Chapter 3: Cross-cutting Foundational Elements under RKDP

4.1 Disaster Risk Management and Resilience

4.1.1 Introduction

Kerala is highly vulnerable to multiple natural and anthropogenic hazards and a changing climate, given its mountainous topography and hydrological features[14]. Communities regularly face low-severity, high-frequency disasters such as floods, rains, landslides, flash floods due to intense precipitation and mudflows. More broadly, the state is largely prone to cyclones, storm surge, coastal erosion, sea level rise, tsunami, flood, drought, lightning, landslide (debris flows), land subsidence (due to tunnel erosion or soil piping), and earthquake. Kerala is also one of the most densely populated Indian states (860 persons per square kilometers) which makes it even more vulnerable to damages and losses because of disasters. Floods are the most common of natural hazards that affects the State. Nearly 14.8% of the State's land area is prone to floods, and the proportion is as high as 50% for certain districts. The state has been included in the earthquake zone III, where the maximum expected magnitude is 6.5[15]. Kerala falls under Moderate Damage Risk Zone for Wind and Cyclone (Vb=39 m/s). As per IMD data for the period 1877-2005, the state witnessed six cyclonic storms and five severe cyclonic storms. The state also witnesses high incidence of lightning, especially in the months of April, May, October and November, which has caused heavy loss of lives. Landslides are a major hazard along the Western Ghats in Wayanad, Kozhikode, Idukki and Kottayam districts. 2018).

Kerala experiences seasonal drought conditions every year during summer months and 50% of its land area is moderately to severely drought susceptible. The State was officially mapped as mild to moderately arid by the IMD after the drought years of 2002-2004, 2010, and 2012. In 2017, the state was hit by the worst drought in 115 years. Increasing incidence of drought is mainly due to weather anomalies, change in land use, traditional practices and lifestyle of people. Other natural hazards faced by the states include forest fires, soil piping, swell waves and tsunami.

4.1.2 Key drivers of Kerala's disaster vulnerability

Multi-sectoral drivers

The impact of heavy rainfall and associated floods in August 2018 was exacerbated by a number of current and legacy factors. The severity of the floods and the damage caused can be attributed to several factors. These include changes in land use and cover, antecedent hydrologic conditions, reservoir storage and operations, encroachment of flood plains, poor agriculture

14 Kerala 2018 Floods PDNA
15 Kerala State Disaster Management Plan 2016

practices adversely impacting downstream riverine ecosystems, shrinkage of carrying capacity of lakes and rivers, inadequate early warning and protocols, lower community preparedness, partial activation of disaster response SOPs etc.[16].

However, there were several underlying multi-sector issues that contributed to the heavy impact of floods and have exacerbated the vulnerability of state to disasters. These include unsustainable and inadequate management of natural resources, climate change. limited/ restricted/restrained dissemination of disaster risk information, lack of awareness of disaster risks, inadequate capacity to deal with high intensity disasters, degrading environment due to extensive exploitation of the natural resources and deforestation, and slow roll out of community-based disaster risk management (DRM) activities.

Deteriorating infrastructure and encroachments: Deteriorating, aging and poorly maintained infrastructure including irrigation channels, minor major and irrigation dams, eroding river embankments, roads, bridges, have accentuated the disaster risks. Encroachments into water bodies and sand mining from rivers, water channels and canals, leading to narrowing carriage capacity of these water channels, poor or nil solid waste management and sanitation disposal /treatment facilities have also contributed to the state's increasing vulnerability to natural hazards.

Poor land use planning: Current land use pattern and practices in the state have also contributed to the increase in disaster risk. Changes in land use and cover also affected the hydrological conditions, which, in turn can affect flood peaks and inundation How much impact historic land cover change in Kerala had on the severity of 2018 floods is yet to be ascertained. On the policy side, land use regulations are spread across multiple, incongruent acts, orders and rules. Lack of streamlined and singular land management policy/regulation and weak enforcement has led to an overlap of business and habitation zones and establishment of associated public infrastructure. This is further compounded by high population density of 860 people/km^2 (2011 Census), narrow, dense and intrinsic road network, dense coastal populations and general higher standard of living of the public as compared to the rest of the country.

Drivers of urban vulnerability to disasters: The widespread flooding in urban and semi-urban areas of Kerala has reaffirmed absence of risk-informed urban planning, non-compliance to design standards, and non-incorporation of resilient features in urban infrastructure. Rapid urbanization influenced habitations into uncontrolled expansion on both banks of the rivers/water bodies thereby encroaching into water channels/bodies and constricting the floodplains. Inadequate storm water drainage and silting of minor storage ponds and flood plains in urban and urban sprawl areas have increased flood risks. Most urban master plans are not yet approved and there is little evidence of hazard risk informed planning process in the State.

16 Kerala 2018 Floods PDNA

Climate change: Jury is still out on the correlation between 2018 floods and climate change. Extreme precipitations and runoff conditions that caused the 2018 flooding were unprecedented. However, despite the significant warming observed between 1951-2017, the mean and extreme precipitation and total runoff have not increased and hence attributing 2018 floods in Kerala to climate change can be difficult[17]. The 2018 floods are more likely to be driven by anomalous atmospheric conditions due to climate variability than anthropogenic climate warming. On the other hand, climate change is likely to be more pronounced in Kerala since extreme precipitation in southern India increases with a much faster (18%/K) rate in response to warming in comparison to north India[18] (Mukherjee et al., 2018). Extreme rainfall at 1-15 days duration in August 2018 in the catchments upstream 15 of the three major reservoirs (Idukki, Kakki, and Periyar) had the return period of more than 500 years. In January 2019, the state, for first time witnessed subzero temperatures in the hills such as Idukki, Munnar, Wyanad etc. for over 4 days leading to frost and formation of snow in many areas. The state has also had its share of droughts with critical droughts in the years of 2013, and winters of 2017. Lack of adaptive capacity of the state to floods, droughts, and mudflows, that are expected to increase in both frequency and severity because of climate change, could worsen their impact. Another impact being witnessed is progressive coastal erosion affecting nearly 63% of the state's 580 km coastline[19].

Some of the other factors that have increased the vulnerability of the population in the state to disasters include - coastal erosion, land subsidence due to tunnel erosion or soil piping and unsustainable exploitation of natural resources These factors, combined with limited consideration of disaster risk within social and economic sectors, partly because of competing demands on limited financial resources and inadequate capacity, underpin the high disaster risk levels in Kerala.

Drivers and challenges specific to the DRM sector

The increasing vulnerabilities due to a variety of factors such as rapid urbanization, environmental degradation, growing population and climate change compounded the disaster risks in the State and this mandated a paradigm shift from a relief centric approach to a proactive and comprehensive mindset towards disaster management covering all aspects from prevention, mitigation, preparedness to response and recovery[20].

17 Mishra V, Shah H: Hydro climatological Perspective of the Kerala Flood 2018, Journal of Geological Society of India, Volume 92, Issue 5, 511-650, doi:10.1007/s12594-0018-1079-3

18 Mukherjee, S., Aadhar, S., Stone, D. and Mishra, V.: Increase in extreme precipitation events under anthropogenic warming
in India, Weather Climate. Extreme., 20(July 2017), 45–53, doi: 10.1016/j.wace.2018.03.005, 2018.

19 Shoreline Change Assessment of Kerala, National Centre for Sustainable Coastal Management, Kerala, June 2018

20 Kerala State Disaster Management Plan Profile, KSDMA

Response-oriented disaster risk management: 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 disaster risk reduction (DRR) across key sectors. Although the SDMP has mandated departments to allocate 10% of their budget for integrating DRR in their sectors, no such allocation has happened in practice.

Inadequate risk information mechanisms: The collection and availability of disaster risk information, including hydro-meteorological data, is limited and scattered across multiple agencies, which, is often not shared between agencies. This reduces the scope of terrain, weather and hydrology and disaster risk informed planning. For example, there are 422 metrological stations managed by 16 agencies comprising of various research institutes, weather monitoring institutions both government and private, commercial entities, and state line departments. River morphological studies and related data is now out dated, and custodians of this data are reluctant to share the same. Data from 143 river gauges, 422 meteorological, and 7 observatory stations are not even automated. Kerala has failed to ensemble these data into a single platform to routinely monitor and provide accurate forecasts and flood warnings. The underlying issue is the prevalent protocol of information sharing is subjected to receipt of forecast data from a single source – Indian Metrological Department (IMD), leading to lower scale of accuracies, and shorter lead time to undertake emergency response measures. Inadequate regulatory arrangements with non-IMD weather data sources prevent the state from utilizing multi-model super-ensemble forecasting, which can significantly reduce errors in model output and provide more accurate forecasting.

Further, data captured by different agencies are not systematically analyzed and shared with the line departments to factor the same into planning and investment decisions. The KSDMA, in the KSDMP profile stipulates plans to add medium and long term structural and non-structural prevention and mitigation plans based on micro-level, hazard, vulnerability and risk analysis. However, this analysis is yet to be undertaken. There is a need to ensure free flow of information to and from all relevant entities to facilitate their systematic planning and investments, enforcement of DRR regulations, monitor implementation and compliance of DRM measures. The state should consider options to develop a data analyzing and clearing house function in the State, preferably under the Kerala Spatial Data Infrastructure (KSDI).

The State Disaster Management Plan stipulates restrictions in hazard zones and has laid checklists for risk assessment, to be followed by the implementing department prior to approving any infrastructure development projects. However, there’s sub-optimal application of risk-information by agencies, partly due to unavailability of downscaled multi-hazard vulnerability maps (up to 1:5000).

Legal and policy framework for disaster risk management: The Kerala State Disaster Management Authority (KSDMA) established under the Disaster Management Act 2005 (Central Act 53 of 2005), in the aftermath of December 2004 Indian Ocean Tsunami, identifies disaster risks as one of the main challenges to Kerala's development aspirations. Although prevention is clearly articulated as a role to be performed by the KSDMA, its facilitating role in pre-disaster risk management and its relationship with sector departments and other related agencies, are not clearly articulated and enforced. The Kerala State Disaster Management Policy of 2010 needs an urgent relook to fit to the newly emerged disaster risks.

Complex Institutional setup for disaster management: The existing institutional arrangements for DRM mainstreaming are complex. Multiple government agencies and departments deal with Disaster Risk Management (DRM) directly or indirectly. The KSDMA is responsible for both risk monitoring, developing and recommending mitigation/DRR measures and providing early warning. However, weather forecasting is done by the IMD, the Central Water Commission (CWC) is responsible for hydrology and climate, Minister of Earth Sciences for monitoring earthquakes, amongst others, without an integrated system linking them to KSDMA.

Under the existing governance structure, KSDMA and DDMAs are placed to support DRM across various government departments and agencies in the state through its coordination and facilitation mandate. However, to play its role in DRM, protocols for relationships and links between the KSDMA and other agencies that produce and analyze DRM related data and information, the sector departments and agencies, need to be developed with clearly defined roles for each institution. Risk governance, capacity, and funding limitations indicate that DRM mainstreaming efforts have not been fully embedded in core sector activities in the state.

Inadequate disaster risk financing mechanism: Current system is characterized mostly by ex-post financing mechanisms (*e.g.*, budget reallocations) rather than ex ante (*e.g.* insurance of public assets, market-based risk transfer etc.). The state draws its finances for DRM activities from Government of India, and multilateral financing institutions like ADB and World Bank which are largely focused on pre and post-disaster response activities and related policy support.

The Disaster Management Act, 2005 provides an enabling environment for the creation/establishment of disaster risk funds– a) disaster response fund and, b) disaster mitigation fund at the National, State, and District-level[21]. Presently only the National and State Disaster Response Funds (NDRF and SDRF) are

21 National Disaster Response Fund (NDRF), State Disaster Response Fund (SDRF), District Disaster Response Fund (DDRF), and National Disaster Mitigation Fund (NDFM), State Disaster Mitigation Fund (SDMF), District Disaster Mitigation Fund (DDMF).

constituted and these funds are primarily aimed at financing expenses for emergency response, relief and rehabilitation only. Both NDRF and SDRF cannot be used for financing either mitigation and/or post-disaster reconstruction activities whereas the Mitigation Funds have not yet been constituted at both National and State levels. Strong financial management of disaster risks supports –

a) **Disaster Risk Management:** By putting a 'price' on the risk, disaster risk finance & insurance (DRFI) provides cost-benefit trade-offs in investment in climate and disaster risk reduction, risk retention, and risk transfer and ensures that the government is financially prepared to enact a swift post-disaster response and reconstruction; and
b) **Public Financial Management:** By strengthening fiscal risk and public debt management agendas helps the government to identify, clarify, and manage its contingent liability to disasters, and to ensure that disasters do not negatively impact the debt profile and budget objectives for a country's development.

4.1.3 Proposed Transformational Approach for Rebuilding Resilient Kerala

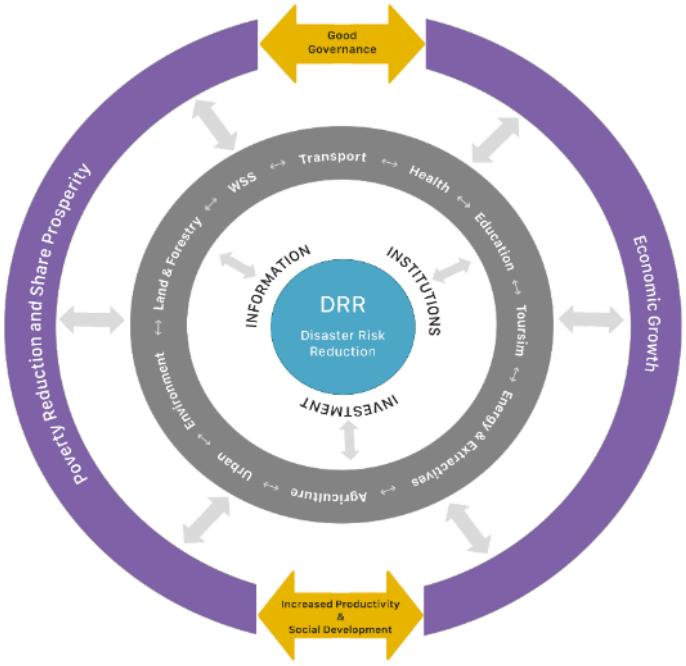
Disaster Risk Management as a Cross-cutting Theme

In order to achieve resilient recovery and development of Kerala, mainstreaming disaster risk reduction and resilience across sectors is key. Resilience is required in all sectors to protect against cascade failure and to adapt the infrastructure against a slowly changing climate over the longer term. The August 2018 floods had a multi-sectoral impact, not just within sectors but also among. The floods highlighted the interdependencies among various sectors and the 'cascade failure' where the failure of one aspect of infrastructure, such as flood defenses and reservoir, can lead to other failures, submerged roads, damaged power infrastructure, leading to power cuts which thereby affect telecommunications networks. The interdependencies in sectors therefore need to be managed well, especially as infrastructure is becoming more interdependent. Mainstreaming resilience across sectors is a systems issue, requiring collaboration, planning and sharing of information between sectors, anchored in the Rebuild Kerala Development Program.

The RKDP takes a systems approach, rather than sector approach, to prepare for next extreme event and adapt to climate change. Resilience in one sector is dependent on resilience in another, so modelling infrastructure systems and scenario planning is essential to ensure that vulnerabilities in one sector do not compromise others. Sharing of data and collaboration across the supply chain will be requisite for such systems-level planning. System oriented resilient recovery and development requires medium-long term planning for adapting and maintaining infrastructure and mainstreaming of resilience in regulatory and policy framework. Regulations and design standards across sectors need to be revised to reflect the multi-hazard exposure, vulnerability and uncertainty due to climate change. Regulation must also be adapted to allow greater information

sharing and collaboration across the supply chain to facilitate Kerala's resilient recovery and development as a whole.

Figure 12: An illustration of the cross-sectoral linkages and disaster risk reduction



In the aftermath of the floods, both structural and non-structural measures need to be undertaken to build resilience and build-back-better. Across sectors like water, roads, transport, infrastructure designs and plans, as well as institutions, regulations and standards need to be adapted and even be adaptable to accommodate a range of future climate conditions. Changes in land cover and use, resource availability and demographics in population will require flexibility in infrastructure location and design. RKDP's multi-sectoral risk-informed recovery and development planning is anchored in three key risk questions:

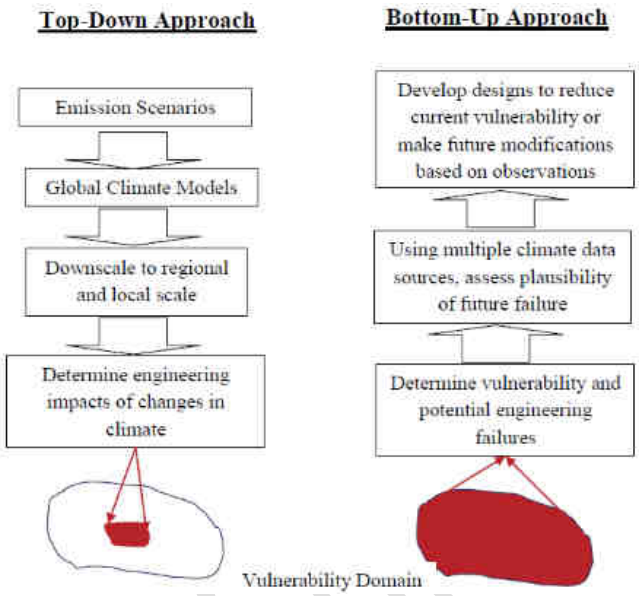
(1) What can happen? (i.e., what can go wrong?)
(2) How likely is it to happen?
(3) If it does happen, what are the consequences?[22]

Answering these questions would require conducting comprehensive multi-hazard risk assessment, that will be key to systematically identify potential hazards, estimate its likelihood of occurrence and its consequences, using appropriate downscaling techniques. All relevant sectors would require vulnerability assessments to determine the design and planning changes required to make their infrastructure and services resilient. Depending on the level of downscaled projections available, sectors can choose to take a top-down

22 Rolf Olsen, Ph.D., American Society of Civil Engineers. (2015). *Adapting infrastructure and civil engineering practice to a changing climate*. Reston, VA, Committee on Adaptation to a Changing Climate.

or bottom up approach. The bottom-up approach is more akin to traditional engineering failure analysis in that modes of failure and the consequences are first assessed. This risk *or climate-informed decision analysis*[23] *would then help* evaluate the plausibility of these conditions occurring in the future.

Figure 13: Top-down versus bottom-up approach to climate proofing and adaptation



Source: Adapting Infrastructure and Civil Engineering Practice to a Changing Climate, 2015

While conducting resilient recovery planning, sectors should consider incremental cost of additional actions, to make cost effective decisions. Disaster risk reduction and embedding resilience would require adding incremental features to reduce failure risks as long as the incremental benefits are perceived to exceed the incremental costs.

Sendai Framework for Disaster Risk Reduction as a Guiding Principle

A resilient rebuilding and development pathway, as envisaged by RKDP, will adopt the Sendai Framework for Disaster Risk Reduction 2015-2030[24] as a guiding principle for developing and prioritizing actions and investments. India adopted the Sendai Framework at the Third UN World Conference for Disaster Risk Reduction in March 2015. Under the Sendai Framework, four priorities for action are identified:

23 Hallegatte, Stéphane, Ankur Shah, Robert Lempert, Casey Brown, and Stuart Gill. (2012). *Investment Decision Making Under Deep Uncertainty – Application to Climate Change*, World Bank Policy Research Working Paper 6193, The World Bank. Sustainable Development Network, Office of the Chief Economist.

24 https://www.unisdr.org/we/coordinate/sendai-framework

i. **Understanding disaster risk:** DRM should be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment. Such knowledge can be used for risk assessment, prevention, mitigation, preparedness and response.

ii. **Strengthening disaster risk governance to manage disaster risk**. Disaster risk governance at the national, regional and global levels is very important for prevention, mitigation, preparedness, response, recovery, and rehabilitation. It fosters collaboration and partnership. Creation and operationalization of national platforms are a critical part of this process, bringing together stakeholders with a role to play in risk reduction and management.

iii. **Investing in disaster risk reduction for resilience.** Public and private investment in disaster risk prevention and reduction through structural and non-structural measures are essential to enhance the economic, social, health and cultural resilience of persons, communities, countries and their assets, as well as the environment.

iv. **Enhancing disaster preparedness for effective response and to 'Build Back Better' in recovery, rehabilitation, and reconstruction.** The growth of disaster risk means there is a need to strengthen disaster preparedness for response, act in anticipation of events, and ensure capacities are in place for effective response and recovery at all levels. The recovery, rehabilitation and reconstruction phases present a critical opportunity to build back better, including through integrating disaster risk reduction into development measures.

Inclusive Resilience

As highlighted in Sendai Framework, the State will integrate gender, age, and disability considerations in policies and practices to ensure inclusive and resilient development. Disability-responsive DRR efforts will be strengthened across the state, including disability sensitive training, appropriate equipment and design and construction of infrastructure for DRR purposes. Understanding the different needs and capacities of women and men is critical to effective DRM, including enhancing women's role in building broader resilience. Efforts will be made to ensure compliance with the 15th Finance Commission's recommendations on gender budgeting in DRR through allocation of seed funds to ensure equitable facilities are made available for both men and women in relief camps and shelters. Further, to ensure gender sensitivity at grass root levels, grant in aid as part of the central allocations to the State may also be allotted to advertise gender sensitivity in disaster risk reduction, thereby augmenting State resources for LSGs.

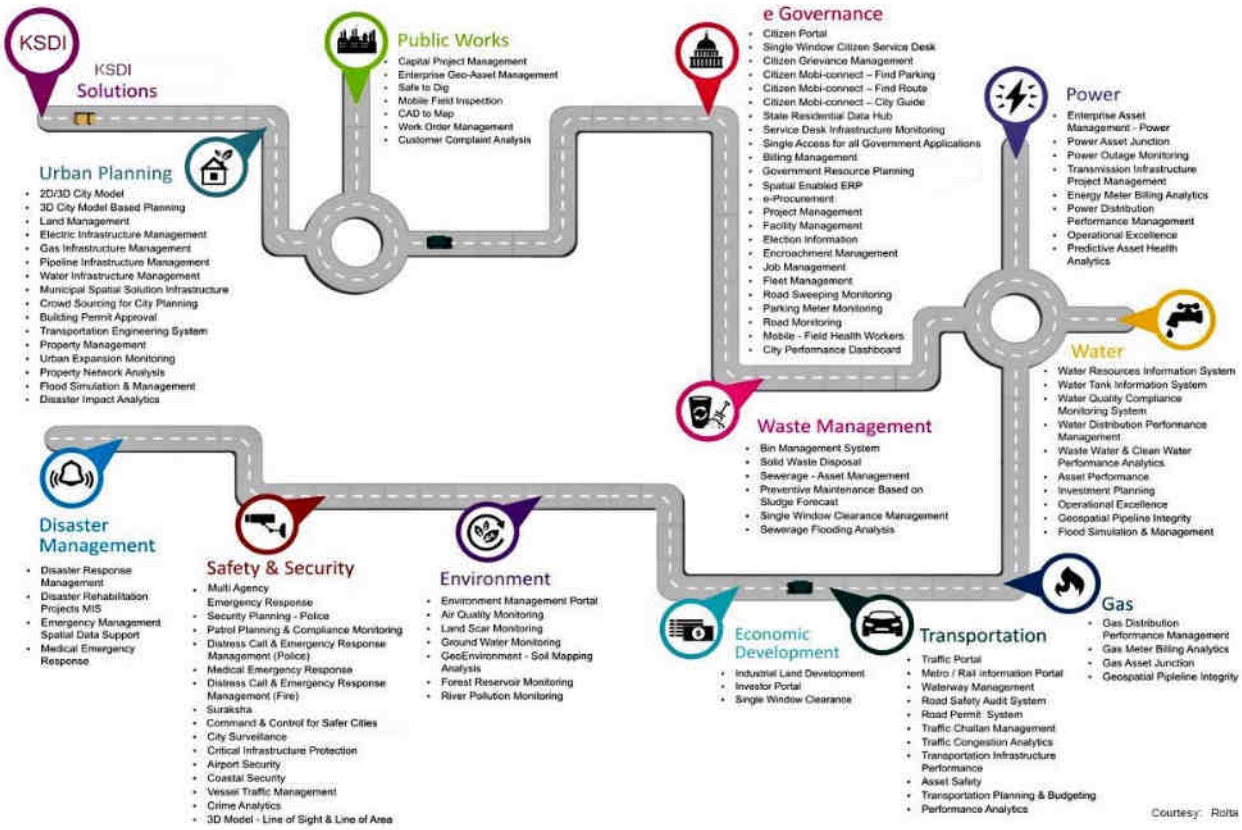
4.1.4 Specific Interventions

Kerala will prioritize *and implement* the following actions and investments using the Sendai Framework as a guiding principle and applying specific principles of resilience as described above. Key principles of resilience are described in Section 3.4.

Priority 1. Understanding disaster risk

- Conduct multi-hazard risk assessments using various return periods. This will include hazard and disaster modeling, exposure database, vulnerability analyses of buildings, infrastructure, and communities, and calculation of damages.
- Prepare multi-hazard risk maps based on the risk assessments and stakeholder consultation workshops.
- Prepare landslide hazard zonation maps in a scale appropriate for planning at local level for all Municipalities and Panchayats in the Hilly areas (at least 1:5,000 scale).
- Integrate the risk maps into master plans. Develop a guideline/policy document for preparation of risk-informed master plans by ULBs.
- Establish a sustainable disaster risk management information system to ensure free flow of information and data between departments and various portals by centrally linking to the Kerala State Spatial Data Infrastructure (KSDI). The data flow diagram is given below for reference.

Figure 14: KSDI data flow diagram



Priority 2. Strengthening disaster risk governance

Mainstreaming disaster risk management into development planning

- Prepare Departmental Disaster Management Plans including a 5-year business/operational plan (2021–2025) for all sectoral departments, an inter-sectoral coordination and information sharing for DRM, and the allocation of the annual plan budget of the respective department for investment in DRR.
- Establish dedicated disaster mitigation cells, units, or focal points in key sector departments (PWD, water, energy, transport, health, education, environment, and agriculture) under the overall guidance of KSDMA and Department of Environment and Climate Change.
- Evolve a comprehensive training strategy of the Disaster Management Virtual Cadre in the State to capacitate the respective departments.

Resilient Design Standards and Enforcement

- Improve flood protection and design standards. Based on the multi-hazard susceptibility, plan and design for once in a 50-year river flood protection for major rivers including the canal systems. The planning will consider both existing climate and land use condition and future scenarios such as year 2040 with climate change and urbanization. Public service design standards may be upgraded to the 1 in 50-year return period flooding and landslide

events (Nodal Department: Water Resources, Public Works Department, LSG Public Works Department).

- Review and amend as appropriate Kerala Municipal Building Rules and Kerala Panchayath Building Rules considering local risk patterns across the State, National Building Code and IS Codes.
- Develop design guidelines for climate resilient municipal infrastructure and ensure proper enforcement for all the physical construction works to improve the quality of municipal infrastructure services. (Nodal Department: Local Self Government Department, Public Works Department and Public Works Department).
- Strengthen the regulatory enforcement procedures and systems to ensure all new critical infrastructure projects comply with safe standards and specifications. Build the capacity of LSGD and PWD engineers as well as Kerala's construction industry in coordination with the Engineering Council of India. Apply third party structural and safety audits to ensure compliance. (Nodal Department: Local Self Government Department)
- Enhance resilience of settlements by providing incentives to constructions that comply with safety standards and have considered site specific hazard susceptibilities. (Nodal Department: Department of Disaster Management, Local Self Government Department, KSDMA)

Institutional Strengthening of KSDMA and DDMAs

- Strengthen the SDMA's role and resources to act as the coordinating and technical support agency for mainstreaming DRR and climate change adaptation into Kerala's development planning and move Kerala towards adaptive governance.
- Update the State and District Disaster Management Plans and emergency operation manuals based on lessons learned from the recent disasters.

Priority 3. Investing in disaster risk reduction for resilience

Mitigation Infrastructure and Measures

- Construct multi-purpose emergency shelters and improve access to such shelters. Hand over the shelters to the communities with corpus fund for operation and maintenance. (Nodal Department: LSGD Public Works Department, DDMA)
- Formulate a long-term Coastal Zone Disaster Mitigation Plan with a comprehensive Coastal Development funds package (2018-19 state budget), year-to-year basis for investments in coastal protection works. (Nodal Department: Coastal Zone Management Authority)
- Invest in flood protection infrastructure based on hydrologic and hydraulic studies in the downstream of each dam and river conveyance capacity at different river sections. At a few critical locations along the channels, install real-time water level sensors for flood early warning. (Nodal Department: Water Resources)

- Construct and retrofit education and health infrastructure in hazard-prone areas to increase safety. Prepare Disaster Management Plans for schools and hospitals. (Nodal Department: Education, Health, KSDMA, Local Self Government Public Works Department)

Landslides Management Strategy

- Develop an integrated approach for landslides management. This would involve land use planning, good land management practices in cropping, grazing and forestry, terrain depended road construction, terracing and other contour-aligned practices in fields and plantations, and participation of local communities. (Nodal Department: Local Self Government, Soil Conservation Department).
- Establish a coordination mechanism between Local Self Governments, Soil Conservation Department, Mining and Geology Department, and Ground Water Department for assessing local landslide risks when planning infrastructure. (Nodal Department: Local Self Government Department)
- Promote the use of bio-engineering solutions along slopes to prevent landslides in development zones and in infrastructure projects (Nodal Department: Local Self Government).
- Based on the landslide damage investigation results from the August 2018 event, consult with outside geotechnical experts including academia to develop a landslide monitoring system plan. Measures may include remote sensing data analysis of slow moving slopes and deployment of systems such as ground-penetrating radars (GPRs) for monitoring landslides susceptibility.

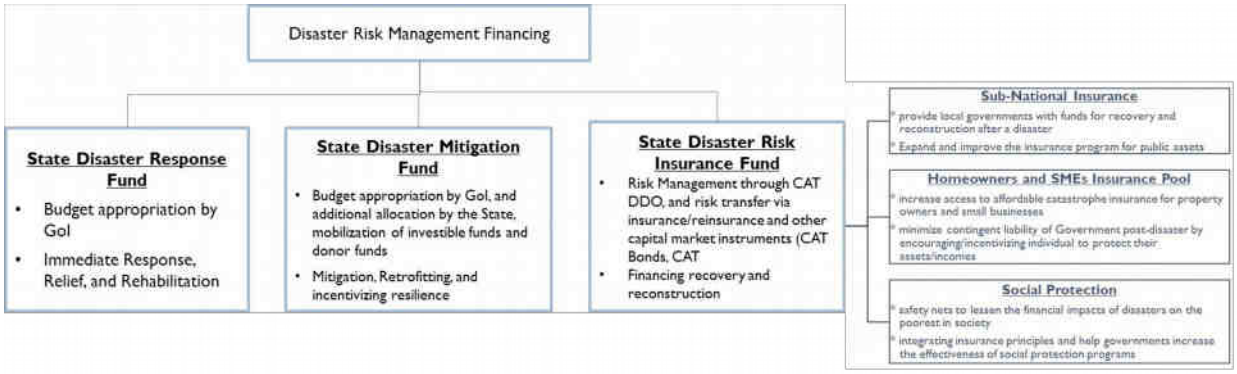
Drought Risk Reduction

- Prepare and implement a State Drought Preparedness and Mitigation Plan.
- Promote graywater recycling and implement public water saving awareness campaigns

Disaster Risk Finance and Insurance

- Develop a State Disaster Risk Finance and Insurance Strategy underpinned by three core functions of State Disaster Response Fund, State Disaster Mitigation Fund, and State Disaster Risk Insurance Fund, as seen in the following image:

Figure 15: New structure proposed for DRM financing



- Launch Diaspora Bonds to finance resilient rebuilding initiatives.
- Develop an incentive program[25] for homeowners and MSMEs to encourage/incentivize catastrophe insurance to protect their assets and businesses (including business interruption risk).
- Popularize existing crop insurance schemes (Nodal Department: Agriculture).
- Develop a model law to insure all critical infrastructure (e.g., roads and bridges, power transmission infrastructure incl. sub-stations, hospitals and schools etc.) in which the government has an interest including Infrastructure-built and operated on PPP basis.
- Develop an insurance-linked social safety net program to support the poorer sections of the community, particularly fishermen and subsistence farmers/agriculture labors, against natural disaster risks.
- Consider innovative value capture financing techniques like TDR, land pooling etc. for raising funds. The Town and Country Planning Act, 2016 has such provisions, however subordinate legislations detailing out these provisions needs to be issued.

Priority 4. Enhancing disaster preparedness for effective response

Improving early warning systems

- Improve hydrometeorological early warning systems. Expedite the establishment of 110 automated weather stations in the State, along with end-to-end multi-hazard early warning systems.
- Develop an advanced hyper local weather prediction tool for monitoring and providing at least village-level extreme weather warnings to public and local authorities. Integrate the tool into the existing decision support system of KSEOC with the support of ISRO.

Improving emergency response systems

- Establish an incident emergency response system in Kerala, as per the NDMA Guidelines on the Incident Response System (IRS).

25 Incentive program could include reduction in stamp duty and/or property tax rebates, interest sub-vention for home/small business loans among other alternatives.

- Strengthen Fire and Rescue Services with adequate high value critical response machinery to fulfill its mandate of being the first responder to emergencies in the State.
- Create two additional Fire and Rescue and Civil Defense training institutes – one in Thiruvananthapuram and the other in Wayanad (with focus on for hill area response training) – to effectively fulfill the mandate of in service training, community capacity building in disaster response and Civil Defense training.
- Strengthen the State Disaster Response Force with adequate human resource and machinery to fulfill its mandates with human resource shared between Fire and Rescue Services and Police.
- Establish an advanced tactical disaster response team with human resource from Fire & Rescue Services and Police.
- Revamp Coastal Police with human resource and machinery to fulfill its mandate of ensuring coastal security, disaster response and in-sea accidents.
- Strengthen Marine Enforcement with human resource and machinery to fulfill its mandate of ensuring marine security, disaster response and in-sea accidents.
- Establish a coordination mechanism between SDMA, DDMAs, and dam operators for early warning, emergency response, and action planning to mitigate downstream impacts (Nodal Department: SDMA, Water Resources, KSEB).

Community-based disaster risk management (CBDRM)

- Create the Civil Defense Force for strengthening and institutionalizing community-based disaster risk reduction initiatives.
- Prepare and implement a capacity building plan linked to the local Civil Defense Volunteers, Community Rescue Volunteers and Aaptha Mithra Volunteers for community-based DRM (CBDRM) in the districts and urban local bodies (ULBs) at high risk, with a focus on women, children, and people with disabilities.
- Design and implement a DRM awareness-raising program for school students from class 1 to class 12 and ULBs at high risk.
- Develop a Comprehensive CBDRM – Communities must be sensitized about their capacity and duty towards DRM process and through simulation and execution drills trained and has a system in place and is capable to take on minor localized disasters at their own and can also trigger and support the government system for prompt action in case of a major disaster.
- Develop a program for constituting Community-based Disaster Management Teams based on global best practices (e.g., Community-based Disaster Management practice of Cuba). It will include training and equipping the presently existing community organizations of students like the National Service Society (NSS) and Student Police Cadet (SPC) as well as community volunteer groups. The trainings will cover detailed first aid lessons and life skills like swimming, rowing and climbing.

Based on the above assessment and discussions with relevant line departments, **immediate time-bound interventions / activities** are summarized in table following:

Table 5: Disaster Risk Management Actions and Results Framework

Activities	(0-6 months)	(0-18 months)	(18 months beyond)	Expected Outcomes
Policy / Regulatory				
- GoK has established new protocols for enhancing emergency preparedness and response capacity of various department.	X			Disaster risk governance strengthened to manage disaster risk (Sendai Priority 2)
- Update the State and District Disaster Management Plans and prepare Departmental Disaster Management Plans including a 5-year business/operational plan (2021-2025), including disaster risk reduction and climate change adaptation.		X		
- Review and upgrade flood protection design standards			X	
- Improve access to disaster risk information in coordination with KSDI			X	
- Strengthen the regulatory enforcement of infrastructure standards and building rules for resilient design and construction of infrastructure and buildings			X	
- Prepare a State Disaster Risk Finance and Insurance Strategy including bonds to maximize finance	X			Disaster risk reduction for resilience (Sendai Priority 3)
Institutional				
- Establish dedicated disaster mitigation cells/units/focal points in core sector departments. Implement		X		Disaster risk governance

Activities	(0-6 months)	(0-18 months)	(18 months beyond)	Expected Outcomes
Policy / Regulatory				
a comprehensive capacity building program for the Virtual Cadre in Disaster Management available in 26 departments to mainstream disaster risk reduction in the respective departments (Nodal Department: KSDMA)				strengthened to manage disaster risk (Sendai Priority 2)
- Establish a coordination mechanism between SDMA, DDMAs, and Dam Operators on emergency response		X		Enhanced disaster preparedness for effective emergency response (Sendai Priority 4)
- Establish a Civil Defense Force for strengthening and institutionalizing community-based DRR initiatives			X	
- Provide training and raise awareness among communities on DRM and training of community-based DRM teams			X	
Investment Planning				
- Construct multi-purpose emergency shelters and improved access to such shelters			X	Disaster risk reduction for resilience (Sendai Priority 3)
- Construct and retrofit existing education and health infrastructure located in hazard-prone areas to higher standards			X	Improved understanding of disaster risk (Sendai Priority 1); Disaster risk reduced for resilience (Sendai Priority 3)
- Formulate a long-term Coastal Zone Disaster Mitigation Plan, Drought Preparedness and Management Plan, Integrated Flood Risk Management Plan as well as a Landslide Management Strategy including nature-based solutions		X		
- Improve hydrometeorological early warning systems including establishment of last mile hazard communication systems and			X	Enhanced disaster preparedness for

Activities	(0-6 months)	(0-18 months)	(18 months beyond)	Expected Outcomes
Policy / Regulatory				
updating existing SOPs for triggering preparedness and emergency response actions (Nodal Department: KSDMA, DDMA)				effective emergency response (Sendai Priority 4)
- Strengthen State Disaster Response Force, Fire and Rescue Services, and Police with appropriate equipment. Establish two additional Fire and Rescue and Civil Defense training institutes.			X	

4.1.5 Technical studies and assessments

The list of key studies to be carried out to support the above policy, institutional and investment activities is provided below.

Table 6: Disaster Risk Management List of Studies

List of studies	(0-6 months)	Estimated costs	(0-36 months)	Estimated costs
Policy / Regulatory				
- Conduct comprehensive 1:10,000 scale land use mapping and terrain linked land use zoning. Conduct comprehensive 1:4,000 scale land use mapping for select urban local bodies of the state (Nodal Department: Department of Planning, Land Use Board, KSREC).	X	INR 1.4 Crores		
- Conduct a 1:25,000 scale multi-hazard, vulnerability and risk assessment incorporating 1 in 5, 1 in 10, 1 in 15 and 1 in 30-year return interval hazard scenarios. Prepare risk maps. (Nodal Department: KSDMA)			X	INR 7 Crores
- Conduct a study to explore sustainable financing options for DRR, preparedness, and response and to establish a sustainable financing mechanism	X	INR 1.4 Crores		
Institutional				
- Conduct an institutional and regulatory assessment for enforcing the Kerala Municipality Building Rules including legal and administrative procedures, construction quality, supervision, and certification systems. Develop a roadmap and training programs for enforcing climate resilient Building Rules and construction standards.			X	INR 1.4 Crores
Investments Planning				
- Conduct a detailed state-wide vulnerability assessment of critical public infrastructure and assets to site/location specific hazards (Nodal Department: PWD, LSGD PWD, DDMA, KSDMA)			X	INR 35 Crores
- Assess the capacity of State and District EOCs including early warning systems and develop a roadmap for strengthening the systems.	X	INR 1.4 Crores		