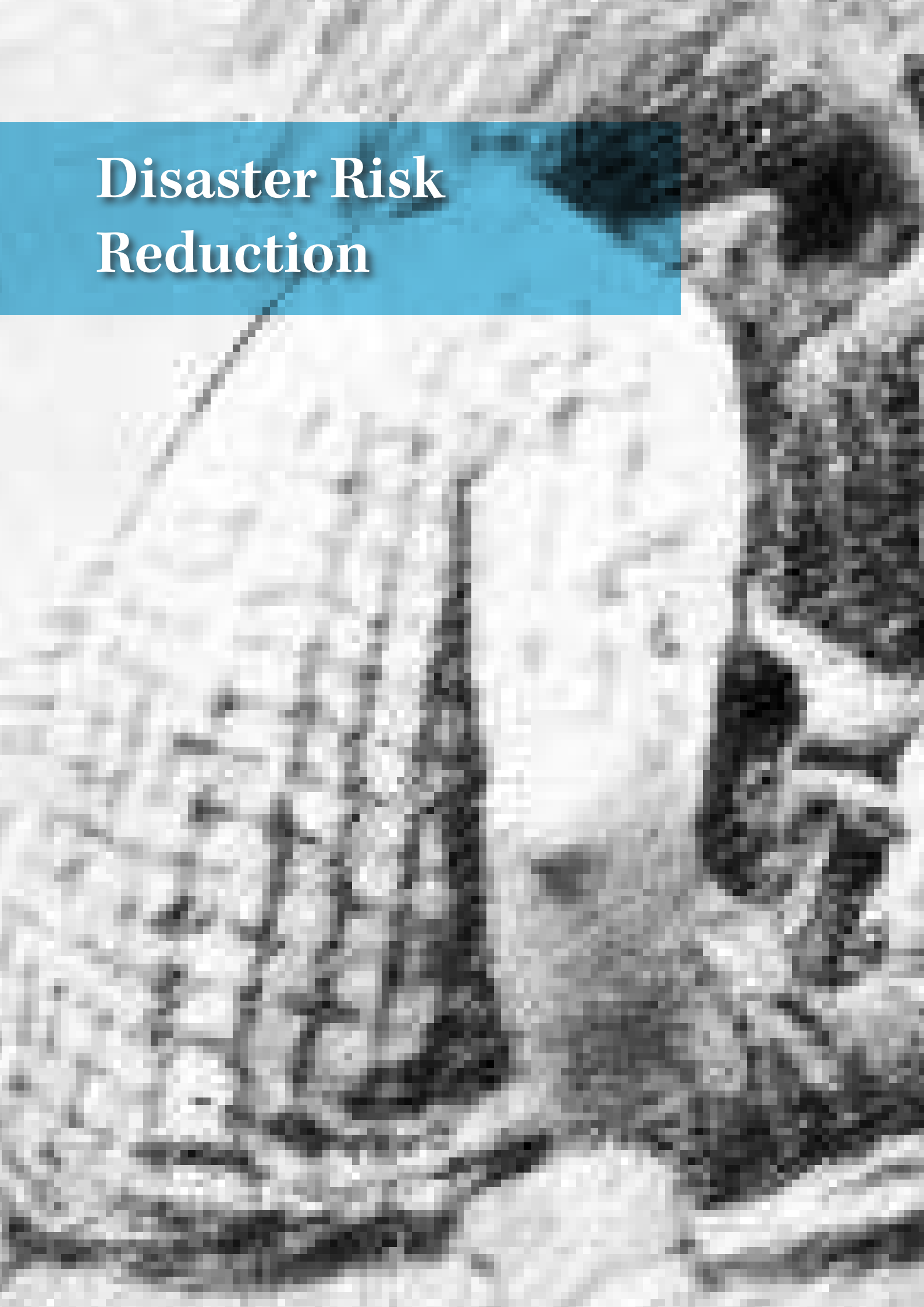
For direct employment generation as a matter of public policy, there is the Department of Local Self Governments with responsibility to implement the national public employment scheme, namely, MGNREGS, in rural areas. In urban areas there is a state government sponsored scheme known as Ayyankali Employment Guarantee that has not been actively promoted, given its low budgetary allocation. The Department of Labour and Skill Development is responsible for implementation of laws relating to conditions of work and safety. It has the added responsibility for skill development for which a few initiatives have been taken (e.g. the Kerala Academy of Skills Excellence). It also has under its wing the industrial training institutes for promoting structured skill development. Although the Department of Industries and Commerce is not directly concerned with employment, it is an important derivative of the promotional activities of the department such as industrial cluster development programmes, IT parks and so on. Special skill development programmes need to be initiated for workers in the industrial clusters that have a higher share of low-educated persons in the total workforce.

The Kerala State Planning Board is the agency for coordinating the plan-related employment dimension in the state. It needs to be strengthened to function as a more coordinated platform to spell out the employment implications of demographic transition, educated unemployment, emigration of Kerala labour and migration of non-Kerala labour, labour legislation, and social security in the changed context of building a new Kerala. The additional challenge is to think afresh for the creation of green jobs in the economy. These issues will have to be factored in the 13th Plan that is undergoing a recast.

Sector Assessment Methodology

This chapter, dealing with such a cross-cutting theme as employment, relied on estimating the loss to the economy and loss to the workers based on secondary data that are quite robust. The immediate impact on workers in specific sectors was assessed based on data made available by departments. However such administrative data as have been made available had to be collected in a short period of time, given the urgent requirement of information. These will have to be revisited through systematic surveys at the local level before undertaking rehabilitation and rebuilding programmes. Qualitative reports on the impact were also sourced through interviews and meetings with officials, non-governmental organisations, social activists, scholars and media reports, all of which have not been incorporated due to limitations of space and time. Given the task of needs assessment, we believe the employment dimension has been captured so as to highlight its crucial importance in reconstruction.

Disaster Risk Reduction



Disaster Risk Reduction

Summary

The post-disaster needs assessment (PDNA) for disaster risk reduction (DRR) is a joint exercise of the Government of Kerala which was led by the Department of Disaster Management and the Kerala State Disaster Management Authority (KSDMA). The assessment team held consultations with the relevant department, district administrations, panchayats and various other stakeholders. The team also visited six affected districts including Wayanad, Idukki, Ernakulam, Palakad, Kozhikode, and Alappuzha.

The assessment covers a review of the disaster management system in the state covering all phases of the disaster management continuum—preparedness, response, relief, mitigation, and prevention.

It includes:

- analysis of the existing institutional structure for DRR in the state, the policy landscape, and the status of implementation of the disaster management plans at various levels;
- performance of the institutions primarily responsible for disaster management in the state with a focus on preparedness, response, mitigation, and prevention;
- performance of the various departments and local government in integrating DRR into the departmental development programmes and plans;
- role of the private sectors, civil society and other organisations; and
- participation of the local community in managing the disaster risks.

With the floods in Kerala in 2018, the DRR sector accounted for INR 16.5 crore in damages and INR 582.52 crore in losses, that is, a net value of INR 599 crore. The estimated recovery cost is INR 109.7 crore.

The vision set out for Nava Keralam is to ensure zero mortality due to disasters with minimal disruption to services and substantive reduction in economic loss. To achieve this vision, the principles of risk-informed programming will be embedded across all the sector recovery plans with additional investments for disaster preparedness and response.

Revival of the State Disaster Response Force (SDRF), enhancing the operational efficiency of the fire and police personnel, a robust early warning mechanism, effective risk and behavioural change communication strategies and adoption of a community-based disaster risk management approach will be required to reduce disaster mortality.

To 'build back better', DRR strategies shall be integrated across the key sector recovery plans/programmes like education, health, tourism, water and sanitation, environment, roads and housing. This will also include introducing necessary changes in the policy, planning, and legal tools. The KSDMA, in coordination with line departments, other state level training institutions and academia, will play an

important role in providing the necessary technical guidance on integrating DRR. Since there will be a lot of new construction, the KSDMA shall develop technical guidelines on the use of disaster resistant technology and circulate them to the relevant departments. Training and capacity building programmes also need to be organised in this regard in association with the relevant technical institutions in the state. Priority will be given to setting a higher level of safety standards while reconstructing schools, hospitals, and other public buildings.

Further, in order to reduce disaster risks, it will be important to link the environment, hazard risks, and development practices. Introduction of a comprehensive land use management policy and Act, necessary amendments in the existing building regulations, environment impact assessment and formulation of special development control regulations for plains, hills, and coastal areas are some of the important measures required in this regard. Building resilience of the urban community in light of the massive urbanisation in Kerala is also the need of the hour.

Technical experts from multi-disciplinary fields such as hydrology, meteorology, civil engineering, agriculture, land-use planning at the KSDMA and the District Disaster Management Authorities (DDMAs) will bring in technical rigour in integrating DRR measures across the sector recovery plans. Advisory groups and expert committees should be set up at the state and district levels for sharing of knowledge and providing technical expertise. The road to recovery will comprise short-, medium- and long-term strategies embracing the four pillars of recovery as indicated in Table 1. Considering the cross-cutting nature of DRR, the Government of Kerala needs to delegate the responsibilities for implementing them amongst the various nodal departments through a consultative process.

Table 1

Aligning the Sector Strategies around the Four Pillars of Recovery

Pillar 1	Room for river and living with the river	Strengthening flood preparedness and response by generating risk maps, improving the early warning and communication system, robust dam crisis management plans, de-silting of canals and drains and investing in a dedicated response force
Pillar 2	Eco-sensitive risk-informed land use and settlement approach	Integrating the environment, hazard, and land use through appropriate policy and planning measures like implementation of land-use zoning regulations and special development control regulations
Pillar 3	Inclusive and people-centred approach	Promoting a community-based disaster risk management approach
Pillar 4	Promoting, knowledge, innovation, and technology	Integrating DRR across sector recovery plans/programmes; strengthening the existing virtual cadre of the KSDMA, developing guidelines for integrating DRR across sectors; training and capacity building programmes, innovative communication, and behavioural change campaigns

[1] *State Disaster Management Plan, p. 46.*

Pre-Disaster Context and Baseline

Hazard and Risk Profile

With a population density of 860 persons per km^2, Kerala is one of India's densest states with a high level of exposure to hazards.[1] The KSDMA categorised hazards under two broad heads—naturally triggered hazards (natural hazards) and anthropogenically triggered hazards (anthropogenic hazards).

Floods are among the most common natural hazards that affect the state. While 14.52% of the total area of the state is prone to floods, in certain districts, this percentage is as high as 50%.[2] With the Western Ghats running through the state, landslides are also a major hazard. The Wayanad and Kozhikode districts are prone to deep-seated landslides while Idukki and Kottayam are prone to shallow landslides. Seasonal drought-like conditions are also common during the summer months. Dry rivers and lowering water tables in summers result in water scarcity in both urban and rural areas. Between 1881 and 2000, Kerala has experienced 66 drought years.[3] The other major natural hazards affecting Kerala include lightning, forest fires, soil piping, coastal erosion and cyclone/strong winds. In 2017, Kerala was hit by Cyclone Okhi, which killed 59 people; 91 people are still missing. The state also falls in seismic zone III.

Human-induced hazards like road accidents, accidental drowning, stampedes, industrial accidents, human epidemics, animal epidemics, dam break and dam spillway operations due to floods and accidents also pose major threats to the state. The state reports a high number of deaths due to accident (4,000 plus per year) and accidental drowning (1,222 per year).[4]

Kerala is also vulnerable to changing climatic dynamics owed to its location along the sea coast and a steep gradient along the western slopes of the Western Ghats. High population density in coastal areas adds to its vulnerability to climate-related problems.[5] It is anticipated that with increasing impact of climate change the state may experience intense rainfall and extreme weather events in the future.

Institutional and Legal Arrangements

The Department of Disaster Management headed by the Additional Chief Secretary, Revenue under the leadership of the Revenue Minister is the nodal department in the state for managing all types of hydrometeorological and geological disasters. In addition, the state government under Section 5.1 of the State Disaster Management Plan, 2016, has identified the roles and responsibilities of various departments during such disasters like human epidemics, heat waves, forest fires, dam break/ spillway, road accidents, pest attacks, air accidents, and others.

Apart from response and recovery, the department is also responsible for all administrative functions, which include:

- issuance of necessary executive orders based on the decision taken by the State Disaster Management Authority (SDMA) and State Electricity Board;
- allocation and approval of funds received from various sources like planned budget of the state, SDRF, and National Disaster Response Force (NDRF);
- approval of the annual working plan of KSDMA; and
- allocation and approval of the utilisation of State Plan for Disaster Management, Mitigation, and Rehabilitation.

[1] Kerala State Disaster Management Plan, 2016, Government of Kerala

[2] State Disaster Management Plan, 2016

[3] Page 46; Kerala State Disaster Management Plan published by Kerala State Disaster Management Authority; http://sdma.kerala.gov.in/p

[4] Page No: 46,48 and 73; Report by National Crime Records Bureau; 2015 ;http://ncrb.gov.in/ - link

[5] Kerala State Action Plan for Climate Change (2014); Department of Climate Change, Government of Kerala;http://www.moef.gov.in/sites/default/files/KERALA%20STATE%20ACTION%20PLAN%20ON%20CLIMATE%20CHANGE.

Affirming the provisions of the Disaster Management Act, 2005, the state government has also constituted the State Executive Committee, the KSDMA, and DDMAs in all the 14 districts. The KSDMA comprises seven members and is chaired by the Chief Minister of Kerala. The Chief Secretary of Kerala is the Chief Executive Officer of the KSDMA and the Additional Chief Secretary, Revenue and Disaster Management, is the convenor. The SDMA is primarily responsible for coordinating various mitigation and preparedness projects, organising capacity building programmes for various stakeholders, conducting risk assessment and dissemination of risk information.

At the district level, the DDMAs have been constituted as per the provisions in the Disaster Management Act. Each district has a Hazard Analyst to assist the district administration. Some of the important functions of the emergency operations centres at the state and district levels are to:

- provide technical advisories and policy inputs to the state government and district administration on various aspects of disaster management;
- update and revise the disaster management plans;
- issue early warnings based on the forecasts and alerts received from various agencies like Indian Meteorological Department (IMD), Central Water Commission (CWC), and Indian National Centre for Ocean Information Services (INCOIS);
- conduct hazard risk and vulnerability assessment and create a disaster database; and
- conduct research.

The State Executive Committee is headed by the Chief Secretary of the state and is responsible for key decision making on the subject of disaster management in the state (Table 2).

Table 2
State Executive Committee

Designation	Role
Chief Secretary	Chairman
Additional Chief Secretary, Revenue and Disaster Management	Convener and Head of the Department of KSDMA
Additional Chief Secretary, Home and Vigilance	Member
Additional Chief Secretary, Finance	Member
Additional Chief Secretary, Health	Member

The State Disaster Management Policy was formulated in 2010. The State Disaster Management Plan was approved in 2016 and is currently being updated post the Okhi cyclone. All the 14 districts in the state developed their district disaster management plans in 2015.

The state has also set up a State Emergency Operations Centre (SEOC) and District Level Emergency Operations Centres with financial support from the 13th Finance Commission. The SEOC functions under the supervision of the Additional Chief

Secretary, Revenue and Disaster Management. Currently, there are 13 specialists associated with the SEOC for providing technical support on various aspects of disaster management.

The state of Kerala has a strong local governance structure. All development activities at the local level fall within the purview of the Department of Local Self Government. However, the capacity to integrate DRR elements in the ongoing development work at the level of the panchayat and urban local bodied is weak. Although the Local Self Government Department (LSGD) has appointed engineers and surveyors at the panchayat level, no mechanism has been established at the local level for embedding the principles of risk-informed development planning particularly while approving infrastructure projects.

The KSDMA has also explored the feasibility of setting set up a multi-stakeholder platform for DRR, which could provide a forum for systematic interaction between the government and various other non-governmental actors like civil society partners, universities, non-governmental organisations (NGOs), faith-based organisations and the private sector. The KSDMA has introduced a process of accrediting credible NGOs in the state and engaging with them to work in the future.

Preparedness and Response

Kerala experiences two rounds of monsoon—the South-west monsoon and the North-east monsoon. Before every monsoon, preparedness meetings are held at the state and district levels to ensure readiness for response. The disaster management plans at the state and district levels have an elaborate section on preparedness and response. The state has also notified the incident response system and formulated the Standard Operating Procedure (SOP) for standardising responses during various disasters. The roles and responsibilities of various departments have been identified in the SOP.

The state forces responsible for search and rescue include the police and fire personnel. In the case of major disasters, there are mechanisms to seek support from the central forces like the Army, Navy, Air Force, and NDRF. Although constituted in 2010, the SDRF is not operational.

The early warning and communication system in the state comprises landline-based telephone, fax, email, Internet group, SMS system, WhatsApp groups, Twitter, very high frequency (VHF) radio networks, satellite phones and community radio stations. The Department of Disaster Management has provided VHF sets to 295 most vulnerable villages and four VSAT phones in three vulnerable districts, that is, Wayanad, Idukki, and Ernakulam, and in the state capital at Thiruvananthapuram. There are 68 manual rain gauge stations as against the minimum requirement of 256. The IMD has installed 11 automated weather stations. Based on the alerts and warnings issued by the IMD and CWC, the SEOC further disseminates it to the district and panchayats. The warning to the last mile is disseminated through newspapers, television, and social media. In addition, the government also uses public address systems and religious institutions including churches, mosques, temples and community radio stations for dissemination of warnings. Under the National Cyclone Risk Mitigation Project, which is being implemented in the state since 2015, there is a component to strengthen the disaster communication network covering all the districts. The project is under implementation and will be completed by March 2020. The state government has also commissioned a project to set up a full-fledged Decision Support System (DSS) and communication system in the SEOC, which will help in strengthening overall preparedness and coordination during disasters. The project is being implemented in a phased manner.

Risk assessment

District level multi-hazard vulnerability maps have been prepared by the National Centre for Earth Science Studies at a scale of 1:50,000. The State and District Disaster Management Plans also provide detailed hazard risk analysis. Kerala falls in seismic zone III. In collaboration with the Kerala SEC and the KSDMA, a digital seismic monitoring network has been set up in the state. The data from these seismographs are transmitted in near real-time to the central receiving station at the SEOC.

Disaster financing

Kerala is one of the few states in India to constitute the State Disaster Mitigation Fund and lay down administrative guidelines for its utilisation. The mitigation fund is being utilised for undertaking innovative projects. Dedicated funding is also available for the SDMA under the planned budget on an annual basis. The annual budget for the year 2018–19 is INR 5 crore. The state also receives the State Disaster Response Fund for response and relief.

Immediate Effect of the Floods

From 1 August 2018 to 19 August 2018, Kerala received 758.6 mm rainfall out of which 414 mm (54%) was received during 15–17 August 2018, causing wide-scale flooding across the state. Water released from the dams further aggravated the problem. However, according to the report of the CWC, the release from reservoirs had only a minor role in flood augmentation as the volume released from the reservoirs was almost similar to the inflow volumes. According to the CWC, the runoff generated from the catchment tapped by the dams during 15–17 August 2018 has been estimated at 2.19 billion cubic metres (BCM). The total live storage capacity under the dams in Kerala is 5.806 BCM. Even if 20% of this live storage was available on 14 August 2018, the flood moderation would only have been 1.16 BCM as against the estimated inflow of 2.19 BCM.

As per the government sources, Wayanad, Pathanamthitta, Idukki, Alappuzha, Ernakulam, Kottayam, and Thrissur are the worst affected districts in the state. The flood affected 5.4 million people (including 2 million children) and 1,259 villages in the state. As per the information put out by Government of Kerala, 433 people died between 29 May 2018 and 29 August 2018, of which 64 were children. There was a point in time when more than 14.5 lakh people were displaced and living in the relief camps. Prolonged flooding and ravaging landslides resulted in heavy damage to houses, roads, and agricultural land. Over 17,000 homes were completely destroyed while 2.17 lakh was partially damaged.

Historically, landslides in Kerala are of debris flow type and are confined to certain catchments. However, due to the unprecedented rainfall, there were numerous deep-seated landslides, rock slides, and landslips. Idukki and Wayanad are the two districts which witnessed major landslides. In total, 342 landslides were reported. According to the maps of the flood-affected areas provided by the National Remote Sensing Centre (NRSC), between 16 July 2018 and 28 August 2018, 65,188 hectares of the land area were inundated. Many areas were under water for more than two weeks.

The flood resulted in serious disruption of telecommunication services and power supply, and transport system hold-ups across roads, railways, and airports. This complicated matters for search and rescue operations, distribution of relief, and restoration of immediate services. The Kochi International Airport was closed for two weeks. In addition, 2.5 million electricity connections and 16,000 transformers were affected.

Post-Disaster Effects

Overall Assessment of the DRR System Performance

Early warning and communication system

Although the early warning system functioned initially, the situation worsened after 14 August 2018. The VSAT phones and the VHF sets available at the district level did not function as expected. The disruption of power supply due to heavy rain led to a breakdown of communication channels in the districts. The district administrations relied on the police wireless system for emergency communication and information sharing.

State and district coordination and response

Since the onset of the monsoon on 29 May 2018, the SEOC and the district emergency operations centres (DEOCs) were functional 24x7 and monsoon preparedness meetings were held at the state and district levels. Based on the forecasts and recommendations of the IMD and INCOIS, regular advisories and warnings were issued by the SEOC to the district administration and public including the fishermen. The first preparedness meeting was convened on 16 May 2018 under the Chairmanship of the State Relief Commissioner with the heads of the departments and the district collectors. A circular was issued with 46 actionable points to be complied with by the departments and the district administrations. On 14 June 2018, the SDMA requested for two teams of the NDRF to be positioned in Kattipara, Kozhikode due to a landslide. Fire and rescue personnel along with the police were deployed across the state for eventualities. On 9 August 2018, the flood monitoring cell started functioning in the Secretariat 24X7 under the Chairmanship of Additional Chief Secretary, Disaster Management. This functioned as a control room with representatives from all the forces. At its peak the rescue operation involved Fire Services, Police, the NDRF, Army, Navy, Coast Guards, Central Reserve Police Force (CRPF), Border Security Force (BSF), and local fishermen. A total of 2,927 fishermen with 669 boats also joined the rescue operations. Around 40,000 police officials were deployed during various stages of flood relief and 2,276 vehicles of the department were used for rescue operations. More than 70,000 volunteers were mobilised across the state to support the rescue and relief operations in the state.

Relief and humanitarian assistance

A total of 3,879 camps, mostly in schools, were set up by the state government after the floods. At one point of time, more than 14.5 lakh people were living in the relief camps. The relief camps were well managed by the revenue officials and panchayats with camp coordination committees constituted at the panchayat level. Each committee comprised a panchayat member, agriculture officer, village officer, revenue officers, and an official from the Department of Health. The 'camp in-charge' in every camp maintained a register and collected information on the family members, income, and expenditure. No major law and order issues were reported by either the media or government officials, and 1,200 health inspectors were deployed to implement the public health preventive and response measures. Free medicines were provided to the affected communities for one month initially after the floods. Systems were set up at the camps for disease surveillance, disinfection of water sources, promoting health education, and testing water quality. Water testing kits were also provided to panchayat wards. The ongoing District Mental Health Programme (DMHP) was further augmented to provide mental health support to the flood-affected people. In Alappuzha and Wayanad districts, community radio stations played an important role in broadcasting information on weather reports

and relief distribution particularly on how to access food and shelter. The Stations directly coordinated the community contributions of food and relief materials and arranged their transportation to the relief camps.

A District Disaster Management team comprising 4–5 members, including a psychiatrist, clinical psychologist, and social workers, was deployed in every district to support the affected community. Agencies of the United Nations like WHO and UNICEF assisted the Department of Health and district administrations in providing support to the community through disease surveillance, setting up of temporary health clinics, repair of water treatment plants, procurement of mobile sludge treatment units, and provision of critical medicines, water filters, and diagnostic kits.

Relief which poured in from all corners of the world was collected, sorted and distributed in a systematic manner by the district administrations with support from local volunteers. The Information Technology (IT) Mission Cell of the Government of Kerala developed an online portal called KeralaRescue.in to coordinate relief distribution and supported the SDMA in the rescue operations. At the same time, due to the absence of specific guidelines and lack of human resources, there were challenges in sorting and distribution of relief materials in some relief warehouses.

Immediately after the floods, the Department of Disaster Management mobilised 38 NGOs for flood response and relief. These NGOs worked in close coordination with the state government and reached out to the most affected people with immediate life-saving needs. At the district level, Inter-Agency Coordination Groups were established. These groups worked in close coordination with the district administrations to distribute relief to the affected people living in the camps. Several private sector companies also extended support to the government both in kind and cash for flood response and rehabilitation.

The state government also reached out to the fishermen and young tech-savvy students and engaged them in rescue and management of relief distribution centres. More than 70,000 volunteers, including engineers, IT technicians, snake catchers, etc., joined in a cleaning drive in the Kuttanad area and cleaned up more than one lakh houses after the floods. In the Kozhikode and Alappuzha districts, the volunteers used an android mobile app called ODK Collect to gather large geo-tagged data and spatial information on the level of flood water, damage to houses, and warning dissemination, which were further mapped on a GIS platform to provide support in decision making. Volunteers also helped in the cleaning of wells and public spaces.

Key Gaps/Challenges

1. There were two major problems identified in early warning communication to the last mile:

    - ***Warning not understood:*** Some of the district administrations indicated that the warnings like red alert or orange alert issued by the IMD for the entire district were not understood well enough to elicit response actions or preparedness planning. More detailed localised warnings indicating the talukas and panchayats are required to take appropriate actions.

    - ***Warning understood but ignored:*** Although Kerala is prone to floods, it does not experience regular flooding. Hence community preparedness to respond to such a disaster was low. Although the flood warnings were provided to the community, there was reluctance to respond to them due to lack of knowledge about the impact of the flood.

2. The clearly established chain of command through Incident Response System (IRS) was hampered by the failure in communication. The SOP for disaster response could not get fully activated. Many flood-affected people were stranded in their own houses for more than five days until the flood waters receded. The reasons for this were many, including lack of understanding of the warning messages, and lack of equipment and information on the geography and demography of the inundated areas to support the search and rescue teams.

3. Since no simulation exercise was conducted before the floods to test the readiness of the existing response forces and the efficacy of the SOPs, the level of system preparedness was low. The existing police and fire forces in the state did not have the necessary equipment to respond to such a devastating flood. Kerala, unlike about 15 other states of India, had not set up a State Level Disaster Response Force.

4. During the period of the real crisis, no reference was made to the district disaster management plans. Human logic and efficient coordination helped district administrations carry out the required response measures. Although the India Disaster Resource Network (IDRN) was updated, during the peak flood period the IDRN portal could not be accessed due to power failure.

5. There are no special disaster response strategies for addressing the needs the elderly and people under palliative care, who comprise a significant percentage of the state population.

Damage and Loss to DRR Assets

The damages normally considered in this section are those related to the infrastructure and facilities relevant for DRR. The damage estimated by the Department of Fire Services has been considered which amounts to INR 16.5 crore. The losses were calculated based on the government's expenses in response-related activities including search and rescue, costs for relief distribution, camp management and logistics' expenditures by the Department of Revenue and Disaster Management. In total, INR 582.52 crore was spent, which has been accounted as a loss (Table 3).

Table 3
Loss Incurred during the Floods

Category	Cost (INR crore)
Relief distribution	230.15
Camp management	78.03
Search and rescue including logistic expenditure for response	274.34
Total	**582.52**

Data source: KSDMA, 23 September 2018.

Emerging Risks and Vulnerabilities

The existing disaster management system in the state is largely response-centric. The disaster management plans prepared at the state and district levels provide a lot of information on hazards but are weak in vulnerability and capacity assessment. The plans are also weak on mitigation and do not provide strategies for mainstreaming DRR across the key development sectors. Although mandated under the Disaster Management Act 2005, majority of the line departments in the state have not yet prepared their departmental disaster management plans. Although the State Disaster Management Plan (SDMP) has mandated departments to allocate 10% of their budget for integrating DRR in their sector, no such allocation has happened in practice.

The existing state response forces have capacity gaps and require more human resources and equipment. At present there are 124 fire stations in the state and on an average, one fire station is responsible for about 2.8 lakh persons in its vicinity. A comprehensive review of the fire and rescue service of Kerala must be commissioned with a focus on aspects such as training curriculum, staff strength, equipment, and SOP. This also calls for an amendment of the Fire Safety Act, 1962, to consider the advances made in the field of disaster management and the changed priorities of the state towards response.

Although the state government has issued an order post-floods to prevent any new construction in the landslide prone areas, there is no land-use management Act or policy in the state which could form the basis for developing land-use zoning regulations for floodplains, hills, and coastal areas in the state. Since most parts of the state are ecologically sensitive as well as prone to natural hazards, it is important to interconnect environmental resilience, hazard risks, and land-use development through a comprehensive land management policy and Act. There is also a need to regulate any change in the existing land use in the catchment area of every reservoir. The SOPs for de-silting of reservoirs as drafted by the Irrigation Department, Kerala, need to be reviewed and appropriately revised by the state government.

Currently, environmental impact assessment (EIA) is not mandatory for all development activities prior to issuance of permits in the catchment area of any reservoir. Kerala is the first state in India which started EIA as a mandatory process in 1978, much before passage of the Environment (Protection) Act in 1986 and at least 14 years before the EIA Notification, 1994. It would be essential to bring back such practices to protect both the environment and lessen the impact of disasters. It will also help in reducing the chance of future loss of infrastructure, human, and finance capital because of natural hazards.

The judgement of the High Court of Kerala in WPC 36879 of 2016 dated 7 March 2017 regarding the inclusion of a clause in building rules, that 'natural drains and streams shall not be obstructed by this development/building permit' has not been implemented yet by the state. Identification of streams and water channels and ensuring the flow of the same without any hurdle must be a priority in any civil construction in the state. Suitable amendments can be made in the building regulations and the Public Works Department (PWD) manual and rules to ensure its implementation.

Quarrying and mining happen rampantly in the areas prone to landslides, which increases the vulnerability of the population. The Kerala Minor Mineral Concession Rules 2015 does not have any provision to prevent mining in the landslide-prone areas. Suitable amendments need to be introduced in this regard.

The risk assessment studies carried out by the state are fragmented and do not provide a composite picture of the risk landscape in the state. The risk maps prepared by the SEOC in collaboration with the Centre for Earth Science Studies are at a scale of 1:50,000. The SDMA has taken the initiative of ensuring that all the data pertaining to the hazard maps are freely available to the public. While this has resulted in awareness among the citizens about hazards and environmental conservation, these maps should ideally be prepared at a scale of 1:10, 000 or 1:5000 if they are to be useful for planning and policy making.

There are only 68 rain gauge stations in the state as against a total requirement of 256. In the era of climate change, which will lead to frequent extreme weather events, it is important to observe micro level weather aberrations. Departments like Irrigation, Agriculture, Vegetable and Fruit Promotion Council (VFPC) have also installed rain gauge stations in the state. The data from these stations may be collated and used for better monitoring.

The building regulations in the state (Kerala Municipal Building Rules and Kerala Panchayat Building Rules) do not have provisions for ensuring structural safety against natural hazards. The capacity at the local level to implement the structural safety provisions as prescribed in the National Building Codes and BIS codes is weak.

Kerala is rapidly urbanising. Census 2011 shows that Kerala has undergone the highest level of urbanisation (47.71%) during 2001–2011[6], with a percentage increase of 83.20 over the previous decade.[7] In this backdrop, there is a need to bring in specific thrust on urban resilience building.

The project on the decision support system and the National Cyclone Risk Mitigation Project, which are crucial for reducing the disaster vulnerability of the state, needs to be implemented on a priority basis.

Sector Recovery Needs and Strategy

The road to recovery comprises short-, medium- and long-term recovery measures. Some of the recovery measures initiated in the short term will continue in the medium and long term. Similarly, some of the medium-term measures will also continue to be implemented in the long term. These strategies will be implemented by the KSDMA, Department of Disaster Management, and other relevant departments in the states. The Government of Kerala may delegate the responsibilities for implementing them amongst the various nodal departments through a consultative process.

Short-Term Measures (0–12 months)

1. Rebuild the damaged fire stations.

2. Establish a failsafe communication network to ensure communications among key officials before, during and after the disaster events. All district magistrates and officers of critical departments should have multiple phone lines and alternative internet connections (in addition to BSNL or other leased lines, mobile 4G and VSATs) so that they can remain connected during a disaster. The possibility to expand high frequency and VHF radio network to reach key officials in line departments needs to be explored. Strengthening of the disaster communication network across all districts under the National Cyclone Risk Mitigation Project (being implemented since 2015) should be completed on a priority basis.

3. Strengthen early warning systems inclusive of last mile dissemination and

[6] *ORGI (2011), Census of India 2011, Office of the Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India.*

[7] *Page 5; State Urbanisation Report, Kerala; A STUDY ON THE SCATTERED HUMAN SETTLEMENT PATTERN OF KERALA AND ITS DEVELOPMENT ISSUES; http://townplanning.kerala.gov.in/sur/SUR.pdf*

response planning. This will include installation of micro-level weather monitoring stations with human resource support for data collection, analysis, dissemination of warnings, and training and capacity building of state and district officials engaged with disaster management. Lessons may be drawn from the experiences of Assam and Karnataka in this context (Boxes 1 and 2).

Box 1: Flood Early Warning System, Assam

With support from the North-Eastern Space Applications Centre (NESAC) in association with Indian Meteorological Department, Central Water Commission, North Eastern Electric Power Corporation Limited (NEEPCO), and the Brahmaputra Board, the Government of Assam developed a Flood Early Warning System (FLEWS).

The FLEWS provides an early warning of flood in magnitude (severity), location (revenue circle/group or cluster of villages) and probable time (within 12–24 hours range), high rainfall warning with location and time, pre- and post-monsoon status of embankment in various flood causing rivers etc.

The alert for a possible flood situation at the district/revenue circle level is given with a lead time of 7–18 hours.

Box 2: Early Warning System by Karnataka State Natural Disaster Monitoring Centre

Karnataka State Natural Disaster Monitoring Centre (KSNDMC) has the densest weather monitoring network in the country. It has established telemetric rain gauges at all panchayats and telemetric weather stations at all the sub-tehsils and micro-watersheds in the state. Observed data is being utilised for developing advisories and weather forecasts. The centre collaborates with national agencies like the Space Application Centre (SAC), Ahmedabad, and the Satish Dhawan Space Centre (SDSC-SHAR), Sriharikota, ISRO. Weather forecasts are being generated for short-, medium-, and long-term time scales.

To disseminate the met information, forecast, and advisories directly to the farmers and local people, a 24x7 interactive help desk, 'VarunaMitra' has been established.

4. Revive the SDRF to strengthen the overall response capacity of the state. The SDRF could be anchored within the Fire and Rescue Department or the Police Department to ensure better coordination. In addition, capacities of Home Guards also need to be strengthened to ensure their readiness during emergencies. Provisions in the State Disaster Response Fund need to be utilised to procure necessary equipment and conduct training of SDRF and other response forces. The state government may consider adopting the model of Odisha Disaster Rapid Action Force (ODRAF) established in Odisha which is specialised in flood rescue (Box 3).

Box 3: Odisha Disaster Rapid Action Force

The Odisha Disaster Rapid Action Force (ODRAF) was setup by the Government of Odisha after the devastating Super Cyclone of 1999. Five units were carved out of the Odisha State Armed Police and Armed Police Reserve in 2001. Subsequently, five more ODRAF units with personnel from fire services were designated as Fire ODRAF.

The teams are equipped with 92 different types of emergency equipments to handle floods, building collapses, cyclones, biological and nuclear disasters.

5. Strengthen the capacity of the local community to receive, understand and react to early warnings through public education campaigns and behavioural change communication drives. Local community groups including children and youth could become key stakeholders for early warning and awareness-raising to complement what is currently absent. Also, community radios could be used to reach out to the local community with key messages. Community Radio Broadcasting is one of the cheapest media processes which transcends literacy barriers and could be used as an effective medium of communication during emergencies and disasters. At present, there are 12 licensed community radio stations in Kerala. Efforts should be made to engage actively with the existing stations and train the Community Radio Staff. Resources could be earmarked for the strategic distribution of FM radio receivers throughout the existing community radio listeners at the panchayats particularly with the women's groups (including Kudumbshree groups), so that the station's broadcast can be received during emergencies. This will be especially important when there is a telecom infrastructure failure. The social media platform of each line department in the state should also be used to reach out to the community with necessary information on risk management and preventive measures.

6. Revision of the state and district disaster management plans and preparation of department-wise disaster management plans in light of the experiences gained from the Kerala floods should be a top priority. The plans should be followed with trainings at the state and district levels and tested through simulation exercises and mock drills. This will ensure that they become dynamic documents that can guide the concerned officials during a crisis. The capacities of the 196 disaster management officials inducted into the Department of Disaster Management also need to be enhanced in this regard. The disaster management plans should also have greater focus on vulnerability assessment and identification of the vulnerable population groups at the district level. Both the state and district plans should provide a detailed strategy for mitigation and prevention along with time-bound actions. The state may also consider strengthening the Disaster Resource Network/IDRN portal through appropriate trainings and expansion of its outreach up to the gram panchayats.

7. Strengthen state and district disaster management authorities to play a coordinating role to mobilise experts, collect data and offer technical assistance to achieve the DRR goals post the Kerala floods. Some of the activities which need to be carried out in this regard are:

    - Engage subject matter experts in the Kerala State Disaster Management Authority (KSDMA) and each district disaster management authority (DDMA) to provide technical guidance on recovery. Multi-disciplinary technical

experts from hydrology, meteorology, civil engineering, agriculture, and land-use planning should be provided at the KSDMA and the DDMAs to bring in technical rigour in integrating DRR measures across the sector recovery programmes. State and district advisory groups and expert committees should be set up for knowledge consolidation and exchange. The KSDMA may also develop sector-specific guidelines, which will become ready-to-use tools for integrating DRR into recovery programmes and provide necessary guidance to the line departments. Since there will be a lot of new construction, technical guidelines on disaster-resistant technology need to be developed and circulated to the relevant departments.

- Also, the KSDMA is currently implementing a novel concept of 'virtual cadres' in the state. This virtual cadre draws in personnel from 25-line departments through an appropriate working arrangement. These officers will be identified as the focal persons for DRR in their respective departments and also trained by the SDMA. The virtual cadres will be responsible for mainstreaming DRR into the departmental plans and programmes and preparation of the department-wise disaster management plans. This initiative of the SDMA is a great example of integrating DRR across departments. It will also address the challenge of frequent transfers of trained personnel as these officers will remain responsible for the DRR-related work, irrespective of their transfer. All departments may immediately nominate members to the virtual cadre of the SDMA.

- Set up a training arm at the SDMA as well as strengthen the capacity of the other training institutions in the state. These institutions can undertake training of trainers across the key line departments for integrating DRR and Climate Change Adaptation (CCA) into sector recovery plans. The training arm of the SDMA will also contribute to strengthening the virtual cadre being set up by the KSDMA.

- Establish a state level multi-stakeholders' forum to share knowledge, information, and responsibilities for reducing risks of disaster and climate change. This forum could be aligned with the United Nations International Strategy for Disaster Reduction concept of National Platforms for Disaster Risk Reduction (https://www.unisdr.org/we/inform/publications/601) and would follow direction of the Ministry of Home Affairs (MHA) to set up a state platform following the adoption of the Sendai Framework for DRR in 2015. Further, after the floods, various citizen groups have been created across the state, which provide an active platform to engage with the community and hear their voices. The DDMAs should work closely with these district level groups to advocate DRR measures. The KSDMA may engage with the Department of Environment and Climate Change to advocate for climate change adaptation.

Medium-Term Measures (1–2 years)

- Conduct state-wide multi-hazard risk assessment and develop risk profiles of each district, which can be annually updated. Generate risk maps preferably at a scale of 1:10,000 or 1: 5000 for better local DRR planning.

- Modernise the fire and emergency services personnel through better search and rescue (S&R) equipment and enhanced training. As of now, only 124 out of the sanctioned 228 fire stations are operational. Review of the fire training curriculum, augmentation of equipment on S&R and inclusion of women in the workforce of fire service are some of the important priorities for recovery investments.

- Establish a system of community emergency response teams (CERTs). Fire services and police already have some experience of running volunteer schemes, which can be mobilised by providing the necessary funds and training. The programme can be started with the CERTs and established, trained and operationalised across all gram panchayats, municipalities, and municipal corporations of Kerala by the end of 2020. The state government is considering setting up a civil defence force which can then subsume the CERTs in the future. The proposal submitted by the SDMA in this regard should be reviewed by the government. Technology like web-based platforms and mobile applications could be leveraged to further support the volunteer schemes.

- Kerala has a strong local governance structure. Panchayats and urban local bodies have the capacity to take key decisions for implementing various local development schemes. After the floods, the panchayats have been vested with the responsibility of planning for the reduction of disaster and climate risks. This calls for the enhancement of the capacities of the local panchayats on risk-informed programming. The KSDMA, LSGD, and Kerala Institute of Local Administration (KILA) shall work in close collaboration to build the capacity of the panchayats.

The key areas of focus should be

  - Strengthen the capacity of the panchayat functionaries to implement and integrate land-use planning, hazard risk zoning and environmental sustainability at the panchayat level.

  - Develop land-use plans at the panchayat level considering the ecology and risks imposed by various hazards.

  - Implement provisions of building codes to ensure structural safety of critical infrastructure and public buildings. Develop appropriate manuals and construction guidelines.

  - Build capacity of panchayat engineers and masons on safe construction, strengthen system for monitoring construction practices and develop appropriate technical guidelines.

  - Further, the state already has a plan to promote the Community-Based Disaster Risk Management (CBDRM) programme; based on the recent flood experiences the CBDRM programme should be immediately rolled out in all the panchayats, municipalities, and municipal corporations. The panchayat-level disaster risk reduction strategy should be further integrated into the gram panchayat development plan (GPDP). Disaster management plans should be prepared in all the 941 panchayats, 87 municipalities, and 6 corporations. The Thiruvananthapuram Corporation has already done urban risk mitigation by preparing ward plans. The KSDMA, in association with KILA, may provide a package/ kit of tools and learning materials to panchayats to implement risk-informed GPDPs.

- Implement demonstration projects in mitigation through the KSDMA. For example, the disability inclusive DRR programme which the KSDMA conceptualized and implemented is a unique best practice; it has helped numerous persons with disabilities during the floods. Similarly, the KSDMA implemented Operation Anantha in 2015, in which 30 km of canals and storm water drains in the city of Thiruvananthapuram were de-silted

and widened. Such initiatives should be upscaled and replicated in other districts of Kerala. In addition, other mitigation projects in hospital safety, school safety, home owner safety, fire safety, and road safety should be conceptualised. The KSDMA, in collaboration with the relevant government departments in the state (Education, Road Safety Authority, Fire Services, LSGD, Health, and Environment and Climate Change), will implement such projects. Such initiatives will develop a culture of preparedness and prevention in the state.

- Develop a comprehensive land-use policy and Land Use Management Act and propose special development control regulations for coastal and hilly areas. Build capacity of the urban local self-governments to implement the regulations on ground.
- Review and amend the Kerala municipal and panchayat building regulations to ensure structural safety. The KSDMA had already reviewed the Kerala Municipal Building Regulations and submitted an expert committee report to the LSGD. The recommendations of the expert committee need to be implemented on a priority basis. Other relevant policies and acts in the state also need to be reviewed to mainstream DRR.

Long-Term Recovery Needs and Measures (3–5 years)

- Critical facilities like hospitals, fire services, police stations, schools, water supply, bridges, and electrical grid stations should be made multi-hazard resistant. The Government of Kerala should assess the structural stability of all existing critical infrastructure and develop a strategy to speedily retrofit or replace them. To start with, the state government should carry out a safety audit exercise of the critical buildings in the state. For ensuring the structural safety of the newly constructed infrastructure, hazard safety cells could be constituted at the district level as well as in the key departments involved in infrastructure development in the state. These cells may have technical experts or establish partnerships with technical institutions to provide the necessary guidance on various aspects of safe construction.
- Monetary compensation provided by the government to the affected population rarely matches the actual losses. Therefore, the state government may consider developing tools for building financial resilience, which include risk transfer, insurance, insurance pooling, micro insurance, etc. A detailed study needs to be commissioned in this regard at the state level to understand the existing risk financing mechanisms and identify the suitable options for risk financing. For insuring the newly built houses after the floods, the Government of Kerala may consider the strategy adopted by the Government of Gujarat after the 2001 earthquake. After the 2001 Gujarat earthquake, all houses reconstructed with government support were insured against 10 disasters/perils. A one-time premium amount was deducted from the housing assistance provided to each beneficiary for a period of 10 years.

Details of the recovery and reconstruction needs, and costs have been depicted in Table 4.

Table 4
Recovery and Reconstruction Needs and Costs

Activity	Recovery and Reconstruction Cost (INR lakh)			
	Short Term	Medium Term	Long Term	Total
Recovery of damaged infrastructure	**1,653**	**0**	**0**	**1,653**
Fire Service /stations	1,653			1,653
Multi-hazard early warning, communication and decision support systems	**20**	**249**	**405**	**674**
Review of the existing state level mechanisms for early warnings and district level dissemination/communication	20			20
In the most vulnerable gram panchayats, 188 weather stations need to be established	76	100	200	376
Establishment of a state-of-the-art early warning and communication systems		73	205	278
Strengthening the communication network from the state to the taluka and village levels				0
Strengthening Emergency Operations Centres/SDMA/DDMAs in the state and at the districts	**20**	**299**	**270**	**589**
Review of the existing SEOC and DEOC (functioning, human resource strengthening and equipment/technology to identify the future needs in the context of recent floods)	20			20
Training and capacity building of DDMAs, and relevant officials at the state and district levels on EOC management and IRS system	29			29
Providing Human Resources (Technical)	100	170	270	540
Institutional strengthening for mainstreaming DRR and CCA	**137**	**218**	**19**	**374**
Review the existing State Disaster Management Policy, Rules, Emergency Operations Center—Standard Operating Procedure in the context of the recent floods	2			2
Review and revision the SDMP and 14 DDMPs on a priority basis	0			
Strengthen the SDMA with experts in agriculture, meteorology, water resources, housing and settlements including urban planning, health, environment, and infrastructure to mainstream DRR and CCA into recovery plans	60	60		120
Developing departmental disaster management plans	60	70		130

Set up a training arm in the SDMA for capacity building on mainstreaming DRR and CCA i. Training needs assessment for nodal department ii. Standard training packages for a wide range of stakeholders iii. Module development for departmental training institutes such as KILA, State Institute of Rural Development (SIRD), Institute of Management, State Institute of Health & Family Welfare (SIHFW) Kerala, and Institute of Land and Disaster Management (ILDM) iv. Deliver training programmes and courses	13	34	50	97
Set up a State Level Multi-Stakeholder Forum (SFDRR) for DRR/advisory groups for consultation, advisory support, knowledge sharing, and monitoring of progress made in achieving the goals of the SFDRR	2	4	4	10
Review and suggest proposed amendments in some of the relevant Policies, Acts and Rules (the Kerala Biological Diversity Rules 2008; Kerala Housing Act, 1971; Land Acquisition, Rehabilitation and Resettlement Act, 2013; Kerala Tourism Policy, 2012; Kerala State Housing Policy, 2011 [draft]; Panchayat Building Rules, 2011; Building Construction Rules; etc.)			15	15
Strengthening Response Mechanism	**800**	**820**	**0**	**1,620**
Revival of the SDRF, training, procurement of equipment (600 personnel at four locations)	800	800		1,600
Strengthening state response forces like fire services, police, civil defence, and home guards				0
Strengthening the IDRN database and customising the data collection till the gram panchayat level, including training		20		20
Risk and Vulnerability Assessments	**150**	**400**	**200**	**750**
Multi-hazard risk and vulnerability assessment and micro level risk mapping covering all districts	100	300		400
Five dam crisis management plans: Banasura, Idamalayar and Pamba–Kakki–Annathod	50	100	100	250
Safety audit of key public buildings			100	100
Implementation of Community-based Disaster Risk Management Programme	**574**	**2,170**	**2,000**	**4,744**
Capacity building of panchayats and urban local bodies on DRR including risk communication and behavioural change communication drives, and preparation of panchayat level plans.	164	1,600	2,000	3,764

Strengthening volunteers' network through technology development of a mobile app	20			20
Developing of 87 municipality and 6 municipal corporation disaster management plans	390	570		960
Knowledge Management	**30**	**140**	**220**	**390**
Review of risk transfer mechanism and recommending mechanism to strengthen it	30			30
Technical guidelines, toolkits, and other IEC materials	0	70	110	170
Constitution of a state hazard safety cell for promoting multi-hazard resilient infrastructure		10		
Implementing key demonstration projects on mitigation		70	100	170
Total	**3,384**	**4,366**	**3,224**	**10,974**

Sector Assessment Methodology

The sector assessment deployed a combination of qualitative and quantitative tools to arrive at its conclusions. These were:

1. Desk review of reports, datasets and government orders in the context of floods.
2. Field visits.
3. Development of templates and questionnaires for data collection.
4. Key informant's interview and focus group discussions at the state, district, and panchayat levels as well as with specific vulnerable groups.

Various documents of the Government of Kerala referred to include:

1. 2010; Kerala State Disaster Management Policy
2. 2015; Kerala State Disaster Management Rules
3. 2012; Guidelines for Administration of State Disaster Mitigation Fund
4. 2015; Kerala State Hazard Profile; http://documents.gov.in/KL/16344.pdf
5. Kerala State Disaster Management Plan, 2016
6. District Disaster Management Plans, All districts, 2016
7. Village Disaster Management Plan, Peringara village, Pathanamthitta district, 2016
8. City Disaster Management Plan, Thiruvananthapuram
9. Memorandum and Amendment to the Memorandum of Floods (2018), Government of Kerala
10. 2013; Report of the High Level Working Group on Western Ghats—Dr. Kasturirangan,

11. 2011; Report of the Western Ghats Ecology Expert Panel—Professor Madhav Gadgil Committee, http://www.moef.nic.in/downloads/public-information/wg-23052012.pdf

12. 2016; Early Warning System Plan of Trivandrum City

13. 2018; Study Report, Kerala Floods of August 2018; Government of India Central Water Commission; Hydrological Studies Organisation Hydrology (S) Directoratehttp://cwc.gov.in/main/downloads/KeralaFloodReport/Rev-0.pdf

People's Participation: Kerala fishermen turn into true heroes for saving flood victims

Not all heroes wear capes, some wield oars and shovels. Take for instance the fishermen who have emerged as the unsung heroes during the worst ever floods in Kerala since 1924.

Braving inclement weather and treacherous waters, hundreds of fishermen in 669 mechanized country boats helped to rescue 65,000 marooned people across the affected areas. Their grit and experience in turbulent waters also helped facilitate the rescue operations carried out by security forces and NDRF in areas where air lifting was not even feasible or just not available.

The fishermen reached out to the worst-affected areas, spending their own money to transport their mechanised boats and fuel in trucks. Incidentally, just a few months ago these same fishermen were reeling from the aftershocks of the Ockhi cyclone and are still themselves recovering.

Venturing into the remote corners with their vessels, they played a decisive role in rescuing people from critical areas like Chengannur and Kuttanad and provided relief materials, essential food items and drinking water to rescue camps. Most of the fishermen involved in the herculean task hail from districts of Alapuzha, Thiruvananthapuram, Malappuram, Kollam, Kannur, Thrissur, and Ernakulam.

In the worst hit Pathanamthitta district alone, about 70 per cent of the total number of people trapped were rescued by local fishermen who had to all along work in harsh weather, Fisheries Minister J Mercykutty Amma said .

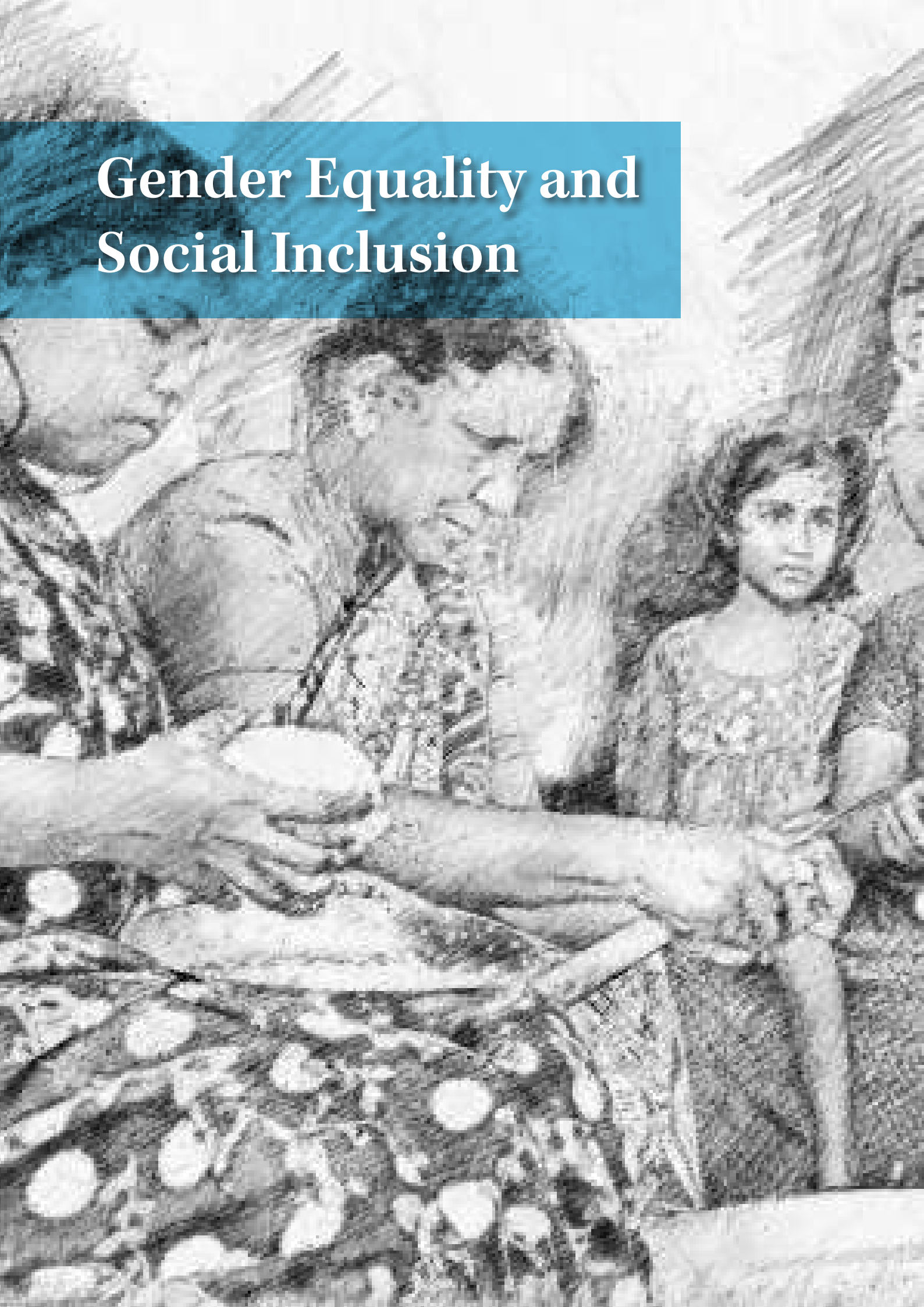
Most of them live in dire conditions, working day and night to make their ends meet, but still took the risk. Majid M K, a native of Malapurram district, narrates his experience of joining the rescue mission in Mattathur, Thrissur. "We were struggling to manoeuvre our boat because of strong water current. There came a point when we worried for our own lives," the 43-year-old says, his voice choking.

Another fishermen involved in rescue operation, said he and his friends did not do it for monetary purpose. "We did a total of 80 trips and rescued around 150 people from Chalakudy over the course of two days. We didn't go there expecting monetary benefits"," he says.

Kerala chief minister Pinarayi Vijayan was quick to acknowledge the efforts of fishermen l "The fishermen intervened in a great way. Many of their vessels got damaged. The government would compensate them for the loss suffered.," he said.

A number of functions were held across the state to honor the services of these heroes of Kerala.

Gender Equality and Social Inclusion



16 Gender Equality and Social Inclusion

Summary

The floods and landslides in Kerala have affected women, girls, boys, men, and transgender persons belonging to various social groups in different ways. Due to pre-existing discriminations based on gender, age, class and caste, unequal access to and control of resources, and other socio-economic disadvantages, women and girls, transgender persons, persons living with disabilities (PWDs), the elderly, female-headed households (FHHs), migrant workers, fisherfolk, as well as Scheduled Caste (SC) and Scheduled Tribe (ST) populations have been disproportionally affected by disasters. These groups have shown different and uneven levels of resilience and capacities to recover.

Each of these populations also has a unique and critical role to play in resilience building, disaster response and recovery. A prime example are the Kudumbashree women and anganwadi teachers who, despite being among those severely impacted, have been at the forefront of recovery and rehabilitation efforts, tending to the needs of their communities and families while coping with the adverse impact on their own livelihood and possessions.

Loss and damage to institutions and systems have been discussed in other chapters and those of particular relevance to vulnerable populations have been cross-referred here. Wage loss of INR 1,358 crore to female workers or of INR 90.4 crore to STs has not been separately included as a loss in this chapter to avoid double-counting.

Recovery needs: This assessment highlights the critical need to reach the last mile of the affected population; the loss of livelihoods which has crippled the ability of vulnerable groups to recover; the risks involved in excessive reliance on unpaid work carried out by women; the risk of unequal access to essential services and resources; and emerging psycho-social needs. This disaster is also an opportunity to establish a robust human rights-based approach to all phases of the disaster management cycle, without leaving any one behind, and based on the principles of non-discrimination and participation.

Highlighting the distinct recovery needs of each group, this chapter specifies differentiated recovery strategies and policy recommendations pertaining to each group in addition to cross-cutting measures. The chapter argues for the prioritisation of those experiencing compound vulnerabilities not only in terms of access to relief mechanisms but also in terms of capacity building efforts. It is critical to ensure that no capacity building effort is limited to a one-off activity but is implemented with a long-term and sustained vision towards empowerment and self-reliance.

The costs of specific recovery measures amount to INR 35.03 crore, with close focus on capacity building of vulnerable populations to help Kerala progress towards becoming a green state.

Resilience, strengthened through effective systems, social protection schemes, and programmes for gender equality and social inclusion, is essential to minimise

the effects of natural disasters on the most vulnerable. This post-disaster needs assessment (PDNA) seeks to assist the Government of Kerala in strengthening the development trajectory of the state by ensuring that no vulnerable group is left behind, thereby helping fast-track the building of 'Nava-Keralam' in a sustainable, eco-sensitive, inclusive, and empowering manner.

Pre-Disaster Context

Population

With a population of 3.34 crore, Kerala is the eighth most densely populated state in India.[1] There are 1,084 women (all ages) to 1,000 men (all ages) in Kerala, which is high compared to the national average of 940 women for 1,000 men.[2] Children aged 0–14 years represent 23.44% of the total population in Kerala, 48.91% of whom are girls.[3] The elderly account for 12.6% of the population.[4] A total of 7.62 lakh PWDs have been identified in Kerala. There are 30.4 lakh members of SCs (51% of whom are female) in Kerala constituting 9.1% of the population and 4.85 lakh members of STs (51% of whom are female) constituting 1.45% of the state population.[5]

Women and Girls

Women constitute 52% of the total population in Kerala.[6] In contrast to the national average of 11%, 22% of all households in Kerala are FHHs.[7] Among the rural FHHs, 34% were included under the 'deprived category' in the Kerala Economic Review.[8] While Kerala has the highest literacy rate in the country, there is a gender differential in literacy rates—men (96.02%) and women (91.18%).[9]

Despite the state's noteworthy performance in other development indicators, there is a significant gap between the labour participation rates of men (57.8%) and women (24.8%).[10] Specifically, the labour participation rate of women in rural areas in Kerala is lower than that of India. The proportion of women workers to total workers is 27.26% among the overall population; it is higher among SCs at 30% and among STs at 39.6%.[11] Yet, among work seekers, the women (at 21.92 lakh) outnumber the men (at 13.31 lakh).[12] The lack of mobility, limited job preferences, and norms dictating gender roles are among the key reasons behind the limited work force participation of women.

Of the 1.14 lakh small-scale industry (SSI) and micro, small and medium enterprise (MSME) units registered in Kerala during 2016–17, 21.53% were promoted by women; 3.27% by SCs (of which 36.07% are women); and 0.63% by STs (of which 28.71% are women).[13] Manufacturing in Kerala has traditionally had a high proportion of female workforce participation mainly because women have historically dominated industries such as coir, cashew, bamboo, handloom, and fish-processing. The tea industry, primarily in the Wayanad and Idukki districts, continues to employ women predominantly.[14]

Access to, and control over, economic resources, especially immovable assets, are the precondition to women's empowerment. Women in Kerala hold a meagre 19% of operational holdings and 13.89% of operated area.[15] As we move from the lower to higher income groups, the share of operational holdings, area operated, and average size decline for women.

More than two-thirds of women (69%) surveyed in the National Family Health Survey (NFHS-4) believe it is justifiable for a husband to beat his wife under some circumstances.[16] Among women aged 15–49 years in Kerala, 15% have experienced physical, sexual or emotional violence, a number that increases among STs (34.5%) and SCs (29.2%).[17] Women whose husbands 'get drunk' are much more likely to

[1] *ORGI (2011), Census of India 2011, Office of the Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India.*

[2] *Department of Economic and Statistics (2017), Gender Statistics 2016–17, Publication Division, Department of Economics & Statistics, Government of Kerala.*

[3] *Ibid.*

[4] *MoSPI (2016), Elderly in India 2016, Social Statistics Division, Ministry of Statistics and Programme Implementation, Government of India*

[5] *ORGI (2011), Census of India 2011, Office of the Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India.*

[6] *Department of Economic and Statistics (2017), Gender Statistics 2016–17, Publication Division, Department of Economics & Statistics, Government of Kerala*

[7] *Ibid.*

[8] *State Planning Board (2018), Economic Review 2017 – Volume Two, Kerala State Planning Board, Thiruvananthapuram, Kerala, India*

[9] *ORGI (2011), Census of India 2011, Office of the Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India.*

[10] *State Planning Board (2017), Economic Review 2016 – Volume A, Kerala State Planning Board, Thiruvananthapuram, Kerala, India*

[11] *ORGI (2011), Census of India 2011, Office of the Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India.*

[12] *Department of Economic and Statistics (2017), Gender Statistics 2016–17, Publication Division, Department of Economics & Statistics, Government of Kerala*

[13] *Department of Economic and Statistics (2017), Gender Statistics 2016–17, Publication Division, Department of Economics & Statistics, Government of Kerala*

[14] *Ibid.*

[15] *Chacko, Ann Mary (2017), 'Land Reforms and Women Land Owners in Kerala: A Question of Power and Empowerment', Social Sciences International Research Journal, Vol 3 Issue 2. Accessed on October 2, 2018 via http://www.imrfjournals.in/pdf/MATHS/SSIRJ-Volume-3-Issue-2-2017/5.pdf*

[16] *IIPS and ICF (2018), National Family Health Survey-4 India 2015-16: Kerala. International Institute of Population Studies, Mumbai.*

[17] *Ibid.*

experience physical or sexual spousal violence (49%) than women whose husbands do not consume alcohol.[18] Only 28% of women who have experienced physical or sexual violence by anyone have sought help.[19]

The Women and Child Development Department (WCD) was set up as an entity distinct from the existing Social Justice Department in 2017. However, the WCD is yet to be operational as a distinct body at the district level and several programmes continue under the Social Justice Department. The state also has a Gender Equality and Women's Empowerment (GEWE) Policy for 2014–2020.[20] According to the Gender and Child Budget for 2017–18, while 11.4% of the state plan budget is allocated to women and girls, only 4.5% of the funds are allocated to programmes in which 90% or more of budget are targeted towards women and girls.[21] The allocation of funds to women and girls is also reflected in the local planning wherein 10% of funds are earmarked for schemes specifically benefiting women. The efforts of successive governments in Kerala to advance gender equality are commendable. However, existing socio-cultural norms continue to discriminate against women and restrict their mobility; crimes against women persist; and low workforce participation, reliance on low-paying yet labour intensive work, and limited ownership of assets such as land impede the substantive empowerment of women.

Persons with Disabilities

There are 7.62 lakh PWDs in Kerala is of which 48% are women.[22] Among PWDs, 22% are mobility impaired (41% women), 13% have multiple impairments, and 9% suffer from mental illness.[23] The PWDs include people identified with issues related to vision, blindness, hearing and speech, and intellectual disability.[24,25] While Kerala has the highest literacy rate among disabled persons (70.9%) in the country, percentage of workers among PWD in Kerala is only 24%, significantly below the national average of 36%.[26] The Social Justice Department and the Kerala Social Security Mission are the key entities responsible for PWDs in Kerala.

Transgender Persons

A state-wide survey identified 25,000 transgender persons in Kerala.[27] The survey reported that over 75% of transgender persons hid their identities at work and about 50% did so with their families as well—a grim reflection of the discrimination, harassment and stigma they continue to experience. Reflecting the reality of compound vulnerabilities, the survey found that, 'only male-born transgenders are able to realise their identity. Female-born transgenders do not get such opportunities due to the patriarchal norms of society'. Of those surveyed, 58% of transgender students drop out before tenth grade, only 11.6% have regular jobs, 51% were denied treatment in hospitals and 32% had attempted suicide. At 84.61%, the literacy rate among transgender persons is also significantly lower than the state average.[28] Kerala was the first state in India to frame a Policy for Transgender Persons which aims to ensure that the rights of transgender persons are protected and enforced and inequities in the areas of health, education, shelter, and public appointment are addressed. In order to oversee the implementation of the Transgender Policy, a Transgender Justice Board was created under the Department of Social Justice.

The Elderly

Kerala has 42 lakh people above the age of 60 years, constituting 12.6% of the state's population, the highest in the country.[29] The feminisation of ageing is evident: 55.09% of those above 60 years are women.[30] Women represent an even higher proportion of 62.29% of those aged 80 and above.[31] In Kerala, 16% of the elderly above 60 years of age are currently in the labour force.[32] The current participation rates amongst the elderly men is 26% and women, 8%; most are involved in unskilled, informal, and

[18] *Ibid.*

[19] *Ibid.*

[20] *Department of Social Justice (2015), Gender Equality and Women's Empowerment Policy for Kerala (2014–2020), Department of Social Justice, Government of Kerala.*

[21] *Finance Department (2017), Gender and Child Budgeting 2017-2018 – Plan Schemes, Finance Department, Government of Kerala.*

[22] *ORGI (2011), Census of India 2011, Office of the Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India.*

[23] *Department of Economic and Statistics (2017), Gender Statistics 2016–17, Publication Division, Department of Economics & Statistics, Government of Kerala*

[24] *Ibid.*

[25] *MoSPI (2016), Disabled Persons in India – A Statistical Profile 2016, Social Statistics Division, Ministry of Statistics and Programme Implementation, Government of India*

[26] *Ibid.*

[27] *Department of Social Justice (2015), State Policy for Transgenders in Kerala 2015, Department of Social Justice, Government of Kerala*

[28] *ORGI (2011), Census of India 2011, Office of the Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India*

[29] *MoSPI (2016), Elderly in India 2016, Social Statistics Division, Ministry of Statistics and Programme Implementation, Government of India*

[30] *Ibid.*

[31] *ORGI (2011), Census of India 2011, Office of the Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India*

[32] *ISEC Bangalore, IEG Delhi, TISS Mumbai, UNFPA (2013) Building a knowledge base on population ageing in India, Status of Elderly in Kerala, 2011, UNFPA*

low paying jobs.[33] The proportion of the elderly working out of compulsion is higher among women (72.3%) than men (39.4%), indicating strong gender differentials in the need for work.[34] A much higher proportion of the working elderly belong to SC, ST, and economically vulnerable groups. Kerala also has the highest old age dependency ratio in the country[35] and with livelihoods being lost as a result of the floods, a greater number of elderly people in the state will likely be dependent on working age populations or on the state for their sustenance.

The Government of Kerala has formulated a State Old Age Policy 2013 and amended the Kerala Maintenance and Welfare of Parents and Senior Citizens Act of 2007, which requires children to provide maintenance to their elderly parents.

Migrant Workers

Nearly 30 lakh migrant workers from outside the state play an important and indispensable role in the state's economy.[36] Barring a few traditional sectors, the economy is highly dependent on these workers for low-skilled and low-valued jobs. Tamil Nadu, Karnataka, Jharkhand, Odisha, West Bengal, Bihar, Uttar Pradesh, and Assam are major migrant-worker-sending states. While a large proportion of these are young, single men from poor rural agrarian families of eastern Indian states with limited education, there is also a significant number of single women and girls as well as senior citizens. There are also families with children, including nomadic communities. Most migrant workers belong to socially and economically deprived communities such as SCs, STs, and minorities.

Kerala offers among the highest wage rates in the unorganised sector in the Indian subcontinent. However, migrants in Kerala live in crowded unhygienic conditions in single room dwellings with limited lighting and ventilation. Many work in hazardous conditions with minimal or no safety measures or social protection, for 12 hours or more, six days a week, drawing lower wages than those earned by state residents.

Scheduled Castes and Scheduled Tribes

Though the socioeconomic status of STs in Kerala is better than that of their counterparts in other parts of India, STs remain outliers in the 'Kerala model' of development despite the state spending more funds on the development of STs than is proportionate to their share in the state's population. Scheduled tribes form 1.45% of the state's population, and 63% of the state's STs are concentrated in the districts of Wayanad, Idukki, Palakkad, and Kasaragod.[37]

Only 1.5% of SCs in India live in Kerala, but within Kerala, SCs are 9% of the state's population. Palakkad district, with 14.4% SCs, followed by Thiruvananthapuram, Malappuram, Kollam, and Thrissur, have higher SC populations. This indicates that SCs are dispersed across the state.[38] The total number of SC workers was recorded at 13.32 lakh (35.06% of whom are women).[39]

The state has a Scheduled Caste Development Department and a Scheduled Tribe Development Department with mandates for each community. Table 1 presents data on the key indicators for the SC and ST populations in the state.

[33] *Ibid.*

[34] *Ibid.*

[35] *MoSPI (2016), Elderly in India 2016, Social Statistics Division, Ministry of Statistics and Programme Implementation, Government of India*

[36] *Peter, Benoy and Narendran, Vishnu (2017), God's Own Workforce: Unravelling Labour Migration to Kerala, Centre for Migration and Inclusive Development, Perumbavoor, Kerala.*

[37] *ORGI (2011), Census of India 2011, Office of the Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India*

[38] *Ibid.*

[39] *Department of Economic and Statistics (2017), Gender Statistics 2016–17, Publication Division, Department of Economics & Statistics, Government of Kerala*

Table 1
Indicators for SCs and STs in Kerala

	SC	ST	State population
Population (in lakh)	30.39	4.85	333
Percentage to total state population	9.1	1.45	-
Child Population (0–18 years) to the community population (%)	27.99	32.73	29.6
Sex ratio (women per 1,000 men)	1,057	1,035	1,084
Literacy rate (%)	88.7	75.81	93.91
Literacy rate—female (%)	85.07	71.1	91.98
Literacy rate—male (%)	92.64	80.76	96.02
Work participation rate (%)	43.83	47.49	38.2
Source: ORGI (2011), Census of India 2011, Office of the Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India			

Post-Disaster Effects

General Context

As per official estimates, 433 lives were lost in the floods and landslides that struck Kerala.[40] These include 268 men (62%), 98 women (23%), and 67 children (under 18) (15%).[41] A possible explanation for the higher number of casualties among men is that more men were outdoors and therefore impacted by the sudden rise in water or landslides. As the primary caregivers, most women would have remained indoors with their dependents, and were therefore protected from the sudden rise in water levels. While the elderly only comprise 12% of Kerala's population, 20% of lives lost were amongst the elderly, a reflection of their heightened vulnerability. Among SCs, 44 people and among STs, 14 people died due to floods and landslides.[42]

It is estimated that there are 6.77 lakh FHHs[43] in the 10 districts[44] most affected by the floods and landslides.[45] Over 2.03 lakh women, 19,432 men, and 99,136 children were reported to have been in 3,644 camps across 14 districts as of 20 August 2018.[46] About 8,600 PWDs and 28,190 senior citizens[47] are estimated to have been affected. Furthermore, 89,158 persons from SC[48] communities and over 10,684 families belonging to STs[49] are reported to have been affected. Only five transgender persons[50] were officially identified as being affected. This is probably an underestimation owing to the heightened vulnerability and stigma experienced by that social group. Figure 1 shows the proportion of fatalities of people belonging to different groups, as a proportion of their population.

Effects on Women and Girls

While over 60% of the fatalities were among men, the differential and lasting effect of the disaster on women and girls needs to be underscored. Women and girls across social groups experience gender-based disadvantages and discrimination, which have been exacerbated in the aftermath of floods. Women and girls who are differently-abled, those belonging to FHHs, SC, ST or the fishing communities, as well as elderly women require special attention due to the compound vulnerabilities they experience.

[40] Data provided by Kerala State Disaster Management Authority, October 10, 2018

[41] Data on transgender fatalities is not available.

[42] Scheduled Caste Development Department and Scheduled Tribe Development Department, Government of Kerala

[43] Baseline for number of FHH from Women and Child Development Department - Annual Survey, 2015-16.

[44] Pathanamthitta, Alappuzha, Kottayam, Idukki, Ernakulam, Thrissur, Palakkad, Malappuram, Kozhikode and Wayanad.

[45] This is the closest estimate we can make as WCD has not calculated the number of FHHs impacted.

[46] Note that the total number of persons who sought refuge in camps may be higher. The only sex and age disaggregated numbers available are as of 20 August 2018, which is why this number is used here. Data provided by KSDMA.

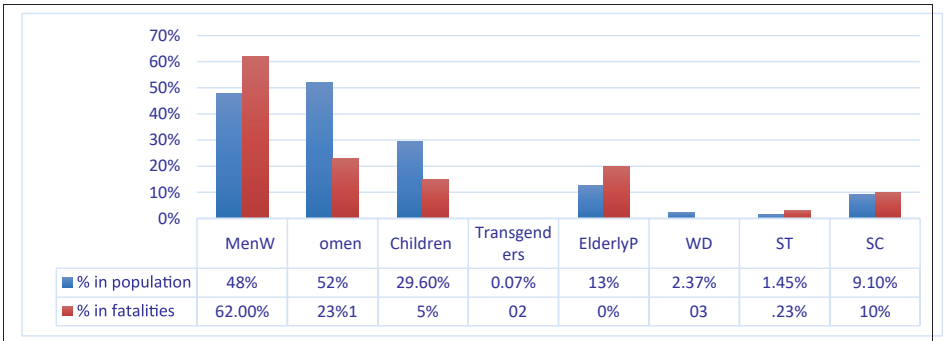
[47] Data provided by Social Justice Department, Government of Kerala

[48] Data provided by Scheduled Caste Development Department. Government of Kerala

[49] Data provided by Scheduled Tribe Development Department, Government of Kerala

[50] Data provided by Social Justice Department, Government of Kerala

Figure 1
Casualties



	MenW	omen	Children	Transgenders	ElderlyP	WD	ST	SC
% in population	48%	52%	29.60%	0.07%	13%	2.37%	1.45%	9.10%
% in fatalities	62.00%	23%1	5%	02	0%	03	.23%	10%

Note: No data was available on fatalities of PWDs or transgender persons.
Source: Share in population (2011) is drawn from the Census 2011.
ORGI (2011), Census of India 2011, Office of the Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India

Effects on Women and Girls

While over 60% of the fatalities were among men, the differential and lasting effect of the disaster on women and girls needs to be underscored. Women and girls across social groups experience gender-based disadvantages and discrimination, which have been exacerbated in the aftermath of floods. Women and girls who are differently-abled, those belonging to FHHs, SC, ST or the fishing communities, as well as elderly women require special attention due to the compound vulnerabilities they experience.

Housing and household assets

The number of houses that suffered loss of household goods is 1.20 lakh.[51] As per data from the Scheduled Caste Development Department and the Scheduled Tribe Development Department, 2,632 houses were completely destroyed and 11,223 partially damaged among SCs, and 520 fully destroyed and 1,134 partially damaged among STs. Additionally, damage to wells (6,800 for SCs and 150 for STs) and toilets (10,154 for SCs and 315 for STs) was also reported.[52] Especially in the case of STs, the destruction of about 30 km of road leading to their habitations, 6.25 km of blocked pathways inside the habitations and 12 broken bridges made relief operations more difficult.[53]

While men have played a prominent role during the initial return to their homes, it is evident from field-visits to Ernakulam, Pathanamthitta, Wayanad, Malappuram, Alappuzha, and Thrissur that a larger share of the longer-term burden of re-setting homes has fallen on women across social groups, significantly increasing their burden of unpaid labour. This burden is compounded in the case of FHHs, particularly elderly women living alone, as well as households with PWDs or persons in need of geriatric care.

Health and nutrition

With more women involved in cleaning and re-setting homes, health concerns like allergies (due to dust from cleaning homes) are likely to impact women more than men. In 2016, 2.72 lakh cases of asthma were reported in the state.[54] This is likely to increase over the coming months, particularly amongst women. Further, in the aftermath of the disaster, as women spend more time looking after the sick, elderly, children and PWDs, they can be further constrained from accessing health services for themselves.

[51] Number drawn from Chapter 7 on Housing, Land, and Settlements of this report.

[52] Data provided by Scheduled Caste Development Department and Scheduled Tribe Development Department, Government of Kerala.

[53] Information shared by the Scheduled Tribe Department, Government of Kerala

[54] Department of Economic and Statistics (2017), Gender Statistics 2016–17, Publication Division, Department of Economics & Statistics, Government of Kerala

As around 99.9% of all deliveries in the state take place in health institutions,[55] damaged health facilities need to be restored at the earliest to avoid the over-burdening of functional facilities. Due to damage caused to a large number of Integrated Child Development Services (ICDS) centres (of the 33,115 anganwadi centres in the state, 1,670 were partially damaged and 131 fully damaged[56]) and the loss of nutritional supplements stored in these centres, the provision of nutritional supplements for pregnant mothers was initially disrupted. Pregnant mothers in almost all flood-affected areas were sheltered in neighbourhood homes or homes of relatives and friends.

Five ICDS offices under the management of WCD were affected and reported a damage of INR 90 lakh[57] (Annexe Table A16.1). The loss incurred by anganwadi centres has been accounted for in Chapter 8 on Health and Nutrition.

Sexual and gender-based violence

Kerala is among the top six states in terms of crime rates against women.[58] The risk of sexual and gender-based violence is typically elevated in the aftermath of a disaster. Specifically, the incidence of domestic violence might increase due to men's loss of livelihoods, loss of homes, and alcohol abuse observed in the aftermath of the floods. This may not be reflected in reported numbers as survivors may not be able to access existing services. Discussions with the district Bhoomika centre counsellors and Women Protection Officers reveal that anecdotal instances of women reporting domestic violence as a result of the frustration of having lost most household belongings are being reported. Data from the State Crime Records Bureau revealed that in 2016 a total of 15,117 crimes against women were reported.[59] Of these, 22.86% were cases of cruelty by the husband or relatives.[60] As is the observed trend elsewhere, it is likely that this number will increase in the aftermath of the floods.

'With houses and livelihoods completely destroyed there are chances that violence against women will go up in the coming months.' (Women Protection Officer, Pathanamthitta)

Psycho-social needs

Post-disaster mental health concerns include depression, anxiety and a range of other post-traumatic stress disorders. Anticipating the high need for psycho-social first aid, the Government of Kerala immediately trained 7,369 volunteers and school counsellors in the days following the flood and posted these counsellors in relief camps.[61] In the camps, most women reported anxiety and depression due to the loss of household assets, work implements, furniture, and essential documents. Table 2 shows the numbers of affected persons reached in camps.

Overall prevalence of any mental disorder is 11.36%. Common mental disorders and severe mental disorders were more common in men than in women. However, specific disorders such as depression, neurotic, and stress-related disorders were more common in women.[62] These numbers are likely to increase in the aftermath of the floods.

At 22.4%,[63] Kerala has among the highest suicide rates in the country—6,436 men and 1,770 women committed suicide in 2016.[64] Since a significant proportion of men commit suicide due to unemployment, financial constraints and loss of pride,

[55] IIPS and ICF (2018), National Family Health Survey-4 India 2015-16: Kerala. International Institute of Population Sciences, Mumbai.

56 Post-flood assessment carried out by the Women and Child Development Department, Government of Kerala.

[57] Ibid.

[58] Department of Social Justice (2015), Gender Equality and Women's Empowerment Policy for Kerala (2014-2020), Department of Social Justice, Government of Kerala.

[59] Kerala Police (2018), Public Information - Crimes Against Women in Kerala (2007-2017), Accessed via, https://keralapolice.gov.in/public-information/crime-statistics/crime-against-women on October 3, 2018.

[60] Ibid.

[61] Summary report on Psychological First Aid for Survivors of Kerala Floods, Women and Child Development Department, Government of Kerala – Sept 2018

[62] National Institute of Mental Health and Neuro Sciences (2016), National Mental Health Survey of India 2015-16 – State Report of Kerala, Institute of Mental Health and Neurosciences, Kozhikode, Ministry of Health and Family Welfare, Government of India, Implemented by National Institute of mental Health and Neuro Sciences.

[63] National Institute of Mental Health and Neuro Sciences (2016), National Mental Health Survey of India 2015-16 – Prevalence, Pattern and Outcomes, Ministry of Health and Family Welfare, Government of India, Implemented by National Institute of mental Health and Neuro Sciences.

[64] Department of Economic and Statistics (2017), Gender Statistics 2016–17, Publication Division, Department of Economics & Statistics, Government of Kerala

Table 2
Psycho-social Services Provided in Relief Camps by NIMHANS Trained Volunteers

Type of Session	Men	Women	Children	Elderly	PWD	Total
Psychosocial First Aid	4,858	7,136	4,699	2,360	111	19,164
Individual Sessions	1,960	3,181	1,845	1,551	109	8,646
Group Sessions	71	144	149	48	4	416

Source: Summary report on Psychological First Aid for Survivors of Kerala Floods, Women and Child Development Department, Government of Kerala, September 2018

addressing increased unemployment must be a key post-disaster priority. Suicidal tendencies in farmers were noted in field discussions in Wayanad, particularly among those who had lost their land, cattle and livelihood sources, and small-scale self-employed informal workers in all sectors.

Water, sanitation and hygiene

In the early recovery stage, the disruption of water sources was a key challenge. Panchayat members highlighted that one of their key tasks has been to ensure the cleaning of wells and chlorination. Existing gender roles place the responsibility of household water management, including fetching and storing water for drinking, food preparation, personal use, household hygiene, washing, and cleaning and taking care of dependents, on women and adolescent girls. Disruptions in water sources therefore have had a disproportionate impact on women and adolescent girls across social groups. This is also reflected in the impact of affected sanitation facilities. For instance, privacy in toilets and bathing areas for women and adolescent girls from the SC community is reported to be seriously compromised in Alappuzha district due to the damage caused to toilets during the disaster.[65]

Employment and livelihoods

A total loss of person-days and wage loss of INR 1,357.90 crore has been estimated in the case of female workers (casual, regular and self-employed workers as categorised in the 68th Round of NSS) in the state due to the floods (Annexe Table A14.1).[66]

At least 3,550 women entrepreneurs within Kudumbashree, the state's poverty reduction initiative, were affected.[67] The overall loss to Kerala's Kudumbashree microenterprise units—set up by women using loans received through Kudumbashree—amounts to INR 7.80 crore.[68] Similarly, over 130 enterprises supported by the Society for Assistance to Fisherwomen (SAF) have been affected, resulting in the need for compensation to the tune of at least INR 1.6 crore.[69] Among SAF beneficiaries, the livelihoods of at least 400 women from the fishing community may have been affected.[70] Poor women engaged in microenterprises feel forced to take on additional loans and risk falling into debt cycles.

Poor women, particularly those who have PWD and elderly as dependents, those who head their households, and those who have lost their livelihoods or households, repeatedly asserted that while the INR 10,000 helped them meet their basic consumption needs in the early days, they are now at a loss as to how they will face the coming days. The provision of a loan as proposed by the government through Kudumbashree offered a line of hope for some, but, considering the risk of falling into a debt cycle, this may not be a viable option for the extremely vulnerable.

[65] *Caritas India, National Dalit Watch-NCDHR (2018) Joint Detailed Needs Assessment (Alappuzha and Idukki) - October 2018. Prepared by Caritas India, National Dalit Watch-NCDHR.*

[66] *Cross-referenced from Livelihoods and Employment Chapter.*

[67] *Data drawn from the State Poverty Mission (Kumdumbasree) Website*

[68] *Data drawn from the State Poverty Mission (Kumdumbasree) Website*

[69] *Society for Assistance to Fisherwoman (SAF), Post-Flood Assessments – SAF, Department of Fisheries, Government of Kerala.*

[70] *Aggregate based on average size of 3.*

Major loss of land has been reported. While this has affected all social groups, SCs, who are primarily engaged in agriculture, have been most affected due to loss of land and agriculture tools. Both male and female workers in different informal occupations have not resumed work for lack of resources to invest in raw materials.

Participation in recovery

Women across social groups have played critical and life-saving roles in immediate response and relief following the floods and landslides, and continue to play a key role in the recovery stage. The prominence of women belonging to and catering to the needs of lower socioeconomic classes is particularly noteworthy, as evidenced by the contributions made by anganwadi teachers, Kudumbashree members, as well as members of other self-help and neighbourhood groups, school counsellors, and ward and panchayat members. At the same time, it is important to be cognizant of the compound burdens placed on poor women. Given the gender roles ascribed to women in Kerala and corroborated by field visits to six districts as well as by other researchers, women have and continue to put in excessive labour, both in the domestic sphere for their families and at the community level for the government, ignoring their own psychological trauma and ailments.[71]

Effects on the Elderly

The vulnerabilities of the elderly living alone, mostly elderly women, were aggravated in the aftermath of the disaster. Field visits to six districts showed that during the evacuations, the elderly resisted moving out of their homes or comfort zones, fearing loss of life and security. Several elderly persons remained in the camps in Pathanamthitta despite discomfort, as younger family members preferred that they receive the distributed benefits in the camps. Some older people chose to remain in camps themselves, in expectation of higher rehabilitation and recovery support. Several did not have a home to go back to.

Medication and palliative care were disrupted immediately following the floods. Trauma associated with the disaster and the lack of support in re-setting their homes prevented elderly persons, especially women living alone, from accessing medical care. Visits to the homes of elderly women living alone in Perunad village of Vadasserikkara Panchayat revealed that they were suffering from depression and anxiety. Elderly women relying on a pension are also likely to use their meagre resources to make their homes habitable again, foregoing food and nutrition and risking anaemia.

A 65-year-old widow living alone demonstrated severe depression and fear. She refused to step out of her home and was delirious. She feared that if she stepped out whatever was left in her house would also be washed away. [Pathanamthitta] District]

Effects on Migrant Workers[72]

Migrant workers living in low-lying areas or near rivers suffered significant loss of assets, documents of proof of identity and other resources. Workplaces were also affected resulting in loss of livelihoods for long periods. Alert messages in Malayalam were not received or understood by the majority of migrant workers. Instances of migrants being denied shelter in intermediate shelters were reported. Stigma and discrimination in some places resulted in the setting up of intermediate

[71] *J. Devika (2018), 'Women and Gender Policy after the Deluge: Some Reflections'. Centre for Development Studies.*

[72] *Peter, Benoy and Narendran, Vishnu (2017), God's Own Workforce: Unravelling Labour Migration to Kerala, Centre for Migration and Inclusive Development (2017).*

shelters only for migrants. Many intermediate shelters for migrants were closed prematurely, leaving many evicted workers without money, food, or shelter.

Migrant workers also reported that their employers were either unable or unwilling to pay wages due to them. Very few migrant workers whose homes were flooded received the INR 10,000 compensation provided by the government. Lack of information about compensation schemes, inability to draw up an application, lack of residential proof, absence of bank accounts, absence during inspection visits by the authorities (inspections took place during the day when migrants go to work), lack of social support to follow up on applications, were some of the reasons. Little or no support was given to migrants to clean their homes, disinfect water sources, or restore electricity. Migrant workers hired for cleaning work after the floods were not given protective gear such as boots, gloves or facial masks and risked snakebites and exposure to hazardous materials.

Migrants were also left out from the prophylactic treatment against leptospirosis. While there was universal shortage of food and clean drinking water in flood-hit areas, the situation was more severe for migrant workers as the areas where they lived were not prioritised by relief volunteers. Except the Government of Odisha, no other migrant sending state provided relief to the flood/landslide-affected workers from their states. Workers not attached to any employer, recently arrived migrants with limited familiarity with the locality, women and girls, families, particularly those with children, migrants from tribal communities, migrants with disabilities, migrants in remote areas or areas which got isolated due to landslides/flood and migrant entrepreneurs were some of the severely impacted subgroups within the migrant population.

Effects on Persons with Disabilities

Over 8,600 PWDs are reported to have been impacted by this disaster.[73] The PWDs were at greater risk because the early warning systems (EWSs) were not always able to reach them on time and mechanisms for their evacuation and rescue were inadequate. The Social Justice Department's mobile intervention units, meant to cover one block in a day (25 units covering 152 blocks in state), could not reach their destinations as per their normal schedules, and therefore diverted their routes to cover accessible areas. Rescuing PWDs was difficult as wheelchairs weigh around 14 kg and rescue volunteers had to seek alternative arrangements like plastic chairs and large, light-weight basins to evacuate PWDs. With a few exceptions, the relief camps were not friendly to PWDs, especially with respect to toilets. The PWDs were forced to find shelter in the homes of relatives or friends. They were also psychologically more impacted than others and will need psycho-social support on a sustained basis. About 40,000 assistive devices are required in the flood-affected districts. [74]

Thanal Palliative & Paraplegic Care Society was at the frontline of the rescue efforts in Ernakulam district. With volunteers trained in paramedical care, Thanal rescued 160 PWDs and elderly plus their bystanders. Thanal's ability to operate successfully can be attributed to two factors. Firstly, Thanal had a strong community-network which they were able to efficiently harness immediately through social media. They had organisation knowledge of households with PWD and geriatric patients, which effectively acted as a vulnerability map; Thanal was able to target and prioritise those households. Secondly, Thanal was among the participants in KSDMA's training programme on disability-inclusive DRR, which strengthened their capacity to respond in an organised manner.

[73] *Post-Floods Survey of Assisted Devices Lost or Damaged, Department of Social Justice, Government of Kerala*

[74] *Social Justice Department, List of Requirements for Assistive Devices in the Flood/Natural Calamity Affected Districts, Government of Kerala*

Reports indicate that prior to the disaster there were 300 women with disabilities in five caregiving institutions.[75] This already exceeds the combined capacity of all the institutions, which is no more than 200.[76] With households facing significant financial losses, combined with increased burdens on female caregivers, it is likely that there will be a greater demand for space in institutions for PWDs.

Effects on Transgender Persons

Data from the Social Justice Department estimates only five transgender persons to have been affected. Discussions with various government officials also revealed that no transgender persons were identified in relief camps. This could have been either because they did not reveal their identity or because they did not stay in camps, choosing to stay, instead, in groups in places they perceived to be safe. Transgender persons may therefore also have been left out of recovery and rehabilitation efforts. As observed during field-visits, in Alappuzha, transgender persons were moved to a relief camp in an unfamiliar municipality area away from their panchayat and reportedly faced harassment.

Effects on Scheduled Tribes

The severity of the disaster in hilly areas with large numbers of tribal colonies in districts like Wayanad, Idukki, Palakkad, and Malappuram directly affected the lives of STs. Colonies in Thirunelli gram panchayat in Wayanad continued to experience gradual land slips where the valley moved downwards into the paddy fields. Similar concerns were shared by respondents from Karuvarakundu and Chaliyar panchayats in Malappuram district.

Estimates of the Scheduled Tribe Development Department show that at least 578 tribal colonies and 10,684 families from ST communities were affected (Annexe Table A16.2). Through a rapid damage assessment, the Scheduled Tribe Development Department has estimated a loss of INR 90.4 crore for the community.[77]

The government has used the social protection provisions system as a policy tool to reduce vulnerability and exclusion among affected people in the time following the floods. District collectors distributed funds to key departments like the Social Justice Department, Scheduled Caste Development Department and Scheduled Tribe Development Department and provided flexibility of use to reach out to the neediest. However, discussions with affected families in some tribal colonies in Wayanad and Malappuram suggested that many of the families in the affected areas had not been included in the beneficiary list for compensatory financial aid (INR 10,000, one-time cash assistance) to cover damages and loss. The Scheduled Tribe Development Department initiated an additional provision of INR 10,000 per family (sanctioned to 2,697 out of 3,419 families). At the same time, the process of implementing the scheme to sanction INR 6 lakh each to the families whose houses were fully damaged and unfit to live in is still ongoing as of October 2018.

In Wayanad and Malappuram districts, several plantation workers reported that they benefited from the additional provision of 15 kg of rice offered to compensate the loss of wages due to the flood. In some cases, tribal families reported that they were affected but did not receive full compensation or are still waiting for the payment.

Effects on Scheduled Castes

Palakkad, with 14.4% SC population, followed by Thiruvananthapuram, Malappuram, Kollam, and Thrissur are the districts which mainly contribute to the total SC population in the state.[78] However, SC communities are spread across the state,

[75] Records shared by the Social Justice Department, Government of Kerala

[76] Ibid.

[77] These losses are not included in the damage-loss calculation for this chapter as they have been counted by other sectors.

[78] ORGI (2011), Census of India 2011, Office of the Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India

unlike the ST populations. The floods and landslides affected 1,260 villages across the state, but it is not clear how this maps with the spread of the SC population in the state (Annexe Table A16.3).[79]

Members of SCs are among those most affected by the loss of agricultural land and homes. A visit to a relief camp that continues to operate in an SC colony in Desamangalam panchayat in Wadakkanchery block, Thrissur district, highlighted that issues related to compensation for lost land/homes are yet to be resolved. Many continued to stay in relief camps either because they did not consider their houses to be safe enough to return to or thought that rent-free or subsidised rental housing would not be available. In certain pockets, information on flood-related schemes had not reached residents. There were people who did not receive cash assistance due to poor understanding of the norms for eligibility.

Impact on Development Goals

The Government of Kerala recognises the need for socially progressive norms, social protection schemes and policies which can pave the way to achieving global, national, and state-level development goals. The effect of the floods on vulnerable groups will impede the efforts towards addressing these inequalities and can further exacerbate them. The impact of the floods on key goals with respect to specific vulnerable groups is discussed below.

The GEWE policy articulates that gender equality is a constitutional promise in India; it is integral to any development strategy, and a goal which cannot be achieved without a focus on the social, economic and political rights, and the empowerment of women. In line with the cross-cutting nature of Sustainable Development Goal 5, 'Achieve Gender Equality and Empower All Women and Girls', the Kerala Gender Statistics Report of 2016 recognises that the empowerment of women is essential to achieving the goals of poverty alleviation, literacy and health, among other areas of development. Kerala has made noteworthy progress on development indicators, but there is recognition that, while necessary, these indicators are not sufficient to advance GEWE.

Pre-existing inequalities and vulnerabilities experienced by women and girls in Kerala primarily in the areas of labour force participation, burden of unpaid care work, access to and control of resources, certain health indicators and gender-based violence are noted in this assessment. Given the effects of the floods and landslides, there is a heightened risk that these inequalities and vulnerabilities are further exacerbated if targeted efforts are not made across sectors.

The low work force participation and high unemployment among women was an area identified as needing specific attention in the GEWE policy and the 13th Five Year Plan. With industries such as agriculture, cashew, coir, fisheries, and handlooms being impacted, women in those industries could be at risk of losing their livelihoods. Similarly, with the microenterprise units of Kudumbashree, SAF and other initiatives being affected, the impact has been severe: not only have women lost their livelihoods, they need to continue repaying previous loans. A new loan, even if subsidised, may not be sufficient for these women to recover. Additionally, home-based workers may not be members of self-help groups and therefore ineligible for compensation of losses suffered.

Immediate relief schemes, such as the loan of INR 1 lakh for women who have lost households and livelihoods, are only available to Kudumbashree members. The eligibility criteria for joining Kudumbashree (such as permanent residence in the relevant location), coupled with the initiative's limited reach among vulnerable populations such as tribal communities and the urban poor, can lead to the

[79] *Disaster Management Department (2018) Government of Kerala Order – Flood 2018 – List of Villages, Taluks and Districts notified as flood/lanslide affected – Modified. Dated 03/10/2018.*

exclusion of women in need. Government support therefore should not be limited to members of specific initiatives. Furthermore, the issuance of INR 1 lakh as a loan to women who may have lost all their belongings, households and livelihood can significantly increase their risk of falling into a debt cycle.

As observed during field-visits and corroborated by independent research,[80] women have shouldered a disproportionate share of cleaning, recovery, and rebuilding efforts on the domestic and community fronts across the state, without compensation. This advances the harmful gender stereotype of women being responsible for carrying out unpaid labour; prevents them from engaging in productive labour which could contribute to their livelihoods; places great mental and physical strain on them; and prevents them from accessing services for their own well-being, including health and psycho-social care.

As the relief amount of INR 6 lakh plus INR 4 lakh is given to land and house owners, women may be excluded from access to and control of such immovable assets, since few are owners of land/houses. As primary caregivers, women may also overlook their own nutritional needs, risking a further increase in the proportion of anaemic women in a state where one-third of women are already anaemic.[81,82]

With homes destroyed and livelihoods lost, there are chances of family members abandoning the elderly, especially elderly women, in the hope of relieving themselves of their duties to take care of them. Anecdotal instances of such nature were reported by the Bhoomika Counsellor in Pathanamthitta.

Since transgender persons experience discrimination and stigma, they were virtually invisible in the recovery or in temporary shelters. It is likely that in the aftermath of the flood, the alienation faced by them has been elevated. In the absence of government data or targeted provision of relief and recovery support to transgender persons, they will likely face hindrances in accessing relief and livelihood opportunities, and are at risk of falling back on unsafe coping mechanisms.

As estimated by Social Justice Department, difficulties faced by PWDs after the floods may be reduced through the distribution of about 40,000 devices at the cost of INR 22.07 crore.[83] There is, however, no estimate of poor people who are also disabled who may need more proactive support from the government. At present, there is no other major plan besides meeting the need for assistive devices.

There is currently no institutional mechanism with adequate human resources to ensure the social protection of migrant workers in the state. Universal access to available measures of social protection should be provided to migrant workers and their dependents. Proactive efforts must be made to ensure that migrant workers can access government initiatives. It is also important to ensure the active involvement of the governments of the native states of the migrant workers at every stage of relief and recovery.

The Scheduled Tribe Development Department, which has estimated a loss of INR 90.4 crore, has prepared an annual plan for 2019–20.[84] Besides economic activities, the plan budgets separately for meeting the basic needs of women and children. Since some of the indicators like malnutrition, early marriage/cohabitation, and school dropout have a poorer baseline figure for STs compared to the rest of the population, and it is likely that the disaster has contributed to a further slip; proactive steps are needed to build back better.

Within the SC community, over 89,000 persons were affected (Annexe Table A16.3).[85] As SC children start with disadvantages from birth, reflected in their lower birth-weights and immunisation rates, their health and nutrition indicators may

[80] J. Devika (2018), 'Women and Gender Policy after the Deluge: Some Reflections'. Centre for Development Studies.

[81] The age range is 15–49 years.

[82] IIPS and ICF (2018), National Family Health Survey-4 India 2015-16: Kerala. International Institute of Population Sciences, Mumbai.

[83] Replacement efforts have already been initiated by the Social Justice Department. Hence, this figure is not included in the calculation of damage-losses.

[84] Information as shared by the Scheduled Tribe Department, Government of Kerala

[85] Information as shared by the Scheduled Caste Department, Government of Kerala

take a further beating during disasters. Given that most of the affected families have been engaged in agriculture and allied activities, the loss of livelihoods will impact several dimensions of poverty. This will need thinking beyond compensation of infrastructure loss; and plans for SC development must be embedded in all core departments and fit well into the Special Component Plan (SCP) framework.

Prioritisation of infrastructure by local governments, as pointed to in recent guidelines from the state,[86] has been noted. This could have the adverse impact of bringing other plan fund activities to a standstill; specifically, this could further affect the already poor utilisation of Tribal Sub Plan (TSP) funds, despite the actual increase in needs for fund utilisation in tribal pockets. Damages related to infrastructure, as reported by the Scheduled Caste Development Department, may need additional SCP funds.

Key Policy Recommendations

Given the variations in the needs and capacities of each group, a single approach for recovery will not suffice. At the same time, it is well recognised that overlaps across groups also exist as a result of which some recommendations are cross-listed from across chapters in the report and across social groups. Overall, policy considerations for the simplification of conditionalities for availing the relevant schemes, expansion of beneficiary lists through bottom-up demand generation and planning, and coordination of roles in providing services at Local Self Government Departments (LSGD) are essential. Figure 2 presents a sampling of key targeted recommendations for different sections of the vulnerable population.

[86] *G.O 2313/2018 - Government of Kerala. Dated 03/10/2018*

Figure 2

Sampling of Key Recommendations for Vulnerable Population Groups Towards Inclusive and Green Re-building

GENDER EQUALITY AND SOCIAL INCLUSION

Cross Cutting	Women and Girls	Elderly	Persons living with Disability
Geo-tagged vulnerability mapping The design and reconstruction of all buildings and community infrastructure informed by the specific needs of each vulnerable group	Financial support for immediate consumption needs of the most vulnerable and affected women Extension of hours of operations of Anganwadi Centers and Pakalveedu	Old age pension to be disbursed monthly in a timely manner Extension of Vayomithram Programme to rural areas Create platforms for intergenerational approach to ageing to allow	District Disability Rehabilitation Centers in all districts Implementation of 4% reservation in Government jobs
Transgender	**Migrant Workers**	**Scheduled Castes and Scheduled Tribes**	**Fishing Communities**
Address the invisibility of Transgenders in the disaster response through the mid-term evaluation Inclusion of the larger LGBTQI population	Proactive efforts for a first step inclusion through State-issued documentation Migrant sensitive redressal systems	All policy discussion and decision begin with discussions led by affected populations and SC and ST CSOs. Industrial Training Institutes to be capacitated to deliver training targeting a 'Green Economy'	Ensure that any plans of relocations are founded on discussions and needs of affected persons and their livelihood needs

Note: LGBTQIA = Lesbian, gay, bisexual, transgender, queer, intersex, and asexual persons

A. Cross-cutting across Vulnerable Populations

A1: Financial support for immediate consumption needs of the most vulnerable and affected: In the case of the poorest of the poor women facing multiple vulnerabilities, namely FHHs, elderly women, women with disabilities, or women who are primary caregivers to PWDs or the elderly, women in SC or ST communities, as well as transgender persons, the government should strongly consider issuing another cash grant of INR 10,000 to enable them to meet their own basic consumption needs and that of their dependents in the time they take to rebuild their livelihoods. A clear set of criteria which prioritises persons and households experiencing multiple vulnerabilities should first be developed, and the issuance of grants can be channelled through Kudumbashree. Kudumbashree, given its expansive reach, can serve as a mechanism to identify the target groups. However, provisions should also be made to allow women who may not be members of Kudumbashree to approach their gram panchayat and register as eligible recipients of this support if they meet the necessary criteria as deemed by the government.

A2: Augment social protection programmes for the most vulnerable: The existing social protection programmes for the most vulnerable, like widow pension, elderly pension, pension for PWDs, and scholarships for SC/ST students, could be increased for 4–6 months to address their increased vulnerabilities and risks due to disasters. Similarly, ration supply for FHHs and SC/ST communities could be doubled for 4–6 months.

A3: Inclusive disaster risk management: In all disaster risk reduction (DRR) planning, participation of vulnerable groups as identified in this chapter and as relevant to each location is critical. Not only will this ensure that their specific needs are addressed, the diversity of voices will also generate innovative solutions. Furthermore, all trainings on disaster response for Kerala State Disaster Management Authority (KSDMA) officials, civil society organisation (CSO) partners, key line departments, gram panchayats, and local responders should be mainstreamed with gender and social inclusion and have a dedicated module on gender equality and social inclusion.

A4: Psycho-social needs: For any provision or service made available to address psycho-social needs, given the existing stigma against expressing such needs, it is recommended that the affected community be mobilised through accredited social health activist (ASHA) workers, anganwadi teachers, Kudumbashree members as well as ward members to utilise such services. The mobilisers should specifically reach out to PWDs, the elderly, and transgender persons. Targeted efforts to reach men, who will be more hesitant to seek support but require psycho-social support and may be more vulnerable to mental disorders, is essential. Efforts to tackle alcoholism should also be prioritised as men may fall back on it as a coping mechanism.

A5: Inclusive design and reconstruction: The design and ensuing reconstruction of all buildings and community infrastructure should be informed by the specific needs of women, PWDs, elderly, and transgender persons and be tailored to the needs of the specific community and their environment. This can be implemented primarily by the Housing Department and LSGD. In certain pockets, specifically among SC and ST communities, material costs and lack of skills have hindered the community's efforts to rebuild even essential sanitary facilities.[87] Such locations should be identified immediately for reconstruction of essential facilities.

A6: Vulnerability mapping: A geo-tagging exercise which captures intersectional vulnerabilities, specifically FHHs, SC and ST persons, transgender persons, PWDs,

[87] *Caritas India, National Dalit Watch-NCDHR (2018) Joint Detailed Needs Assessment (Alappuzha and Idukki) - October 2018. Prepared by Caritas India, National Dalit Watch-NCDHR.*

elderly, and migrant workers should be carried out. The results of the exercise should ideally be overlaid with a hazard map reflecting geographical vulnerabilities and risks. This can be jointly carried out across relevant departments as well as the Kudumbashree. The prior experience of WCD in carrying out geo-tagging exercises for anganwadi centres could be harnessed.

A7: Early warning systems: All EWSs should be informed by the needs of each section of the vulnerable population. For instance, EWSs should be available in languages spoken by migrant labourers, be accessible and user-friendly for all, particularly for PWDs as well as the elderly in need of palliative/geriatric care.

A8: People-led resilience: Certain populations, specifically fisherfolk and SC and ST communities, live in areas that are either not accessible or on the outskirts of cities, which are more hazardous. Moreover, their means of livelihood are often tied to their location. It is therefore critical that any plans for relocation are founded on discussions with affected persons and keeping in mind their livelihood needs.

B. Women and girls

B1: Reduction of care/unpaid labour burden on women and livelihoods support: While the volunteer spirit showcased by Kudumbashree women and anganwadi teachers should certainly be commended, any remaining flood response or recovery work requested of anganwadi teachers or Kudumbashree women should be remunerated to ensure that they are not exploited through intensive unpaid labour.

Instead of over-reliance on the unpaid labour of women, utilisation of other resource pools such as youth volunteer networks should be explored. At the district level, the district collector can identify volunteer groups that emerged in the aftermath of the floods, link them with the relevant panchayats and request their assistance in the remaining labour-intensive recovery work to complement the above. Specifically, as the WCD is relying on corporate social responsibility, CSOs, and volunteers for the re-building of anganwadi centres situated in rented buildings, this mechanism can be of benefit.

Offering livelihood opportunities should be complemented with a reduction in the care burden for women to take up such opportunities. As a way of the state assisting women in reducing this care burden, anganwadi centre hours can be extended for working women by the WCD so that women can drop their children prior to their work hours and pick them up after. The day can be split into two shifts for anganwadi teachers. Similarly, the hours for pakal veedu day care homes for the elderly also need to be extended to accommodate the schedules of working women. In the long run, all care duties should be equally shared by men. While this requires a deep cultural shift, it is necessary to start now. All gender-awareness efforts—specifically by Kudumbashree, WCD and LSGs—should re-visit their programming to ensure that the engagement of men and boys in advancing gender equality is a key component.

B2: Prevention of gender-based violence: In the existing gender awareness programmes led by the Women's Commission and State Women's Development Corporation, specific efforts to reach men should be made, particularly with respect to modules on gender-based violence. Furthermore, new stakeholders should be brought in; for instance, partnering with trade unions to raise awareness on all forms of gender-based violence, positive masculinity and gender equality.

Noting the incidence of domestic violence and the fact that over one-third of women consider it acceptable for a husband to beat his wife under certain circumstance,

bodies such as the Jagrita Samitis (Vigilance Committees) should be empowered and capacitated to proactively address gender-based violence in their communities. It is recommended that this is initiated through an assessment on the functioning of Jagrita Samitis in a representative sample of districts (included as a costed recovery need).

B3: Identifying and targeting female-headed households: Existing criteria for identifying FHHs used by WCD do not include households where the male family member is absent due to migration. The inclusion of these households as FHHs is strongly recommended. An increase in this type of FHHs is expected in the coming months as more men migrate for economic opportunities. It is critical that the type of FHH is disaggregated along with a mapping across other vulnerabilities in the annual survey carried out by WCD. Anganwadi teachers who carry out this survey should be given a thorough training on the new criteria and disaggregation. It is recommended that this feeds into recommendation A6.

B4: Reduce inequality in ownership of resources such as homes: For homes that are being reconstructed using government grants, joint titles in the names of both an adult male and female should be mandated.

B5: Skill upgradation and improved livelihood opportunities: Women selected through the Kudumbashree Neighbourhood Groups and by the panchayat should be trained in skills useful for redeveloping affected parts of their environment in an ecologically sound manner. Such work options can then be included in the Mahatma Gandhi National Rural Employment Guarnatee Act (NREGA) scheme. A critical area of investment is the skill upgrade of selected women engaged in agriculture by building their adaptive capacity on climate-resilient agriculture through various means including the protection of the natural resource base and biodiversity (included as a costed recovery need). Being the custodians of their surrounding environments, this would enable affected women to actively contribute towards rebuilding a 'Green Kerala' while enhancing their own resilience.

B6: Monitor risk of debt-cycle: Given the risk that poor women in debt, particularly affected Kudumbashree women and women relying on similar microenterprises, might fall into a debt trap, it is recommended that local 'financial advisors' are made available to guide these women at risk (included as costed recovery).

B7: Gender awareness and sensitisation: While several actors carry out gender awareness programmes, gender resource centres (GRCs) at the panchayat level are particularly well-placed to carry out long-term and sustained efforts as opposed to one-off activities. The GRCs can be developed into hubs that lead gender awareness and sensitisation efforts. As a first step, in the panchayats where they exist, comprehensive and mandatory training on gender equality and women's empowerment, including normative and programmatic components, should be provided to all GRC members. All projects should clearly indicate how they will be sustainable and their long-term impact monitored.

In panchayats with no GRCs, GRCs should be established through the appointment of gender experts who must compulsorily possess expertise on gender and women's rights. If not, this should be bridged with a comprehensive training on the subject.

C. Scheduled Castes and Scheduled Tribes

C1: Revised guidelines for the use of Tribal Sub-Plan (TSP) and SCP funds in affected areas: Policy decisions should begin with discussions with affected SC/ST populations, and SC/ST CSOs. Proactive efforts to mobilise affected populations must be made, including measures to accommodate their accessibility and availability.

C2: More membership in Kudumbashree; MNREGS listing: A comprehensive panchayat-based list of the most vulnerable people should be developed by locating, identifying, and characterising the population by memberships and scheme benefits, especially for the destitute and most deprived. It is recommended that this be plugged into recommendation A6.

As SCs depend on agriculture as their main livelihood, one way to address the loss of jobs and tools could be by increasing the person-days in MGNREGA, for both men and women. Market expansion should be enabled for farmers through, among others, the creation of platforms and networks for farmers to sell their products without losing profit shares to middle-men. Programmes to enhance the capacity to develop organic farming, harnessing knowledge possessed by the community including through seed-sharing, are recommended (link to C3).The Forest Rights Act and Protected Forest Land should be used to implement the land distribution programme (buy land) to provide land to every landless member of STs and SCs within the next two years. The vigilance and control over recovering and restoring land that can be distributed to those eligible should also be increased.

C3: Livelihoods and capacity enhancement: A campaign should be conducted in mission mode to identify skill gaps among the tribal population, in their areas of aptitude and interest, with respect to entrepreneurial and employable skills. This would ensure a grassroots and locally-relevant approach to capacity enhancement.

Existing institutions (including industrial training institutions) for SC communities should add modules on life-skill training with a focus on youth and women. Existing material on industrial training should be upgraded to focus on and impart skills to contribute to a green economy.

Like the recent efforts to bring Chendamangalam handlooms to a larger market by the fashion fraternity, the Scheduled Caste Development Department and the Scheduled Tribe Development Department, along with the Tourism Department and private sector partners, can identify ways to expand the market for local crafts in tribal areas. The Scheduled Tribe Development Department and Tourism Department are also encouraged to develop eco-tourism in a manner that is led by the local community and provides an income for them.

C4: Identification of disparities: Given the heterogeneous nature of the SC community, disparities within the community across the state and at each local government are to be identified to initiate special micro-planning exercises.

D. The elderly

D1: Regular medical care and counselling of the elderly: This could be achieved by extending the Vayomitram Programme to rural areas.

D2: Improving access of the elderly to employment through MGNREGA: As 16% of the elderly are part of the labour force, with the number of work-seekers likely to increase, provision of employment that is elderly friendly is recommended.

D3: Creating platforms for an intergenerational approach to ageing: This would allow for exchange of support between young people and the elderly in a mutually beneficial manner. For instance, consider the establishment of linkages between an elderly person living alone to a young family in the community. The experiences of the elderly in this arrangement should be closely monitored. Non-governmental organisations and community-based organisations in partnership with the Kerala Social Security Mission and Social Justice Department could lead such pilot efforts.

D4: Training on and plans for evacuation: As in the case of PWDs, this should include components and availability of equipment needed for the safe rescue and evacuation of geriatric patients (see G1).

D5: Old age pension: This should be disbursed in a timely and regular manner.

E. Migrant workers

E1: Understanding of differential impact: An assessment/verification of migrant households impacted by floods/landslides should be done by those who can communicate with them, keeping in mind their availability (after 6:00p.m.), language needs, and any cultural differences.

E2: Documentation: There should be mechanisms to provide adequate documentation for migrant workers. Efforts should be made to help those who do not have bank accounts to open accounts.

E3: Grievance mechanism: Migrant-sensitive grievance redress systems should be set up to understand and address the grievances of migrants who were affected by the floods/landslides.

E4: Accessibility: Eligibility norms for compensation should be simplified, while also ensuring translation across different languages to maximise the number of families that can receive benefits.

F. Transgender persons

F1: Understanding of differential impact: During the review of progress on the Transgender Policy, the impact of the floods on transgender persons should be an area of focus. Special emphasis should be placed on the impact on their livelihood and measures to rehabilitate them with income generating activities.

F2: Other sexual and gender minorities— the LGBTQIA: The needs and concerns of LGBTQIA should be identified, and the development of an overarching LGBTQIA Policy should be considered, building on the existing Transgender Policy.

G. Persons with Disabilities

G1: Training on search, rescue and evacuation of PWDs: This should be provided to all rescue teams (fire force, police, volunteer groups and others identified by KSDMA). Evacuation plans for PWDs must be framed and incorporated into DRR strategies and can include supply of necessary equipment. This effort can be built on KSDMA's ongoing work on disability-responsive DRR.

G2: Design and construction of all government buildings should be informed by the needs of PWDs. This includes ensuring implementation of the 'Accessible India Campaign'. Steps to make workplaces PWD-friendly include incorporating tools such as Braille systems, wheelchair ramparts, and audio texts.

G3: In addition to the implementation of a 4% reservation of government jobs for PWDs, concerted efforts to improve the labour force participation of PWD through accessible livelihood opportunities should be identified, along with ensuring capacity building.

G4: District Disability Rehabilitation Centres should be established in all districts across the state.

H. Fishing Community

H1: Given the heightened risk of reliance on debt, recommendation B6 would be equally relevant for the larger fishing community.

H2: Similarly, noting the linkages between their livelihood and location of stay, it is critical that any considerations of relocating a fishing community– if their current location is highly exposed – should be led by the community, as recommended in A8.

Table 3
Recovery Needs

Item	Damage (INR crore)	Loss	Recovery Needs (INR crore)			
			Short term	Medium term	Long term	Total
ICDS offices, Women and Child Department	0.9	0	0.9	0	0	0.9
Strengthening evidence base and knowledge management						
Assessment of differential needs (migrant workers, transgender persons etc)	0	0	0.5	0	0	0.5
Geo-tagging cross-cutting vulnerabilities	0	0	0	0.5	0	0.5
Enhanced Gender Resource Centres	0	0	0	0	1	1
Outreach: Leave No One Behind						
Mobilisation at community level to ensure registration as specific vulnerable groups	0	0	0.12		0	0.12
To support neighbourhood groups, embedded financial advisors targeting women vulnerable to debt-trap	0	0	0.05		0	0.05
Capacity building: Greater resilience						
Climate resilient agriculture initiated through Kudumbashree Joint Liability Groups (mass effort)	0	0	29.46		29.46	416
Technical training to women for recovery rebuilding work	0	0	1	0	0	1
Capacity building at industrial training institutes and other vocational institutions (target SC and ST) to train for jobs in the 'Green Economy'	0	0	1.5		1.5	416
Total						**35.03**

Sector Assessment Methodology

This exercise was carried out under the guidance of the Kerala Women & Child Development Department and the Social Justice Department. This chapter also greatly benefitted from the substantive inputs received from the Scheduled Caste Development Department, the Scheduled Tribe Development Department, the Kerala Social Security Mission, the Planning Board as well as the State Gender Advisor. Consultations with local self-government bodies, Kudumbashree and SAF also contributed to this assessment.

A desk review of government data from the above departments as well as research and input from institutions such as the Centre for Development Studies, the Centre for Migration and Inclusive Development, Sakhi Women's Resource Centre, the Inter-University Centre for Disability Studies, Sree Sabareesa College, Differently Abled Welfare Federation, Caritas India, National Dalit Watch-NCDHR, Cultural Academy for Peace, and Thanal Palliative and Paraplegic Care Society complemented by field visits to Idukki, Malappuram, Wayanad, Alappuzha, Ernakulam, and Pathanamthitta formed the basis of the data and information used in this chapter. The field visits comprised of key informant interviews, focus group discussions, workshops and field-observations. Respondents and participants included district collectors, ICDS officers, ST and SC promoters, anganwadi workers, school counsellors, affected persons including women, PWDs, the elderly as well as members of the SC, ST and fishing communities. Due to time constraints, the assessment did not include direct interviews with transgender persons or migrant labourers; instead, it relied on information from CSO representatives and government counterparts working with these groups.

Local Governance

Local Governance

Summary

For the purpose of this post-disaster needs assessment (PDNA), this chapter covers services and institutions of local self-government (including gram panchayats, municipalities, and municipal corporations), police stations and revenue offices.

The floods and landslides in Kerala in August 2018, led to significant damage to government buildings, vehicles, office equipment and records. Despite staff and buildings being inundated, most government services continued to operate throughout the flood and landslides. Special efforts were made to replace identity cards and other important documents lost by affected families soon after the flood waters abated.

The estimated cost of the damage to government buildings is INR 28 crore and the recovery costs are estimated to be INR 32.2 crore. These are conservative estimates and do not take into account the additional capacity required by local governments to implement recovery programmes. Losses borne by local governments in terms of reduction of local revenue and increased expenditure incurred on relief and recovery activities could not be assessed due to lack of data.

The PDNA recognises the important role of local governments in recovery and reconstruction in terms of: i) ensuring participation of people through gram sabhas and other platforms; ii) disseminating information on recovery assistance packages; iii) addressing grievances of the affected population; iv) maintaining transparency and accountability in the use of funds for recovery; and v) integrating recovery needs in their annual plans.

Local governments will have to augment capacity with technical expertise to support their role in the recovery process. They may also need to revise their annual plans and develop a separate recovery plan for the next three to five years.

Pre-Disaster Context

The 73rd and 74th Constitutional Amendments in 1992 led to the passing of the Kerala Panchayat Raj Act and the Kerala Municipality Act in 1994. Consequently, over the next 25 years, Kerala developed a unique model of decentralised governance with well-devolved funds, functions, and functionaries at gram panchayat, block, and district levels. At present there are 1,200 local governments in Kerala—941 gram panchayats, 152 block panchayats, 14 district panchayats, 87 municipalities, and 6 municipal corporations. A gram panchayat in Kerala is large, with an average population of 30,000,average staff of 21 people, annual budget of INR 15–20 crore, and 27 different sources of funds at its command.

In operational terms, Kerala has been practising a participatory planning method, thanks to what is referred to as the people's planning movement. This promotes higher level of accountability and transparency, and expectedly lower levels of corruption.[1] Recently, the state government has initiated the second people's campaign primarily for enhancing production along with management of natural resources, agriculture, and drinking water. Incidentally, these are some of the critical areas that have been severely hit during the floods, affecting 1,259 out of 1,664 villages across the state.[2]

[1] *An all-India survey conducted by the Centre for Media Studies in 2017 declared Kerala to be the second-least corrupt state. Only 4% of Malayalis said that they paid bribes for public services. http://cmsindia.org/sites/default/files/Monograph_ICS_2017.pdf*

[2] *Government order No. (P) No.05/2018/DMD dated 29.09.2018.*

Kerala has devolved substantial powers to local governments in terms of three 'F's: functions, functionaries, and funds. In year 2014–15, the state has been ranked first in India in the Panchayat Devolution Index. This is an annual study commissioned by the Ministry of Panchayati Raj, Government of India since 2006. The 2014–15 study was conducted by the Tata Institute of Social Sciences (TISS).[3] The state government has transferred 26 out of 29 functions to local governments and 17 out of 18 functions to municipalities and municipal corporations. This covers almost all core areas like housing, electrification, access to food, health care, education, employment guarantee, insurance, welfare provisions, and special care for the most vulnerable populations like the aged, the disabled, and the destitute.

Some of the subjects transferred to rural governments—including agriculture, water supply, construction of roads and bridges, upkeep of schools and health centres, and welfare for vulnerable populations—have a strong bearing on post-disaster recovery.[4] On the other hand, and importantly, the subjects transferred to urban governments—including the regulation of land use and construction of buildings, urban planning, town planning and urban forestry, protection of environment and promotion of ecological aspects—have direct pre-disaster management dimensions as well.

The state government has devolved about 30% of the plan funds as untied funds to the local governments for planning and implementing projects independently every year. The total funds allocated in 2018–19 amount to about INR 7,000 crore.

With intensive capacity building and experience, many panchayats have become considerably better equipped to handle disaster management work. The state government is primarily responsible for disaster management, while local governments have limited concurrent powers. However, the local governments have hundreds of transferred staff with dual reporting to line departments, besides their own staff.

Evidence shows that local self-governments with higher level of decentralisation and well-defined devolution systems can deliver effective disaster management and post-disaster recovery. In the case of Kerala, this is a promise to tap. According to the Public Affairs Centre, Bengaluru, Kerala has topped the Public Affairs Index (PAI) for 2018 as the best governed state for the third consecutive year since 2016 among large states. A bottom-top approach, implementation of appropriate technology, adherence to science and a vigilant community can ensure effective risk governance in the state, which could create space for mainstreaming priorities of the Sendai Framework of Disaster Risk Reduction, Sustainable Development Goals 11 and 13, and United Nations Framework Convention on Climate Change (UNFCCC).

The current PDNA covers both: a) the physical recovery needs of institutions of local governments, police stations, and revenue offices affected by the disaster, which can be measured by the damage to local government infrastructure and assets; and b) the functional capacity of local government to deliver relief and recovery services for the affected people. It also discusses the effect, impact and recovery needs of these institutions.

Post-Disaster Effects

Damage to Infrastructure and Assets

Many of the government offices, banks, and other institutions devolved to the local governments were flooded. This included panchayat buildings, krishi bhavans, veterinary clinics, hospitals, health dispensaries and several other panchayat-run institutions. Several police stations and fire and rescue offices in the low-lying areas

[3] *https://thelogicalindian.com/news/empowering-local-governments-kerala-tops-the-list/*

[4] *PDNA Guidelines, Volume B.*

were inundated. The most affected areas were Aluva and Paravoor in Ernakulam district, Ranni and Pandalam in Pathanamthitta district, Kuttanad and Chengannurin Alappuzha district, Mananthavady and Panamaram in Wayanad district, and Munnar and Cheruthoni in Idukki district.

Documents, records, and other valuable things stored in such institutions were lost because of the floods and could not be salvaged due to submergence for a long duration. Computers and peripherals were also damaged. The situation was worsened by the fact that 15 August was a national holiday and so no one was available in the offices to safeguard the records.

Some of the office vehicles were inundated. The estimate for their repair was many times the value of the vehicles themselves. As government-owned vehicles have only third-party insurance, insurance coverage for repairs was also not available. Table 1 presents the district-wise financial estimates of the damage to public offices.

Table 1
Estimates of Damage for Public Offices (in INR lakh)

District	Police station		Panchayat office/LSG		Revenue offices		Miscellaneous*		Total Cost
	Unit #	Total Cost	Unit #	Total Cost	Unit #	Total Cost	Unit #	Total Cost	
Thiruvananthapuram							3	61.00	61.00
Kollam					1	0.90	2	4.19	5.09
Alappuzha	19	715.00	1	100.00	30	115.83	6	35.00	965.83
Kottayam	15	72.25							72.25
Pathanamthitta	11	252.48			11	57.25	6	74.00	383.73
Idukki	8	247.26					2	113.00	360.26
Ernakulam	7	288.75			1	4.60	18	65.00	358.35
Thrissur	11	30.14			6	14.75	7	13.85	58.74
Palakkad	2	6.25			1	1.00	1	1.80	9.05
Malappuram	1	3.29			1	3.55	2	4.70	11.54
Kozhikode	20	79.70					10	70.25	149.95
Kannur							2	6.00	6.00
Wayanad	9	191.76			2	25.00	5	99.55	316.31
Kasaragod							1	35.00	35.00
Grand Total	103	18.86	1	100.0	53	222.75	65	58.31	2,793.10

Source: Chief Engineer Public Works Department and Director General of Police
**=Misc. covers treasury, sales tax, judiciary, quarters, and rest house.*

Losses

Local governments lost some of the revenue they would have levied by way of license fees, entertainment tax on film theatres, etc. However, there is no data available to assess the losses incurred. Similarly, they used their 'own funds' for cleaning houses and public places, providing relief material, and hiring of boats to shift people to safer places. This could also not be assessed due to the absence of data.

Effect on Governance Services and Functions

Local government offices and revenue offices were closed for four or more days due to damages to buildings, inundation, and deployment of officials for search, rescue, and relief activities. However, there was no major disruption in services because most of the records had been digitised. It was found that digitising the remaining records, keeping e-copies with back-ups in multiple servers and proper digital security are important to ensure that all government records are safe and available at multiple locations.

Normally, services of panchayats are sought by people for issuance of certificates and official documents. Due to floods, many people lost their records and documents like Aadhar Card, Election ID, PAN Card, passport, driving licence, ration card, land related documents, land deeds, tax receipts, registration documents, utility receipts (Kerala State Electricity Board, water and telephone bills, etc.), bank documents (pass book, ATM cards, financial/investment related bonds), loan documents, pension documents, birth certificates, etc. As Government of Kerala has extended IT services to the panchayat level, the local offices were able to provide copies or issue new ID cards and other documents that were damaged in the floods.

Apart from ID cards and other documents, local governments provide other services—water supply, power supply, telecommunication, transport services, etc.—which were also affected, but these services were resumed within a day or two of the water receding. Schools under the local governments also started functioning normally within a week, with the exception of those that were destroyed or severely damaged.

Considering the widespread destruction and damage, the state government issued an order asking the local governments to repair rural roads, bridges, and public institutions, over[5] and above the otherwise business-as-usual implementation of plan fund activities.[6] Local self-governments were asked to modify their annual plans and reprioritise funds and activities.

Despite all the disruption due to the floods and landslides, local self-governments were at the forefront of search, rescue, and relief efforts. The panchayat workers worked alongside district authorities in coordinating relief distribution, identifying beneficiaries for assistance and supporting people with relief items where possible. During the relief stage, the state government requested local governments to spend their funds on disaster relief, and to deploy the panchayat staff, including the engineering wing, for disaster management work. Elected members of the local governments worked round the clock to coordinate relief and rescue operations. During the post-relief phase, local self-governments led the massive exercise of cleaning houses, public places, schools, and hospitals. Engineers from the panchayat departments were engaged in assessing the damage and loss to houses and buildings, panchayat-managed institutions, and other infrastructure.

Over 40,000 police personnel in the state were active in the rescue and relief operations for about 15–30 days. However, this did not affect their core services and functions of providing protection to the lives of people and to property.

[5] G.O 2313/2018 LSG dept

[6] Reprioritisation of plan funds could be done for Anganwadi worker and helpers' honorarium; EMS housing scheme loan repayment; transfer, credit expenses related to Atal Mission for Rejuvenation and Urban Transformation (AMRUT) scheme; new projects under Scheduled Caste Sub Plan and Tribal Sub Plan; add-ons to Centrally Sponsored Schemes and state schemes; Ashraya/DFK; special projects suggested by the state government; re-categorization of spill-over projects under Category-2; Life mission projects; Swachh Bharat Abhiyanand Suchitwa Mission work. By 15 September, remodified plans should be submitted.

Impact

Local governments could not undertake major activities and interventions as per their annual plans for about four months due to the floods, landslides, and heavy rains during June–September 2018. The average expenditure by several gram panchayats visited by the PDNA teams in September was less than 15% of the annual budget. Due to the floods and landslides, several planned projects may not be undertaken in time or funds may have to be reprioritised to address immediate needs arising from the floods. This may temporarily affect some of the developmental goals.

On a positive note, local self-governments are likely to receive substantial additional funds from the state government for recovery and reconstruction over the next three to five years. This will provide them with an opportunity to build back better.

Role of Panchayats in Recovery and Reconstruction

Local self-governments have a large role to play in the delivery of essential services to people. It is likely that the panchayats will be engaged in the implementation of recovery programmes. The following steps are suggested as part of the recovery strategy of local governments.

- Develop a recovery plan for each local self-government body to address the recovery needs of the people. This plan can be developed with the assistance of technically qualified persons including students and volunteers, with people's participation and discussions in the gram sabha.
- Establish an information cell within the panchayat office to create awareness among the households about the recovery assistance packages for the community.
- Use the local gram sabha to prioritise and approve recovery programmes and submit recovery programmes to relevant authorities for funds and implementation.
- Identify beneficiaries and prioritise assistance to the most vulnerable. The support of panchayats is particularly important in the reconstruction of houses, where they can assist in prioritising a list of the most vulnerable within each panchayat and garner local community support for the reconstruction of houses for vulnerable people who have no family members to participate in reconstruction work.
- Provide support towards the assessment of damage across all houses and public infrastructure including roads, minor irrigation projects, repair of agriculture, livestock and fisheries service centres, in collaboration with the relevant officials.
- Set up Housing Facilitation Centres in select panchayats and support training of local youth and Kudumbashree women in cost effective and disaster resilient technologies.
- Distribute special assistance to all vulnerable groups including people living with disabilities, the aged, including funds and programmes for Scheduled Caste (SC) and Scheduled Tribe (ST) communities.
- Support and create awareness on integrated water resource management including community sensitisation on concepts of 'living with water' and 'room for river'.

- Ensure better compliance with respect to waste disposal; support the reduction, reuse, and recycling of all debris from the floods and landslides.
- Use programmes under the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGS) to repair basic infrastructure within the panchayats.
- Place the final recovery plans of all gram and ward sabhas under the lieutenant governor to ensure transparency.
- Discuss the progress of implementation of recovery programmes as a regular agenda item in all gram sabhas/ward sabhas.
- Ensure transparency by erecting display boards at project sites that show the total value of the project, name of contractor, and other pertinent details.
- Conduct social audits of all reconstruction works undertaken by various departments in the gram sabhas/ward sabhas.
- Set up panchayat level grievance redress cells.

Table 2
Recovery and Reconstruction Needs for Governance Services

Short term (12 months)	(Medium term (12–35 months)	Long term (36–60 months)
Repair all partially damaged public buildings.	Rebuild fully damaged public buildings.	
Repair damaged vehicles.	Replace vehicles.	
Restore records and documents.		
Deploy technical staff to panchayats to support and oversee housing reconstruction, construction of roads and schools, and other programmes.	Train local self government officials, members, and communities through Kerala Institute of Local Administration, Kudumbashree, and Institute of Management	Exploring use of 25% of the centrally sponsored schemes (flexi-funds- circular of the Ministry of Finance (September 2016) for disaster mitigation activities
Setup panchayat level information centres for recovery.	Conduct social audits to review progress and accountability of recovery programmes.	Promote the idea of risk transfer mechanisms, especially larger insurance coverage by utilising low premium insurances provided by the state and central governments.
		Give priority to financial resilience of the communities and start by utilizing the low premium insurances provided by the state and the central government.

Sector Recovery needs

It must be noted that the damages ascertained with respect to public offices (police, revenue, and local self-governments) amount to INR 28 crore.[7] The recovery cost mostly includes repair and restoration of the public offices, which has been assessed by stakeholders to be similar. These costs may rise by 10%, after further

[7] *As concluded from discussions with Chief Engineer, Public Works Department and Director General, Police, Government of Kerala*

dialogue with the Public Works Department and with the inclusion of resilient and eco-friendly construction, which may escalate the recovery needs to INR 32.20 crore.

Sector Assessment Methodology

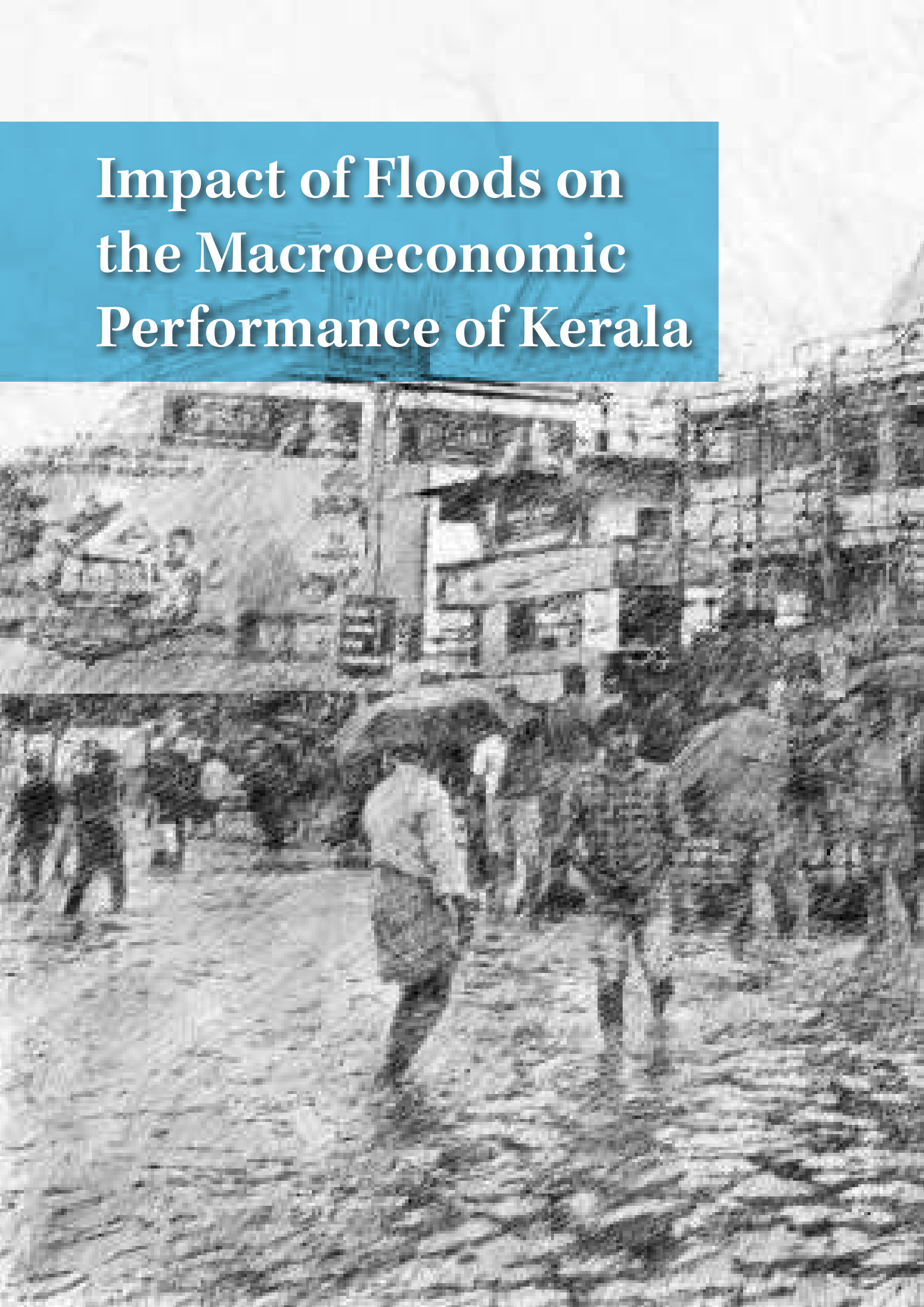
Given the paucity of time, a rapid sector assessment methodology was adopted. Secondary data was collected from the departments of revenue, health, social justice, agriculture, education, and agencies like the Kerala Disaster Management Authority, Kerala Water Authority, and Kerala Electricity Board. Field visits were made to various parts of Ernakulam district by two teams. A formal discussion was held with the District Collector, Ernakulam, and district level officers of all line departments. Focus group discussions were held with groups of officers, people's representatives, and affected people. The information received from various departments was subjected to ground-truthing through interactions with various stakeholder groups before the report was prepared.

The Chief Engineer, Public Works Department (PWD) and Director General of Police provided the estimated costs for buildings and repairs. The cost of replacement of fully damaged vehicles was estimated at INR 10 lakh per vehicle for about 100 vehicles. No costs for the repair of vehicles were included. The cost for each panchayat-level training programme was estimated at INR 25,000 and the cost of setting up information centres was estimated at INR 10,000 per centre.

Conclusion

The flood and landslides that took place in August 2018 were a major disaster for Kerala's infrastructure and economy. The resilience of the community helped the state bounce back to a semblance of normalcy. The role of local governments in restoring services, reconstructing houses, supporting local economic recovery, and other public services will go a long way not only in restoring normalcy but also in rebuilding a resilient Kerala. The role of local government is paramount in achieving the government's vision of a Nava Keralam.

Impact of Floods on the Macroeconomic Performance of Kerala



Impact of Floods on the Macroeconomic Performance of Kerala

The mega-floods of 2018 have impacted the economy and society of Kerala in many different ways. The trail of destruction left by the floods has resulted in considerable damage to different aspects of the economy. In the current note, the focus is on three separate but related dimensions. These are the impact of the floods on the growth performance of the state measured in terms of the Gross State Domestic Product (GSDP) growth rate, both in nominal and real terms, during 2018–19, and the fiscal situation of the state in terms of revenue receipts and expenditures. The note also presents some facts on the remittances to the state during 2018–19, which were impacted largely by the continuing depreciation of the Indian Rupee vis-à-vis other leading currencies, primarily the US Dollar. Each of these three dimensions are dealt seriatim.

Gross State Domestic Product Growth

In this section, an attempt is made to understand the impact of the floods on the state's GSDP growth for the year 2018–19. The floods could slow down the growth rate of GSDP both through the demand and supply side. The impact on the supply side includes destruction of production facilities in manufacturing, damage to service delivery channels like roads and vehicles, and crop loss and land degradation in agriculture. The demand side impact includes reduced demand for many goods and services due to damage to household assets like houses, which may force people to reduce their consumption in order to restore their lost assets. Further, tourism is an important source of demand for many services like hotels and transport in the state. Floods can cause a reduction in tourism due to the fear of a post-flood epidemic and destruction and submergence of many tourist destinations.

Another aspect of impact is its duration, which may vary from sector to sector. For instance, in the service sector, the flood can largely have short term negative impact on output. This sector may be able to recover fast after service delivery infrastructure like roads and airports have been repaired and reinstated. Therefore, it can be reasonably assumed that the negative impact on these sectors lasts for a maximum of one month. On the other hand, in agriculture, due to crop loss and land degradation, floods can have a long-term impact, causing loss in production in the current as well as coming years. Similar is the case with inland fisheries. It was reported that many of the aquaculture farms were submerged and lost their fish stock, affecting supply for a whole year.

In order to assess the impact, sectoral and aggregate GSDP at current and constant prices, were considered. The level of sectoral aggregation varies between current and constant series, because the current price series has been sourced from the EPW Research Foundation (EPWRF) India Time Series database and constant series has been obtained from the latest Kerala Economic Review, published by the Kerala State Planning Board. The constant price series is more disaggregated. Since detailed

information on the impact of the floods on various sectors of Kerala's economy is not available, estimates are informed guesses and are based on the following steps.[1]

1. It is assumed that all sectors of the economy, except public administration, have been adversely affected by the floods.

2. In the services and manufacturing sectors, the severe production loss can last for a maximum of one month. In agriculture, fisheries, and livestock, the loss in production can extend over a year or beyond.

3. In order to assess the impact, following three scenarios were considered.

    - No impact: This is the benchmark case. Here, the output of each sector is projected using the average growth rate of that sector during the last five years.

    - Mild impact: A 5% reduction in the monthly output of the service sector and manufacturing and a 2.5% reduction in the annual output of agriculture, fisheries, and livestock is assumed to have resulted.

    - Worst impact: A 12% reduction in the monthly output of the service sector and manufacturing and a 4% reduction in the annual output of agriculture, fisheries, and livestock is assumed.

Table 1 and Table 2 present the projected growth rates of GSDP for the three scenarios listed above. Table 1 presents the projection at current prices and Table 2 at constant prices. It is important to note that the projected growth rates do not include any possible increase due to reconstruction activities.

The exercise shows that the mega-floods are expected to reduce the growth rate in GSDP in the current fiscal year (2018–19) by 0.60 to 1 percentage point.

[1] *In fact the output of the public administration could increase due to rescue and relief operations.*

Table 1
Projected Impact on GSDP at Current Prices, 2018–19

Sector	GSDP (INR crore)			Growth rate (%)			Loss in GSDP (INR crore)	
	Pre-flood	Medium impact	High impact	Pre-flood	Medium impact	High impact	Medium impact	High impact
Crop	29,245	28,514	28,075	0.10	-2.43	-3.98	-731	-1,170
Livestock	23,915	23,317	22,959	10.37	7.84	6.29	-598	-957
Forestry and logging	15,483	15,418	15,328	17.18	16.76	16.17	-65	-155
Fishing	13,774	13,429	13,223	17.36	14.82	13.27	-344	-551
Mining and quarrying	3,649	3,634	3,613	4.11	3.69	3.11	-15	-36
Manufacturing	67,633	67,351	66,956	9.41	9.00	8.41	-282	-676
Construction	83,854	83,505	83,015	6.38	5.96	5.38	-349	-839
Electricity, gas, and water supply	6,139	6,113	6,078	3.83	3.41	2.82	-26	-61
Transport, storage, and communication	52,496	52,278	51,971	8.71	8.29	7.71	-219	-525

Trade, hotels, and restaurants	1,31,613	1,31,065	1,30,297	12.37	11.95	11.36	-548	-1,316
Banking and insurance	27,218	27,104	26,945	8.89	8.48	7.89	-113	-272
Real estate, ownership of dwellings	1,14,379	1,13,902	1,13,235	13.55	13.14	12.55	-477	-1,144
Public administration	24,776	24,776	24,776	6.23	6.23	6.23	0	0
Other services	86,270	85,911	85,407	10.68	10.27	9.68	-359	-863
GSDP	**6,80,444**	**6,76,317**	**6,71,879**	**10.11**	**9.50**	**8.84**	**-4,127**	**-8,565**

Table 2

Projected Impact on GSDP at Constant (2011–12) Prices

Sector	GSDP (INR crore)			GSDP growth rate (%)			Loss in GSDP (INR crore)	
	Pre-flood	Medium impact	High impact	Pre-flood	Medium impact	High impact	Medium impact	High impact
Crop	21,726	21,183	20,857	-4.21	-6.74	-8.29	-543	-869
Livestock	13,905	13,558	13,349	2.99	0.46	-1.09	-348	-556
Forestry and logging	4,100	4,083	4,059	-0.69	-1.11	-1.7	-17	-41
Fishing	4,167	4,063	4,001	1.41	-1.12	-2.67	-104	-167
Mining and quarrying	2,980	2,967	2,950	1.27	0.85	0.27	-12	-30
Manufacturing	47,278	47,081	46,806	4.55	4.13	3.54	-197	-473
Electricity, gas, water supply	5,047	5,026	4,997	1.08	0.66	0.07	-21	-50
Construction	63,794	63,528	63,156	2.6	2.18	1.6	-266	-638
Trade & repair services	75,069	74,756	74,318	6.44	6.02	5.44	-313	-751
Hotels & restaurants	6,711	6,683	6,644	1.84	1.42	0.83	-28	-67
Railways	1,688	1,681	1,671	7.54	7.12	6.53	-7	-17
Road transport	28,610	28,491	28,324	5.01	4.6	4.01	-119	-286
Water transport	199	198	197	-5.14	-5.56	-6.14	-1	-2
Air transport	3,036	3,024	3,006	30.85	30.43	29.85	-13	-30
Services incidental to transport	584	581	578	-0.82	-1.24	-1.82	-2	-6
Storage	29	29	29	-1.86	-2.28	-2.87	0	0
Communication	12,021	11,971	11,901	10.08	9.66	9.07	-50	-120
Financial services	25,286	25,180	25,033	7.9	7.49	6.9	-105	-253
Real estate, ownership of dwelling	83,405	83,058	82,571	9.4	8.99	8.40	-348	-834

Sector	GSDP (INR crore)			GSDP growth rate (%)			Loss in GSDP (INR crore)	
Public administration	15,891	15,891	15,891	0.03	0.03	0.03	0	0
Other services	53,832	53,608	53,294	4.3	3.88	3.3	-224	-538
GSDP	**4,69,359**	**4,66,640**	**4,63,630**	**5.09**	**4.51**	**3.86**	**-2,719**	**-5,729**

Fiscal Situation of Kerala

It is clear that the floods have had a serious adverse impact on Kerala's GSDP. The total damage and losses estimated by the Post Disaster Needs Assessment (PDNA) team amount to around INR 26,720 crore (USD 3.8 billion) without including the damage to roads, power, irrigation, private buildings and properties. The losses to state revenues and the additional burden of current and capital expenditure are likely to be substantial. In this note, an attempt is made to estimate these and suggest ways for mobilising additional resources.

General Background

Around 78% of the own tax revenue of the state comes from commodity taxes (that is, the erstwhile Value Added Tax (VAT), which has been subsumed under the Goods and Services Tax (GST) since 1 July 2017, and sales tax on petroleum products and alcoholic liquor for human consumption[2]). As can be seen from Table 3, the growth rate of revenue from commodity taxes and VAT/GST had entered a slowdown phase since 2013–14. With the compensation on the implementation of GST, the growth rates picked up during 2017–18.

Table 3
Growth Rates of Commodity Taxes and VAT/GST (%)

Year	Commodity Tax	VAT/GST
2014–15	12.15	8.08
2015–16	10.14	10.45
2016–17	11.61	10.68
2017–18	11.95	15.24
2017–18*	5.82	3.49

*Note * Growth rate without considering GST compensation. Commodity taxes = VAT/GST + sales tax on petroleum products and alcoholic liquor for human consumption.*
Source: Finance Accounts, Kerala, C&AG and State GST Department.

Projections for 2018–19

Revenue Receipts

In the budget estimates for 2018–19, the projected growth rate of own tax revenue was 20%. Even in a normal scenario, it would have been an arduous task to achieve the growth rate in the budget estimate, going by the lower growth rates in the preceding fiscal years.

[2] *Within commodity taxes, 52% was from VAT and the balance 48% from petroleum and alcoholic liquor for human consumption.*

With the introduction of the E-Way Bill for the movement of goods and services, and the stabilisation of a new tax system along with the simplification of procedures, GST compliance was expected to improve in 2018–19. But the losses as a result of the unprecedented heavy floods have proved to be a dampener to these expectations, and growth rate projections need to be lowered. The pertinent question is what can be the expected growth rate of GST, commodity tax, and own tax revenue[3] during 2018–19.

During 2018–19, the growth rate of GST is expected to be maintained at 14% with 2015–16 as base (as per the Compensation Act). But the revenue from petroleum products is subject to the following considerations.

Remittances consist of the following four components:

- There could be an immediate dip in petrol and diesel consumption due to damage to vehicles in the flood.
- Part of it would be compensated by the rise in prices and purchase and repair of the vehicles. But here, too, substitution effect may come into play if some people shift to public transport.

Another expectation is that of additional consumption expenditure on the replacement of goods damaged in the course of the floods. No precise estimation of the latter is possible, but any gain on one side is likely to be offset by other factors. For example, the slowdown expected in the real estate market could adversely affect the revenues from stamp duty and registration fees. On the other hand, the government may earn more by way of Motor Vehicle Tax on the purchase of new vehicles.[4] But due to probable gains getting offset by likely losses, a substantial one-time increase cannot be expected.

As already stated, before the floods ravaged the state, there was an expectation of higher growth due to GST, through better compliance after the implementation of the E-way Bill. There is a possibility of additional revenues coming in by way of a cess in GST as a result of natural calamity, which is under the active consideration of a Group of Ministers formed by the GST Council. With better enforcement systems in place, higher compliance is bound to take place, even with the adverse impact of the floods. With better compliance, the growth rate of GST without compensation, which was only 3.49% during 2017–18, can be reasonably expected to reach at least 7.5%.[5] With compensation, the GST revenue growth during 2018–19 could bring in 15% more revenue. The revenue from commodity taxes is likely to maintain the same growth rate, as the sales tax revenue growth from the inelastic consumption of petroleum products and alcoholic liquor for human consumption is not likely to fall. At an annual growth rate of 15%, revenue from commodity tax is likely to be INR 44,165 crore during 2018–19. The budget estimate for revenue from commodity tax is INR 46,796 crore and the expected shortfall is INR 2,631 crore.

Taking this as 78% of the own tax revenue,[6] the own tax revenue for 2018–19 is estimated at INR 57,351 crore. This amounts to a shortfall of INR 1,257 crore from the budget estimate. With the central devolution of taxes remaining the same and some additional grants, which can be reasonably expected, this shortfall could be partially compensated.

Going by recent trends of actual revenue receipts growing at 16%–17%, the budget estimate of revenue receipts worth INR 1,02,801 crore for 2018–19 implies a growth rate of 16.47% over the revised estimate of INR 88,267 crore for 2017–18. Considering a shortfall of INR 2,630 crore in the provisional figures of 2017–18 over those of the revised estimates (for receipts from commodity tax), the revenue receipts for

[3] Own tax revenue is commodity tax (VAT/GST + sales tax on petroleum products + sales tax on alcoholic liquor for human consumption) + stamp duties and registration fees + motor vehicles + state excise duties + other taxes.

[4] Besides, the government is also not planning to refund the 15-year road tax collected from vehicles which have been totally damaged during the floods.

[5] This is the growth rate of VAT for 2015/16, which was at its lowest during 2015–16 to 2017–18. The growth rate during 2016–17 was 10.01%. Our projected growth rate of 7.5% is on the lower side.

[6] Based on recent trends.

2017–18 can be downwardly revised to INR 85,637 crore. With a growth rate of 16%, the revenue receipts for 2018–19 can be projected at INR 99,339 crore. This is short of the budget estimate of 2018–19 by INR 3,462 crore.

Revenue Expenditure

The total damage and loss estimated by the PDNA is around INR 26,720 crore. In this, the loss component is around INR 16,100 crore and the damage component is around INR 10,600 crore. The latter would substantially fall in the revenue expenditure as it would take the character of repairs and maintenance. A part of losses, say around one-fourth, estimated at INR 4,000 crore, could fall under the revenue expenditure category. The budget estimate for 2018–19 projects the growth rate of revenue expenditure at 14.17%. With substantial damage to roads (estimated at approximately INR 10,000 crore) the revenue expenditure is likely to go substantially above the budget estimates for 2018–19. Immediate relief and rehabilitation work will also add pressure on revenue expenditure. The budget estimate for revenue expenditure for 2018–19 is INR 1,15,661 crore while it is actually likely to be around INR 1,30,661 crore, an additional INR 15,000 crore.

Based on our projections, the revenue deficit can rise to INR 31,332 crore, which would be 2.44 times the budget estimate of INR 12,860 crore for 2018–19, without factoring in additional resource mobilisation (Table 4).

Table 4

Budget Estimates and Projections after Considering the Impact of Floods, 2018–19 (INR crore)

Item	Budget estimate	Estimate after considering flood impact
Own Tax Revenue	58,608	57,351
Revenue Receipts	1,02,801	99,339
Revenue Expenditure	1,15,661	1,30,661
Revenue Deficit	12,860	31,331
Additional Resources a+b+c+d		13,000
a) Central Grants/ Other Aid	—-	8,000
b) GST cess	—-	3,000
c) From better GST compliance	—-	1,500
d) Mobilisation from Non-Tax Revenues	—-	500
Revenue Deficit	12,860	18,331 (31,332)*

*Note: * The figure in parenthesis is the revenue deficit before additional resource mobilisation.*
Source: Budget Documents, Government of Kerala and estimations in the note.

Once revenue expenditure increases by INR 15,000 crore and revenue receipts fall, there will be little room for routine capital expenditure, leave alone additional capital expenditure, as the limit on borrowing is 3% of the GSDP.

Remittances

Although remittances are not affected by floods per se, one may expect a higher amount of remittances during 2018–19 due to the ongoing depreciation of the rupee. During 2017–18, remittances were expected to be between a low estimate of INR 78,000 crore (according to the Reserve Bank of India) and INR 85,000 crore (according to Kerala Migration Survey done by the Centre for Development Studies). The estimated remittances to Kerala in 2018–19 are INR 95,532 crore without considering the depreciation of the rupee and INR 1,04,331 crore when the depreciation is factored in (Annexe Table A18.1)

Remittances to Kerala by non-resident Keralites account for only about 15% of Kerala's GSDP in 2018–19. In order to understand the possible effect of this on the post-flood economy of Kerala, it is important to understand the components of these remittances.

Remittances consist of the following four components:

1. Inward remittances for family maintenance;
2. Local withdrawals/redemptions from NRI deposits;
3. Gold and silver brought through passenger baggage; and
4. Personal gifts/donations to charitable institutions

Components (i) and (iv) are likely to increase due to the depreciation of the INR, and component (ii) is likely to increase due to families withdrawing larger amounts from previous deposits for reconstruction activities, primarily in the districts of Alappuzha, Kollam, Pathanamthitta, and Malappuram.

Increased remittances can come in very handy for the reconstruction of affected households and businesses of migrant households. This would also give impetus to the local economy by way of increased consumption.

Conclusions

The following are the main conclusions arising from the assessment :

- In the worst case scenario, the reduction in Kerala's GSDP growth rate in 2018–19 will be 1.27% at current prices and 1.23% at constant prices. Compared to the pre-flood situation, Kerala's overall GSDP is expected to fall by at least 0.60% in the case of medium impact and by as much as 1.20 percentage points in the case of high impact.
- The worst-affected areas in loss in GSDP at constant prices in the state in 2018–19 are crops (INR 869 crore), followed by real estate (INR 834 crore), trade and repair (INR 751 crore), construction (INR 638 crore), and livestock (INR 556 crore).
- The revenue receipt in Kerala in 2018–19 is likely to be reduced by INR 3,462 crore.
- The revenue deficit without additional resource mobilisation in 2018–19 is expected at INR 31,332 crore—2.4 times more than the budget estimate.

Human Impact

Human Impact

Introduction

A human impact assessment calls for a people-centred approach that focuses, in particular, on (i) the human dimensions of the impact of disasters; (ii) the distinct needs and priorities of different groups of people; and (iii) the sociocultural aspects of disaster recovery in addition to economic imperatives. More specifically, it underscores the need to recognise the non-quantifiable and non-monetary costs of disasters on people's lives. These would include emotional shocks, psychosocial damages, distress and trauma as well as the new insecurities in the lives of people arising out of the disaster.

Development and deprivation are multi-dimensional. The most fundamental dimensions pertain to the ability to lead a long and healthy life, being knowledgeable and having a decent standard of living. Equity and equality are core principles of development. Accordingly, a human impact analysis of disasters focuses on the following dimensions and indicators:[1]

Living conditions, health and education: This dimension is measured on indicators for multi-dimensional poverty index, that is, impacts of the disaster on water, sanitation, electricity, cooking fuel, housing and essential household assets, as well as health and education.

Livelihoods: Livelihoods are measured in terms of people's access to livelihoods (all occupations), income, productive assets, and resources.

Food security: This dimension is measured in terms of the three pillars of food security (food availability, access and utilisation) and household coping strategies.

Gender equality: Gender equality is measured as the gender differential impact, access to resources, and decisions.

Social inclusion: This is measured in terms of unequal access, unequal participation, denial of opportunities, and the identification of vulnerable populations.

Pre-Disaster Context

Kerala has a long history of investing in people and enhancing their capabilities. The state is globally acknowledged for its impressive achievements in human development. Many of Kerala's human development indicators are at par with those of developed countries. Within India, Kerala ranks first among the Indian states on the Human Development Index (HDI). According to the most recent data, the state reports a literacy rate[2] of 94% (vis-à-vis a national literacy rate of 73%), life expectancy at birth[3] of 75.2 years (as against the national average of 68.8 years), and infant mortality rate (IMR)[4] of 10 per 1,000 live births (as against India's IMR of 34). Only 7% of the state's population lives below the below the poverty line—the lowest among the Indian states. Human development has also been more equitable in Kerala than in the other Indian states.[5] For instance, Kerala ranks the best on the inequality-adjusted HDI which indicates the least loss of HDI on account on inequality.[6] Kerala's performance on some of the critical indicators of socioeconomic development vis-à-vis India is given below in Table 1.

[1] *United Nations Development Programme, "Guidelines for Assessing the Human Impact of Disasters".*

[2] *Office of the Registrar General (2011), Census of India 2011, Ministry of Home Affairs, Government of India.*

[3] *Department of Economic Affairs (2018), "Economic Survey of India 2017–18", Department of Economic Affairs, Ministry of Finance Government of India, Statistical Appendix, Table 9.1.*

[4] *http://www.censusindia.gov.in/vital_statistics/SRS_Report_2016/8.Chap%204-Mortality%20Indicators-2016.pdf*

[5] *Planning Commission (2013), Press Note on Poverty Estimates 2011-2012, Government of India, Planning Commission. http://planningcommission.nic.in/news/press_pov2307.pdf*

[6] *M.H. Suryanarayana, Ankush Agrawal and K. Seeta Prabhu (2011), 'Inequality-Adjusted Human Development Index for India's States', UNDP, http://www.undp.org/content/dam/india/docs/inequality_adjusted_human_development_index_for_indias_state1.pdf*

Table 1

Key Socioeconomic Statistics, Kerala and India

Indicator	Kerala	India	Source
Multi-dimensional Poverty Index (%), 2015–16	1.1	27.5	Refer source 1 below
Poverty headcount ratio %	7.1	21.9	Refer source 2 below
Per capita net state domestic product per annum at current prices in INR	1,47,190	94,130	Refer source 3 below
Total dependency/old dependency/young dependency ratios	56.3/19.6/36.7	65.2/14.2/51.0	Refer source 4 below
Literacy rate (%)	94	73	Refer source 4 below
Female literacy rate (%)	92	65	
Child sex ratio (girls per 1,000 boys)	964	919	Refer source 4 below
Overall sex ratio (females per 1,000 males)	1,084	943	
Infant mortality rate (infant deaths per 1,000 live births)	10	34	Refer source 5 below
Neonatal mortality rate per 1,000 live births	6	24	Refer source 5 below
Under-5 mortality rate per 1,000 live births	11	39	Refer source 5 below
Maternal mortality ratio per one lakh live births	46	130	Refer source 6 below
Life expectancy at birth (years) 2011–15	75.2	68.8	Refer source 7 below
Stunted % of children in 0–59 months age group	19.7	38.4	Refer source 8 below
Anaemic % women in 15–49 years age group	34.2	53.0	Refer source 8 below
Women of 15–49 years whose BMI is less than 18.5 %	9.7	22.9	Refer source 8 below
Gross enrolment ratio at elementary/secondary/ higher secondary	95/102/78	97/80/56	Refer source 9 below
Percentage of currently-married women in 20–24 years age groups who were married before 18 years of age	7.6	26.8	Refer source 8 below
Household % without access to toilets at home	3.8	53.2	Refer source 4 below
Household % with access to improved source of drinking water	43.2	75.6	Refer source 4 below

Sources:

1. Oxford Poverty and Human Development Initiative (2018). "India Country Briefing", Multidimensional Poverty Index Data Bank. Oxford Poverty and Human Development Initiative, University of Oxford.
2. Poverty headcount ratio % - Planning Commission (2013), "Press Note on Poverty Estimates 2011-2012", Government of India.
3. DEA (2017), "Economic Survey of India 2016–17", Department of Economic Affairs, Ministry of Finance Government of India.
4. ORGI (2011), Census of India 2011, Office of the Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India.
5. Office of the Registrar General of India (2016), "Sample Registration System (SRS) Bulletin 2016", Ministry of Home Affairs, Government of India.
6. Office of the Registrar General of India (2018), "Special Bulletin on Maternal Mortality in India 2014-16", Sample Registration System, Ministry of Home Affairs, Government of India
7. DEA (2018), "Economic Survey of India 2017–18", Department of Economic Affairs, Ministry of Finance Government of India.
8. NFHS-4 (2015–16), "National Family Health Survey, Round 4", Ministry of Health and Family Welfare, Government of India, http://rchiips.org/nfhs/pdf/NFHS4/KL_FactSheet.pdf
9. Government of India, UDISE data, https://data.gov.in/dataset-group-name/u-dise

Table 2

Projected impact on GSDP at constant (2011/12) prices

District	MPI poor %	Infant Death rate (per 1,000 live births)	Literacy rate	Female literacy rate	children stunted%	children wasted%	children underweight %	Household % with improved sanitation facility	% HH with improved sanitation facility
Alappuzha	0.8	3	93.7	94.2	14.5	16.6	17.2	97	97
Ernakulam	0.2	3	95.9	94.5	12.4	15.9	12	99.3	99.3
Idukki	2.1	2	92	89.5	15.1	24.2	14.8	94.6	94.6
Kannur	0.6	5	95.1	93.3	25.3	10.2	10.5	98.9	98.9
Kasaragod	1.9	3	90.1	86.5	18.7	9.7	13.9	97.7	97.7
Kollam	1.6	2	94.1	92.3	14.4	18.8	14.2	98.1	98.1
Kottayam	0.1	6	97.2	96.5	22	16.2	11.3	98.9	98.9
Kozhikode	0.9	14	95.1	93	18	13.5	18.5	99.4	99.4
Malappuram	1.6	3	93.6	91.6	26.3	22.3	17.3	98.7	98.7
Palakkad	1.0	3	89.3	85.8	20.2	10.3	19.1	96.7	96.7
Pathanamthitta	1.2	4	96.5	95.8	13.3	14.4	11.4	97.4	97.4
Thiruvananthapuram	1.5	10	93	91.2	19.5	13.1	21.6	96.8	96.8
Thrissur	0.4	6	95.1	93.6	20.8	15.3	14	99.5	99.5
Wayanad	3.9	4	89	85.7	27.7	23.9	27.2	95.3	95.3

Disparities persist though and have been highlighted subsequently in this chapter and elaborated upon earlier in sector chapters. The floods and landslides have affected the marginalised and excluded groups to a greater extent and have the potential for accentuating the disparities further.

Human Impact of Floods

Highlights

- People in 1,259 out of 1,664 villages, that is 75% of the villages in the state were flooded.
- 1.4 million people were evacuated to public camps
- 433 lives were lost in the floods and landslides—268 men, 98 women, and 67 children.
- 44 of the dead belonged to Scheduled Castes and 14 belonged to Scheduled Tribes.
- 20% of the fatalities comprised the elderly.
- Lives of over 8,600 persons living with disability were affected by the disaster.
- Access to piped water was disrupted for 6.7 million people.
- 1.4 million people lost access to water from shallow wells.
- 400,000 people were left without access to toilets due to damage to latrines.
- Severe damage to more than 17,000 houses jeopardised access to home, water, electricity, cooking fuel and assets for approximately 74,000 people.
- 1,74,690 buildings were damaged either fully or partially, potentially affecting 7.5 lakh people
- All schools closed from 2 to 23 days in affected districts. A total of 1,613 schools affected. Some schools in Alappuzha remained closed for more than a month. Attendance as low as 20% in many schools even after reopening.
- Close to 332 health facilities were fully or partially destroyed; another 61 Ayurveda institutions and 59 Homeopathic institutions were damaged.
- Livelihoods of 74.56 lakh workers (53.21 lakh men and 21.35 lakh women); 22.77 lakh migrants; 34,826 persons working in micro, small, and medium-sized enterprises, and 35,107 plantation workers were affected for 1–1.5 months. Total wage loss of INR 5,943 crore for men and INR 1,358 crore for women was estimated.
- Nearly 1,219 anganwadi centres were affected out of which 114 were completely damaged. This may be expected to disrupt the provisioning of supplementary food to pregnant women, nursing mothers, and children below 6 years of age.
- The poor, vulnerable women, the elderly, people living with disabilities, Scheduled Tribes, and children were disproportionately affected.
- People are in trauma owing to loss of family members, friends, and neighbours; loss of assets, belongings, and important documents. They are also faced with the ominous prospect of rebuilding their lives with the realisation that private losses may not be adequately recompensed.

Examining the Human Impact of the Disaster

Impact on living conditions, health, and education

The heavy rains and floods caused considerable damage with close to 1.4 million people being evacuated to publicly provided camps during the floods as their homes were inundated with flood water.

Health risks multiplied with flood impact on drinking water sources and sanitation facilities. About 6.7 million people, that is, 20% of the population temporarily lost access to piped water. Additionally, more than 3.17 lakh shallow wells were damaged in the six worst-affected districts further exposing 1.4 million persons to hazards of water contamination.[7] About 95,146 household latrines (of which 88% were rural) were substantially damaged.[8] This put 400,000 people beyond sanitation services. Appropriate water and sanitation services need to be restored at the earliest though there has been no significant outbreak of water-borne diseases.

It has been reported that 1.75 lakh buildings have been damaged either fully or partially, potentially affecting 7.5 lakh people. Out of these, around 17,300 buildings have been either destroyed or have reported damages of more than 75% and need to undergo reconstruction, severely constraining access to water, sanitation, electricity, and cooking fuel for approximately 74,000 people. Lack of access to these essential services adversely affects women more than men. Loss of assets is significant for the affected population.

In the education sector, services provided by schools and anganwadi centres have been disrupted. More than 1,700 schools in the state were used as relief camps during the floods. Most of the camps closed after ten days. Teachers and education department officials were involved in cleaning the schools as well as volunteering in the camps. Floods affected teaching and learning in almost all the districts with institutions being closed from 2 to 23 days. A total of 1,613 schools have been affected by the floods. Some schools in Alappuzha were closed for more than a month. To make up for the lost instructional days, all the schools are now open on Saturdays, and many teachers teach for two extra hours daily.

However, even when the schools reopened, the attendance was as low as 20% in many schools. Students were not attending school owing to trauma and stress because of loss of family/friends and large-scale damage to their homes or neighbourhood. In many instances, teachers visited students to motivate them to attend school. Students, particularly from class X and XII are anxious because of loss of books and notes which may have to be written again. Sanitation, hygiene, and safety of students present cause for concern in the post-flood period. PDNA sector team reports that there is a danger of children, especially girls dropping out of school unless steps are taken to make the school safe still. Trauma and stress, if unattended, could affect learning outcomes and have an adverse effect even in adult life.

While education services were disrupted temporarily, with additional measures, the overall goals for the education sector have not been affected. However, it remains to be seen if there are any dropouts due to this disaster, especially among the most marginalised social groups.

Access to healthcare in Kerala is by far the best in the country. The health sector's response to the flood was remarkable. However, people's access to health care facilities has been severely affected by the floods. Close to 332 health facilities have either been fully or partially destroyed. Another 61 Ayurveda institutions and 59 Homeopathic institutions were damaged as a result of the floods. It will constrain

[7] *Additional Memorandum on Kerala Floods by State Relief Commissioner, Disaster Management, GoK - Page 32*

[8] *Suchitwa mission damage assessment – 13.09.2018*

access to health care, particularly in areas with vast devastation. Interviews in the field indicate that service delivery was quickly restored and maintained by the Health Department through intersectoral coordination. However, affected people, particularly children, women, elderly and people with disabilities experienced shock and trauma which may have a long-term impact on their mental health.

Additionally, the affected population is experiencing trauma owing to loss of property, assets, savings of the entire lifetime, necessary papers and document, jewellery, etc. Also, it is essential to recognise substantial private losses that may not be adequately compensated for by public funding, and this would aggravate the sense of loss.

Overall, there were 4.16 lakh multi-dimensionally poor people in Kerala. While it has not been possible to conduct a survey to assess the impact of floods on multi-dimensional poverty, sector reports indicate that despite the loss of infrastructure, the overall poverty levels may not increase. This demonstrates the proactive role of the state government in public provisioning of services.

However, the multi-dimensionally poor will be disproportionately affected by the floods as high levels of poverty, and low levels of human development will limit the capacity of these poor households to access services increasing the intensity of deprivations that they face.

Impact on livelihoods

A majority of workers in Kerala are employed in the informal sector. Although not all informal workers are poor, most of them work without formal employment contracts that may entitle them to social security and other benefits. The massive damage to all the sectors of the economy has rendered them without work, and severe loss of work-days have been reported. The worker participation rate for women in Kerala is already low and is expected to drop further.

A summary of the number of people whose livelihoods have been affected is given below:

- 74.56 lakh workers (of which 53.21 lakh are men, and 21.35 lakh are women)
- 22.77 lakh migrants
- 34,826 person working in MSMEs
- 35,107 plantation workers, most of whom are women.

Most casual workers and daily wage earners such as agriculture labourers, workers in the coir, handloom, construction sector and the plantations, running in thousands, have experienced wage loss of 30–45 days. The PDNA estimates wage loss of INR 5,943 crore for men and INR 1,358 crore for women. The coping strategies of casual labourers are limited as they survive at subsistence level. Loss of daily wages and livelihood opportunities will hinder their capabilities for recovery. The PDNA reports that even though people have gone back from public camps, there is no work and there is a serious concern regarding livelihoods.

Livelihoods for women will be particularly affected. Workers in small enterprises (including those run by Kudumbashree[9] members) and those who worked in the artisanal sector at low wages (majority of whom were women) suffered massive livelihoods set back due to the floods. It may result in higher rates of unemployment and worsened standard of living in the short term.

[9] Kudumbashree is the poverty eradication and women empowerment programme implemented by the State Poverty Eradication Mission (SPEM) of the Government of Kerala. It has a three-tier structure for its women community network, with Neighbourhood Groups (NHGs) at the lowest level, Area Development Societies (ADS) at the middle level, and Community Development Societies (CDS) at the local government level. Membership is open to all adult women, limited to one membership per family. The Kudumbashree network by 15 March 2017 had a total membership of 43,06,976 women.

Impact on food security

Even though Kerala fares better than other Indian states on food security and nutrition indicators, the loss of income due to the disaster and the losses in the primary sector are likely to have an adverse impact on food and nutritional security.

Nutrition may be impacted because of the damage caused to the agriculture sector and food stocks reported by the Public Distribution System and the Integrated Child Development Services centres. Nearly 1,219 anganwadi centres were affected out of which 114 were entirely damaged. This will negatively impact the provision of supplementary food to pregnant women, nursing mothers, and children below six years of age. There might be interruptions in the distribution of iron and vitamin-A supplementation compromising nutrition security of women and children. Vulnerable sections of the population (such as SC/ST/elderly) which are reportedly suffering from trauma may need extra support to reduce morbidity and improve nutritional status.

Kerala has a high percentage of women suffering from anaemia (34%). Similarly, in Kerala, only 44% of children aged 6–23 months are fed the minimum number of times per day as recommended by WHO for infant and young child feeding practices and even fewer (38%) are fed from the appropriate number of food groups. Only 21% are fed according to all three recommended practices. Any deterioration of health and food security is likely to jeopardise this further.

Gender equality and social inclusion

While development gains in Kerala are more equitably distributed than other Indian states, spatial, gender and social inequalities persist. Wayanad district fares worse than others on most development indicators— close to one-fifth of its population belongs to Scheduled Tribes. The worker participation rate for women in Kerala is among the lowest in the country; the same is true of people living with disabilities. The old-age dependency ratio is among the highest in the country; in economic terms, it is the highest for rural men among Indian states. The Scheduled Tribes fare worse on most development indicators than the rest of the population. Institutionalised inequality in access to services exacerbates the impact of the disaster, and therefore the poor, vulnerable women, elderly, people living disability, Scheduled Tribe are more at risk of falling into a poverty trap if attention is not paid to them.

The Accountability to Affected Population (AAP) Kerala survey[10] in the district of Alappuzha and Wayanad conducted by UNICEF indicate the following:

- 52% of the respondents reported that their houses had been damaged due to floods and landslides. 32% of these had not been assessed.
- Of the 42% of the respondents who stated that they were aware of households in their community being left out of recovery assistance, 36% were people with disability, 28% were SC/ST; 17% were female-headed households, and 11% were elderly.
- 35% of respondents were not satisfied with the post-flood relief and rehabilitation efforts. 23% of these were people with disability, and 38% were SC/ST; 15% were female-headed households, and 13% were elderly.
- 90% of the respondents reported that they had not received any assistance for reconstruction or repair of homes. 24% of these were people with disability and 45% belonged to SC/ST.

[10] UNICEF India conducted the Accountability to Affect Population – Kerala survey in October 2018. The analysis presented in this chapter pertains to responses received from Alappuzha and Wayanad. More than 1,450 respondents were interviewed in 68 out of 72 gram panchayats and 6 urban local bodies of Alappuzha. In Wayanad, close to 1,300 respondents were interviewed in 15 out of 23 gram panchayats and 3 urban local bodies.

- Slightly more than half of the respondents were not aware from where to access information on relief and recovery assistance—37% of these were SC/ST; 20% were people with disability, and 15% were women.
- The most critical information that communities wanted before, during and after the floods was weather forecasting and warning (31%); information on relief camps (21%), relief assistance (19%), search and rescue (18%), and health and psychosocial support (12%).
- 62% respondents reported that women had access to safe house and relief; 67% reported that women had access to proper toilets.

A detailed assessment of the impact of the flood on women and social groups is presented in Chapter 16 on Gender Equality and Social Inclusion.

Human Impact and Development Goals

The Government of Kerala's Approach Paper to the XIII Five Year Plan identifies nine priority areas focusing on all aspects of sustainable development with people's participation. It aims at fighting social exclusion. Strengthening physical, social, and financial infrastructure is a significant priority for the Government of Kerala. These relate well to the Sustainable Development Goals that have been endorsed by the Government of India. Kerala is among the front-runner states of India on most of the SDGs.

Efforts to attain XIII Five Year Plan priorities of the Government of Kerala as well as SDGs related to economic, social and environmental dimensions have been negatively impacted. The core strength, however, remains the tradition of people's planning and participation at the local level which can be effectively utilised for rebuilding a green and sustainable Kerala.

Recovery Needs

An analysis of responses received through the AAP survey in Alappuzha and Wayanad districts on the needs identified by the community is given below.

In response to suggestions for making relief distribution more citizen-friendly, 31.9% wanted relief distribution to be more inclusive and participatory; 31.1% wanted more information on gratuitous relief and entitlements; 20.1% suggested ease of access to government officials; and 16.8% indicated ease of access to elected representatives.

An overwhelming majority (92%) identified the need for strengthening disaster preparedness. Of these, 39% suggested conducting risk and vulnerability profiling of the panchayats; 30% suggested preparation of village disaster management plan and 29% suggested risk-informed Gram Panchayat Development Plans (GPDP).

The priorities identified by the community to be addressed after the floods are as follows: housing (22.8%), access to safe drinking water (16.5%), health (16.2%), food (11.1%), cash grants (7.8%), infrastructure restoration (3.4%), seeds and tools for agriculture (3.1%), safety and security (2%). Priorities such as loans to restart business, social protection, and psycho-social support were identified by less than 1% of the respondents as important.

Table 3

Data Disaggregated by Various Categories of Respondents

Question Description	Answer Type	% of Responses							
		Total	People living with disability	SC/ ST	Women headed households	Children (Boys 11-18 years)	Children (Girls 11-18 years)	Elderly (60 years+)	Other Respondents
What are the most important priority needs to be addressed after the floods?	Housing	22.8	21.1	39	12.1	0.6	0.6	13.1	13.4
	Health	16.2	19.6	37	12.8	0.8	0.6	12.9	16.3
	Palliative care	7.7	21.6	38.5	12.8	0.3	0.7	15	11
	Access to safe drinking water	16.5	22	39.2	10.4	0.5	0.8	13.7	13.5
	Education	7.4	20.9	40.5	15.5	0.9	0.6	10.8	10.8
	Food	11.1	21.5	35.9	12.7	0.5	0.4	12.4	16.7
	Seeds and tools to revive agriculture	3.1	28.3	36.6	7.5	0.4	0.7	10	16.5
	Cash grants	7.8	27.9	38.1	9.4	0.1	0.6	11.3	12.5
	Loans to restart business	0.6	19.6	23.2	16.1	1.8	1.8	16.1	21.4
	Infrastructure restoration (roads, bridges, etc)	3.4	22.3	44.9	8.5	0	1.3	10.5	12.5
	Safety and Security	2.1	20.3	44.5	9.3	0.5	0.5	9.9	14.8
	Social protection	0.7	26.2	38.5	12.3	0	3.1	6.2	13.8
	Psycho-social care	0.2	13.3	6.7	33.3	0	0	6.7	40
	Protection of children against physical and sexual abuse, trafficking, child labor, violence etc.	0.3	20.8	41.7	20.8	0	0	8.3	8.3
	Others	0.2	20	40	6.7	0	0	6.7	26.7

Table 4

Responses to a Question on Priority for Reconstruction Other Than Homes

Question Description	Answer Type	% of Responses							
		Total	People living with disability	SC/ ST	Women headed households	Children (Boys 11-18 years)	Children (Girls 11-18 years)	Elderly (60 years+)	Other Respondents
Besides rebuilding your home, what are the other rnstruction priorities of your communities? Please rank.	Water Supply	31.1	21.9	38.7	12	0.7	0.6	12.8	13.4
	Schools	11.8	19.3	40.8	14.4	0.9	1.2	12.5	10.8
	Roads	30.2	21	37.4	11.6	0.8	0.8	13.4	15
	Health facilities/ Primary health centers	17.6	21.5	36.7	14.1	0.4	0.9	12.9	13.4
	Land use/ land availability for homes	8.3	20.7	38.6	15.5	0.2	1.7	14	9.4
	Others	1.0	27.9	36.1	11.5	1.6	1.6	6.6	14.8

Recommendations:

The Government of Kerala has begun drafting its XIII Five Year Plan. Additionally, there is also a global consensus on Agenda 2030 which focuses on sustainable development. Kerala reports high levels of human development and extremely low levels of multi-dimensional poverty. However, it is increasingly being adversely affected by natural disasters which may become more frequent due to climate change. Against this backdrop, the rebuilding and recovery strategy provides an opportunity to refocus on development that is sustainable, that takes into account factors that affect climate change, and that 'leaves no one behind'. Kerala has demonstrated in the past that early investments in promoting health and education as well as in enhancing people's capabilities can have a positive effect on improving incomes. It now has the opportunity to be a trailblazer in adopting a green path to sustainable development.

From the perspective of the people, further benefits to Kerala are likely to accrue by adopting the following approaches:

Empower people as agents of change: As has been mentioned above, groups that are most affected by floods (and disasters in general) include women and Scheduled Tribes. The fishing community, particularly one engaged in inland fisheries, has also been adversely affected by floods. However, these are also the groups that have a deep understanding of their direct environment. They possess traditional know-how and skills for managing natural resources, particularly, water management, agriculture, fisheries, and conserving biodiversity. In the process of building back better, it will be imperative to involve them in building a green and resilient Kerala.

Leave no one behind: Districts and groups that are already lagging behind the others with respect to multi-dimensional poverty indicators and other development indicators need more focused attention in the recovery strategy. This is particularly

true of Wayanad and Idukki districts which are among the most affected by floods and where multiple vulnerabilities overlap. These districts have the highest percentage of multi-dimensionally poor people and have a high percentage of Scheduled Tribes population. Ensuring restoration of services to these districts and making them accessible to poor households will enable bridging the development gap.

Strengthen people's institutions for sustainable development: Kerala has been a pioneer in the process of decentralisation. Close to 40% of the funds are devolved to institutions of local governance. There needs to be an increased focus on planning for sustainable development in the panchayats and urban local bodies. It is equally vital to capitalise on Kerala's legacy of local governance, people's planning, people's movements, Kudumbashree, farmers and other cooperatives in recovery design and implementation processes. Similarly, there is an opportunity to capitalise on the unprecedented outpouring of voluntary action to strengthen local communities and establish easily accessible forums for making representations, regular interaction, seeking redress, and accountability.

Most urgently needed is a humane approach to recovery that focuses on reducing insecurities in the lives of people. At a minimum, this will call for the design of interventions that empower individuals in a manner which reduces their anxieties and stress by minimising paperwork required to avail of relief benefits or get duplicate personal records. It will be equally important to factor in culture and context to develop differentiated strategies to address the needs and priorities of different groups. A human impact assessment also implies the need to allocate more substantial resources—human and financial—for addressing the needs of the most vulnerable groups.

It is clear from this disaster that Kerala needs to adopt a revised path towards sustainable development. There is no doubt that well-functioning institutions and high levels of human development are assets that can contribute to better management as well as " building back better" and faster. However, moving forward, the state needs to look more intensely at issues of sustainability and use of the SDG framework to rebuild a new Kerala.

Best Practices

Best Practices: Country Case Studies

Natural Disaster Recovery and Interventions from Across the World

New Zealand: The 2010 And 2011 Canterbury Earthquakes, Policy and Institution and Programmatic Framework for Recovery[1]

On 4 September 2010 an earthquake of 7.1 Richter magnitude struck 44 km west of Christchurch and shook the Canterbury region of New Zealand's South Island. Another quake, 6.3 in Richter magnitude, struck on 22 February 2011, 6 km from the Christchurch Central Business District where the older commercial buildings were already considerably damaged from the previous quake.

Government Response: Policy

Two days after the first quake (6 September 2010), Prime Minister John Key appointed Gerry Brownlee, the Minister for Economic Development, as Minister for Canterbury Earthquake Recovery.

The Canterbury Earthquake Response and Recovery (CERR) Bill was also introduced and unanimously passed in one day (CERR Act 2010), providing statutory power to support earthquake response. This effectively allowed national government ministers to override almost any New Zealand law and thus transferred considerable lawmaking power from the legislative to the executive branch of the national government. The CERR Act 2010 also established the Canterbury Earthquake Recovery Commission (CERC), composed of the mayors of the three affected local governments, and four appointees from the national government supported by a secretariat and hosted by the Ministry of Economic Development. The main purpose of CERC was to facilitate better coordination between impacted communities and for the national government to act as a clearinghouse for government agencies and deal with issues that could not resolved at the local level.

In April 2011, the Parliament enacted the Canterbury Earthquake Recovery (CER) Act 2011[2], repealing the CERR Act 2010,[3] though all orders passed and actions taken under the CERR 2010 Act remained in force. The CER Act 2011 required the development, within nine months, of a long-term recovery strategy and a draft recovery plan for the Christchurch Central Business District. The Canterbury Earthquake Recovery Authority (CERA) was also established in March 2011.[4]

Canterbury Earthquake Recovery Authority

The CERA developed the draft Recovery Strategy for Greater Christchurch (an overarching framework of 23 programmes to guide the Canterbury recovery efforts). The recovery strategy included an overall vision, goals, guiding principles and six programme components—leadership and integration, economic recovery, social recovery, cultural recovery, the built environment, and the natural environment. In partnership with other agencies, the CERA also developed a recovery monitoring and reporting framework including:

[1] *Johnson, Laurie and Olshansky, Robert (2017). After Great Disasters: How Six Countries Managed Community Recovery. Policy Focus Report. Cambridge: Lincoln Institute of Land Policy. https://www.lincolninst.edu/sites/default/files/pubfiles/after-great-disasters-full_0.pdf*

[2] *This Act was repealed in 2016: http://www.legislation.govt.nz/act/public/2011/0012/latest/DLM3653522.html*

[3] *http://www.legislation.govt.nz/act/public/2010/0114/latest/TMPN10898.html*

[4] *It was disestablished on 18 April 2016 as the government transitioned from leading the recovery, to establishing long-term, locally-led recovery and regeneration arrangements. https://dpmc.govt.nz/our-business-units/greater-christchurch-group/roles-and-responsibilities/disestablishment-cera*

- a monthly economic recovery dashboard;
- quarterly reports of economic indicators for the Canterbury region;
- an annual Canterbury well-being index to track social recovery; and,
- a semi-annual well-being survey of approximately 2,500 randomly selected residents.

The CERA managed the two-and-a-half-year cordoning and demolition process in the main city, planning and reconstruction, voluntary residential acquisition and clearance process, and the expedited planning for new residential developments to offset housing losses.

Earthquake Commission (EQC) The EQC was tasked by the national government to take direct responsibility for the repairs or rebuilding of insured homes, rather than only paying cash settlements to homeowners

The EQC's geotechnical analyses of land damage mapped 22,500 properties in Canterbury and separated them into three recovery zones, with the 3,300 most severely damaged properties—in zone C—likely to be demolished and rebuilt. Engineers attended detailed land-damage evaluations.

The Stronger Christchurch Infrastructure Rebuild Team (SCIRT) was formed with three organisations (CERA, Christchurch City Council, and New Zealand Transport Agency), and would finance repairs of the damaged infrastructure. Five companies would be responsible for the design, infrastructure repair, and reconstruction work.

Zonal Rebuilding

The Government of New Zealand classified the region's earthquake-damaged residential properties into four zones.

- **Red Zone:** unsuitable for reconstruction; part of a central government-backed voluntary buyout programme; and once purchased, the central government would own these properties/land.
- **Green Zone:** suitable for rebuilding but further divided into three technical categories (TC) of foundation repair and reconstruction requirements.
- **Orange and White Zones:** areas requiring further investigation.

Following a Cabinet approval in 2011, of the above land zone and buyout programme for all the properties in the red zone areas, CERA obtained voluntary sale and purchase agreements from 95% (7,143) of red zone residential property owners who accepted one of two options: (i) to sell both their land and structures; or, (ii) to sell only their land and maintain their insurance claims to buildings and contents. Two years after the launch of this programme, however the actual policy development and implementation of the residential land zoning and buyout process took over five years to complete. The government offered only half the pre-earthquake value of land for uninsured residential and non-residential properties in the red zones

'Share an Idea'

In response to CER Act which required the Christchurch City Council to develop a recovery plan, the Council launched a public engagement campaign known as 'Share an Idea'. This campaign attracted more than 106,000 suggestions and included a web-based notice board for ideas. Five overarching themes emerged: (i)

a greener city; (ii) a stronger built environment identity marked by low rise buildings and heritage buildings; (iii) a more compact business district in Christchurch with a new convention centre, improved access to transport, wifi ; (iv) improved housing, recreational facilities, and cultural resources; and, (v) greater accessibility to the Christchurch business district (CBD) and the area around it.

The CER Minister established a Christchurch Central Development Unit (CCDU) to prepare a final Christchurch Central Recovery Plan including a blueprint. The blueprint became law and placed 17 anchor projects and use-oriented precincts within the central city and reduced the CBD footprint to only 40 hectares (ha).

Lessons

A critical aspect of the Canterbury recovery was the leading role of the national government, which bears responsibility both for financing much of the residential reconstruction and insuring properties against future disasters. It investigated land damage and developed a comprehensive strategy for addressing ground failure issues and reducing uncertainties for insurers and property owners. Key lessons on recovery around governance, policy, and land use is listed below.

Governance arrangements: The centralisation of authority at the national level for recovery and land-use policymaking may have strengthened coordination among national agencies, expedited the policy and decision-making processes and ensured accountability for the sizeable national government expenditure. It may also have been effective at facilitating coordination across multiple levels of the government, building capacity at the local and regional levels and promoting collaboration and empowerment among government agencies and with the private sector.

Policies for hazardous areas: The Government of New Zealand financed much of the residential reconstruction and is continuing to insure the nation's residential properties against future events, through the EQC. The EQC's unique obligation to repair residential land damage led to regional geotechnical studies which provided scientific information to shape the residential land zoning and land buyout policies. The Red Zone voluntary buyout programme, offered options for residents to sell and relocate and reduced the financial risks to the government and insurers. These policies have reduced the future risks of hazards significantly, improved the region's building stock, and protected property values.

However, the widespread damage to residential building stock created immediate shortage of both rental and for-sale housing and costs rose by 30% on an average over a five-year period. Additionally, lengthy insurance settlements and difficult foundation engineering requirements for new houses meant that many residents did not experience the certainty that the national government's land zoning decision has intended to provide. Exacerbating the problem, affordable rental housing or government-owned social housing constituted a high proportion of lost housing units; as a result, these displaced households could not find affordable housing and homelessness grew. There was also a concern about the lack of information and public participation in the policy development and decision-making process throughout the recovery.

Sri Lanka: Post-Conflict and Post the 2004 Tsunami[5]

Northern Sri Lanka, in the aftermath of the signing of a ceasefire agreement between the Government of Sri Lanka (GoSL) and the Liberation Tigers of Tamil Eelam (LTTE) in 2002, was characterised by massive destruction and damage to private property and public infrastructure. Public services were barely functional and needed to be restored. Over 90% of privately-owned houses were damaged or destroyed. In

[5] *Swiss Agency for Development and Cooperation, Operational Manual Guidelines and Tools for the Implementation of a Rehabilitation and Reconstruction Programme in a Post-Conflict Context Based on Best Practices and Lessons Learnt in Northern Sri Lanka from 2009–2015*

December 2004, large tracts of coastal Sri Lanka were further devastated by the tsunami, with massive loss to life and property.

Reconstruction

In 2002, following the signing of the peace agreement, the Swiss Agency for Development and Cooperation (SDC) had, along with the GoSL, set up a field coordination office in Jaffna to support the construction and rehabilitation of educational facilities, housing and community infrastructure in the region. Several livelihood projects were also implemented.

Housing

The SDC became active in the reconstruction of houses, in collaboration with a Consortium of Swiss Organisations. Upon the GoSL's request, Switzerland also agreed to contribute to the GoSL-led island-wide Cash for Repair and Reconstruction (CfRR) programme. The initiative was piloted in December 2009 in the small village of Maravanpulo, (in Jaffna, Northern Province Sri Lanka) where SDC supported:

- the reconstruction of 300 permanent houses by returnee families through an owner-driven cash-for-housing approach;
- the restoration of essential community infrastructure; and,
- the provision of livelihood support.

Based on the positive outcomes of the pilot initiative, SDC extended the reconstruction programme to the Jaffna and Kilinochchi districts of Northern Province, in collaboration with several donors and implementing partners. Overall, the Consortium of Swiss Organisations coordinated the reconstruction and repair of over 10,000 houses at a cost of CHF 19.5 million.

By the end of 2015, SDC had assisted over 32,000 conflict-affected returnees from 45 villages to resettle in their places of origin with safe housing, essential community infrastructure, and restored livelihoods. This represents approximately 11% of the post-conflict housing reconstruction needs in the districts of Jaffna and Kilinochchi.

Since 2010 over 5,050 conflict-affected families (14% female-headed households) have been resettled in their places of origin, in secure permanent shelters, and in a safe living environment with dignity. A psycho-social counselling component was designed to provide assistance to families struggling with the completion of their houses and to link them with existing local support systems. Post-completion village assessments show 98% of beneficiaries highly value their houses constructed on the principles of 'building back better', addressing their vulnerabilities.

Income and Livelihoods

Over 50% of the assisted families have incomes below the national poverty line, with female-headed families reporting less than one-third of the national poverty line's minimum income. Alerted by increasing indebtedness levels among beneficiaries, SDC also added a financial counselling component to the programme resulting in over 95% of housing beneficiaries showing improved awareness of financial management. This tool was presented to stakeholders and highlighted the need for better access to attractive credit options in future housing assistance programmes.

The livelihood component has benefited over 1,260 households, 20% of which are headed by females and would otherwise have had no livelihood opportunity, and 70% are below the national poverty line. These families have increased their

monthly income by an average of 40% as a result. Small producer groups have been formed and linked with sizeable private sector actors under long-term purchasing agreements for future sustainability. This provides members with local options and alternatives to unskilled migration abroad. The majority are women who now fully manage their small enterprises, with independent incomes and access to mainstream production chains.

Community Infrastructure

The community infrastructure component ensures access to education and safe drinking water. By constructing and capacitating 39 preschools, SDC has enabled all preschool-aged children (including children with disabilities) in 39 villages to attend a preschool with trained teachers and adequate equipment in line with national guidelines. An external evaluation of the preschools confirmed that they provide quality, child-friendly and protective environment. The SDC has offered all returnee families in 42 villages access to drinking water within 500 m of their home, as recommended by Sphere Minimum Standards. The rehabilitation of ponds, construction of wells and hygiene facilities has been done with the active involvement of women at all stages, taking into consideration the needs of women and children.

Japan: 2011 Earthquake and Tsunami– Rebuilding Homes and Livelihoods[6]

On 11 March 2011, a magnitude 9.0 offshore earthquake generated tsunami waves with record heights that inundated over 216 square miles (560 sq km) of coastal land in northeast Honshu and severely affected Iwate, Miyagi and Fukushima Prefectures. In all, 15,880 people perished, and 2,694 are still reported missing. Nearly 400,000 buildings were either entirely or severely damaged. Direct financial damage to buildings, utilities, and social infrastructure was approximately ¥16.9 trillion[7] (USD 169 billion). Together, the Great East Japan Earthquake and Tsunami and the subsequent nuclear disaster count amongst of the world's worst modern catastrophes.

Evacuees from Fukushima Prefecture faced a particularly complex and long-term evacuation because of the nuclear disaster and contamination to surrounding land. Initially, residents within a 12.5 mile (20 km) zone were forced to evacuate. However, the zone soon grew larger in size and after several revisions, the contaminated areas were separated into three zones based on the levels of radiation and the potential for occupancy.

Central Government Response

National Reconstruction Design Council

One month after the March 11 disaster, Japan's Prime Minister Naoto Kan established the National Reconstruction Design Council (NRDC), charged with developing concepts and strategies for recovery and rebuilding. Its fifteen members came from academic, business, and religious groups, along with the governors of Iwate, Miyagi, and Fukushima Prefectures. Also, a nineteen-member study group was established to provide technical support to NRDC and on 25 June 2011, the council released its 39-page national recovery vision titled 'To Reconstruction: Hope Beyond the Disaster'. The vision presents general concepts and strategies for physical recovery, ideas for job creation and regional economic recovery and proposals for sustaining and ultimately resolving the Fukushima nuclear crisis among other things. The document underscored the leadership of the local governments in all areas of recovery with the exception of recovery of the Fukushima nuclear disaster which was to be led by the national government.

[6] *Johnson, Laurie and Olshansky, Robert (2017). After Great Disasters: How Six Countries Managed Community Recovery. Policy Focus Report. Cambridge: Lincoln Institute of Land Policy. https://www.lincolninst.edu/sites/default/files/pubfiles/after-great-disasters-full_0.pdf*

[7] *http://www.reconstruction.go.jp/english/topics/GEJE/index.html*

The NRDC called for a two-level approach to future tsunami-risk management. Based on historical tsunamis in the Tohoku region, a Level 1 (L1) tsunami was defined as an event with greater than 1% annual probability of occurrence, and a Level 2 (L2) tsunami had less than 1% annual probability of occurrence. The 2011 tsunami was classified as an L2 tsunami. The policy consensus was that large-scale structural measures, such as levees, would protect land and people against L1 tsunamis. Additional land-use and non-structural measures, such as evacuation plans, would supplement levee defences to secure human lives against L2 tsunamis.

Based on these principles, the NRDC report presented five schematics of future land-use patterns to reduce the risk of tsunamis, including relocating people (and the land-use), and raising the base elevation of land and the heights of levees. The council's vision represented a fundamental shift in disaster-related policymaking in Japan, which traditionally focused on 'disaster prevention'—seeking to avoid disaster damage altogether. The Ministry of Land, Infrastructure, and Transportation (MLIT) hired consultants to help local governments develop land-use plans that incorporated the L1 and L2 tsunami-protection concepts.

National Reconstruction Agency

The Government of Japan combined its 1995 Hanshin Awaji earthquake recovery and 1923 Tokyo earthquake governance approaches to establish the National Reconstruction Agency (NRA) which reported to the Prime Minister and managed the national recovery funds that flowed either through national ministries or directly to local governments. The agency was established formally on February 2012. It is authorised to run until at least October 2020, but it can be extended if necessary

The NRA coordinates the national ministries that oversee reconstruction programmes in collaboration with responsible line ministries and monitors the recovery fund established in September 2011. It also directly administers various recovery activities to reduce administrative tasks for local governments. Offices include the national headquarters, three offices in Iwate, Miyagi, and Fukushima Prefectures, and eight branch offices in the severely affected communities along the coast. The authorising legislation also established the Reconstruction Promotion Council (RPC), an oversight committee composed of experts and government leaders who monitor the quality of reconstruction.

National Programmes for Rebuilding after Disaster

Four national-level programmes address the physical rebuilding of local areas. To access funds under these programmes, prefectural and local governments were required to complete a recovery plan, deliver the plan to the reconstruction agency for review, and submit applications that aligned with the national reconstruction guidelines released in June 2011.

- **Collective Relocation Programme** initially established in 1972 to promote the relocation of disaster-prone communities before disasters, now relocates communities away from tsunami hazard zones.
- **Land Readjustment Programme** is used to rebuild more safely, primarily by raising the base elevation of land.
- **Public Housing Programme** stems from the Act on Public Housing of 1951 and subsidises public rental housing for disaster survivors without the financial capacity or ability to rebuild their own houses.

- **Tsunami Recovery Zone Programme** was created through national legislation in October 2011 to establish special zones in which rebuilding was more flexible than in other funding programmes. This programme funds redevelopment of essential urban services and facilities in devastated localities. It can be used for industrial, residential, and mixed-use redevelopment, as well as the development of agricultural land.

Response of Most Affected Prefectures: Iwate, Miyagi and Fukushima

Shortly after the March disaster, each of the three most severely affected prefectures established its reconstruction bureau and recovery advisory committee. Similar to the National Reconstruction Design Council, each of these committees was composed of academics and leaders from government, industry, and community.

Iwate and Miyagi Prefectures

Both prefectures quickly initiated plans to gather input from cities and residents on reconstruction principles, policies, and project proposals for national government funding. Plan proposals included relocating housing in various combinations, elevating land uses and infrastructure, providing protective walls, engaging in cooperative economic development efforts, and investing in new technology and energy efficiency.

Iwate and Miyagi Prefectures completed their recovery plans by August and October 2011, respectively, and both set a ten-year timeframe for rebuilding with the caveat that a significant commitment of national funds would be needed to fulfil these visions.

Fukushima Prefecture

The Prefecture did not complete its draft plan until the end of December 2011 because of complications resulting from the nuclear disaster at the Fukushima Daiichi Nuclear Power Plant.

Replacing staff

Before local governments could plan, they needed to replace staff and officials who perished in the disaster. Prefectures dispatched staff to affected cities; national ministries sent help to both the prefectures and cities. For the first time, Japan's Ministry of Land, Industry, Transport and Tourism provided funds for cities and prefectures to hire consultants to assist with recovery planning.[8]

Local planning processes

Most local governments established local advisory committees, integrated national and prefectural reconstruction concepts into local plans and involved citizens in the planning process. However, the pace of planning varied considerably. Some cities initiated efforts soon after the March 2011 disaster and announced plans within the first two months. By the first anniversary, 59 local governments had prepared reconstruction plans that outlined basic principles and strategies for rebuilding. The number continued to rise to a total of 81 by the third anniversary. Most local governments set seven- to ten-year targets for rebuilding.

The level and method of citizen involvement in planning varied by locality. Some localities shared information and collected citizen input through surveys, workshops, and newly created machi dzukuri or town planning committees. Other cities, particularly larger ones, had more limited outreach, mostly via early-

[8] *Johnson, Laurie and Olshansky, Robert (2017). After Great Disasters: How Six Countries Managed Community Recovery. Policy Focus Report. Cambridge: Lincoln Institute of Land Policy. https://www.lincolninst.edu/sites/default/files/pubfiles/after-great-disasters-full_0.pdf*

stage questionnaires and public hearings conducted midway through preparing the draft plan. As the draft neared completion, public presentations focused on sharing information rather than soliciting feedback. While the plans varied in their specificity, almost all featured policies for land-use planning, promoting industrial and economic revitalisation, managing and reducing disaster risk, and protecting lives and the environment.[9]

To provide more local oversight and to help accelerate decontamination and recovery efforts, the reconstruction agency established a second headquarters in Fukushima Prefecture to work with a new Tokyo headquarters for Fukushima reconstruction and revitalisation.

Ongoing Challenges

Criticism over the slow pace of recovery was mounting, particularly in areas that were being reconstructed. In February 2013, weeks before the second anniversary of the disaster, Prime Minister Abe announced significant reforms to both the NRA and the recovery programmes, with the goal of accelerating disaster reconstruction.

The Reconstruction Agency has worked to increase the flexibility of national recovery programmes by relaxing the criteria for prefectural and local recovery projects. As of August 2013, ¥581 billion (USD 5.81 billion) in national funding was allocated to 92 local governments in 11 prefectures. However, even with the reforms and broader programme definitions, it continues to be difficult to transfer funds to local governments for implementation.

Obstacles include the lack of local governmental capacity, shortages in labour, scarcity and surging prices of materials, difficulties in securing storage sites for contaminated soil materials, and trouble coordinating the reconstruction plans with residents. Decisions about where and how to rebuild have been sources of continuing debate between local governments and residents. While some localities want higher levels to increase safety, others want lower heights, reflecting community concerns for aesthetics and future coastal access.

By the fifth anniversary of the disaster, most debris had been cleared in Miyagi and Iwate prefectures. Work is underway to elevate land, relocate communities to higher ground, and construct public housing. By March 2015, the national recovery budget of ¥ 25.5 trillion (USD 255 billion) for the first five years had been spent. The reconstruction agency estimates that an additional ¥ 6.5 trillion (USD 65 billion) will be needed to complete the work planned for the next five years of recovery. The NRAs priorities are to complete housing reconstruction, ensure business recovery so that people do not move elsewhere in search of employment, and provide for the physical and mental health of disaster victims, especially the elderly.

The recovery in Fukushima Prefecture will take much longer. Some people may not be able to return to their land and homes for10 years, and it may take 30 years to entirely dismantle the nuclear power plant. The Act authorising the Reconstruction Agency set a sunset date of October 2020, so the long-term commitment to revitalising Fukushima Prefecture remains unclear.

Challenges and Lessons

The primary approach of the government after earthquakes is focused on land readjustment, redevelopment and collective relocation with an emphasis on new reconstruction of safer houses and infrastructure. These programmes are challenging because it requires consensus from all property right holders and therefore implementation takes a long time.

[9] *ibid*

The NRA is perceived to be very successful in cutting across traditionally rigid and separate agency structures and programs and providing more integrated programmes and services to disaster affected communities. Despite the delays in setting up this new institution which invited considerable criticism, the . governance arrangements through NRA for post disaster recovery was seen to be successful in Japan. There were some tensions between the national government and local governments because unlike in other disasters, local governments in the Tohoku region did not have the share the recovery program costs for land readjustment, collective relocation and other programmes administered by NRA. This is a departure from earlier disasters and government policy where local governments are primarily responsible for post disaster response and recovery. However, It is also noted that the governance capacity in Tohoku was limited due to the significant loss in local leaders and staff in the disaster.

After the 2011 disaster, the central government was more generous with funding than it was in 1995. It no longer requires local governments to share in the cost of land readjustment and other recovery programmes. Victims are compensated for the losses of rebuilding, displacement, and unemployment. Some worry, however, that a costly precedent has now been set without full consideration of the tremendous financial burden this places on the central government and citizens when the next huge disaster inevitably occurs.

Indonesia: 2010 Merapi Volcano Eruption: Monitoring and Evaluation Mechanisms for Recovery[10]

Government Response

Following the eruption of Merapi volcano in November and December 2010, the Government of Indonesia conducted post-disaster needs assessment (PDNA) and developed a recovery and rehabilitation action plan. Resources were made available to restore livelihoods and reconstruct all damaged infrastructure in the villages affected by the eruption.

The Government of Indonesia wanted to track the progress of recovery. United Nations Development Programme (UNDP) supported the National Agency for Disaster Management (BNPB), the Disaster Risk Reduction Forum of Yogyakarta and Central Java, and an organisation called Survey METER to conduct periodic surveys covering 1,290 households in four districts to measure the progress of recovery in the affected communities. Indicators on income, expenditure, asset ownership, access to essential services, nutrition, health, education and disaster preparedness were used to track the progress of recovery. The annual household survey uses long-term data to compare the pre- and post-disaster situation in a community and then tracks the implementation of rehabilitation and reconstruction programmes.

By gathering data over a period, the survey measures the extent to which affected community members have recovered. The government used the survey results to revise and adjust the recovery programmes so that the benefits were distributed evenly. Based on this experience, the Government of Indonesia has developed an official Disaster Recovery Index. The index uses 22 variables to measure progress in critical sectors of recovery, going beyond the reconstruction to focus on resilience of households and communities. The Disaster Recovery Index is the first known systematic index for measuring disaster recovery and reconstruction programmes.

[10] *UNDP 2016: A Guidance note : National Post Disaster Recovery Planning and Coordination*

The Philippines: Comprehensive Disaster Risk Reduction and Management In Basic Education Framework

The Department of Education (DepEd), Philippines designed the comprehensive Disaster Risk Reduction and Management (DRRM) in Basic Education Framework, in August 2015.

The main aims of the DRRM in Basic Education Framework are: (i) ensuring safety and resilience-building in offices and schools; (ii) ensuring that quality education is continuously provided and prioritised, even during disasters and emergencies; (iii) protecting learners and education workers from death, injury, and harm in schools; (iv) planning for educational continuity in the face of expected hazards and threats; (v) safeguarding education sector investments; and, (vi) strengthening risk reduction and resilience through education.

The framework institutionalises DRRM structures, systems, protocols and practices in offices and schools, and provides a common understanding to implement DRRM in primary education. The framework sets the direction and priority areas for DRRM in DepEd while maintaining the prerogative of field offices to decide on specific activities to undertake depending on their exposure to hazards, available resources and existing partnerships and linkages.

The DRRM also provides guidance on:

- the inclusion of DRRM in the school, division and regional and central education development plans;
- The implementation of DRRM for education practitioners' and partners' planning and programming at all levels;
- defining the agency's preparedness, response, recovery and rehabilitation initiatives concerning hazards affecting school operations; and

Table 1
Summary Of Policies, Programmes and Activities on School Safety Implementation

Safe Learning Facilities	School Disaster Management	DRR in Education
Adopted disaster resilient designs for classroom construction • Designed temporary learning spaces as an alternative to tents • Strengthened construction monitoring process by engaging school heads • Access-friendly schools for children with disabilities • Assessment of school buildings' structural integrity and stability (ASSIST) • DRRM section in the EBEIS questionnaire	Established DRRMO with DRRM coordinators in 17 regions and 221 division offices • Established coordination with education partners and other government agencies • Developed the School DRRM Manual • Annual school risk assessment • DRRM integration in SIP • Quarterly earthquake and fire drills and road safety education for children	• Mainstreaming concepts in the elementary and secondary school curricula and extra-curricular activities • Integration of DRRM/climate change adaptation (CCA) in the new K to 12 curriculum • Uploading of DRRM reference materials in the learning portal beginning 2015

Safe Learning Facilities	School Disaster Management	DRR in Education
• 88% of schools were already mapped for geospatial analysis • Establishment of the policy on camp management • Establishment of the quick response fund that can be used by disaster-affected schools	• Continued implementation of 3-pronged school-based National Greening Programme: tree planting/ reforestation; vegetable garden in schools; solid waste management • Policy on student-led school watching and hazard mapping • Policy on family during an Earthquake • Preparedness homework	• Training for teaching and nonteaching staff for DRR and CCA in K-12 Curriculum • Strengthening support for psychosocial interventions

- *Source: Comprehensive school safety practices in Asia (year NA); Editors: Ronilda Co, Cedric Hoebreck, Christine Apikul. World Vision*
- *DO 37, S. 2015 – THE COMPREHENSIVE DISASTER RISK REDUCTION AND MANAGEMENT (DRRM) IN BASIC EDUCATION FRAMEWORK: Department of Education, Republic of Philippines*
- *School Disaster Risk Reduction and Management Manual: - Booklet 1; Department of Education, Republic of Philippines*

- collaboration with private schools.
- A lot has been achieved regarding policies, programmes and activities since the development of the framework which is given below.

Learning from Best Practices in Kerala, India

Restoration of Irrigation-cum-Drainage System through Peoples' Participation: The Meenachil–Meenantnara–Kodur River Rejoining Project in Kottayam[11]

The Meenachil River system originates in the Western Ghats in the eastern part of Kottayam district. It flows about 78 km to the west to reach the Vembanad Backwaters. Mennanthara River is a small tributary of the Meenachil River originating as a small stream near Aarumanur, flowing through Ayarkunnam, Manarcadu, and Vijayapuram panchayats and joining the main river near Kottayam town and Kodur River. Another tributary of Meenachil River on the southern side of Kottayam town, which re-joins the main river just before reaching the Vembanad backwaters, aided in irrigation-cum-drainage systems and was part of water transport system extending from Kollam to Cochin from pre-British period.

A lot of small rivulets, streams and small man-made canals estimated to be more than 3000 km in length had interconnected these rivers providing very good drainage and water availability to the region. With the emergence of surface transport the importance of these water bodies dwindled, several of which got filled up, and became locations of waste deposit and pollution. As a result, paddy cultivation reduced, conversion of wet lands decreased, wells and ponds got polluted and dried up, ecology was damaged, contagious diseases became prevalent due to poor water quality and life situation worsened.

[11] *PDNA team, Environment Sector*

Inception

In July 2017 a few youngsters organised by 'Green Fraternity' (an organisation for social and environmental causes) undertook to voluntarily clean 'Nattassery thodu' (canal) with on objective to re-join the river system and increase water flow. Their success in cleaning 3 km of canals triggered widespread appreciation. The Peoples' Committee for the River Rejoining Project was formed on 28 August 2017.

At a function inaugurated by Dr T.M. Thomas Issac, Hon. Finance Minister of Kerala. Adv. K. Anil Kumar was 'selected' as the co-ordinator of the committee. About 15 organisations are involved in ecological, social, environmental and historically relevant activities and individuals from several sectors, irrespective of social, cultural, political, occupational, financial disparities cooperate with the activities.

Methodology

The activities pertaining to each stream or locality are undertaken by a small action committee within the area, under the leadership of a convener. The activities such as restoration of a water body, cultivation of fallow land, prevention of waste disposal, village tourism activities etc. will be undertaken based on a time-bound action plan involving local bodies and government departments/agencies. Contributions, if needed, are collected from people in locations where activities are taken up and each contributor is informed about the details of utilisation of money. Thirty such committees are functioning at present.

Currently 'Harithakeralam Mission' has formed a committee of officials under the Chairmanship of the District Collector to facilitate the activities and link the services to complement the activities initiated by the people. Departments such as Agriculture, Irrigation, Rural Development, Revenue, Soil Survey & Soil Conservation, LSGD, Education, Kerala Agricultural University, Krishi Vigyan Kendra, Animal Husbandry, Tourism, Kudumbashree, Suchitwa Mission, Public Health, Planning, Co-Operation, Police, etc., have collaborated in this effort so far. The local bodies involved are Ayarkunnam, Manarkad, Vijayapuram, Puthupally, Vakathanam, Panachikadu, Thiruvarppu, Aymanam, Kumarakom gram panchayats and Kottayam Municipality.

Achievements

1. Cultivation of fallow land in 540 acres in Menanthara Riverbank area, and 210 acres in Kodur river bank area.

2. Restoration of about 700 km of streams (desiltation, widening and protection of riverbanks).

3. About 22 acres recovered from encroachment on the banks of the river and stream.

4. The utilisation of 4,24,290 man days under MGNREGA, for riverbank protection, laying coir geotextiles, land preparation for cultivation in fallow lands.

5. Four village tourism programmes (Malarikkal Fest, Padiyarakkadavu Water Tourism, Vakathanam Heritage Fest, Kavanatinkara 'Vacation Harvest') organised aimed at integrating people for social causes.

6. Organised a peoples' campaign' Everybody to water body', in entire Meenachil River Basin (31 gram panchayats and 4 municipalities, involved in a massive campaign to find out drainage and sewage outlets contaminating the water body and report for action).

The project aims to work on removal of silt in the estuary of the rivers to prevent the impact of floods, strengthen outer bunds of paddy, facilitate water transport and paddy cultivation, restoration of about 2000 km streams, cultivation of paddy in 2100 acres, and extend the activities to the entire Meenachil River Basin area and to entire Kottayam District.

Ramps and Multi-storeyed Barns for Animals[12]

Mr Alexander a farmer from Pandanad Panchayat of Alappuzha has adopted mixer livestock farming by rearing cattle, buffaloes, and goats. Prior to the floods he had 200 goats, 30 buffaloes, and 7 cows. He reared cattle and buffaloes on the ground floor and goats on the first floor. He had put a ramp made of bamboos/wood for the movement of the goats. During the floods, he shifted the buffaloes and cows in milk to the first floor with goats. As there was not enough space, therefore other animals could not be relocated resulting in the death of all the remaining animals.

This turned out to be best practice for rearing animals. It is strongly recommended that in the Build Back Better process, such structures are made in future. This could be on the Pucca cement/concrete pillars and ramp. All the cattle sheds to be built should be of this type. The cattle and buffaloes could be reared on ground floor, but in the event of such calamity it will turn out a boon to the farmers.

'One Paddy One Fish'[13]

The Kole wetlands are low-lying tracts located 0.5 to 1 m below mean sea level (MSL) and remain submerged for about six months in a year covering an area of about 13,632 hectares spread over Thrissur and Malapuram districts. The area extends from Chalakudy River in the south to Bharatapuzha River in the north, and to Ponnani Taluk. The Kole Wetlands act as natural drainage system for both Thrissur City and District through a network of canals and ponds which connect different parts of Kole wetlands to the river and then to the Arabian sea. It supports a unique system of rice cultivation from December to May and is submerged from June to November due to the monsoon.

Recently the Kerala Department of fisheries has begun promoting the 'one paddy one fish' culture, where carp fish are stocked for the months when the fields are submerged. This gives the farmers additional income and boosts fish production from available water sources.

Jayanti Kole Padam in Chazhur village is a 102 ha field shared by 293 farmers. The secretary of the Kole Pada Sangham, Mr Bhuvandas, explained that they had stocked around 8.25 lakh carp seeds in April 2018, of which 3.12 lakh seeds were provided by the government. They had also been doing some supplementary feeding apart from the natural feed. They had already provided feed worth INR 4.8 lakh. The flood has not only washed away the stock of fish but also damaged nine pumps and many parts of the bund.

Waste as an Economic Resource

Chile: Self-Supply of Renewable Energy (SSRE) NAMA[14]

Chile is continuously expanding its use of renewables in electricity production. The Self-Supply Renewable Energy (SSRE), NAMA Support Project, consults small and medium-sized businesses on investing in renewables for self-supply—from photovoltaic systems to biogas.

When Fabiola Osega talks about the biogas system she introduced at her workplace, it is clear that the technology has won her over. 'It is a beautiful system, incredibly

[12] *PDNA team, Agriculture, Fisheries and Livestock sector*

[13] *PDNA team, Agriculture, Fisheries and Livestock sector*

[14] *http://stories.nama-facility.org/chile-renewable-power/2/*

compact and very effective,' she says. The chemical engineer works as an environmental officer for the waste management company Stericycle in Valparaíso, a port city about 100 km north-west of the Chilean capital of Santiago. 'We process about 40,000 tonnes of household waste each month. Organic waste naturally emits biogas when it decomposes. It is only logical that we put that energy to use and also prevent the emission of harmful gases into our atmosphere.'

In operation now for nearly two years, the plant's three motors each produce 1.5 megawatt of electricity from the waste deposited at two of Stericycle's disposal sites. 'I like to call them my giant bioreactors,' says Osega. Stericycle uses a small portion of the energy captured from organic waste for self-supply needs such as illumination and machine drives; the remaining 97 per cent are sent to the public grid.

In the first year of operation, CO2 emissions at the site were reduced by about 95,755 tonnes. 'We underwent a very rapid transformation from a simple landfill site to a sustainable electricity producer,' Osega points out. For workers at the company, the shift was advantageous: suddenly, their work was about more than just useless waste. 'The daughter of one of our garbage collectors proudly explained that her father now collects trash that is turned into electricity.'

Chile has been making great strides in expanding its electricity production through the use of renewable technologies. Its share of the installed generation capacity already exceeds 40%, mainly thanks to large hydropower, wind and solar plants. By 2035, the country wants to increase the share of the electricity generation to 60%. 'In addition to the large plants, an essential component in achieving this target will be smaller self-supply systems,' explains Marcel Silva, a renewable energy specialist for the Chilean Ministry of Energy. 'We want to create incentives for companies in various industrial sectors to generate their electricity from renewables.'

Unlike Stericycle in Valparaíso, many Chilean companies are sceptical when it comes to investments in renewable energy. They do not see energy production as part of their job and are seldom able to assess the advantages, yield or reliability of the different technologies. A survey conducted by the Ministry of Energy at the end of 2015 revealed that 63% of decision makers in the industrial sector were unaware of how renewable energy projects could be implemented and 17% knew very little. 'Many people are still in the dark about this topic, so we want to spread the word as much as possible,' says Marcel Silva. 'We have seen a growing interest on the part of companies since consumer demand for sustainable products and services is also on the rise.'

This transformation to renewables will happen in part thanks to the Self-Supply Renewable Energy (SSRE) NAMA Support Project implemented by the Chilean Ministry of Energy and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). Technical experts of the NAMA Support Project have looked at individual sectors such as the fruit processing industry to determine which renewable technologies and which scale make the most sense, also regarding economics. Companies can request their analyses and best-practice examples at no charge. 'We answer questions, organise workshops and offer initial assessments for renewable energy investments,' says Stephan Remler, the GIZ project lead for the SSRE NAMA. 'We provide project development support on request as well.'

The warehousing company Bodegas de San Francisco is one of the businesses that received support from NAMA specialists. Now, management wants to install the first solar panels on the flat roof of its new storage facility in Santiago. The expected output is 25 kilowatts, which will illuminate the warehouse and charge the batteries of electrically operated transport machinery.

'This is an investment in sustainability and a pilot project to test the profitability of photovoltaic systems and give us the skills and expertise we need for further projects in the future. Chile has enormous potential in the area of solar energy,' says project manager Cristóbal Salvatierra, who attended one of the SSRE NAMA workshops. 'Before the workshop, we knew very little about the technology, legal situation or costs. However, afterwards, we were extremely well prepared for the tendering procedure.' Seven photovoltaic providers submitted their bids; six weeks later the ink was drying on the contracts.

There are numerous providers in Chile that plan, construct, operate and service solar equipment. However, when it comes to micro-hydro and biogas plants, providers are still few and far between. Right now, there are only three companies that specialise in biogas technology. 'To stimulate the supply-side market as well, we are currently partnering with the Ministry of Energy and the Super intendency of Electricity and Fuels (SEC) to train specialists such as biogas technicians,' explains Stephan Remler. Training materials are provided free of charge as part of the SSRE NAMA to enable and facilitate the dissemination of these topics.

In 2018, the financial component of the SSRE NAMA was launched and implemented by the KfW Development Bank. The KfW will collaborate with Chilean banks to create attractive loans that companies can use to finance renewable energy projects for their own energy needs. The financial component will also include a guarantee fund as well as subsidies for feasibility studies and for concrete investments in renewables.

Like Cristóbal Salvatierra, the chemical engineer, Fabiola Osega recently attended an SSRE NAMA workshop on the topic of biogas. 'I wanted to know which other industries are using biogas; it was precious to hear about the experiences of others and share my own,' she says. During the workshop, she learned that other companies use the waste heat from their biogas production to boost plant efficiency. 'We have not yet exploited that possibility, and now we want to assess to see if it would make sense in our case.'

Fabiola Osega is confident that the scepticism of many Chilean companies will vanish once people start to see some positive examples. 'At Stericycle, we have an open-door policy. Everyone is welcome to come and visit our biogas plant. We see ourselves as allies on the road to sustainability, not as competitors,' she says. 'It certainly requires a great deal of effort and investments, but the new mindset is worth it in the end.'

Green Infrastructure and Post-Disaster Recovery Scenarios[15]

At the regional scale, green infrastructure is a network of natural areas and open spaces that provide multiple benefits for people and wildlife, such as regional parks and nature preserves, river corridors and greenways, and wetlands (Benedict and McMahon 2006)[16] At the neighbourhood and site scales, the U.S. Environmental Protection Agency (EPA) refers to green infrastructure as storm water management practices that mimic natural processes by absorbing water, such as green streets, green roofs, rain gardens, and pervious pavement. Trees are a type of green infrastructure that spans these scales, from regional woodlands to the urban forest to street and other tree plantings.

Green infrastructure plays a vital role in preparation for and recovery from natural disasters. Climate change scenarios project that precipitation and temperature extremes, storm frequency and intensity, and sea-level rise will accelerate in the coming century. By incorporating green infrastructure into post-disaster recovery, communities can become more resilient to future disasters.

[15] The Planning for Post-Disaster Recovery: Next Generation Briefing Papers; published by the American Planning Association in collaboration with the Federal Emergency Management Association. (https://planning-org-uploaded-media.s3.amazonaws.com/legacy_resources/research/postdisaster/briefingpapers/pdf/greeninfrastructure.pdf)

[16] The Planning for Post-Disaster Recovery: Next Generation Briefing Papers; published by the American Planning Association in collaboration with the Federal Emergency Management Association. (https://planning-org-uploaded-media.s3.amazonaws.com/legacy_resources/research/postdisaster/briefingpapers/pdf/greeninfrastructure.pdf)

KEYPOINT #1: Green infrastructure reduces damage from storm surge and flooding and plays a role in other types of disasters

Damage from flooding in inland areas, and from storm surge and flooding in coastal environments, is significantly reduced when natural wetland, riparian, and floodplain areas and the ecosystem services they provide are protected. Buildings, roads, and other supporting infrastructure are particularly vulnerable to storm damage when constructed in these areas, and loss of natural functions such as flood storage capacity can increase damage to development on adjacent, less sensitive lands. Thus green infrastructure is particularly useful to reduce damage from natural disasters and conserve environmentally sensitive areas through strategies such as the acquisition of land or easements, natural resource protection ordinances, and other regulatory controls and incentives.

In many urban areas, natural resources such as streams, floodplains, and wetlands have been replaced by development and natural hydrological processes have been disrupted by fill and impervious surfaces. The conventional storm water management approach in such areas has been to collect the high volumes of runoff generated during storms and convey them via pipes to nearby waterways. This approach can exacerbate flooding from major storms and degrade water quality, for example from combined sewer overflow (CSO) in older cities with combined storm and sanitary sewer systems. Green infrastructure is an alternative approach that retains storm water near where it is generated through infiltration (rain gardens, storm water planters, pervious surfaces, etc.) and evapotranspiration from trees and other vegetation.

While green storm water infrastructure is most commonly used at the site scale to manage runoff from smaller storms, when deployed at a watershed scale, it can reduce flooding from more massive disasters such as the benchmark 100-year storm. The New York City Department of Parks & Recreation manages approximately 2,500 green streets, many of which performed well during Hurricane Sandy. Former Mayor Michael R. Bloomberg's post-Sandy plan to address future climate risk, A Stronger, More Resilient New York, , recommends expansion of the city's green streets programme as part of a strategy to mitigate the impacts of extreme weather events.[17]

Green infrastructure and how it is managed plays a role in other types of natural disasters. For example, intense urban heat waves such as those experienced by Chicago (approximately 700 fatalities in 1995) and Europe (more than 70,000 fatalities during the summer of 2003) will likely become more common in the future as a result of climate change and the global trend of increasing urbanisation. Green infrastructure such as trees, parks, and green roofs can ameliorate the so-called urban heat island effect. One study found that adding 10% green cover in high-density residential areas in Manchester (United Kingdom), will keep maximum surface temperatures at or below 1961–1990 baseline levels in the 2080s, contrasting with a projected 1.7o C to 3.7o C increase, due to climate change with no increase in greening.[18]

Drought is a type of natural disaster that can adversely impact green infrastructure by weakening natural ecosystems, making them more susceptible to invasive species, disease, and pests, and causing the loss of urban trees and other vegetation.[19] The Manchester study notes that the potential of green cover to moderate surface temperatures is adversely impacted by drought when grass dries out and loses its evaporative cooling function.[20] Mature trees retain this cooling function longer than grass, and the study recommends that adequate water be provided to vegetation during droughts (which may, however, conflict with the need to restrict water usage).

[17] New York, City of. 2013. A Stronger, More Resilient New York. New York City Economic Development Corporation. https://www.nycedc.com/resource/stronger-more-resilient-new-york

[18] Gill, S.E., J.F. Handley, A.R. Ennos, and S. Pauleit. 2007. 'Adapting Cities for Climate Change: The Role of the Green Infrastructure'. Built Environment. Vol. 33 No. 1. pp.115–133.

[19] Schwab, James, aicp, ed. 2013. Planning and Drought. PAS Report no. 574. Chicago: American Planning Association.

[20] Gill, S.E., J.F. Handley, A.R. Ennos, and S. Pauleit. 2007. 'Adapting Cities for Climate Change: The Role of the Green Infrastructure'. Built Environment. Vol. 33 No. 1. pp.115–133.

Such issues are particularly important in arid regions such as the southwestern United States, highlighting the need to conserve native ecosystems that are adapted to the climate and to specify low-maintenance, drought-resistant plant species.

Wildfires are another type of disaster with implications for green infrastructure in drier climates. For example, low-intensity wildfire is a natural occurrence that maintains the health of southwestern Ponderosa Pine forests, but fire suppression has resulted in dense, overcrowded tree stands that threaten development with destructive and costly wildfires. To combat this risk, Flagstaff (ranked as Arizona's most at-risk wildfire community) developed a comprehensive fire management programme with five core areas: public preparedness, strategic development, response, land-use management, and hazard mitigation[21] Land-use planning focuses on creating and maintaining fire-adapted neighbourhoods (www.fireadapted.org), while hazard mitigation involves managing forest conditions and fuel regimes to reduce the likelihood of destructive wildfires.

KEY POINT #2: Resilience to natural disasters is one of a broad array of benefits provided by green infrastructure.

Green infrastructure can mitigate the direct effects of natural disasters through services such as reducing storm water runoff, buffering against storm surge in coastal environments, and reducing surface temperatures during heat waves, while also providing a broad array of other community benefits. Serving to maintain the triple bottom line of environmental, economic, and social return on investment, these additional benefits include:[22]

Environmental

- Improved air and water quality
- Natural habitat preservation
- Climate change mitigation (from reduced fossil fuel emissions, reduced energy consumption, and carbon sequestration)

Economic

- Creation of job and business opportunities
- Increased tourism, retail sales, and other economic activity
- Increased property values
- Reduced energy, health care, and gray infrastructure costs
- Provision of locally produced resources (food, fibre, and water)

Social

- Promotion of healthy lifestyles through walking, biking, and outdoor recreation
- Improved public health outcomes (e.g., by connecting people to nature)
- Increased environmental justice, equity, and access for underserved populations
- Enhanced community identity through public art, culture, and places for people to gather

While many of the above benefits do not directly relate to post-disaster recovery, they can contribute to increased community resilience and, in doing so, reduce

[21] Schwab, James, aicp, ed. 2009. Planning the Urban Forest: Ecology, Economy, and Community Development. PAS Report no. 555. Chicago: American Planning Association.

[22] Rouse, David C., aicp, and Ignacio F. Bunster-Ossa. 2013. 'Green Infrastructure: A Landscape Approach'. PAS Report no. 571. Chicago: American Planning Association.

vulnerability to natural disasters. A park designed to accommodate flooding during storms while providing benefits such as recreation, social interaction, and increased commerce is an example of using green infrastructure to leverage multiple benefits beyond mitigating the direct impacts of a disaster. The triple-bottom-line analysis conducted for Green City, Clean Waters, the EPA-approved plan prepared by the Philadelphia Water Department to address the CSO problem, found that USD 1 million in green infrastructure investments would yield a USD 2.2 million return on investment over a 40-year period. The monetary return was calculated for eight different factors, such as green jobs generated, additional recreational user-days, reduced energy consumption, and fewer heat-related deaths.

Green infrastructure can be of particular value for poor and disadvantaged neighbourhoods that too often suffer a disproportionate share of the impacts of a natural disaster. Incorporating green infrastructure into planning for post-disaster recovery can provide multiple environmental, economic, and social benefits for these neighbourhoods, which frequently have fewer trees and green spaces than more advantaged communities.

KEY POINT #3: Particularly in urban contexts, green infrastructure must be combined with the gray infrastructure to reduce damage from natural disasters effectively.

According to a recent study by the Natural Capital Project and the Nature Conservancy, 16% of the U.S. coastline, inhabited by 1.3 million people and representing USD 300 billion in residential property value, is located in high-hazard areas.[23] In all 67% of these areas are protected by natural green infrastructure (intact reefs, dunes, marshes, and other coastal vegetation), and the number of people and total property value exposed to hazards would double if this habitat were lost.

These findings underscore the effectiveness of preserving and restoring natural habitat areas, as well as mimicking the services provided by such areas through 'nature-based' approaches (e.g., artificial oyster reefs and living shorelines), to increase resilience to natural disasters. However, in many populated areas at risk from flooding, natural ecosystems have been extensively altered or replaced by development. Moreover, barrier beaches, dunes, riverine floodplains and the like are dynamic systems that move in response to natural processes such as erosion and sea-level rise, with implications for adjacent developed properties. Green infrastructure can reduce damage but may be insufficient to protect against catastrophic events such as the storm surge experienced by New York during Hurricane Sandy.

Traditional structural protection measures (often referred to as gray infrastructure) include, among others, seawalls, bulkheads, breakwaters, and jetties to protect against erosion and storm surge in coastal areas and levees, dams, embankment walls, and channelisation to protect against flooding and erosion in inland areas. Such measures can be effectively deployed to protect urban and other areas with extensive investment in buildings and infrastructure.

Considerations regarding the use of gray infrastructure include cost relative to benefits provided (it is typically more expensive than green infrastructure), unintended consequences caused by interruption to natural processes, and the possibility of inadequate protection or even failure during catastrophic events (e.g., levee failure in New Orleans during Hurricane Katrina). Examples of unintended consequences include barriers that displace flooding from one area to another or groynes (coastal erosion structures typically constructed perpendicular to the shoreline to trap sand) that cause beach erosion along the 'downdrift' shoreline.

[23] *Arkema, Katie K., Greg Guannel, Gregory Vertutes, Spencer A. Wood, Anne Guerry, Mary Ruckelshaus,Peter Kareiva, Martin Lacayo, and Jessica M. Silver. 14 July 2013. Coastal Habitats Shield People and Property from Sea-Level Rise and Storms. NATURECLIMATECHANGE DOI:10.1038/NCLIMATE1944*

Integrated approaches to planning for future disasters combine green and grey infrastructure strategies. For example, a study of Howard Beach, a neighbourhood in Queens that was flooded by Hurricane Sandy, concluded that a combination of natural and structural defences would provide the most cost-effective protection against future storms[24] These 'hybrid' strategies include restored marsh, mussel beds, rock groynes, removable flood walls, and floodgates.

On a larger scale, A Stronger, More Resilient New York combines nature-based (e.g., beach, dune, and marsh restoration) and structural (e.g., floodwalls and storm-surge barriers) measures to protect against the effects of climate change.[25]

Louisiana's Coastal Protection Master Plan proposes a combination of restoration, nonstructural, and targeted structural measures to provide increased flood protection for all communities[26]. If current trends continue, Louisiana's coastline is projected to lose 1,750 square miles over 50 years from multiple causes, including alteration of natural ecosystems, land subsidence, storms, and sea-level rise.

Annual damages from coastal flooding are projected to increase almost tenfold (from USD 2.4 billion to USD 23.4 billion in 2061). The plan proposes nine project types, ranging from marsh creation, barrier island restoration, and oyster barrier reefs to bank stabilisation and structural protection (levees, flood walls, and pumps). The most significant proportion of the proposed USD 50 billion investment is allocated for marsh creation (USD 20 billion).

While the above discussion addresses protection against flooding and storm surge, similar concepts can be applied to other types of natural disasters. One example is to combine green infrastructure (trees, green roofs, etc.) with building technology (e.g., active and passive cooling systems) to reduce the heat island effect that exacerbates urban heat waves. Another is to preserve active fault systems, unstable soils (prone to earth-shaking, liquefaction, or mudslides), and low-lying coastal areas (subject to tsunamis) as green space while implementing state-of-the-art building codes to reduce the risk of damage from earthquakes.

KEY POINT #4: Green infrastructure resources can suffer severe damage from disasters, which in the absence of preplanning can be exacerbated in short-term recovery response.

The most significant structural component of green infrastructure in urban areas, the urban forest takes years to grow and cultivate but can be devastated in a single disaster. The Federal Emergency Management Agency's Public Assistance guidance, National Response Framework, and National Recovery Framework primarily address trees as debris (standing or on the ground), and during the immediate recovery phase, they are too often viewed as a problem that slows response efforts. If handled poorly, the community can be faced with years of expensive restoration to bring back a mature urban forest and the multiple benefits it provides.

Post-storm surveys have shown that most trees and branches that fail during storm events have pre-existing structural defects that could have been prevented through proper planting and pruning practices. Furthermore, these defects could have been detected and corrected if the trees had been inspected before the storm. Thus the most effective way for a community to improve preparedness and reduce damage to its urban forest from a major storm is to develop a tree risk management programme that includes periodic inspections and corrective actions.[27] To facilitate recovery, response plans should be developed during preplanning to specify contractual arrangements, the involvement of licensed and qualified arborists, damage assessment protocols, staging areas, opportunities for the use of woody debris, etc.

[24] https://www.nature.org/content/dam/tnc/nature/en/documents/urban-coastal-resilience.pdf, 2013

[25] New York, City of. 2013. A Stronger, More Resilient New York. New York City Economic Development Corporation. https://www.nycedc.com/resource/stronger-more-resilient-new-york

[26] Louisiana Comprehensive Master Plan for a Sustainable Coast 2012 http://coastal.la.gov/2012-coastal-master-plan/

[27] Pokorny, Jill; O"Brien, Joseph; Hauer, Richard; Johnson, Gary; Albers, Jana; Bedker, Peter; Mielke, Manfred. 2003. Urban Tree Risk Management:A Community Guide to Program Design and Implementation. USDA Forest Service Northeastern Area State and Private Forestry 1992 Folwell Ave. St. Paul, MN 55108

Dunes, marshes, and wetlands are adapted to withstand storm damage if natural processes such as overwash (the landward transport of beach sediments across a dune system) are retained. Other types of coastal vegetation can sustain significant damage from saltwater flooding, storm surge, and high winds; in 1989, approximately 4.45 million acres of forest were damaged by wind and water when Hurricane Hugo struck South Carolina.[28] Inland flooding can cause significant damage to riparian forests, particularly if trees and shrubs are inundated for weeks during the growing season. Foresters estimate that 36,546 acres of riparian and community forests were impacted by flooding along the Missouri and Mouse Rivers in June 2011, and thousands of dead and toppled trees were inventoried on public lands.[29]

While the effects of a severe storm can be devastating, the long-term recovery phase provides the opportunity to 'regrow' healthy forests—and other forms of green infrastructure—that provide enhanced community benefits while being more resilient to future disasters. Recommended strategies include replanting with low-maintenance, low-risk, and long-lived species; maximising below- and above-ground growing space and minimising infrastructure conflicts; preparing and maintaining baseline tree inventories; and implementing regular structural pruning, inspection, and maintenance programmes.

Conclusion

The potential of green infrastructure to reduce damage from natural disasters has risen to the forefront in recent years in the aftermath of catastrophic events such as Hurricanes Katrina and Sandy. Preservation and restoration of marsh, dune, floodplains, and other natural systems; creation of living shorelines, oyster reefs, and other nature-based solutions; and integration of green resources (trees, green streets, green roofs, etc.) into the urban environment can increase community resilience while providing multiple environmental, economic, and social benefits. Planning for post-disaster recovery should use green infrastructure in combination with appropriate structural protection measures to reduce potential risks; specify how short-term recovery will address trees and other green resources; and set the framework for incorporating green infrastructure into long-term recovery. The result will be healthier communities that are more resilient to future disasters.

[28] *www.seesouthernforests.org/case-studies/climate*

[29] *Kangas, Michael. 2013. Flood Recovery Guide for Green Infrastructure in Communities. North Dakota Forest Service*

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Annexe 2: Abbreviations and Acronyms

ADB	Asian Development Bank
ADHS-M	Additional Directorate of Health Services-Medical
ANR	Agriculture and Natural Resources
ARDs	Authorised Retail Dealers
ASCI	Administrative Staff College of India
ASHA	Accredited Social Health Activists
AWC	Anganwadi Centre
AWW	Anganwadi Worker
BBB	Build Back Better
BIS	Bureau of Indian Standards
BOSs	Business Opportunity Seminars
BPL	Below Poverty Line
BRC	Block Resource Centre
BRR	Badan Rehabilitasi Dan Rekonstruksi
CBDRM	Community-Based Disaster Risk Management
CC	Cement Concrete
CCA	Climate Change Adaptation
CDRC	Capacity Development Resource Center
CEC	Continuing Education Centre
CEO	Chief Executive Officer
CERT	Community Emergency Response Team
CIAL	Cochin International Airport Limited
CMR	Custom Milled Rice
COSTFORD	Centre of Science and Technology for Rural Development
CSEB	Compressed Stabilised Earth Blocks
CSO	Civil Society Organisation
CWC	Central Water Commission
CWRDM	Centre for Water Resources Development and Management
DCPU	District Child Protection Unit
DDMA	District Disaster Management Authority
DEA	Department of Economic Affairs

DHFW	Department of Health and Family Welfare
DLU	District Level Unit
DMA	Directorate of Municipal Administration
DMF	Design and Monitoring Framework
DPI	Directorate of Public Instruction
DPO	District Project Office
DPR	Detailed Project Report
DRM	Disaster Risk Management
EE	Executive Engineer
EIA	Environmental Impact Assessment
EPWRF	Epw Research Foundation
ESIA	Environmental and Social Impact Assessments
EWS	Economically Weaker Sections
FAR	Floor Area Ratio
FHH	Female-Headed Household
FIDIC	International Federation of Consulting Engineers
FRBMA	Fiscal Responsibility and Budget Management Act, 2003
GAP	Gender Action Plan
GER	Gross Enrolment Ratio
GEWE	Gender Equality and Women's Empowerment
GI	Galvanised Iron
GIS	Geographic Information System
GOI	Government of India
GPDP	Gram Panchayat Development Plan
GRC	Gender Resource Centre
GSDP	Gross State Domestic Product
GST	Goods and Services Tax
GWP	Global Water Partnership
HFC	Housing Facilitation Centre
HPPCL	Himachal Pradesh Power Corporation Limited
HPPTCL	Himachal Pradesh Power Transmission Corporation Limited
IAHE	Indian Academy of Highway Engineers
ICB	International Competitive Bidding
ICDS	Integrated Child Development Services
ICMR	Indian Council of Medical Research
ICZM	Integrated Coastal Zone Management

IDRB	Irrigation Design Research Bureau
IDRN	India Disaster Resource Network
IDSP	Integrated Disease Surveillance Programme
IEC	Information, Education and Communication
IED	Independent Evaluation Department
IFA	Iron–Folic Acid
IHIP	Integrated Health Information Platform
IHME	Institute for Health Metrics and Evaluation
IHME	Institute for Health Metrics and Evaluation
IIT	Indian Institute of Technology
IMD	Indian Meteorological Department
IMR	Infant Mortality Rate
INCOIS	Indian National Centre for Ocean Information Services
IRDAI	Insurance Regulatory and Development Authority of India
ISM	Indian Systems of Medicine
IT	Information Technology
IWM	Integrated Watershed Management
IWRM	Integrated Water Resource Management
JHI	Junior Health Inspector
JICA	Japan International Cooperation Agency
JPHN	Junior Public Health Nurse
JRDNA	Join Rapid Disaster Needs Assessment
KILA	Kerala Institute of Local Administration
KMSCL	Kerala Medical Services Corporation Limited
KPCB	Kerala Pollution Control Board
KRWSSA	Kerala Rural Water Supply and Sanitation Agency
KSCSTE	Kerala State Council for Science, Technology and Environment
KSDMA	Kerala State Disaster Management Authority
KWA	Kerala Water Authority
LARR	Land Acquisition, Rehabilitation and Resettlement Act
LIFE	Livelihood Inclusion and Financial Empowerment
LIG	Low Income Group
LPG	Liquefied Petroleum Gas
LSGB	Local Self Government Body
LSGD	Local Self Government Department

MCRHRDI	Dr. Marri Channa Reddy Human Resources Development Institute
MCT	Micro Concrete Tiles
MDBs	Multilateral Development Banks
MGNREGS	Mahatma Gandhi National Rural Employment Guarantee Scheme
MMR	Maternal Mortality Rate
MR	Measles Rubella
MSL	Mean Sea Level
MSME	Micro, Small, and Medium Enterprises
MSW	Municipal Solid Waste
NBC	National Building Code of India, 2016
NCCR	National Centre for Coastal Research
NCD	Non-Communicable Disease
NDRF	National Disaster Response Force
NESRIP	North Eastern State Roads Investment Program
NFHS-4	National Family Health Survey, Round 4
NFSA	National Food Security Act
NGO	Non-Governmental Organisation
NHM	National Health Mission
NHP	National Hydrology Project
NICMAR	National Institute of Construction Management and Research
NIE	National Institute of Epidemiology
NIMHANS	National Institute of Mental Health and Neuro Sciences
NNM	National Nutrition Mission
NPSP	National Polio Surveillance Project
O&M	Operation and Maintenance
ODF	Open Defecation Free
OIIAWMIP	Orissa Integrated Irrigated Agriculture & Water Management Investment Project
ORC	Our Responsibility To Children
PAI	Public Affairs Index
PCDC	Project Capacity Development Cell
PCRs/TCRs	Project Completion Reports/Technical Assistance Completion Reports
PDNA	Post-Disaster Needs Assessment
PDS	Public Distribution System
PHFI	Public Health Foundation of India
PWD	Person With Disability

PMAY	Pradhan Mantri Awas Yojana
PMU	Project Management Unit
PSM	Public Sector Management
PTA	Parent–Teacher Association
RCC	Reinforced Cement Concrete
RR	Random Rubble
RRT	Rapid Response Team
RUIDP	Rajasthan Urban Infrastructure Development Project
S & R	Search and Rescue
SAF	Society for Assistance To Fisherwomen
SASEC	South Asia Subregional Economic Cooperation
SC	Scheduled Caste
SCP	Special Component Plan
SDGs	Sustainable Development Goals
SDMA	State Disaster Management Authority
SDRF	State Disaster Response Force
SEOC	State Emergency Operation Centre
SESIA	State Environmental and Social Impact Assessment
SFDRR	State Level Multi-Stakeholder Forum for DRR
SIDBI	Small Industries Development Bank of India
SIPMIU	State Investment Program Management and Implementation Unit
SIUD	State Institute of Urban Development
SLR	Sea Level Rise
SMC	School Management Committee
SOPs	Standard Operating Procedures
SPV	Special Purpose Vehicle
SSI	Small-Scale Industry
ST	Scheduled Tribe
STAGI	State Technical Advisory Group On Immunisation
SupplyCo	Kerala State Civil Supplies Corporation
SWM	Solid Waste Management
TDR	Transfer of Development Rights
TG	Transgender
THR	Take-Home Ration
TNA	Training Needs Assessment

ToR	Terms of Reference
TSP	Tribal Sub Plan
TT	Tetanus Toxoid
TVET	Technical and Vocational Education and Training
UHC	Universal Health Coverage
UN	United Nations
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention On Climate Change
UNFPA	United Nations Population Fund
UNICEF	United Nations Children's Fund
VAT	Value Added Tax
VHF	Very High Frequency
WASH	Water, Sanitation and Hygiene
WCD	Women and Child Development
WFP	World Food Programme
WHO	World Health Organization
WRD	Water Resources Department

Annexe 3: Chapter Annexes

Housing, Land, and Settlements

This annexe shows the analysed data in the domain of housing damage in Kerala caused by the recent floods and landslide. The analysis has helped to arrive at the Post Disaster Needs Assessment (PDNA) and recovery strategy in the Housing Sector Report, Kerala. The analysis carried out in this section is based on Local Self Government Department (LSGD) database, Kerala (4 October, 2018, 4:35PM) supported by some field visits.

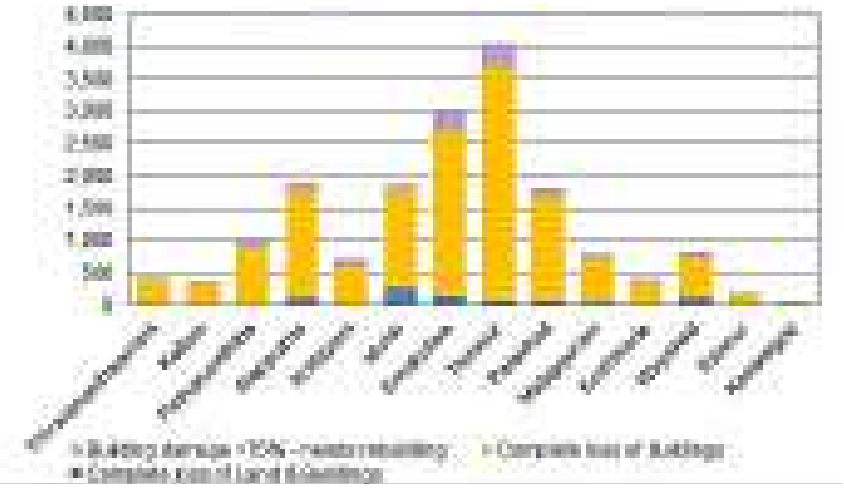
Table 1
Five Categories of Damage to Buildings used during Damage Assessment Survey

Extent of damage (roof type: concrete) (%)					Extent of damage (roof type: tile) (%)				
15	16–29	30–59	60–74	>75	15	16–29	30–59	60–74	>75
Source: IKM Rebuild Kerala, accessed on: 4 October 2018, 4:35 p.m.									

Damage Assessment of Buildings

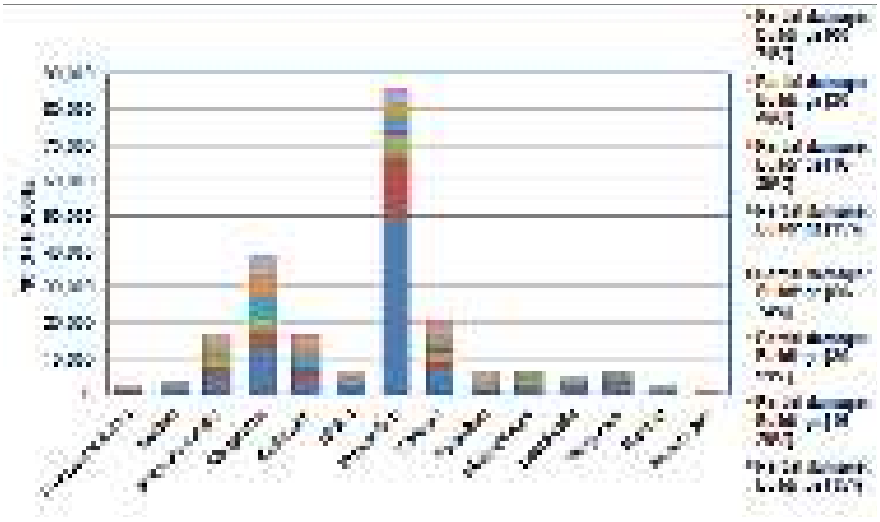
Completely damaged buildings: Figure A7.1 shows district-wise need for rebuilding completely destroyed houses, houses destroyed along with land, and damage more than 75%.

Figure 1
Rebuilding Need by District



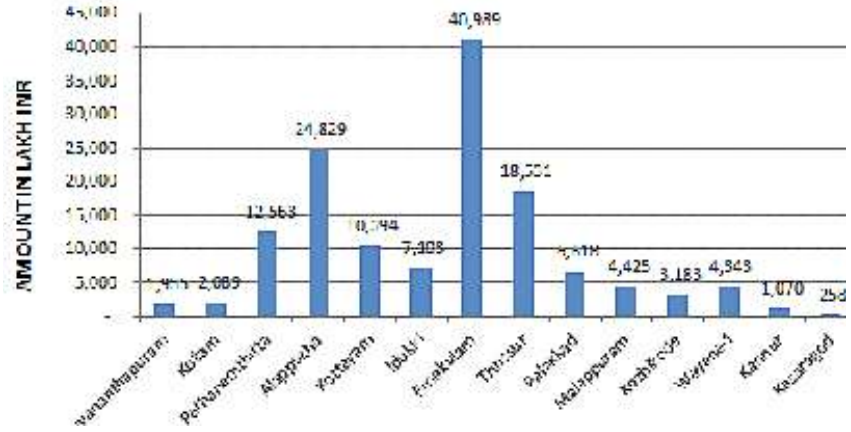
Partially damaged buildings: The total number of partially damaged buildings is 2.17 lakh of which buildings with concrete roof comprise 64% and those with tiled roof comprise 36%. The extent of damage is the highest in Ernakulam (40%) followed by Alappuzha.

Figure 2
Partially Damaged Buildings by District



Household goods loss + cleaning of well and house: Many buildings lost their household goods. The loss of household goods caused the people a lot of discomfort for weeks (reported by people at Pathanamthitta and Alappuzha). People could not sleep for consecutive nights since the mattresses were wet and kitchen could not be used. This affected the old, sick, pregnant women, and the children. During the field visits the people were found to be drying their suitcases, clothes, etc.

Figure 3
Value of Household Goods Lost and the Cost of Cleaning the House and its Well by District



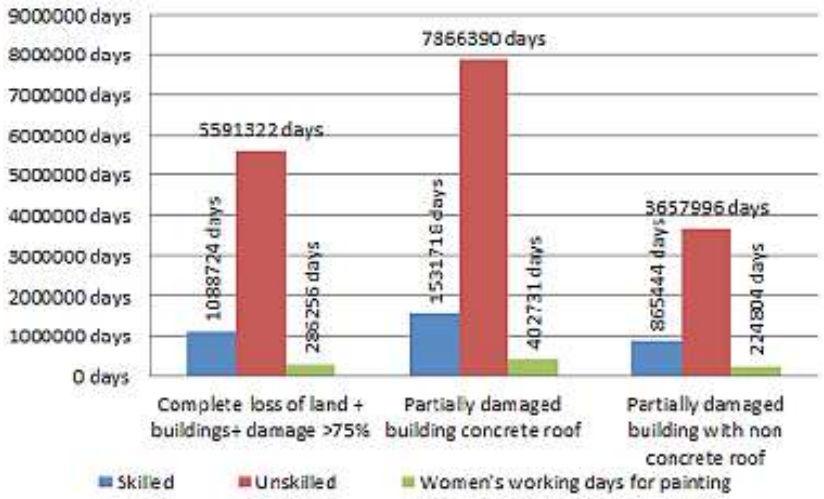
Source: Data collected from the Executive Engineer's Office, Alappuzha

Impact on Livelihoods

The reconstruction presents a huge opportunity for employment generation and business for the local masons and the building materials market. Only painting during reconstruction would generate 9 lakh working days for women artisans. Apart from that, 35 lakh working days of skilled masons and 171 lakh working days of unskilled workers job will be created in the reconstruction work. This would be an opportunity for the resources to learn build back better methods of construction.

Figure 4

Employment Generated due to Reconstruction (person days)



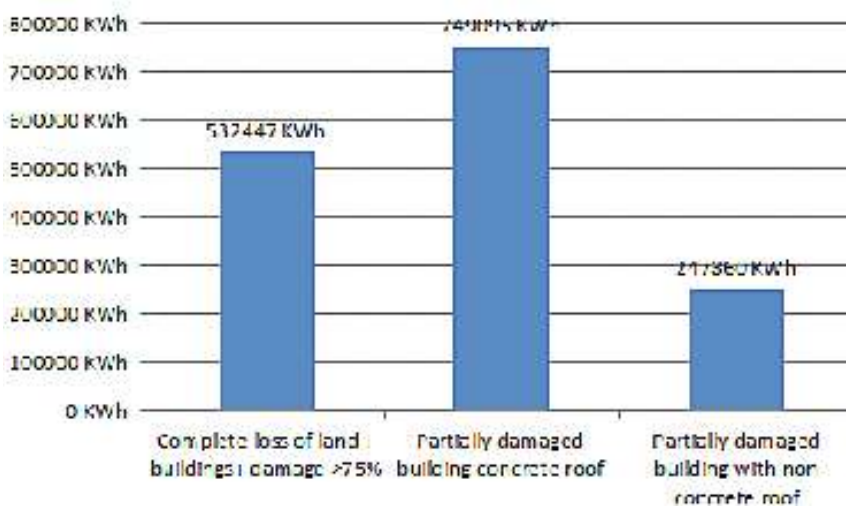
Reconstruction: Environmental Impact

Reconstruction will lead to the embodiment of non-renewable energy and CO2 emission and lead to depletion of natural resources. The reconstruction will embody 1,529 MW of non-renewable energy and cause emission of 718 thousand tons of CO2. If rat trap bonded wall and cement stabilised mud block are used, considerable amount of embodied energy and CO2 emission could be saved.

Non-renewable Energy: Figure 5 shows the impact of reconstruction on non-renewable energy due to the production of materials using fuel such as petroleum products, coal, fire wood, etc. It excludes the non-renewable energy requirement for transportation of the finished materials to the respective sites.

Figure 5

Consumption of Non-Renewable Energy During Reconstruction (kWh)

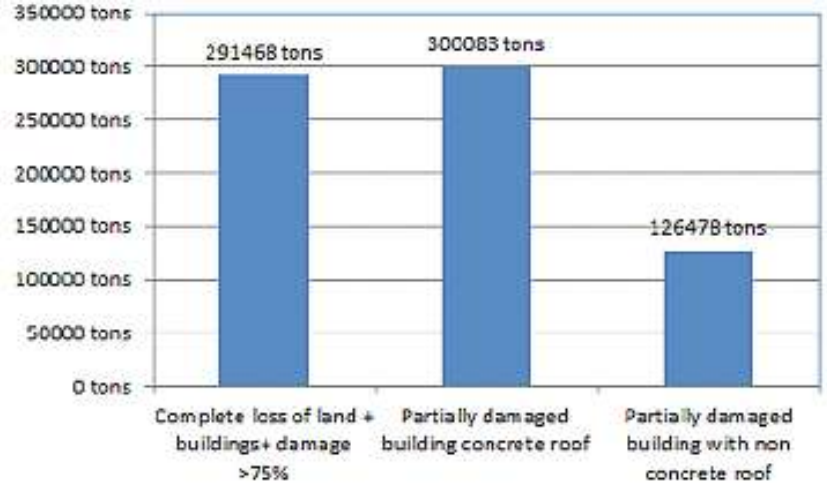


Source: PhD thesis, P K Das (BMTPC, Development Alternatives, and other sources)

CO2 emission: Figure 6 shows the impact of reconstruction on CO2 emission due to the production of materials using fuel such as petroleum products, coal, fire wood, etc. It excludes the CO2 emission for transportation of the finished materials to the respective sites.

Figure 6

CO2 Emission at Production Point during Reconstruction (in tons)



Health & Nutrition

Table 1

Damage to Infrastructure and Assets (Health Sector)

Damage to infrastructure and assets (Health)									
	Public health sector			Homeopathy			Indian system of medicines		
	Centre type	Units	Total cost (INR crore)	Centre type	Units	Total cost (INR crore)	Centre type	Units	Total cost (INR crore)
Full Destruction (F)	Primary	41	187.86	GHH	0	0	GAH GAD/ ational Health Mission (NHM)	0	
Total (F)		41	1,878,559,500		0	0		0	0
Partial Damage (P)	Primary	272	40.16	GHH	2	2	GAH/ GAD / NHM	59	2.14
	Secondary	15	10.93	GHD	45	4			
	Tertiary	4	2.87	NHM Disp.	14	0.83			
Total(P)		291	53.96		61	6.57		59	2.14
Assets (Medicine) A			14.00						8.10
Total (F+P+A)		332	255.81		61	6.57		59	10.24
Grand Total: Damage (INR) 272.62 crore									
Grand Total: Damage (USD) 3,894.54 million									

Table 2
Cost of Loss (Health Sector)

Loss (Health)					
Budget line	Item/Task	Total cost (INR lakh)	Short-term cost (INR lakh; 0–12 months)	Medium-term cost (INR lakh; 12–36 months)	Long –term cost (INR lakh; 36–60 months)
Infrastructure	Demolition, rubble removal and cleaning, disinfection etc. in health facilities	57	5,700,000	2280000	1710000
Temporary health facilities	Relief camps (logistics, manpower, transportation, local purchase of drugs)	239.56	95.83	71.87	71.87
	Operational cost for the temporary health facilities	128.48	51.39	38.54	38.54
TOTAL[A]		**425.04**	**170.02**	**127.51**	**127.51**
Higher costs of health services delivery	Increased number of patients (non-communicable diseases)	68.68	27.47	20.60	20.60
	Referral and transport of patients, including those Injured	51.95	20.78	15.59	15.59
	Purchase of medicines consumables and supplies	207.76	83.11	62.33	62.33
	Trainings on health conducted during floods	1.30	0.52	0.39	0.39
	Accommodation and local transport for health workers arriving from other states	182.85	73.14	54.85	54.85
	Mental health support	8.00	3.20	2.40	2.40
TOTAL[B]		**520.54**	**208.22**	**156.16**	**156.16**
Governance	Additional coordination and disaster management needs	109.13	43.65	32.74	32.74
	Development of a real-time EWARS	1,200.00	480.00	360.00	360.00
TOTAL [C]		**1,309.13**	**523.65**	**392.74**	**392.74**

Interventions above normal budget allocations to mitigate disaster-related risks	Health and nutrition promotion and IEC in print, social media etc.	97.93	39.17	29.38	29.38
	Screening for malnutrition	0.50	0.20	0.15	0.15
	Water quality testing and chlorination	40.00	16.00	12.00	12.00
	Vector control and monitoring	91.45	36.58	27.44	27.44
	Disinfection of polluted areas + saving animals	52.00	20.80	15.60	15.60
	Medical waste management	13.52	5.41	4.06	4.06
TOTAL[D]		**295.40**	**118.16**	**88.62**	**88.62**
Grand Total: Loss (INR) [A+B+C+D] 2550.11 lakh					
Grand Total: Loss (USD) [A+B+C+D]3.64 million					
(USD Conversion at INR 70/USD 1)					

Table 3

District-Wise Damage and Loss (Health Sector)

District	Damage						Loss
	Type of damage	Public health sector		Homeopathy		Indian systems of medicine		(INR crore)
		Number of units	Cost	Number of units	Cost	Number of units	Cost	
Alappuzha	Full destruction	7	166.80	0	0			
	Partial damage (major & minor)	40	16.16	16	1.64	20	0.54	1.37
	Total	47	182.96	16	1.64	20	0.54	1.37
Pathanamthitta	Full destruction	1	2.60	0	0	0	0	
	Partial damage (major & minor)	20	8.25	7	0.52	7	0.47	1.50
	Total	21	10.85	7	0.52	7	0.47	1.50
Thrissur	Full destruction	2	0.80	0	0			
	Partial damage (major & minor)	45	13.91	7	0.48	8	0.17	4.37

Ernakulum	Total	47	14.71	7	0.48	8	0.17	4.37
	Full destruction	2	5.50	0	0			0.19
	Partial damage (major & minor)	38	5.25	15	2.99	13	0.75	
Wayanad	Total	40	10.75	15	2.99	13	0.75	0.19
	Full destruction	15	6.77	0	0	0	0	0.29
	Partial damage (major & minor)	61	3.08	2	0.21	1	0.15	
Kozhikode	Total	76	9.85	2	0.21	1	0.15	0.29
	Full destruction	1	0.60	0	0	0	0	0.04
	Partial damage (major & minor)	3	1.09	1	0.11	0	0	
Malappuram	Total	4	1.69	1	0.11	0	0	0.04
	Full destruction	0	0	0	0			0.24
	Partial damage (major & minor)	38	0.23	2	0.22	2	0.02	
Palakkad	Total	38	0.23	2	0.22	2	0.02	0.24
	Full destruction	3	0.50	0	0	0	0	0.04
	Partial damage (major & minor)	5	0.34	0	0	3	0.02	
Kannur	Total	8	0.83	0	0	3	0.02	0.04
	Full destruction	4	0.89	0	0	0	0	0.04
	Partial damage (major & minor)	4	0.89	0	0	0	0	
Kottayam	Total	8	1.78	0	0	0	0	0.04
	Full destruction	5	2.90	0	0			2.79
	Partial damage (major & minor)	26	3.06	4	0.06	5	0.01	

Idukki	Total	31	5.96	4	0.06	5	0.01	2.79
	Full de-struction	1	0.50	0	0	0	0	0.50
	Partial damage (major & minor)	11	1.71	5	0.14	0	0	
	Total	12	2.21	5	0.14	0	0	0.50
Trivan-drum	Full de-struction	0	0	0	0	0	0	0
	Partial damage (major & minor)	0	0	1	0.07	0	0	
	Total	0	0	1	0.07	0	0	0
Kollam	Full de-struction	0	0	0	0	0	0	0
	Partial damage (major & minor)	0	0	1	0.13	0	0	
	Total	0	0	1	0.13	0	0	0
Kasara-god	Full de-struction	0	0	0	0	0	0	0
	Partial damage (major & minor)	0	0	0	0	0	0	
	Total	0	0	0	0	0	0	0
State incurred		0	14	0	0	0	8.10	14.12
	Total	0	14	0	0	0	8.10	14.12
Total state damage/ loss	Full de-struction	41	201.86	0	0	0	8.10	25.50
	Partial damage (major & minor)	291	53.96	61	6.57	59	2.14	
	Total	332	255.81	61	6.57	59	10.24	25.50
Grand total: Damage (INR)		**272.62 crore**				**Loss (INR)**	**25.50 crore**	
Grand total: Damage (USD)		**38.95 million**				**Loss (USD)**	**3.64 million**	

Table 4

District-wise Damage to Public Health Facilities

District	Fully damaged buildings	Partial damage
Wayanad	15	64
Alappuzha	7	76
Kottayam	5	35
Kannur	4	4
Palakkad	3	8
Thrissur	2	60
Ernakulam	2	66
Pathanamthitta	1	34
Kozhikode	1	4
Idukki	1	16
Malappuram	0	42
Trivandrum	0	1
Kollam	0	1
Kasaragod	0	0
Total	**41**	**411**

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Table 5

District-wise Damage and Loss (Health – Private Sector)

District	Individual practitioners (lakh)	Private health facilities (lakh)	Cost
Alappuzha	252.91	125.00	377.91
Ernakulam	368.93	593.62	962.55
Pathanamthitta	86.17	4.75	90.92
Kottayam	3.50	0	3.50
Idukki	51.00	0	51.00
Palakkad	4.00	0	4.00
Thrissur	292.02	1,569.55	1,861.57
Malappuram	5.00	10.00	15.00
Trivandrum	1.50	0	1.50
KERALA	1,065.03	2,302.92	3,367.95

Table 6

Damage and Loss (Nutrition) (INR crore)

Services with losses		Infrastructure damage	Assets	Total damage	Services/ relief (loss)	Total damage and loss
ICDS	AWC/ICDS Offices	78.55	7.13	85.68		85.68
	Nutrimix Plants	0.21	2.13	2.34		2.34
Food and civil supplies	ARD (PDS)*and distribution		5.26	5.26	2.11	7.37
SupplyCo: NFSA	Rice		73.80	73.80		73.80
	Paddy		39.14	39.14		39.14
SupplyCo Retail Chain	PDS-Depots		5.84	5.84		5.84
	Other Stores		14.12	14.12		14.12
Grand total: Damage and Loss (INR crore)		**78.76**	**147.43**	**226.19**	**2.30**	**228.49**
Grand total: Damage and Loss (USD million)		**11.25**	**21.06**	**32.31**	**0.33**	**32.64**
Note: AWC = Anganwadi centre; ICDS = Integrated Child Development Services; PDS = Public Distribution System; ARD =						

Cultural Heritage

Table 1

Recovery Costs (INR crore)

Districts	Short-term needs (0–12 months)	Medium-term needs (12–36 months)	Long-term needs (36–60 months)
Pathanamthitta	14.59	10.28	0.89
Alappuzha	0.25	0.06	0.02
Idukki	0.10	1.52	3.01
Ernakulam	14.97	3.19	0.91
Thrissur	20.73	3.87	1.26
Palakkad	3.29	0.74	0.20
Wayanad	0.10	0.02	0.01
Total costs (INR crore)	54.02	19.68	6.29
Total costs (USD million)	**7.72**	**2.81**	**0.90**
Total recovery costs	**INR 79.90 crore (USD 11.43 million)**		
For restoration required in the medium term, the recovery cost is calculated at the rate of 20% of the actual damage, inflated at the rate of 4% per annum for a period of three years. The long-term recovery cost estimated at the rate of 5% of the actual damage, inflated at the rate of 4% per annum.			

Agriculture, Fisheries and Livestock

Table 1

Total Crop Sector Damage per District (INR lakh)

Districts	Damage to infrastructure	Damage to crops	Damage to irrigation	Soil degradation
Thiruvananthapuram	17	3,543	7,777	
Kollam	0	3,308	1,841	309
Pathinamthitta	507	6,728	9,526	5,125
Alappuzha	1,143	768	28,593	4 ,873
Kottayam	124	5,035	1,554	391
Idukki	40,293	9,214	4,360	5,011
Ernakulam	475	1,330	10,371	753
Thrissur	1,142	4,473	13,678	444
Palakkad	1,692	1,155	7,474	537
Malappuram	142	8,839	5,209	1,945
Kozhikode	27	3,033	8,597	424
Wayanad	91	35,336	2,778	11,857
Kannur	0	4,902	3, 744	348
Kasaragod	3	391	1 ,025	
Total (INR lakh)	**45,656**	**88,055**	**1,06,525**	**32,016**

Table 2

Value of Total Crop Production Losses per District (INR lakh)

Districts	Private	Public	Total
Thiruvananthapuram	4,544	0	4,544
Kollam	16,382	12	16,395
Pathinamthitta	21,027	54	21,082
Alappuzha	35,239	0	35,239
Kottayam	22,432	0	22,432
Idukki	22,666	33	22,699
Ernakulam	4,039	64	4,103
Thrissur	9,657	236	9893
Palakkad	11,987	3	11,990
Malappuram	18,517	16	18,534
Kozhikode	1,03,056	163	1,03,219
Wayanad	64,206	90	64,296
Kannur	12,483	13	12,495
Kasaragod	8,849	51	8,899
Total	**3,55,084**	**735**	**3,55,819**

Table 3

Production Loss in Fisheries by District and Ownership (INR lakh)

District	Aquaculture		Fisheries		Total
	Public	Private	Public	Private	
Thiruvananthapuram	25	65		2	92
Kollam	8	164		709	881
Alappuzha	0	1,729		14	1,743
Ernakulam	112	800		88	1,000
Thrissur	88	3,638		14	3,741
Malappuram	8	332		7	347
Kozhikode	3	153		5	161
Kannur	11	44		0	55
Kasargode	0	1		0	1
Kottayam	29	1,155		198	1,381
Pathanamthitta	48	68		14	130
Idukki	0	69		7	76
Palakkad	15	164		1	180
Wayanad	32	307		0	339
Total	**9,068**			**1,059**	**10,127**

Livestock

Table 4

Value of Livestock Production Loss per Animal and per District (INR lakh)

Districts	Cows	Buffa-loes	Calves	Heif-ers	Sheep/ Goats	Poul-try	Ducks	Pigs	Quails	Total
Thiruvananthapuram	6	0	8	0	0	21	0	5	0	40
Kollam	88	1	22	13	3	11	0	0	0	139
Pathanamthitta	364	5	57	97	16	55	141	00	0	734
Kottayam	16	3	37	14	10	69	10	0	0	302
Idukki	80	9	20	9	6	18	0	3	0	146
Alappuzha	283	21	560	40	240	266	735	0	0	2,146
Ernakulam	922	274	73	86	160	433	27	0	0	1,974
Thrissur	944	7	3	56	52	507	0	85	0	1,680
Palakkad	53	2	4	5	0	2.2	0	0	0	86
Malappuram	60	0	10	5	13	769	14	0	0	871
Kozhikode	24	0	2	2	2	63	0	0	0	93
Kannur	25	0	1	4	0	4	1	0	1	36
Wayanad	85	31	3	7	8	50	0	12	9	205
Kasargod	4	0	0	0	0	0	0	0	0	4
Total	**3,098**	**352**	**827**	**338**	**510**	**2,287**	**930**	**105**	**10**	**8,456**

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Water and Sanitation

Table 1

Drinking Water Coverage in Kerala

Type of main drinking water source	Household Coverage (%)		
	Total	Rural	Urban
Piped water	29	13	16
Tap water (treated)	23	9	14
Tap water (untreated)	6	4	2
Well	62	34	28
Covered well	15	8	7
Uncovered well	47	27	21
Hand pump	0.5	0.2	0.3
Borehole/tube well	4	2	2
Spring	1	1	0
Spring	1%	1%	0%

River/canal	0.2	0.2	0.0
Pond/lake/tank	1	1	0
Other sources	2	1	1
Accessibility			
Within the premises	78	39	39
Near the premises	14	9	5
Away	8	6	2

Source: ORGI (2011), Census of India 2011, Office of the Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India

Table 2

Piped Water Coverage vs. Shallow Wells by District

District	Population accessing any water source (%)		
	Piped water systems		Shallow wells (%)
	KWA Schemes (%)	Jalanidhi Schemes (%)	
Thiruvananthapuram	65	1	71
Kollam	44	4	87
Pathanamthitta	59	2	99
Alappuzha (Alleppey)	66	0	57
Kottayam	31	6	85
Idukki	17	7	50
Ernakulam	87	0	49
Thrissur	40	6	75
Palakkad	38	7	54
Malappuram	19	8	74
Kozhikode (Calicut)	19	6	79
Wayanad	19	10	75
Kannur	23	4	87
Kasargod	15	4	64
Kerala	41	4	64

Source: Kerala Water Authority (KWA) inputs to Joint Rapid Disaster Needs Assessment (JRDNA) team

Table 3
Sanitation Coverage in Kerala

Type of toilet facility	Household coverage (%)		
	Total	Rural	Urban
Total number of households	100	53	47
Water closet	67	31	35
- Into piped sewer system	12	5	7
- Into septic tank	50	24	27
- Into other system	4	2	2
Pit latrine	28	18	10
- With slab/ ventilated improved pit	28	18	10
- Without slab/ open pit	1	1	0
Other latrine	0.2	0.1	0.1
Public latrine	1	1	0
Open	4	3	1
Night soil disposed into open drain	0.16	0.06	0.10
Night soil removed by human	0.04	0.02	0.02
Night soil serviced by animals	0.02	0.02	0.01
Accessibility			
Toilet facility within the premises	95%	49%	46%
No toilet within the premises	5%	4%	1%

Source: ORGI (2011), Census of India 2011, Office of the Registrar General and Census Commissioner of India, Ministry of Home Affairs, Government of India

Table 4
Solid Waste Generation in Kerala

Region	Population	Per Capita MSW Generation (gram/day)	Total MSW Generation (TPD)
Corporation	30.12	470	1,415
Municipalities	129.23	350	4,523
Gram Panchayats	174.71	235	4,106
Total	**334.06**		**10,044**

Source: Varma (2013), Kerala Economic Review, 2017; accessible at: http://spb.kerala.gov.in/ER2017/web_e/ch71.php?id=7&ch=71

Table 5

Damages in Water Supply and Sanitation Sub Sectors

District	Drinking water								Sanitation			
	Damaged KWA Schemes				Damaged Jalanidhi Schemes		Damaged Shallow Wells		Damaged Latrines			
	Schemes (nos.)		Cost		Schemes (nos.)	Cost	Wells (Nos.)	Cost (Rs. - lakhs)	Latrines (Nos.)		Cost (INR lakh)	
	Urban	Rural	Urban	Rural					Urban	Rural	Urban	Rural
Thiruvananthapuram	4	25	125.47	200.93	-	-	-	-	-	-	-	-
Kollam	9	32	147.20	120.80	-	-	-	-	90	216	13.86	33.26
Pathanamthitta	4	34	252.50	1,656.65	15	67.49	42,406	5,088.72	2.023	12,936	311.54	1,992.14
Alappuzha (Alleppey)	7	14	235.42	474.15	-		58,611	7,033.32	4,203	39,886	647.26	6,142.44
Kottayam	13	20	586.53	494.75	38	157.79	44,154	5,298.48	1,086	7,926	167.24	1,220.60
Idukki	1	33	62.00	406.10	228	1,287.62	-		154	1,957	23.72	301.38
Ernakulam	20	69	848.88	582.69	-	60.26	78,209	9,385.08	724	4,078	111.50	628.01
Thrissur	16	71	208.78	778.83	43	258.56	89,635	10,756.20	1,403	8,448	216.06	1,300.99
Palakkad	6	25	71.85	372.33	24	101.72	-	-	374	2,132	57.60	328.33
Malappuram	20	18	287.77	71.84	63	240.33	-	-	1,398	3,766	215.29	579.96
Kozhikode (Calicut)	2	16		39.35	108	516.80	-	-	69	148	10.63	22.79
Wayanad	5	11	37.25	90.40	43	222.50	3,988	478.56	113	1,846	17.40	284.28
Kannur	1	4	5.70	5.25	18	87.67	-	-	3	167	0.46	25.72
Kasargod	-	-	-	-	3	23.47	-	-	-	-	-	-
Sub Total	108	372	2,869.35	5,293.97	583	3,023.91	317,003	38,040.36	11,640	83,506	1,793	12,859.90
Sub Sector Total				**49,227.59**							**14,652.46**	

Source (KWA & Jalanidhi Schemes): KWA Rapid Disaster Needs Assessment summary – dated 19.09.2018

Source (Shallow wells): Addl. Memo. on Kerala Floods by State Relief Commissioner, Disaster Management, Government of Kerala – page 32

Source (Latrines): Suchitwa Mission damage assessment – 13.09.2018

Assumption: Damage per well INR 12,000; damage per latrine INR 10,000

Table 6

Damages in Solid Waste Management Sub Sector

Name of District	Estimated Cost of Damage (INR lakh)								
	Household level				Community level			Institution level	Total cost by district
	Pipe compost	Biogas plants	Compost bin	Plastic shredding units	RRF Units	Aerobic systems	Community biogas plants	Ins. SWM Units	
Thiruvananthapuram	4.60	10.40	88.00	10.00	5.00	40.00	90.00	73.00	321.00
Kollam	2.50	5.50	46.60	10.00	5.00	10.00	50.00	87.00	216.60
Pathanamthitta	83.50	187.80	1,586.30	40.00	20.00	15.00	150.00	842.00	2,924.60
Alappuzha (Alleppey)	96.70	217.50	1,836.60	60.00	30.00	120.00	250.00	256.00	2,866.80
Kottayam	114.40	257.50	2,174.20	30.00	15.00	25.00	170.00	341.00	3,127.10
Idukki	7.40	16.60	140.50	20.00	10.00	10.00	140.00	27.00	371.50
Ernakulam	292.90	659.00	5,565.30	60.00	30.00	50.00	120.00	656.00	7,433.20
Thrissur	174.40	392.40	3,313.80	60.00	30.00	80.00	280.00	579.00	4,909.60
Palakkad	8.60	19.30	162.90	10.00	5.00	15.00	100.00	134.00	454.80
Malappuram	19.20	43.30	365.50	10.00	5.00	15.00	180.00	124.00	762.00
Kozhikode (Calicut)	24.40	54.80	463.10	10.00	5.00	15.00	100.00	157.00	829.30
Wayanad	14.00	31.40	265.10	20.00	10.00	20.00	80.00	65.00	505.50
Kannur	2.90	6.40	54.20	10.00	5.00	20.00	50.00	74.00	222.50
Kasargod	2.00	4.60	38.60	10.00	5.00	40.00	60.00	12.00	172.20
Sub Total (different units)	847.50	1,906.50	16,100.70	360.00	180.00	475.00	1,820.00	3,424.00	**Sub Sector TOTAL**
Sub Total (Functional level)		**18,854.70**				**2,835.00**		**3,424.00**	**25,113.70**

Source (SWM): Suchitwa mission damage assessment – 13.09.2018

Table 7

Losses in Water Supply and Sanitation Sub Sectors

District	Drinking Water						Sanitation	
	KWA Schemes		Jalanidhi Schemes		Cost of emergency response (Rs. - lakhs)		Cost of cleaning Wells (Rs. - Lakhs)	Cost of Cleaning Latrines (Rs.-lakhs)
	Water loss for 7 days (ML)	Cost of water loss (INR lakh)	Water loss for 7 days (ML)	Cost of water loss for (INR lakh)	Immediate restoration of water services	Water supply to relief camps		
Thiruvananthapuram	122.50	7.35	-	-	66.00	-	-	-
Kollam	343.00	20.58	-	-	58.50	0.56	-	15.30
Pathanamthitta	836.5	50.21	2.70	0.16	157.50	8.05	4,240.60	747.95
Alappuzha (Alleppey)	740.25	44.42			136.50	18.75	5,861.10	2,204.45
Kottayam	292.46	17.55	16.60	1.00	165.00	4.87	4,415.40	450.60
Idukki	164.15	9.85	36.72	2.20	82.50	0.00		105.55
Ernakulam	3,355.10	201.31	-	-	621.00	337.40	7,820.90	240.10
Thrissur	1,195.25	71.72	32.82	1.97	696.00	-	8,963.50	492.55
Palakkad	430.71	25.84	19.43	1.17	124.50	-	-	125.30
Malappuram	711.27	42.68	32.85	1.97	139.50	0.12	-	258.20
Kozhikode (Calicut)	175.00	10.50	19.30	1.16	39.00	-	-	10.85
Wayanad	164.50	9.87	28.79	1.73	45.00	-	398.80	97.95
Kannur	175.42	10.53	6.52	0.39	12.00	-	-	8.50
Kasargod	-	-	1.01	0.06	-	-	-	-
Sub Total	8.706.46	522.41	196.74	11.81	2,343.00	369.75	31,700.30	4,757.30
Sub Sector Total				**34,947.27**				**4,757.30**

Assumptions: Cleaning cost per well INR 10,000; cleaning cost of latrines INR 5,000; water supply system production loss lasted for 7 days

Source (KWA & Jalanidhi): KWA Rapid Disaster Needs Assessment – 19.09.2018

Source (Emergency response): Additional Memorandum on Kerala Floods by State Relief Commissioner, Disaster Management, Government of Kerala - Page 29

Source (Wells): Additional Memorandum on Kerala Floods by State Relief Commissioner, Disaster Management, Government of Kerala - Page 32

Source (Latrines): Suchitwa Mission damage assessment – 13.09.2018

Table 8

Losses in Solid Waste Management Sub Sector

Name of District	Cleaning houses		Cleaning public areas				Disposing animal carcasses			
	Houses (Nos.)	Cost (INR lakh)	Urban wards (Nos)	Rural wards (Nos)	Cost -Urban (INR lakh)	Cost - Rural (INR lakh)	Large animals (Nos)	Small animals (Nos)	Birds (Nos)	Cost (INR lakh)
Thiruvananthapuram										
Kollam										
Pathanamthitta	11,622	348.66	83	426	41.50	106.50	107	86	72,104	27.84
Alappuzha (Alleppey)	15,418	462.54	154	862	77.00	215.50	664	2,371	90,415	84.03
Kottayam	16,432	492.96	152	422	76.00	105.50	137	471	61,258	29.94
Idukki	-	-	69	792	34.50	198.00	-	-	-	-
Ernakulam	36,231	1,086.93	288	924	144.00	231.00	2,689	2,453	149,286	203.76
Thrissur	28,956	868.68	287	1,297	143.50	324.25	1,832	2,247	374,921	226.55
Palakkad										
Malappuram										
Kozhikode (Calicut)										
Wayanad	2,348	70.44	56	278	28.00	69.50	34,759	137	3,319	1,740.32
Kannur										
Kasargod										
Sub Total	111,007	3,330.21	1,089	5,001	544.50	1,250.25	40,188	7,765	751,303	2,312.44

Sub Sector Total (INR lakh) **7,437.40**

Assumption: Cleaning cost per house INR 3,000

Assumption: Cleaning cost per house INR 3,000

Source (Household cleaning): Suchitwa Mission damage assessment – 15.09.2018

Source (Public cleaning): Additional Memorandum on Kerala Floods by State Relief Commissioner, Disaster Management, Government of Kerala - Page 24

Source (Carcasses disposal): Additional Memorandum on Kerala Floods by State Relief Commissioner, Disaster Management, Government of Kerala -

Table 9

Additional Long-Term Reconstruction Needs and Costs

Description	Estimated budget (INR crore)		
	Short-term	Medium- term	Long- term
WATER			
Resilience building of 20% of household wells in 8 districts (other than the 6 districts with the most well damage)		611.73	
Revamping 19 existing urban KWA water schemes in 4 districts; Kottayam, Ernakulam, Thrissur and Wayanad (Note: The budget for a single scheme in Ernakulam is INR 30,000 lakh and benefits 284,865 people)		311.23	
Revamping 51 existing KWA rural water schemes in 9 districts		72.29	
Utilising 10 unutilised KWA urban water schemes in 6 districts; Pathanamthitta, Alappuzha, Thrissur, Palakkad, Wayanad and Malappuram (benefiting 859,636 people)		552.00	
Utilising 12 unutilised KWA rural water schemes in 3 districts; Pathanamthitta, Palakkad and Wayanad (benefiting 850,843 people)		396.50	
Utilising 10 unutilised KWA urban water schemes in 6 districts; Pathanamthitta, Alappuzha, Kottayam, Idukki, Thrissur and Kozhikode (benefiting 593,222 people)		420.4	
Utilising 28 unutilised KWA rural water schemes in 9 districts; Pathanamthitta, Alappuzha, Kottayam, Idukki, Ernakulam, Thrissur, Palakkad, Wayanad and Kozhikode (benefiting 1,334,171 people)		758.75	
Construction of 4 new urban water schemes for KWA in 2 districts; Thrissur and Wayanad		295.00	
Construction of 10 new rural water schemes for KWA in 5 districts; Pathanamthitta, Idukki, Ernakulam, Palakkad and Wayanad (benefiting 691,380 people)		463.50	
Construction of 5 new urban water schemes for KWA in 4 districts; Thrissur, Palakkad, Malappuram and Kozhikode			1,149.72
Construction of 20 new rural water schemes for KWA in 7 districts; Pathanamthitta, Kottayam, Idukki, Thrissur, Palakkad, Malappuram and Kozhikode (benefiting 1,607,675 people)			1,679.70
Water Sub Sector Total (Rs. – crore)		6,710.82	
SANITATION			
Building resilience through provision of septic tanks to 2,314,910 household latrines in all the 14 districts (30% of the state's households were assumed to be vulnerable)		3,472.37	
Provision of 30 mobile sewage treatment units to local government bodies		0.75	
Construction of 100 new off-site septage management plants to all the districts		150.00	
Sanitation Sub Sector Total		3,623.12	

SOLID WASTE MANAGEMENT	
Collection, sorting, storage and disposal of flood generated solid waste including e-waste	
SWM Sub Sector Total (INR crore)	N/A
WASH SECTOR – Additional Long Term Recovery and Reconstruction Summary	
WASH SECTOR TOTAL (INR crore)	10,333.94
Note: BBB – Build Back Better, DRM – Disaster Risk Management	

Employment and Livelihoods

Table 1

Estimated Person Says and Wage Loss Due to Kerala Floods 2018

Category	Total workers (2011–12) lakh	Workers affected (%)	Affected workers (lakh) [col. 1x col. 2]	Days lost	Total man days lost (lakh)	Daily wage rate INR	Total wage lost (INR crore)
Male Workers Only							
Casual	35.37	56.98	20.15	13	262.00	700	1,834.03
Regular	21.22	56.98	12.09	13	157.19	840	1,320.38
Self Emp.	34.11	56.98	19.44	13	252.67	770	1,945.56
Total	90.7	56.98	51.68		671.86		5,099.97
Additional for Alappuzha (50%), Wayanad (50%) and Ernakulam (20%) of workers in each category (= 6.31 % of total workers in the state)							
Casual	35.37	6.31	2.23	13	29.01	700	203.10
Regular	21.22	6.31	1.34	13	17.41	840	146.22
Self Emp.	34.11	6.31	2.15	13	27.98	770	215.45
Total	90.7	6.31			74.40		564.76
Additional 13 days for Alappuzha (50% of workforce = 3.11 % of total workforce)							
Casual	35.37	3.11	1.10	13	14.30	700	100.10
Regular	21.22	3.11	0.66	13	8.58	840	72.07
Self Emp.	34.11	3.11	1.06	13	13.79	770	106.19
Total	**90.7**	**3.11**			**36.67**		**278.35**
Female Workers Only							
Casual	10.81	56.98	6.16	13	80.08	330	264.25
Regular	12.34	56.98	7.03	13	91.41	597	545.71
Self Emp.	13.25	56.98	7.55	13	98.15	362	355.30
Total	36.4	56.98	20.74		269.64		1,165.26
Additional for Alappuzha (50%), Wayanad (50%) and Ernakulam (20%) of workers in each category (= 6.31% of total workforce)							

Casual	10.81	6.31	0.68	13	8.87	330	29.26
Regular	12.34	6.31	0.78	13	10.12	597	60.43
Self Emp.	13.25	6.31	0.84	13	10.87	362	39.35
Total	36.4	6.31	2.30		29.86		129.04
Additional 13 days for Alappuzha (50% of workforce) (= 3.11% of total workforce)							
Casual	10.81	3.11	0.34	13	4.37	330	14.42
Regular	12.34	3.11	0.38	13	4.99	597	29.78
Self Emp.	13.25	3.11	0.41	13	5.36	362	19.39
Total	36.4				14.72		63.60
Total loss of person days and wage Loss							
Men					782.93		5,943.09
Women					314.22		1,357.90
Men and women					1,097.15		7,300.99

Note: Average earnings for male casual labour is taken at INR 700 for Kerala workers and INR 840 for regular employed (based on the ratio between casual and regular worker wages as reported in the 68th Round of NSS for Kerala). For the self-employed a rule of thumb is used by taking INR 770, i.e. 10% above casual workers but 10% below regular workers. Days lost: 13 days (15 to 31 August). Additional 13 days for 50% workers in Alappuzha and Wayanad and 20% workers in Ernakulam. Another 13 days for 50% workers in Alappuzha.

Female wages were 47% of male wages for casual labour and 71%of male wages for regular female workers. This ratio has been applied to the wages of women casual workers. For self-employed earnings, women's earnings are taken at 47% of male earnings (as in the case of casual workers) since 8.8% of women workers are 'unpaid family workers' and 27.6% are 'own account workers' such as street vendors and home-based workers.

Disaster Risk Reduction

Table 1

Replacement Costs

Districts	Replacement cost of the building (INR lakh)	Replacement cost (INR lakh) of other materials (furniture; vehicles; other logistics)
Alappuzha	55.00	0
Ernakulam	55.00	301.55
Idukki	0	0
Kannur	0	0.75
Kasaragod	0	0
Kollam	0	0
Kottayam	55.00	543.00
Kozhikode	40.00	164.32
Malappuram	0	90.00
Palakkad	8.00	61.68
Pathanamthitta	0	0

Thiruvananthapuram	5.00	66.15
Thrissur	0	208.00
Wayanad	0	0
Total	218.00	1435.45

Table 1

Recovery and Reconstruction Needs and Costs (INR lakh)

Activity	Short Term	Medium Term	Long Term	Total	Assumptions
Recovery of Damaged Infrastructure	1,653	0	0	1,653	
Fire Service	1,653			1,653	
Multi Hazard Early Warning, Communication and Decision support systems	20	249	405	674	Unit cost of INR 2 lakh; 88 and 100 stations in medium and long term
Review of the existing state level mechanisms for early warnings and district level dissemination/ communication	20			20	Costing prepared in consultation with KSNDMC
188 weather stations to be established in the most vulnerable gram panchayat for weather monitoring		176	200	376	State has already commissioned this work under the National Cyclone Risk Mitigation Project .The proposal can be reviewed and augmented to cover the entire state
Establishment of a state of the art early warning and communication system		73	205	278	
Strengthening the communication network from state to Taluka and village level				0	An institution/group of experts will be appointed to do the review

Strengthening state and district emergency operation centres (SEOCs and DEOCs)	20	299	270	589	2 trainings each per district and for 15 departments @ INR 50,000
Review of the existing SEOC and DEOC functioning, human resource strengthening and equipment/ technology to identify the future needs in the context of recent floods	20			20	15 meteorologists across 14 districts and 1 at SDMA @ INR 1.5 lakh per month
Training and capacity building of district disaster management authorities (DDMAs), and relevant department officials at state and district level on EOC management and IRS system		29		29	
Human Resources (Technical) at the DDMAs and state DMA		270	270	540	One Time Allocation
Institutional strengthening for mainstreaming disaster risk reduction (DRR) and climate change adaptation (CCA)	137	218	19	374	13
Training and capacity building of district disaster management authorities (DDMAs), and relevant department officials at state and district level on EOC management and IRS system		29		29	
Review the existing State DM Policy, Rules, EOC-SOP in the context of recent floods	2			2	84
Review and revision the SDMP and 14 DDMPs in priority	0				26 departmental plans revised @ INR 5 lakh; (12 departmental plans are immediate priority)

Strengthen the SDMA and DDMA with experts from various sectors i.e. agriculture, meteorology, water resources, housing and settlements including urban planning, health, environment, infrastructure to mainstream DRR and CCA into development plans	60	60		120	INR 50,000 for 26 nodal departments as immediate priority, training for 42 departments @ INR 2 lakh;
Developing departmental disaster management plans	60	70		130	Cost of convening, workshops, advocacy etc
Set up a training arm in SDMA for capacity building on mainstreaming DRR and CCA a. training needs assessment for nodal departments b. standard training packages for a wide range of stakeholders c. Module development for departmental training institutes such as KILA, SIRD, IMG, KSIH&FW, ILDM d. delivering training programmes and courses	13	84		97	Review of 10 key policies/ legislations/regulations @ INR 1.5 lakh each
Set up a state-level multi-stakeholder forum for DRR / advisory groups for consultation, advisory support, knowledge sharing and monitoring of progress made in achieving goals of SFDRR	2	4	4	10	Cost of convening, workshops, advocacy etc

Review and suggest proposed amendments in some of the relevant Policy, Acts and Rules (the Kerala Biological Diversity Rules 2008; Kerala Housing Act, 1971; Land Acquisition, Rehabilitation and Resettlement Act, 2013; Kerala Tourism Policy, 2012; Kerala State Housing Policy, 2011 (draft); Panchayat Building Rules, 2011; Building Construction Rules; etc.)			15	15	30% of cost of setting up a NDRF Battalion which is close to INR 56 crore
Strengthening Response Mechanism	800	820	0	1,620	Budget allocated under the planned budget
Revival of State Disaster Response Forces (SDRF) , training, procurement of equipment (600 personnel at 4 locations)	800	800		1,600	One Time Allocation
Strengthening of fire services, police, civil defence and home guards				0	
Strengthening the IDRN data base and customising the data collection till the GP level including training	800	20		20	Based on average costs for a state-wide exercise
Risk and Vulnerability Assessments	150	400	200	750	INR 50 lakh is the cost for one plan.
Multi-hazard risk and vulnerability assessment and micro level risk mapping covering all districts	100	300		400	The no. of buildings will be decided in consultation with the state government. Cost of building will vary.
Five Dam Crisis Management Plans: Banasura, Idamalayar and Pamba–Kakki–Annathod	50	100	100	250	

Multi-hazard risk and vulnerability assessment and micro level risk mapping covering all districts	100	300		400	The no. of buildings will be decided in consultation with the state government. Cost of building will vary.
Safety audit of key public buildings			100	100	INR 4 lakh allocation per panchayat. Activities include DRR plans linked to gram panchayat domestic product (GPDP), risk education, behavioural change, capacity building, Institutionalising CERT teams
Implementation of Community Based Disaster Risk Management Programme	574	2170	2000	4744	One time allocation
Capacity building of panchayats and urban local bodies on DRR	164	1600	2000	3764	INR 10 lakh per municipality plan and 15 lakh per corporation plan; (30 municipalities and 6 corporations to be immediately prioritised)
Setting up of volunteer's network through development of a mobile app	20			20	
Developing of disaster management plans for 87 municipalities and 6 municipal corporation	390	570		960	One time allocation
Knowledge Management	30	140	220	390	
Review of risk transfer mechanism and recommending mechanism to strengthen it	30			30	One time allocation
Promotion Innovative Mitigation Programmes/initiatives/ guidelines	0	70	110	170	Additional allocation to SDMA Plan Funds
Constitution of state hazard safety cell for promoting multi hazard resilient infrastructure within the PWD			10		

Implementing key demonstrative DRR and CCA mitigation projects in the area of hospital safety, school safety; disability inclusive DRR ; Safe Housing; water and environment conservation etc.		70	100	170
Total	1,731	4,366	3,224	10,964

Case Study: Building Financial Resilience[1]

Many middle class and lower middle-class households have suffered severe losses during the floods by way of: (i) direct damage to/or total loss of the house; (ii) loss of household assets; (iii) and loss of business and business assets.

Governments can take steps to reduce the negative financial effects of disasters in a manner that protects both people and assets. Financial protection helps a government manage these shocks without compromising development, fiscal stability, and well-being. Disaster risk financing and insurance can also help state/countries prepare for increased climate variability.

Historically, governments mostly addressed the financial effects of natural disasters on an ad-hoc basis. Countries are now increasingly focusing on proactive planning before a disaster strikes. A handful of industrialised countries had taken this approach, and it is now gradually being taken up by governments the world over.

Financing Disaster Response in India

India has a very well-developed mechanism for financing disaster response, relief, and immediate recovery in India. Successive government finance commissions have deliberated on the issue and allocated funds for this purpose both at the national level (National Disaster Response Fund) and at the state level (State Disaster Response Fund).

However, these funds are not used to pay out compensation for losses, but only to provide minimum support to those affected to help them start life again. Thus the monetary gap between the actual loss and the support given by the government is wide. The Government of Kerala has announced one-time monetary support of INR 4 lakh per household to all those affected, irrespective of the income group they belong to. Those who have lost their land will be given INR 6 lakh.

Despite this generosity by the government, the uncompensated loss incurred by the people remains huge. People already in financial (and other) distress, further increase their burden by taking loans from the formal and informal sectors. The poorest of the poor are supported by the government, but if the people affected are above the poverty line, then support is not available.

Challenges

The majority of Kerala's population has income higher that is than the national average. The cost of household items lost could be tentatively put at INR 10–12 lakh per household. Houses in Kerala are normally large and so the replacement

[1] *NIDM*

cost of the average house would be more than INR 40–50 lakh. This cannot be compensated by the government exchequer and the initial support given by the state is very meagre, in comparison to the loss. Such natural calamities may not be a one-time phenomenon and could occur repeatedly, increasing vulnerability further, multiplying manifold the burden on the state exchequer. Looking at Kerala's risk profile, it would be appropriate for the government to come up with new financial tools for building financial resilience in the state and its people. Risk transfer, insurance, insurance pooling, micro insurance could be possible alternatives.

Disaster risk financing and insurance aims to increase national and local fiscal resilience. A comprehensive strategy can secure access to post-disaster financing before an event strikes, ensuring rapid, cost-effective liquidity to finance recovery efforts.

Four Strategies to Strengthen Financial Resilience

The main financial protection beneficiary groups are (i) national and local governments; (ii) homeowners; (iii) small and medium enterprises (SMEs); (iv) farmers; and (v) the poorest. Governments normally seek to strengthen the financial resilience of different groups by using appropriate strategies for each.

Sovereign disaster risk financing

This financial tool aims to increase the capacity of national and sub-national governments to provide immediate emergency funding, as well as long-term funding, for reconstruction and development. Governments can also use this tool to account for other contingent liabilities, such as government-supported agricultural insurance or social protection schemes that will require payouts following a disaster. Finally, sovereign disaster risk financing requires the setting up of systems to effectively allocate and disburse funds.

Contingent credit

This is a financial instrument that allows governments to secure funds ahead of a disaster, to be made immediately available in case of emergency. In 2008, the World Bank approved the first such loan, called a Catastrophe Deferred Drawdown Option (CAT-DDO). Contingent credit complements other instruments such as national reserves to finance high frequency, low severity events.

Examples include, Mexico's natural disaster fund, called FONDEN, and catastrophe risk transfer solutions to finance low frequency, high severity events such as sovereign insurance pools created by the Caribbean and Pacific island states. The Government of Colombia, for example, is building on international best practice in insuring public concessions for infrastructure worth USD 38 billion to transfer risk to specialised risk carriers.

Property catastrophe risk insurance

This insurance aims to protect homeowners and SMEs against loss arising from property damage. The Turkish Catastrophe Insurance Pool (TCIP), a public–private partnership between the Government of Turkey and the domestic insurance industry, is one such example that provides earthquake insurance to homeowners. The TCIP increased catastrophe insurance coverage from less than 3% of residential buildings, to 23% nationwide and over 40% in urban areas. Since its establishment in 2000, the TCIP has paid nearly 21,000 claims, totalling over USD 70 million as of January 2014; US flood insurance could be also considered a similar example (see Box Case Study 1.1).

Disaster-linked social protection

This helps governments strengthen the resilience of the poorest and most vulnerable to the debilitating effects of natural disasters. It does this by applying insurance principles and tools to enable social protection programmes such as social safety nets to scale up and scale out assistance to beneficiaries immediately following a disaster.

The Government of Ethiopia, for instance, is integrating disaster risk contingency planning and financing into the Productive Safety Net Programme, its food security safety net. Starting in 2006, the programme began using disaster risk financing and insurance tools on a trial basis to expand its capacity during extreme events. A contingent financing window allowed Ethiopia to increase the number of beneficiaries of food assistance during the 2011 Horn of Africa drought from 6.5 to 9.6 million drought-affected people. (World Bank 2013)

While a government may not need to pursue all four policy options, disaster risk financing and insurance strategies commonly build on a combination of these strategies. Together, they help the government clarify, reduce, and manage its contingent liabilities to natural disasters. These options do so by using financial risk information to clarify the financial costs and benefits of disaster risk reduction, retention, and transfer; by enabling greater risk transfer to the private sector; and by providing strategies and tools for more responsible management of the remaining costs associated with natural disaster risk.

These interventions are not independent and can be aligned to bring about multiple wins. For example, if a government decides to establish a risk financing pool to retain some amount of agricultural risk—meaning this pool will cover certain pre-determined losses—this same entity could be used to absorb a layer of risk from a cash transfer programme that will need to deliver significantly more payouts in case of a disaster. This allows the government to build on the initial investment in developing a risk financing entity for multiple uses. A good example would be the USA's National Flood Insurance Programme (see Box Case Study A18.1.1).

Box Case Study 1.1: National Flood Insurance Programme, USA

According to the Federal Emergency Management Agency (FEMA), floods (including inland flooding, flash floods and flooding from seasonal storms) occur in every region of the United States. In fact, 90% of all natural disasters in the US involve some type of flooding. If anyone is moving into a new home, apartment, or business location, he/she may ask the mortgage lender, local officials, or insurance professional if the location has been known to flood.

The National Flood Insurance Program (NFIP) will also be able to provide flood risk information on your area. Even if one doesn't live in a high flood risk area, one is still living in some danger of loss from a flood, because 20% of all flood claims are filed in low to moderate flood risk areas. That means, one should know how to prepare for the possibility of a flood, know your flood insurance options and obtain adequate coverage.

Flood insurance basics

- *Insuring oneself against a flood is a little different than other policies.*
- *Floods are not covered under homeowners and renters policies. Only a specific flood insurance policy will cover home flood-related losses.*

- *Most flood insurance is administered through the federal government. Homeowners, renters and businesses can purchase flood policies from an insurer under contract with FEMA. Federal flood insurance is available where the local government has adopted adequate flood plain management regulations under the NFIP—and many communities participate in the programme.*
- *Flood insurance covers direct physical losses from floods and losses resulting from flood-related erosion caused by waves or currents of water exceeding anticipated cyclical levels and accompanied by a severe storm, flash flood, abnormal tide surge or a similar situation that results in flooding.*
- *Flood insurance coverage for the structure and contents of the home are sold separately. Buildings are covered for replacement cost, but coverage for personal property is available on an actual cash value basis only.*
- *The maximum flood insurance coverage amount is USD 250,000 for the structure of the home and USD 100,000 for the contents of the home. ('Excess' coverage over and above the maximums that are available from NFIP is offered by private insurers).*
- *Flood losses for cars are covered under the optional, comprehensive portion of a standard automobile insurance policy.*
- *Commercial flood insurance is available from the NFIP; it provides up to USD 500,000 of coverage for your building and up to USD 500,000 for its contents. one can also purchase what's called "excess" insurance coverage to rebuild properties valued above those limits.*

Source: FEMA Site: fema.gov

Financial Disaster Risk Analytics

The need for financial risk information and risk analysis to enable progress in disaster risk financing and insurance highlights a fifth, crosscutting policy area: financial disaster risk analytics. Financial risk analytics empowers governments to take more informed decisions by bridging the gap between raw risk data and information that is useful to policy makers. While this is not a type of disaster risk financing per se, it is a prerequisite for effective use of disaster risk financing strategies and tools.

Many governments have chosen to include improving the quality and availability of financial risk information and the adoption of financial risk analytical tools as policy objectives in their overall disaster risk financing and insurance strategies. For example, financial risk analytics helped policy makers in the Philippines to understand the all-important details when deciding between financial instruments for a sovereign risk transfer transaction. This helped the government to identify the most appropriate and financially efficient strategies to fund disaster losses, based on the country's risk profile and political constraints faced (see also Clarke and Poulter 2014).

Disaster risk financing and insurance sits at the nexus of four major policy practices:

- disaster risk management, in terms of how it contributes to building resilience;
- public financial management, in terms of how it addresses the impact of shocks on public finances;
- financial sector development, in terms of how it builds a strong financial sector

for risk transfer; and,

- social protection, in terms of how it supports contingent financing to reach the poorest.

Thus, disaster risk financing and insurance strategies are best advanced when integrated into broader strategies in one or more of these fields. Indeed, strong public financial management of disaster risk is particularly important to support the execution of broader disaster risk management strategies, specifically, disaster risk financing and insurance programmes.

The private sector plays an essential role in the ongoing development of, and access to, disaster risk financing and insurance solutions. It does this primarily by providing capital and technical expertise, and by driving innovation. The private sector also plays a crucial role through public- private partnerships in insurance programmes, for example in the delivery of payouts to beneficiaries as well as in the education of consumers.

Convergence between insurance and reinsurance markets and capital markets through the emergence of alternative risk transfer solutions (such as catastrophe bonds and catastrophe swaps) have allowed the pool of catastrophe risk-bearing capital to increase flexibly over the past decade. For example, investors such as pension funds who typically would not have interacted with the world of catastrophe risk have had the opportunity to put their capital to work in instruments such as catastrophe bonds. Risk takers such as insurance and reinsurance companies have been able to increase their capacity to underwrite risk by passing excess risk on to new capital sources.

In the current Kerala floods, as in many developing countries, most of the disaster losses were uninsured. The financial market, people who have high exposure, private sectors who have to design the insurance product and the governance of disaster risk management have been very shy in providing such options to the people where the government cannot guarantee the compensation of loss occurring due to disasters. Examples abound of developing countries gradually capitalising the insurance market as an option for building financial resilience.

Agencies such as insurance companies, re-insurance, Insurance Regulation Development Authority, Department of Finance, Revenue, World Bank, UNDP, National Institute of Disaster Management, National Disaster Management Authority, National Insurance Academy, Insurance Institute of India, Gujarat State Disaster Management Authority may be invited to further deliberate and draft an appropriate disaster insurance product with the Government of Kerala.

Gender Equality and Social Inclusion

Table 2

Statement of Losses to Integrated Child Development Services (ICDS) Offices as on 26 September 2018

Districts	Completely damaged and need re-construction		Partially damaged and need repair	
	No. of ICDS offices	Reconstruction charges (INR 50 lakh/centre)	No. of ICDS offices	Repair charges (INR 10 lakh/office)
Thiruvanantha-puram	NIL	NIL	NIL	
Kollam	NIL	NIL	NIL	
Pathanamtitta	NIL	NIL	1	10.00
Alappuzha	NIL	NIL	NIL	
Kottayam	NIL	NIL	NIL	
Idukki	NIL	NIL	NIL	
Ernakulam	1	50.00	1 (Alangad)	10.00
Thrissur	NIL	NIL	1	10.00
Palakkad	NIL	NIL	NIL	
Malappuram	NIL	NIL	NIL	
Wayanad	NIL	NIL	1 (Panamaram adl)	10.00
Kozhikkode	NIL	NIL	NIL	
Kannur	NIL	NIL	NIL	
Kasargode	NIL	NIL	NIL	
TOTAL	1	50.00	4	40.00

Table 2

Statement of Losses to Integrated Child Development Services (ICDS) Offices as on 26 September 2018

	Flood-affected col-onies	Flood-affected families	Families shift-ed to relief camps	Number of people died
Wayanad	338	3810	3810	-
Malappuram	19	495	495	7
Kozhikode	27	181	173	-
Kannur	14	449	423	-
Palakkad	30	1150	374	3
Ernakulam	16	282	282	-
Thrissur	25	279	278	-
Idukki	56	3243	1368	4

Pathanamthitta	19	430	114	-
Kottayam	31	213	166	-
Thiruvananthapuram	3	152	152	-
Total	**578**	**10,684**	**7,635**	**14**

Source: ST Department, Government of Kerala

Table 3

Post-Flood Situation-Based Planning Need in Each District as Estimated by the Scheduled Caste Department, Government of Kerala

District	No. of people affected	No. of people in camps	No. of houses completely destroyed	No. of houses partially destroyed	Loss of own land	No. of damaged toilets	No. of damaged wells
Thiruvananthapuram	885	0	75	320	0	128	13
Kollam	2,521	2,061	5	14	0	0	22
Pathanamthitta	6,651	5,125	234	1,413	1	963	0
Alleppey	20,867	19,163	166	1,470	0	1,639	6,012
Kottayam	9,159	7,466	331	1,167	0	0	0
Idukki	1,637	1,393	65	234	0	0	0
Ernakulam	17,301	10,324	373	2,878	0	4,811	384
Thrissur	21,709	10,174	971	2,311	69	1,676	9
Palakkad	1,350	0	265	618	0	333	202
Malappuram	3,034	2,153	71	476	23	398	135
Kozhikode	2,999	2,443	12	52	0	125	1
Wayanad	976	621	57	248	72	81	22
Kannur	69	16	6	20	0	0	0
Kasargod	0	0	1	2	0	0	0
Total	89,158	60,939	2,632	11,223	165	10,154	6,800

Source: Data collected from SC Department, Government of Kerala

Macro Impact

Table 1

Estimates of Remittances to Kerala During 2018–19 With and Without Depreciation of the Indian Rupee

Estimates of remittances to Kerala (without depreciation)	Amount
Actual remittances to India during the April to June 2018 (INR crore)	125,700
Estimated remittances to India during 2018–19 (INR crore)	502,800
Estimated remittances to Kerala during 2018–19 (INR crore)	95,532
Estimates of remittances to Kerala (with depreciation)	**Amount**
Actual remittances to India during the April to June 2018 (USD billion)	18,763
Estimated remittances to India during 2018–19 (USD billion)	75,052
Estimated remittances to Kerala during 2018–19 (USD million)	14,259.88
Estimated remittances to Kerala during 2018–19 (INR crore)	104,331.36
Increase in remittances due to INR depreciation (INR crore)	8,799.36
Increase in remittances due to INR depreciation (%)	9.21
Estimated remittances to Kerala (without depreciation) (INR crore)	95,532
Estimated remittances to Kerala (with depreciation) (INR crore)	104,331.36

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