GOVERNMENT OF KERALA

STATE PLANNING BOARD

THIRTEENTH FIVE-YEAR PLAN
2017-2022

WORKING GROUP ON

CLIMATE CHANGE AND DISASTER MANAGEMENT

REPORT

AGRICULTURE DIVISION

THIRUVANANTHAPURAM
MARCH 2017

PREFACE

In Kerala, the process of a Five-Year Plan is an exercise in people's participation. At the end of September 2016, the Kerala State Planning Board began an effort to conduct the widest possible consultations before formulating the Plan. The Planning Board formed 43 Working Groups, with a total of more than 700 members – scholars, administrators, social and political activists and other experts. Although the Reports do not represent the official position of the Government of Kerala, their content will help in the formulation of the Thirteenth Five-Year Plan document.

This document is the report of the Working Group on Climate Change and Disaster Management. The Chairperson of the Working Group was Professor T Jayaraman.The Member of the Planning Board who coordinated the activities of the Working Group was Professor T Jayaraman. The concerned Chief of Division was Dr P Rajasekharan.

Member Secretary

CONTENTS

CHAPTER 1
CONTEXT

1. Comprehensive understanding and accurate prediction of climate are crucial for decision-making in agriculture, water resource management, disaster management, and for various other socio-economic sectors. Increasing network of observations of weather parameters, coastal/oceanic variables, hydrological parameters and inundation maps and advanced skillful modelling framework for accurate climate prediction and climate change projection, are useful for the preparedness to face the challenges thrown by climate variability and climate change. Increased incidence of extreme events such as floods, droughts and storms will affect the safety and efficiency of fishing operations and increase damage and disruption to coastal and riparian homes, services and infrastructure. Sea level rise and other large-scale environmental changes will have unpredictable effects on coastal environments and livelihoods. In the context of climate change and natural disasters it is also crucial to assess effectiveness of various adaptation strategies and mainstream such strategies, including disaster management planning, with overall planning for development.

2. The working group on *Climate Change and Disaster Management* met thrice during October-November 2016 to deliberate on various issues associated with climate change and disaster management in the context of 13th Five Year Plan in Kerala. This report provides a summary of these deliberations and is structured as follows: The next section discusses the climate variability and climate change projections for Kerala. The third section discusses briefly the impacts of climate change in Kerala. The fourth section provides a summary of vulnerability to disasters in Kerala. The fifth section discusses various issues associated with climate change adaptation and mainstreaming of climate change adaptation in Kerala. The sixth section presents a brief overview of the disaster management plan for Kerala. The final section presents recommendations of the working group.

3. We emphasize that the working group report is not a proxy for a detailed State Level Action Plan for climate change. Its primary goal is to locate climate change and its impact on Kerala within the scope of development and planning and to indicate broadly some of the immediate issues that need to be focused on.

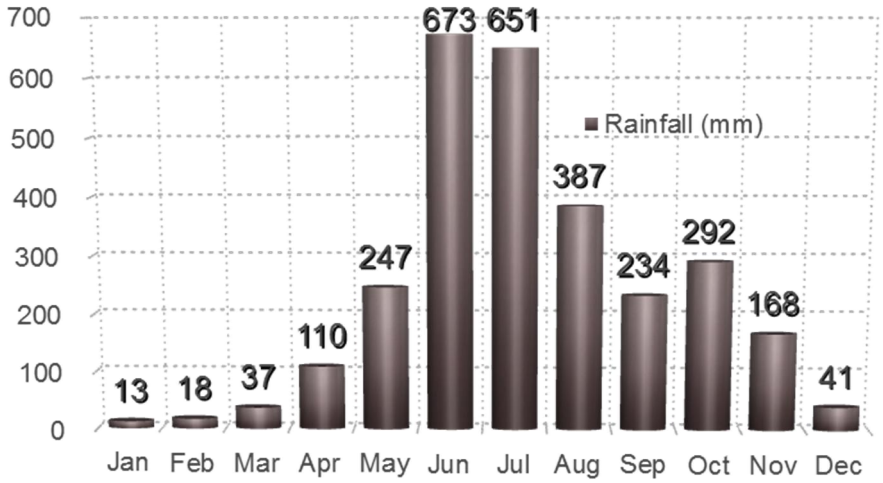
CHAPTER 2
CLIMATE VARIABILITY AND PROJECTIONS

4. Kerala is characterized by monsoonal climate, which is controlled by its orographic features such as mountains and Western Ghats, coastline, vegetation and water bodies. The average height of the Western Ghats in Kerala is about 950m, but it attains height of 1800 to 2600 m at certain places. Floods and landslides are common phenomena during the rainy season. Out of the 44 rivers, many originate from Western Ghats. Three rivers are east flowing as tributaries to the Kaveri while all others are west flowing. These rivers dry up or thin out during the dry season since all of these are rainfed. In addition, inland water bodies influence the climate of its neighborhood. The largest is the Vembanad lake stretching an area of 200 km². Five rivers drain into this lake which open into the Arabian sea at Kochi. Other major lakes are Kayamkulam (60 km²), Ashtamudi (50 km²) and Sasthamkota (4 km²) which is the only natural fresh water lake. The following sub-sections discuss briefly the climatic conditions prevailing in Kerala, their variability and projected changes. Annexure 1 provides more comprehensive discussion.

Rainfall

5. The annual rainfall over Kerala comprises rainfall received during the winter, pre-monsoon, southwest monsoon and post monsoon/north-east monsoon season, with their contribution to the total as 1%, 13.8%, 68.1% and 17.1% respectively. The state receives bountiful rain with annual average rainfall which is about 2.5 times more than that of all-India average. The annual variation of rainfall in Kerala (Fig. 1) shows that South-West (SW, from June to September or JJAS) and North-East monsoon (NE, from October to November or ON) are the two monsoon seasons of the state, of which SW monsoon is the dominant rainy season.

Figure 1 *Annual variation of climatological rainfall of Kerala (1901-2012).*



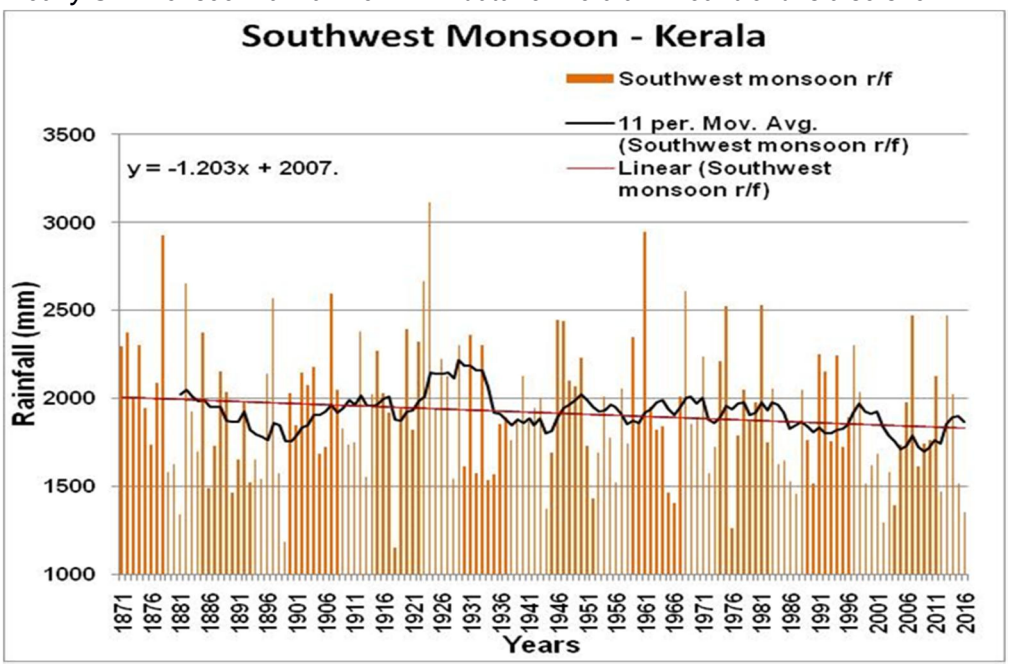
Source Weather and Plant Health Management in Kerala, KSPB, Govt. of Kerala, 2015.

6. The annual amount of rainfall shows considerable spatial variation from north to south with the northern region receiving 380 cm whereas the southern region receiving about 180 cm. Since about 70% of the annual rainfall is received during the southwest monsoon season, i.e., the summer season of June-September, the variability of the southwest monsoon is crucial for the state's economy.

7. There is a long-term insignificant decreasing trend in the annual mean rainfall over Kerala during the last 146-year period. Whereas, a significant declining trend in annual rainfall is noticed from 1965

onwards. A decrease of 27 mm only was noticed during the study period of 146 years as against the normal rainfall of 2837 mm whereas a decline of 338 mm was noticed during the period of last 100 years as against the normal rainfall of 3025 mm. A decreasing trend of 15% in the annual rainfall is noticed in the last decade. A relatively wet period (excess rainfall) was seen in earlier decades from 1900 to 1980. Observed rainfall trend over Kerala shows that there is significant decrease in southwest monsoon rainfall in recent times. Consistently, the southwest monsoon rainfall is decreasing at the rate of 12.03 mm per decade (Fig. 2). Although the northeast monsoon rainfall depicts significantly increasing at the rate of 6.6 mm per 10 years, it is not sufficient to offset the decreasing trend in annual rainfall.

Figure 2 *Yearly SW monsoon rainfall from IMD data for Kerala. Linear trend is also shown.*



Source IITM, Pune

Temperature

8. The diurnal and seasonal variation of the temperature at any site is mainly determined by location, height and proximity to the ocean. The variation is small along the coast and larger over the interior and high terrain. The surface temperature found to drop with the onset of monsoon. The average temperature and its diurnal variation is the lowest in this season except over the interior high terrain (Table 1).

Table 1 *Temperature (Normal) pattern over Kerala*

Station	January			April			July			October		
	Max	Min	Range	Max	Min	Range	Max	Min	Range	Max	Min	Range
Thiruvan-anthapuram	33.3	20.1	13.2	34.3	22.8	11.5	31.2	21.7	9.5	31.8	22.0	9.8
Kochi	32.5	21.1	11.4	32.8	23.0	9.8	29.9	22.1	7.8	30.8	22.5	8.3
Palakkad	35.4	19.8	15.6	39.5	21.9	17.6	30.5	21.1	9.4	33.3	21.8	11.5
Kozhikode	33.0	19.8	13.2	34.3	22.8	11.5	30.9	21.9	9.0	32.3	22.1	10.2
Mangalore	34.1	19.5	14.6	33.6	22.9	10.7	30.7	21.3	9.4	32.0	21.9	10.1

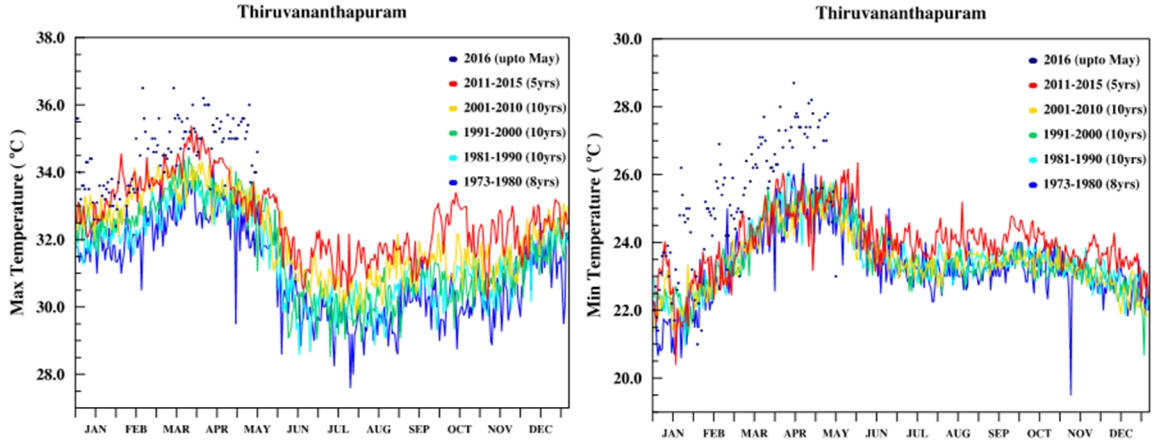
Source India Meteorological Department, Pune

9. The climate of Kerala is changing in ways that can be attributed to human-caused emissions of GHGs. The surface temperature over the state is warming. Average maximum and minimum temperatures for the last decade were the highest in the state from 1901 through 2007. This increasing trend is clear in both annual mean and the mean of SW monsoon season, for both maximum temperature (T_{max}) and minimum temperature (T_{min}). It is also to be noted here that there is a close linkage between rice grain yield and T_{min} with a tendency for reduction in yield with increase in the T_{min}.

Climate Change and Projections

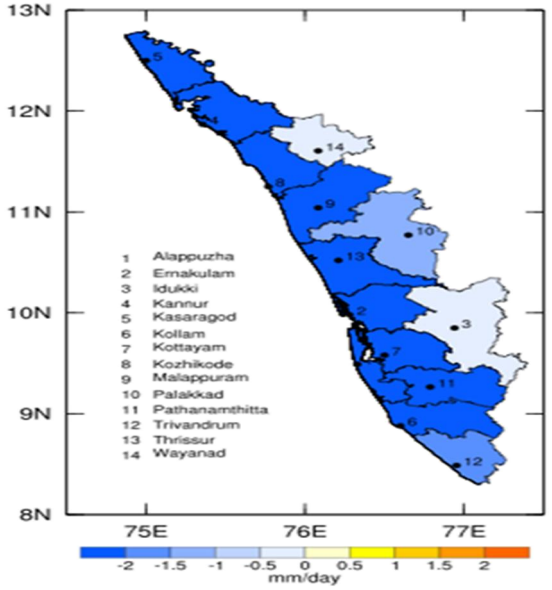
10. Maximum, minimum and average temperatures in the state has been consistently warming and 2016 happens to be the warmest on record (Fig. 3). Associated with this the greenhouse gas (GHG) concentration have also crossed the limit of 400 ppm, which would have disastrous effect on agriculture. Concurrently, the farmers are facing challenges of natural resource degradation, high input costs and frequent weather fluctuations due to anthropogenic climate change (e.g, climate change and its impact on plantation sector). At the end of the 21st century, the model at the district-level, predicts a significant decrease in precipitation over Kerala (Fig. 4). In addition, there is large spatial heterogeneity within the state.

Figure 3 *Mean annual variation of maximum and minimum temperatures averaged over different periods from 1973 to 2015 and 2016, at Thiruvananthapuram. Temperatures are increasing in recent period and 2016 is the warmest*



Source GHCN, NOAA

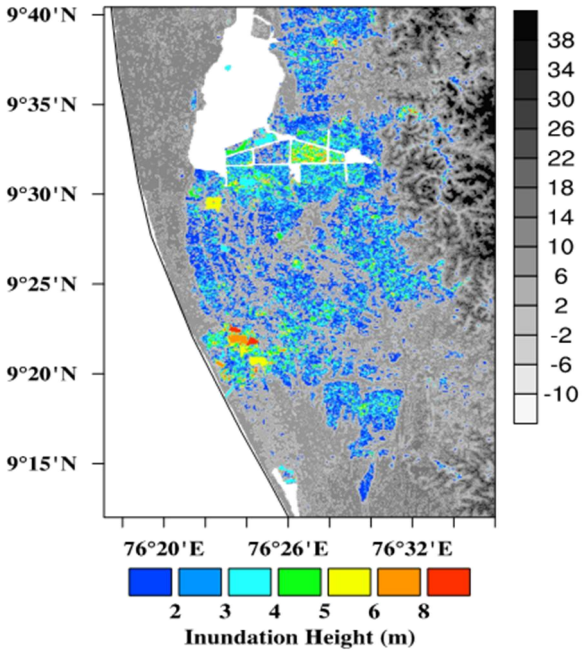
Figure 4 *District-wise difference in SW monsoon rainfall between future projection and present-day simulation of a 20-km model*



Source Weather and Plant Health Management in Kerala, KSPB, Govt. of Kerala, 2015

11. First hand estimation of inundation maps especially for the state's coastal regions, in circumstances of extreme rainfall or natural disasters such as cyclones, is highly necessary for efficient planning of strategies to adapt to the changing climate where extreme rainfall events are expected to increase in future. For example, a first order estimation of possible inundation of Kuttanad area when an extreme rainfall occurrence of magnitude 100 mm/day is shown in Fig. 5. As per this estimation about 36% of the land area will be inundated by 1-4m, by an extreme rainfall event with rainfall of 100 mm/day.

Figure 5*The inundation map for Kuttanad region due to extreme rainfall.*



Source Model at CSIR-4PI

CHAPTER 3
IMPACTS OF CLIMATE VARIABILITY AND CLIMATE CHANGE IN KERALA

Climate Change Vulnerability Profile of Kerala

12. Vulnerability to climate change can be considered to be high in the State due to unique social, economic, environmental and physical conditions that amplify susceptibility to negative impacts and contribute to low capacity to cope with and adapt to climate related hazards. The State is Vulnerable because of the following:
    1. Kerala constitutes only 1.18 % of the total areas of India but accounts for about 3.1 % of India's population. The density of population is 859 persons/ sq. km which is the three times as densely settled as rest of India.
    2. High dependency of the state's socio-economic nature to climate sensitive sectors like Agriculture, fisheries and forests.
    3. Multi Hazards profile of the states which is more exposed to climate related hazards like flood and droughts.
    4. Kerala has a very long coastline of 570 km, out of which 322 km is prone to sever sea erosion.
    5. Occurrence of many fragile ecosystem of the state like Mangroves, Shola forest and Tropical evergreen forest, river Pozhi and Azhi etc. and many biodiversity regions.
    6. Reduction in the availability of fresh water and impacts on agriculture production and food security due to predicted decline of rainfall.
    7. Boundary shifts for different forest types, with consequent implication for species diversity and forest dependent communities.
    8. Threats of sea level rise in the low lying areas along the coastal areas of the state.
    9. Changes of virulence and disease pattern especially vector borne and water borne diseases.
    10. Increase energy demands and subsequent impacts on climate sensitive infrastructure.
    11. Land degradation may also be exacerbated in the state, posing additional threats to human well-being and development if human pressures on lands intensify.

Agriculture

13. Agriculture is the mainstay of state economy and provides food and livelihood security to a substantial section of the population. Cultivated land is declining year after year across the state and production is stagnated mostly due to weather aberrations. In the projected climate change scenario, temperature rise is being experienced across the state. Thus an increase of temperature by 2°C by 2025 would affect paddy production in Kerala. With each degree rise in temperature, rice yield would be reduced by 6%. The crop maturity period may also get reduced, which might affect the paddy productivity drastically. This would adversely affect the state where rice is the staple food of majority of the population. Widening in temperature range along with deforestation may be detrimental to thermo-sensitive crops like cardamom, coffee, tea, cocoa and black pepper cultivation across the high ranges of Kerala. Any sort of change in climate will have a detrimental effect on the cropping seasons and cropping pattern that has been traditionally practiced in the state. Ultimately rains and temperature change will make many of the crops currently raised in the state unsuitable. Heavy pre-monsoon showers (and a lethal attack by wasps) may hit pepper production in Kerala, the main producer of the commodity in India. Increase in maximum temperature of 1-3° C during summer 2004 adversely affected thermo-sensitive crops like black pepper and cocoa in Kerala. Records show that almost all the plantation crops suffered to a great extent in 1983 and 2004 due to disastrous summer droughts. Climate change and unseasonal rain in November and January over the years 2009 and 2010 had been dampened the prospects of mango farmer's in Palakkad district of the state.

Moreover, the climate projections across the high ranges indicate that the Southwest Monsoon rainfall is likely to decline, and surface air temperature and its range are likely to increase. Under such circumstances, there is a threat to thermo sensitive crops like black pepper, cardamom, tea and coffee. At the same time, arable land along the coast lines are bound to be reduced as an intrusion of saline water. Coastal erosion, submergence of shorelines could mainly affect agriculture through inundation of low lying lands.

Fisheries

14. A marine fishery is one of the important revenue-earning and employment-opportunity sectors, contributing significantly to the economy of Kerala. Kerala has very productive fishing waters in the Indian seas. The annual fish production along the Kerala coast was about 6.2 lakh tonnes during 2006-2010. About 1.4 lakh people are employed either fulltime or part-time in marine fisheries. Fish trade has expanded significantly over the last two decades, with annual value at first sale at around Rs 2500 crores. Production from Kerala contributes 20% to the all-India marine fish landings. Production comes from three subsectors, viz., mechanized subsector (60.3% to the region's total production), motorized subsector (35.5%), and non-motorized subsector (4.2%).

15. In recent years, the sector is facing serious challenges. The marine fish catch has reduced from 6.70 lakh tonnes in 2013 to 5.76 lakh tonnes in 2014 and further to 4.82 lakh tonnes in 2015 (CMFRI annual reports), i.e., decline of 28% in three years. The main contributor to the reduction is sharp fall in the landings of the oil sardine. The catches have been either very close to or have exceeded the potential yield for several fish stocks due to overfishing. There are evidences of overexploitation, depletion of coastal fish stocks and competition among stakeholders in sharing the renewable, but limited resources. Climate change exacerbates this situation. It is being increasingly realized that all the subsectors of fisheries will be impacted by climate change. Considering the important role of fisheries for food supply, food security and income generation, research and policies on adaptation and mitigation of this sector to climate change should receive priority.

16. From the recent investigations carried out by the Central Marine Fisheries Research Institute (CMFRI), the following responses to climate change by different marine fish species are discernible in the Indian seas (Vivekanandan, 2011):
    1. Shift/Extension of distributional boundary;
    2. Shift/extension of depth of occurrence; and
    3. Phenological changes).

17. A few species will be benefited, but others will lose. Similarly, a few locations will gain, but others will lose. These changes will alter the abundance of fish populations and result in novel mix of species. This will, in turn, drive changes in the fishing methods, and incur economic costs to the fishermen and other stakeholders in the supply chain. In the state 10 species of fresh water fish have been identified as most threatened due to climate change. Warming of water may impact fish diversity, distribution, abundance and phenology. Besides exploring northern waters, the Indian mackerel has been descending deeper as well during the last two decades.

Forest and Biodiversity

18. Forests and biodiversity have significant contribution to the state economy. Climate change has the potential to cause immense deterioration to forest and lead to biodiversity loss, affecting both individual species and their ecosystems that support Sustainable Development of the state.

Devastating effects on the native habitats of many animals and plants due to climate change is likely to drive a considerable number of today's known animal and plant species to extinction. Of the 300 rare endangered species or threatened species in the Western Ghats, 159 are in Kerala. Of these 70 are herbs, 23 climbers, eight epiphytes, 15 shrubs and 43 trees. Besides, hot temperature and dry condition also increase the likelihood of forest fires in the state that eventually resulted deterioration of sizable amount forest cover in the state.

Health

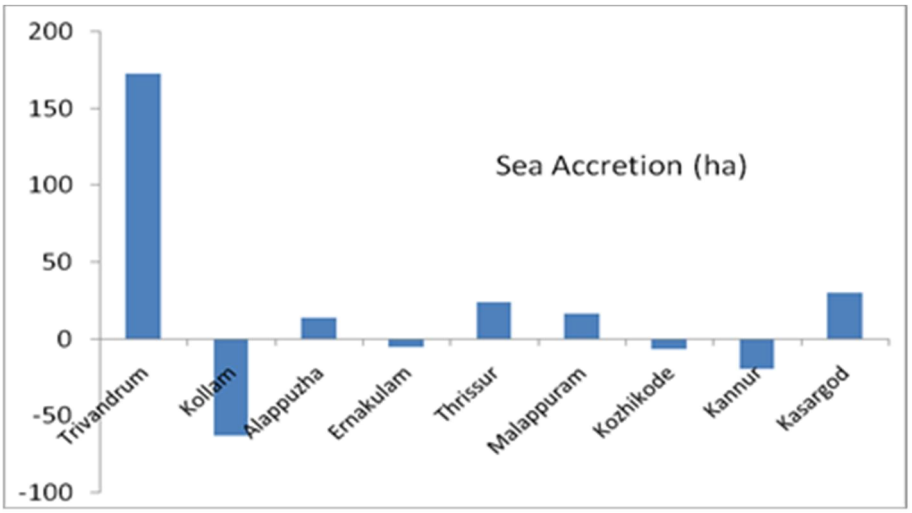
19. The State has been witnessing an unprecedented upsurge of the vector-borne diseases since 1996. Japanese encephalitis first appeared in the state in Kuttanad area in Alappuzha district in the year 1990. Dengue fever surfaced as a new problem in the state in 1997 and has now become almost endemic in the state. Chikungunea fever, yet another arborial disease which appeared in epidemic form during 2006-07 added a new dimension to the entire scenario of the vector borne diseases in Kerala. In 2008, the World health Organization (WHO) reported that an outbreak of Chikungunya in Kerala in the last two years (2006 and 2007) was mainly due to climate change. Due to change in climate, Malaria symptoms have been reported from various places in the state and also in near future state may become a malaria prone state.

Sea level rise

20. Kerala, with a narrow contiguous area extending along the coast, is more dependent on coastal resources than any other state in the country. About 30% of the population lives in the coastal areas, resulting in a very high density of > 2000 persons per sq.km. The sea level rise for Cochin (southwest coast) is estimated as 2 cm in the last one century (Emery and Aubrey, 1989; Das and Radhakrishna, 1993). However, the rate of increase is accelerating, and it is projected that it may rise at the rate of 5 mm per year in the coming decades. Considering this, it is possible that the sea level may rise by 25 to 30 cm in 50 years (Dinesh Kumar, 2000). An increase in mean sea level will affect waves, currents and bottom pressure in the near shore region. In general, an increase in mean water depth will be accompanied by an increase in mean wave height, resulting in a more severe wave attack on the coast and a greater wave induced littoral drift. The erosion due to sea level rise for Kerala is estimated as 7125 m3 per year, implying an erosion rate of0.3 x 106 m3 per year, which could be attributed to the effects of wave attack. Using the extreme conditions of wave height and sea level rise, future erosion potential is expected to increase by 15.3% by the year 2100 (Dinesh Kumar, 2000). Besides destruction through increased rates of erosion, the sea level rise increases the risk of flooding. This will damage or destroy many coastal ecosystems such as mangroves and salt marshes, which are essential for maintaining many wild fish stocks, as well as supplying seed to aquaculture. Higher sea levels may make groundwater more saline, harming freshwater fisheries, aquaculture and agriculture and limiting industrial and domestic water uses.

21. One of the indicators considered under climatic variability was net area of sea accretion/erosion in the coastal districts of Kerala. It was found that compared to the year 1996, sea erosion was maximum (63 ha) along Kollam District in the year 2009 (see Fig. 6 below). On the other hand, accretion of 173 ha was noticed along Trivandrum District. Development of vulnerability index and ranking brings about preparedness among the governments to evolve suitable policies so as to reduce the risk of climate change.

Figure 6 *Sea Accretion/Erosion Area in the Coastal Districts of Kerala – 1996 to 2009*



Overall Vulnerability of Districts to Climate Change

22. The major climate change hotspot districts in Kerala are Alappuzha, Palakkad and hilly districts of Wayanad and Idukki. As per SAPCC, Alappuzha and Palakkad districts are the most vulnerable to climate change exposure as these districts have higher values of Composite Vulnerability Index. Four districts that are under high vulnerable groups include districts located in hilly region *i.e.* Idukki and Wayanad and Southern district of Thiruvananthapuram and Northern district Kannur.

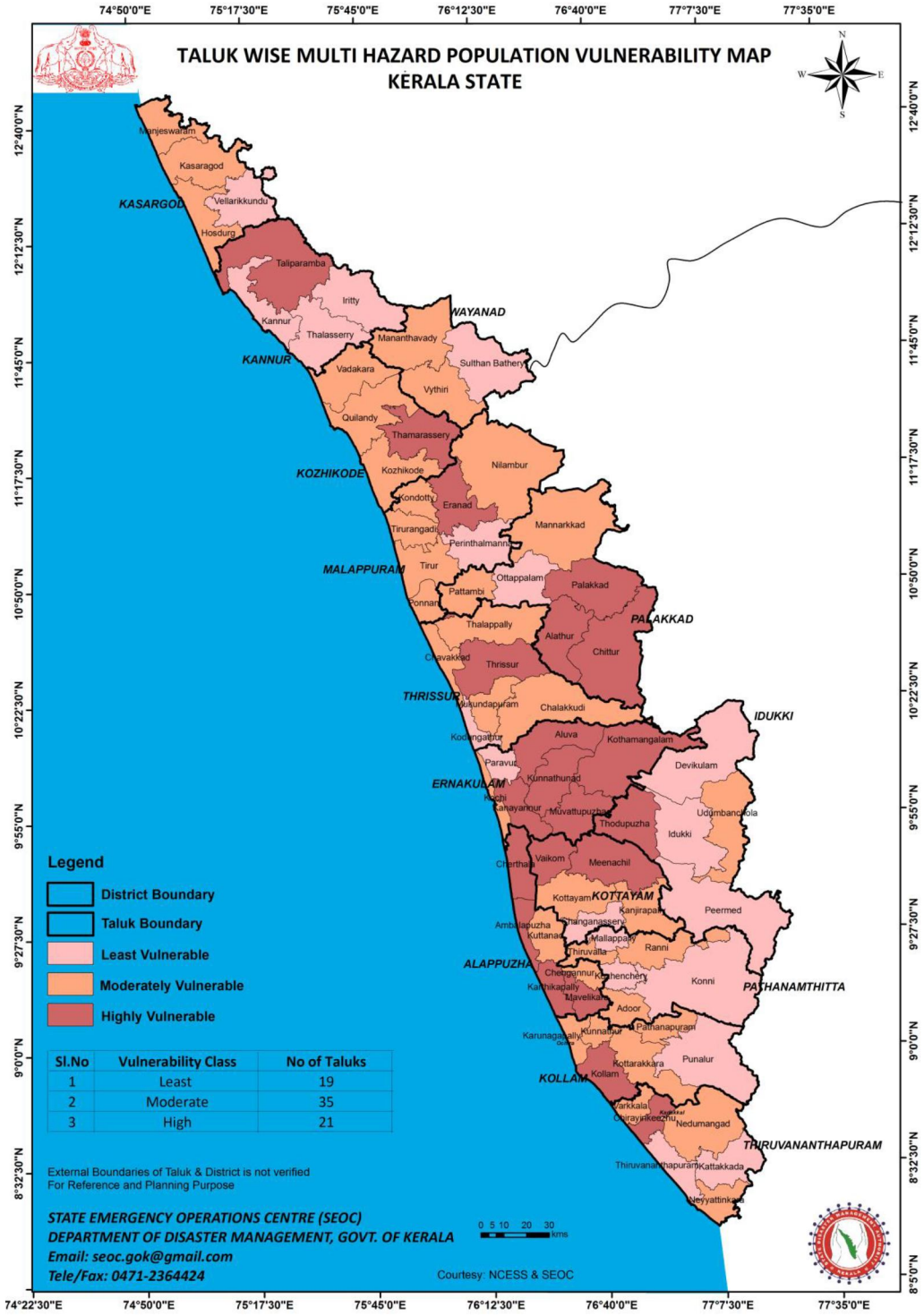
CHAPTER 4
DISASTERS – PROFILE AND VULNERABILITY

23. Kerala is multi hazard prone. The State is prone to 17 Natural Hazards and 22 Anthropogenic Hazards that have disaster potential. The natural hazards include several climate induced hazards such as floods, drought, cyclones, and sudden onset events like flash floods, landslides etc.

24. Kerala is susceptible to cyclonic winds. 96.9% of the total area in the state lies in the 140.4 km/h wind zone (moderate damage risk zone) and rest lies in 118.8 km/h wind zone. Climatic change may accelerate most intense cyclones in the Arabian Sea. The probable maximum storm surge height in the state is 3.5 m and minimum is 2.3. If the storm surge happens during high tide, the maximum surge height in the state may reach 4.2 m and minimum storm height may reach up to 3 meters. This has added significance especially because altitude of lowlands which constitutes about 54.17% area in the state, is only 10-300 m, and the altitude of coastal plain and lagoons which constitutes about 16.40% of the total areas is 10 m of the MSL.

25. The State Disaster Management Plan 2016 provides detailed analysis of the vulnerability. Based on the multi-hazard vulnerability assessment, Kerala has identified 21 highly vulnerable taluks and 35 moderately vulnerable taluks. Focus shall be primarily to empower the administrative systems and communities of these taluks to prepare effectively for disaster risk reduction from an 'all hazards perspective' as directed by Government of India. Figure 7 shows the multi-hazard vulnerability of Taluks of Kerala.

Figure 7 *Multi-Hazard Vulnerability of Kerala*



CHAPTER 5
CLIMATE CHANGE ADAPTATION

26. Any discussion on climate change adaptation must recognize two sometimes contrasting perspectives on the nature of adaptation: (a) climate change imposes a distinct and additional burden on the society; (b) climate adaptation, is one response among many, to a host of socio-economic and environmental pressures and cannot necessarily be isolated from regular development activities.

27. Under some circumstances, the additional vulnerability of economic agents to climate change and specific measures to reduce this vulnerability can be clearly identified. For example, if climate change is expected to increase precipitation and flooding in certain areas, the additional economic damages from these floods and 'adaptive' investments required to reduce these damages can be established. Thus, in these circumstances, it may be possible to identify clearly the additional burden of climate change and adaptation.

28. However, climate adaptation may be rendered in-effective if policies are not designed in the context of other development concerns. For instance, a comprehensive strategy that seeks to improve food security in the context of climate change may include a set of coordinated measures related to agricultural extension, crop diversification, integrated water and pest management, and agricultural information services. Some of these measures may have to do with climatic changes and others with regular economic development. Thus, in the broader development context, building adaptive capacity is much more than developing climate-related adaptation strategies. It is thus useful to examine climate adaptation, whether it is spontaneous or policy driven, in tandem with other economic development options.

Climate Science and Economics of Adaptation

29. Climate change impact assessment and adaptation studies require predictions from climate models. To plan for adaptation some important changes are required in the inputs provided by current climate models.
    1. First, climate predictions are needed at finer spatial resolutions than are currently available from the global climate models. This is beginning to happen – for example, the Indian Institute of Tropical Meteorology has developed high resolution (50x50 km) regional climate change scenarios for India using the Hadley Centre regional climate model (PRECIS) that is forced by the state-of-the-art coupled general circulation model (HadCM3). Similar exercises are underway to develop a suite of high resolution future climate scenarios for India by running three regional climate models (e.g., PRECIS, WRF and RegCM3) using the lateral boundary conditions from five IPCC-AR5 coupled models.
    2. Second, future scenarios of climate need to go beyond predictions on temperature and precipitation. Along with these primary variables, the impact and adaptation community would benefit from knowledge on secondary variables such as heating degree days that combines information on available temperature range over the growing period of agricultural crops, heat index, starting and ending days of seasonal monsoon rainfall, storm surge etc.
    3. Third, for effective use of adaptation instruments such as crop insurance, more accurate weather data at disaggregated level is needed. Efforts should be made to increase the network of meteorological stations and agro-met stations.

Adaptation Instruments

Insurance as Adaptation Strategy

30. It is widely believed that insurance could serve as an appropriate adaptation strategy. In India the entry of private insurance companies to offer index insurance to farmers has given rise to optimism. However, the costs of designing a contract are still very high and it is hard to establish basis risk[1].

Local Weather Stations

31. It is often argued that weather data from simple agro-met stations can be of significant use to farmers for their farm management practices. This is well documented through studies undertaken by MSSRF (2008) in India and SEI (2008) in Africa. However, since this evidence is not based on random experiments, further analysis is needed to deal with problems of self-selection by farmers and the associated implications for understanding farm level outcomes.

Migration as an Adaptation Strategy:

32. The usual development paradigm has seen migration of people from inland towards coastal regions. However, with rise in sea levels and coastal inundation, reverse migration may be witnessed. An important issue in this context relates to the triggers associated with sea-level rise and inundation that prompt migration.

Information Diffusion as Adaptation Strategy

33. Often lack of information can lead to catastrophic consequences. While the government might be doing its bit in undertaking the campaigns, say for instance, to reduce heat stroke effects, it may not be reaching the targeted end-users due to lack of adequate understanding about information diffusion pathways. Similar examples exist in case of knowledge dissemination in agriculture.

Ecosystem Based Adaptation

34. While the general analysis points to the significant role of ecosystem services in mediating climate impacts (e.g., protection provided by mangroves from cyclone storms), there is less evidence regarding actual adaptation costs. By linking such costs with payments for ecosystem services, climate change adaptation can be effectively integrated with environmental management.

35. In addition to the generic adaptation strategies outlined above, sector-specific strategies could be identified along with potential departments/institutes that would implement them. Such discussion is made below with reference to two important sectors in Kerala, namely agriculture and fisheries.

1The mismatch between what a policy-holder expects insurance policies to cover and what the insurance contracts actually provide as loss indemnification represents basis risk in insurance.

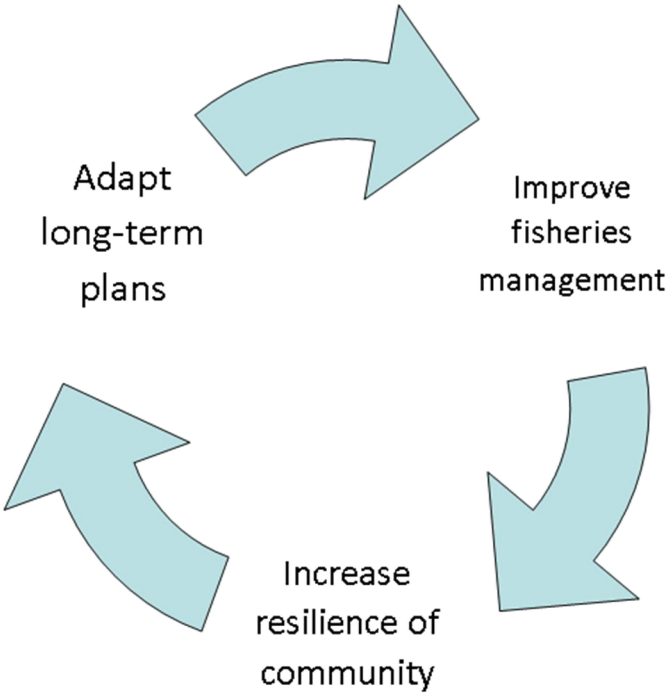
Table 2 *Adaptation Strategies – Agriculture*

Strategy	Activity	Agencies
Crop Improvement and Management	Research on developing new varieties of crops tolerant to climate extremes; Spread of improved seeds; Diversified crops and cropping system; Input management and enhancing input use efficiency	Indian Cardamom Research Institute; Central Tuber Crops Research Institute; Agriculture Department
Mainstreaming Integrated Pest Management System	Research on characterising and spread of new pests due to climate variability and change; Promotion of organic pest control activities	Kerala Agriculture University; Agriculture Department
Sustainable Land Use and Management	Improvement of water use efficiency; Research on soil testing and suitability	Agriculture Department; Soil Survey Department
Flood Control and Drought Management	Flood and drought vulnerability assessment of major agro-climatic regions	Agriculture Department; State Disaster Management Agency
Promotion of Crop Insurance Schemes	Extend weather based insurance scheme in all intensive farming areas	Agriculture Department
Promotion of Weather Forecasting	Setting up more weather stations in each agro-climatic zone; Provision of localized weather to the farming community	Agriculture Department
Strengthening livelihoods through work and income security interventions	Assistance to farmers for livelihood diversification, improve agricultural practices	Agricultural Department; Kerala Agriculture University

Adaptation Strategies – Fisheries

36. The adaptation of fisheries sector to climate change should be addressed at two levels: (i) improving the resilience of fish populations by adopting effective fisheries management measures; and (ii) improving the resilience of fishing communities by adopting effective livelihood and life protection measures. These adaptations have to be continuously monitored through long-term plans (see Figure 8 below).

Figure 8 *Components of Climate Change Adaptation Plan for Marine Fisheries*



37. In the context of climate change, the primary challenge to the fisheries sector will be to ensure food supply, enhance nutritional security, improve livelihood and economic output, and ensure ecosystem safety. These objectives call for identifying and addressing the concerns arising out of climate change; evolve adaptive mechanisms and implement action across all stakeholders on a long-term (see Table below). In response to shifting fish population and species, the fishing sector may have to respond with the right types of craft and gear combinations, on-board processing equipment etc. Governments should consider establishing Weather Watch Groups and decision support systems on a regional basis. Allocating research funds to analyze the impacts and establishing institutional mechanisms to enable the sector are also important. The relevance of active stakeholder participation and collaboration to exchange information and ideas is being felt now as never before.

Table 3 *Options for coping with climate change in fisheries*

Concerns	Adaptive mechanisms
Uncertainties in fish availability and supply	1. Adopt Code of Conduct for Responsible Fisheries 2. Develop knowledge-base for climate change impact on fisheries; 3. Predict medium and long term probabilistic production; 4. Assess the adaptation capacity, resilience and vulnerability of marine production systems; 5. Adjust fishing fleet and infrastructure capacity; 6. Consider the synergistic interactions between climate change and other factors such as fishing
New challenges for risk assessment	1. Consider increasing frequency of extreme weather events; 2. Consider past management practices to evolve robust adaptation systems; 3. Identify and address the vulnerability of specific communities; consider gender and equity issues
Complexities of climate change interactions into governance of frameworks to meet food security objectives	1. Recognition of climate-related processes, and their interaction with others; 2. Action plans at State level based on (a) Code of Conduct for Responsible Fisheries; (b) Integrated ecosystem-based fisheries plans, (d) linkage among cross-sectoral policy frameworks such as insurance, rural development and trade; 3. Action plans by (a) strengthening fisheries organizations and place climate change agenda as a priority; (b) evolving common platforms and sharing the best practices with other states.
Fisheries may be more vulnerable in conflicts with other sectors	1. Action plans should involve not only fisheries institutions/ departments, but also those for national development planning and finance; 2. Sharing and exchange of information with other sectors; 3. Existing Marine Fisheries Regulation Act needs to be reviewed by mainstreaming climate change.
Financing climate change adaptation and mitigation measures	1. Fishermen, fish farmers, processors, traders and exporters should increase self protection through financial mechanisms; 2. Improving equity and economic access such as microcredit should be linked to adaptation responses; 3. Financial allocation in state budget for risk reduction and prevention practices such as early warning systems and disaster recovery programmes and for relocation of villages from low lying areas; 4. Fiscal incentive for reducing the sector's carbon footprint and other mitigation and adaptation options.

Source Modified after Allison *et al*., 2004; Handisyde *et al*., 2005; FAO, 2008; Vivekanandan, 2011

Climate Finance

38. While much of the climate change adaptation is likely to be funded by regional budgets, there are various national and international funds available to effectively manage and adapt to the impacts of climate change. Some of the important funds available are discussed below:

Adaptation Fund

39. The Adaptation Fund is an international fund established in 2001, with Secretariat in Washington, D.C., under the United Nations Framework Convention on Climate Change (UNFCCC).It finances concrete climate adaptation and resilience activities of developing countries that are parties to the Kyoto Protocol. The fund aims to reduce the adverse effects of climate change facing communities, countries and sectors. It is managed by a Board, with the World Bank acting as interim Trustee, and has been fully operational since 2010. By the end of 2015, the total revenue of the Fund was USD 539.1 million. To date, the Fund has supported climate change adaptation in the areas of water resources management; land management; agriculture; disaster risk reduction; health; infrastructure development; fragile ecosystems (including mountainous ecosystems); integrated coastal zone management etc. The financial instrument used is grants. National Bank for Agriculture and Rural Development (NABARD), is the national implementing entity accredited for the fund in India.

Green Climate Fund (GCF)

40. The Green Climate Fund (GCF) was adopted by 194 countries party to the UN Framework Convention on Climate Change (UNFCCC) in 2010, at 16th session of the Conference of the Parties (COP 16) in Cancun. It was established to act as a central global investment vehicle for climate finance, under which industrialized countries would assist developing countries with new finance for public and private sector projects and programmes. It is headquartered in the Republic of Korea. The mission of the GCF is to achieve a global paradigm shift towards low-emission and climate-resilient development pathways, through providing support to developing countries for the curbing of their emissions and for adaptation to the unavoidable impacts of climate change, within the context of sustainable development. Over the years, the GCF is expected to become the main multilateral financing mechanism to support projects, programmes, policies and other activities in developing countries. Advanced economies have formally agreed to jointly mobilize USD 100 billion per year by 2020 to address the pressing mitigation and adaptation needs of developing countries. The Fund is committed to achieving a balance between its funding for mitigation and adaptation initiatives at a ratio of 50:50.The Fund has identified five investment priorities which can have an impact in multiple results areas, targeting both mitigation and adaptation in an integrated and holistic manner. The priorities are:
    1. Climate compatible cities;
    2. Sustainable low emission climate resilient agriculture;
    3. Scaling up finance for forest and climate change;
    4. Enhancing resilience in small island developing states;
    5. Transforming energy generation and access.

41. The Fund is governed by the GCF Board consisting of 24 independent members, with an equal number of members from developing and developed countries. Like the Adaptation Fund, the GCF will give recipient countries direct access to funding through accredited national (NABARD is the NIE for India), regional and international implementing entities and intermediaries. Alternatively, countries can access funding through accredited international entities, such as multilateral development banks, UN agencies, and regional organizations like the Secretariat of the Pacific Regional Environment Programme.

International Climate Initiative (IKI)

42. Established in 2008, the International Climate Initiative (IKI) is a funding instrument of the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB). It finances climate and biodiversity projects in developing and newly industrialising countries, as well

as in countries in transition. As a key element of Germany's contribution to climate finance, the IKI provides assistance mainly through technology cooperation, policy advice, and capacity development. These efforts provide various co-benefits, particularly the improvement of living conditions in partner countries, and complements the German Government's existing international, multilateral and bilateral cooperation.

43. For the first few years the IKI was financed through the auctioning of emission allowances, but it is now funded from the budget of the BMUB. In accordance with a Bundestag resolution, the IKI receives EUR 120 million from the BMUB budget every year. The Energy and Climate Fund (EKF), which is replenished through the auctioning of emission allowances in the EU ETS, contributes additional funds to the IKI. German climate finance from budgetary sources and climate relevant finance, amount to almost EUR 3.5 billion. The projects are funded as per the needs of the partner countries and are intended to support them in the following areas:
    1. Mitigating greenhouse gas emissions
    2. Adapting to the impacts of climate change
    3. Conserving natural carbon sinks with a focus on reducing emissions from deforestation and forest degradation (REDD+)
    4. Conserving biological diversity.

44. Financial support from the IKI is mainly delivered in the form of grants and concessional loans, which serve to mobilise additional funding, including in particular private investment, and the promotion of sustainable business models for climate change mitigation.

Special Climate Change Fund (SCCF)

45. The Special Climate Change Fund (SCCF) was established in 2001 under the UN Framework Convention on Climate Change (UNFCC), to finance activities, programs, and measures relating to climate change that are complementary to those funded under the Climate Change Focal Area of the Global Environmental Facility (GEF), and by bilateral and multilateral funding. The SCCF was created to address the specific needs of developing countries under the UNFCCC. While adaptation is the Fund's top priority, the SCCF also focuses on technology transfer and its associated capacity building activities. It supports activities which are country-driven, cost-effective, and integrated into national sustainable development and poverty reduction strategies, as well as National Adaptation Programmes of Actions (NAPAs). The SCCF is also intended to catalyse and leverage additional finance from bilateral and multilateral sources. The investment priorities of SCCF include, Adaptation; Transfer of technologies; Energy, transport, industry, forestry, and waste management; and Economic diversification for fossil fuel dependent countries.

National Adaptation Fund on Climate Change (NAFCC)

46. Under an umbrella Programme, Government of India has established the National Adaptation Fund on Climate Change (NAFCC) and Climate Change Action Programme (CCAP), within the Ministry of Environment Forest and Climate Change (MoEF&CC). The objective of the NAFCC is to assist State and Union Territories that are vulnerable to the adverse effects of climate change in scaling up climate change adaptation interventions, in accordance with the National Action Plan on Climate Change (NAPCC) and State Action Plan on Climate Change (SAPCCs). It has a budget provision of Rs 350 crores for the year 2015-16 and 2016-17, with an estimated requirement of Rs 181.5 crores for financial year 2017-18. The National Bank for Agriculture and Rural Development (NABARD) has been appointed National Implementing Entity and is responsible for implementation of

adaptation projects. The State Government Departments are the Executing Entities and can submit proposals for accessing NAFCC funds.

47. In addition, the CCAP, launched by the Ministry of Environment, Forest and Climate Change (MoEF&CC) will focus on assessing the impact of climate change in vulnerable areas, capacity building and setting up of an institute for conducting climate change studies. The NAPCC and SAPCC are both part of the CCAP, which in total has a budget of INR 290 crore.

48. The NAFCC supports concrete adaptation projects and programmes aligned with the national and state action plans' missions in agriculture, horticulture, agro forestry, environment, allied activities, water, forestry, urban, coastal and low-lying system, disaster management, human health, marine system, tourism, habitat sector and other rural livelihood sectors to address climate change related issues. In addition, the Fund supports in preparation of climate scenarios, capacity building of stakeholders and knowledge management. The priorities of the CCAP are to build and support capacity at the Central and State level to assess the impact of climate change in vulnerable areas, and launch studies and projects to address the challenges of climate change in all dimensions.

NAFCC Project in Kerala – Project for Promotion of Integrated farming Systems of Kaippad and Pokkali coastal wet lands:

49. A project 'Promotion of Integrated farming systems of Kaippad and Pokkali in coastal wetlands of Kerala' was sanctioned under NAFCC in 2015. The total cost of the project is Rs 25 crore. The period of the project is four years (2015-19). The Agency for Development of Aquaculture (ADAK), Department of Fisheries, Government of Kerala, is the Executing Entity of the project. The proposed area of the project is 600 hectares (300 hectares in Kannur District and 300 hectares in Ernakulam, Thrissur and Alappuzha districts). The broad objectives of the project are providing the main infrastructure facility of strong outer 'bunds' with sufficient height; use of tall varieties of salt tolerant paddy; integrating fishery to enhance paddy cultivation and maximize the inland fish production through sustainable aquaculture.. The project will help simultaneous cultivation of rice and shrimp / fish in low-lying wetlands where there were no cultivation earlier. It will also improve the quality of life for local farmers through higher disposable incomes. It will improve access to fresh water, as peripheral 'bunds' will prevent seepage of sea water to fresh water sources, capacity building of farmers and will reduce displacement of labourers from nearby areas and provide employment to women. It will also check carbon emission, as wetlands have good potential to act as carbon sink.

Mainstreaming

Need for 'Mainstreaming'

50. The present-day vulnerability to natural disasters is significantly high in developing countries and the available evidence suggests that the climate change will have large adverse effects on several climate sensitive sectors in the developing countries. Though there are several proposals for adaptation funding in developing countries, the prospects do not look very bright. The scope for accessing international funding for large and fast developing countries like India is further limited.

51. In view of this, the best available option that developing countries may have is to 'mainstream' climate change adaptation policy into their existing and future development policy and planning. Incremental resources put towards climate change specific measures, while continuing on the

overarching developmental goals (such as poverty eradication, reducing food insecurity) may be required. An approach that aims at improving development prospects, while making the economy and its poorer population more climate resilient could be synergistic. Socio-economic development has the potential to reduce the existing development deficit and in turn adaptation deficit, both of which could in turn augment the capacity of the country to adapt to climate change and natural disasters. Mainstreaming will also enable a more integrated approach towards achieving development objectives and avoids piece meal approach.

52. There are several other contexts where mainstreaming is often advocated – examples include, gender, environmental change etc. Thus, mainstreaming is not new in the development policy context, even though there has always been lack of conceptual clarity on how mainstreaming could be achieved and what institutional structure will facilitate mainstreaming. These two issues are discussed briefly below.

Mainstreaming – Approaches

53. Summarizing various studies on mainstreaming, Pervin et al. (2013) point that mainstreaming is often a deliberate process, targets multiple routes and/or outputs (i.e., policies, plans, programs etc.), and takes places across multiple levels of governance.

54. Mainstreaming typically follows one of the three main approaches, namely,
    1. Integrationist – involves adding-on an issue to current development plans and policies without questioning and addressing the inherent social inequalities. For example in the context of gender mainstreaming, this could involve experts suggesting changes in bureaucratic processes, say through reservation for women.
    2. Agenda Setting – is more consultative in nature and recognizes marginalized voices. In the context of gender mainstreaming, there is increasing demand for shift from the integrationist approach to agenda setting approach of mainstreaming.
    3. Transformative – aims to transform the existing development agenda and is most radical form of mainstreaming. In gender mainstreaming context, this approach recognizes the inequalities between men and women and that these inequalities intersect with other inequalities based on class and race, resulting in complex location specific inequalities.

55. Based on various country experiences with regard to mainstreaming climate resilience into development planning, Pervin et al. (2013) identify three broach approaches that can be seen parallel to the evolution of mainstreaming approaches mentioned above.
    1. Climate-Proofing Approach – aims to protect development interventions that have been planned without taking climate change into account. It simply aims at making the development intervention resilient to climate variability and climate change.
    2. Climate-first Approach – aims to address incremental change in existing climate related risks. Typically involves designing pilot intervention strategies that are climate resilient and (if found effective) subsequently scaled up to sectoral and/or national plans.
    3. Development-first Approach – keeps climate resilience as an integral part of the development planning process from the very beginning.

56. In the context of planning in Kerala, as is the case in several other regions, the mainstreaming is being attempted through the first two approaches that can together be labeled as 'development-led' approach. The box below describes sectoral-level mainstreaming with reference to fisheries sector.

Box 1 *Mainstreaming with reference to fisheries sector*

Mainstreaming Adaptation – Fisheries

Fisheries sector is directly affected by climate change. Strategies for fisheries sector are critical to highlight the impacts of climate change and promote investments to reduce climate-related impacts. As the Marine Fishing Regulation Act (MFRA) is the key instrument for regulating fishing in the State, it is necessary to mainstream climate change adaptation into the Act. The MFRA should integrate considerations of climate change adaptation into budgeting implementation and monitoring processes at state level. This will be a multi-year, multi-stakeholder effort grounded in the contribution of climate change adaptation to human well being, economic growth, and achievement of the fisheries sector.

Entry points for mainstreaming climate change adaptation into the development planning process for example could be, integrating and proper implementation of sea safety and MCS mechanism into the MFRA; and developing capacity and awareness programmes. Increased budget allocations for adaptation policy measures need to be made. Climate-proofed and specific adaptation policy measures for climate change adaptation in the fisheries sector need to be funded by the finance or sector ministries for the identified entry points under the MFRA.

To integrate climate change adaptation into the MFRA and other policy processes, it is important to consider the following steps:(a) State-specific evidence collected on the costs and benefits of climate change and adaptation (e.g. impact, vulnerability and adaptation assessment, socio-economic analysis, demonstration projects; (b) Adaptation and its links to development, sea safety measures, monitoring of fishing activities and poverty reduction need to be included in the working documents.

57. Sector strategies also need to include clear indicators of impact to enable the effectiveness of measures to be monitored over time. The strategies are then translated into concrete measures, including through budget allocations, which provide another opportunity for adaptation mainstreaming.

Institutional Structure for Mainstreaming

58. In India, State Action Plan on Climate Change (SAPCC) and State Disaster Management Plan (SDMP) are the formal institutional platforms at state-level to mainstream climate risk and disaster risk into development planning. Few recent studies (Dubash and Jogesh, 2014; Bahadur et al., 2016) that studied the SAPCC and SDMP, respectively of different states provide useful insights about the process.

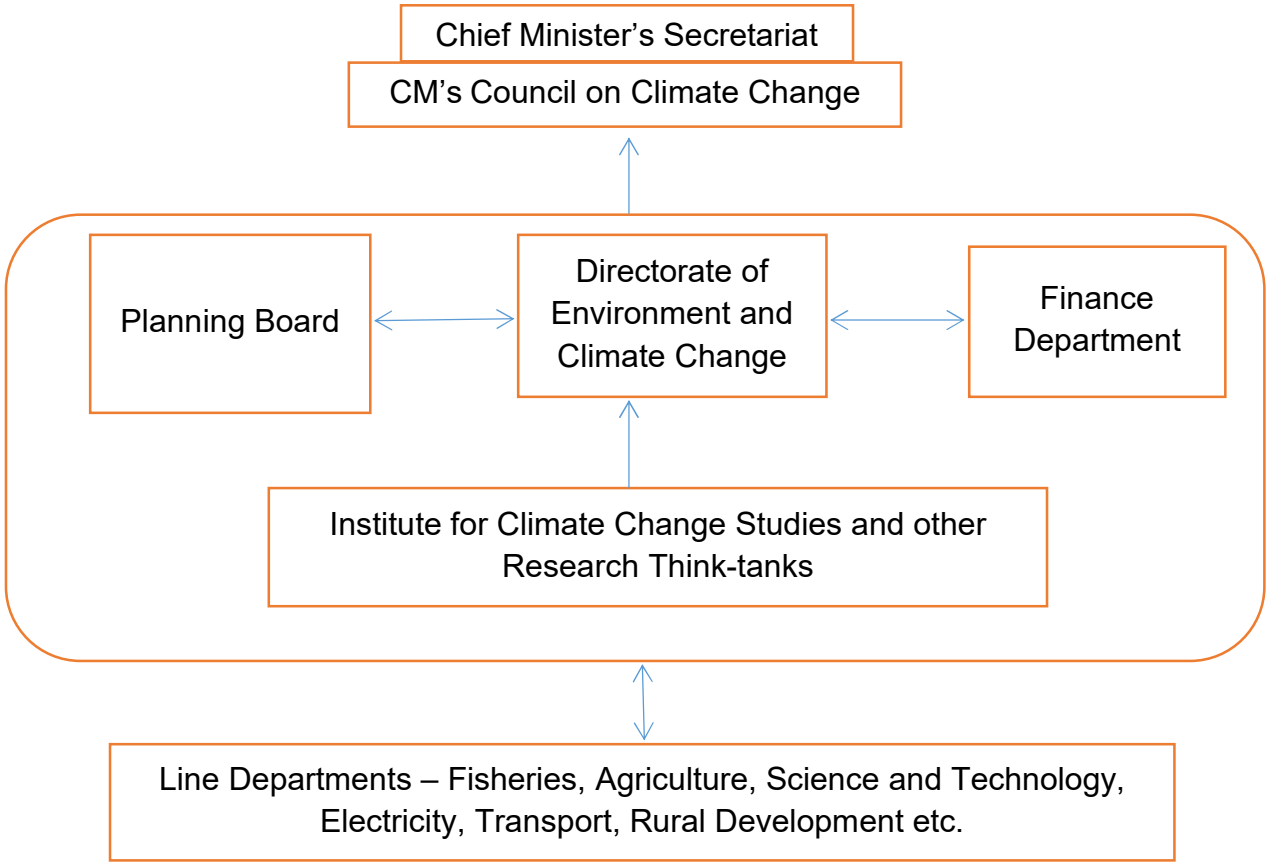
59. The plans prepared either in the climate change context or the disaster management context should not run parallel to the development plans that the state governments make. For effectively addressing the climate risk and the disaster risk it is important to synergize different plans into development planning.

60. The SAPCCs are typically prepared by a nodal agency (such as Department of Environment) with inputs from various other departments. However, given the long-term nature of the climate change problem, the Planning Department could have also taken-up the process. Such ex-ante option could run the risk of greater capacity shortfalls in climate change knowledge than environment departments. Also, there could be greater acceptability among different departments for the coordinating role done by DoE. In such ex-post option, the state planning departments should

consider and integrate the outcomes of the climate plans into development planning exercise, as is being attempted currently in the context of Kerala. Further it must be noted that, like the planning process, the SAPCC as well as SDMP should be seen as dynamic processes that are periodically revised. For this purpose as well as effective implementation of the plans, an appropriate institutional structure may be conceived and nurtured. Dubash and Joseph (2016) provide a detailed account of the evolution of institutions for climate policy at the national level. Drawing inferences from this experience, the following institutional structure is being suggested for Kerala (see Figure 9). To facilitate effective coordination and infuse required seriousness to the climate change issue, it is important to put all the climate change activities under the direct supervision Chief Minister's secretariat, which in turn could be assisted by Chief Minister's Council on Climate Change.

61. Two important constituents of the proposed institutional structure are the Directorate of Environment and Climate Change and the Institute of Climate Change Studies. The Directorate of Environment and Climate Change could focus on capacity development and knowledge management besides coordinating between the line departments and working in tandem with the Planning Board and the Finance Department. The Institute of Climate Change Studies on the other hand could become the main think-tank on climate change issues in the state. The proposed activities of these two in the 13th Plan period are described in detail in Annexures. However, both institutions are in need of considerable strengthening in terms of both resources and capacities. Civil society and local-level governance are important constituents of the process of mainstreaming. Annexure 4 outlines some aspects of civil society engagement in Kerala. While the initiative and energy of civil society groups have an important role to play, in Kerala the voluntary efforts of civil society groups should be effectively integrated into informing the work and institutional framework of local self-government institutions in both climate change and disaster management. Given the strength and sweep of local self-government institutions and their track record in Kerala, the engagement of local communities with climate and disaster issues can be best and most appropriately institutionalised through local self-government. This is in contrast to other states where the institutions of local self-government are either weak or subject to a high degree of elite capture which places greater emphasis on civil society organisations. This does not appear to be the situation in Kerala.

Figure 9 *Institutional Structure for Climate Governance at State-level*



CHAPTER 6
DISASTER MANAGEMENT

62. The Disaster Management Act, 2005 (Central Act 53 of 2005) mandates the establishment of the State Disaster Management Authority, State Executive Committee and District Disaster Management Authorities. Accordingly the Government of Kerala framed the Kerala State Disaster Management Rules, 2007 vide *Kerala Extraordinary Gazette S.R.O No. 201/2007 dated 1st March 2007 (amendments vide S.R.O No. 583/2013 dated 17th July 2013 and S.R.O. No.263/2016 dated 2nd March, 2016)* and notified the State Disaster Management Authority, the State Executive Committee, and the District Disaster Management Authorities. The State Authority is composed of ten (10) members, chaired by Chief Minister and convened by Additional Chief Secretary, Revenue and Disaster Management. The Chief Secretary (*inter alia Chairperson of the State Executive Committee*) is the Chief Executive Officer of KSDMA. The other ex-officio members are Hon'ble Minister for Home and Vigilance, Hon'ble Minister for Agriculture, Additional Chief Secretary, Home and Head of State Emergency Operations Centre who is inter alia the Member Secretary of the Authority.

63. Section 23 (1) of the DM Act, 2005 makes it mandatory for every State to have a State Disaster Management Plan (SDMP) for every State and vide Section 23 (6) 'appropriate provisions shall be made by the State Government for financing for the measures to be carried out under the State plan'. KSDMA has approved the State Disaster Management Plan for the period 2016-17 and the same has been approved by the Government vide GO (Rt) No. 3667/2016/DMD dated 9th September 2016. The plan also lays a perspective for disaster risk reduction in the next 5 years in line with the SENDAI framework for disaster risk reduction adopted by India and for the period 2015-30[2].

64. The State Disaster Management Plan 2016, in Section 8.7 has identified 7 broad themes under the SENDAI framework of action for disaster risk reduction in the state in the 13th five year plan period. These themes were also subsumed into the New Delhi Declaration 2016 as adopted in the Asian Ministerial Conference for Disaster Risk Reduction. For achieving the long term (15 years) goals as laid out in the 'Asian Regional Plan for implementation of the SENDAI Framework for Disaster Risk Reduction, 2016', the National Disaster Management Plan 2016, and the 'calls on governments' as in the New Delhi Declaration, KSDMA has formulated the 7 broad themes and have matrix linked each theme to a specific call as in the New Delhi Declaration, for implementation, as given below in the table 4. The detailed discussion on each theme is provided in the Annexure 5. The Institute of Land and Disaster Management (ILDM) in its note (included in Annexure 6) argued in favour of virtual systems for better management of disasters in Kerala.

2 The Sendai Framework for Disaster Risk Reduction 2015-2030 (Sendai Framework) is the first major agreement of the post-2015 development agenda, with seven targets and four priorities for action. It was endorsed by the UN General Assembly following the 2015 Third UN World Conference on Disaster Risk Reduction (WCDRR).

Table 4 *Potential Directions of Disaster Management in Kerala*

Sl. No	Broad themes for implementation in 2017-22 state plan scheme of KSDMA	Call on Government in New Delhi Declaration 2016	SENDAI priority	Requirement
1	Community based disaster risk reduction – formation, training and capacity building of Civil Defence Corps in Kerala	Call 10: Strengthen inclusive collaboration at the local level to build on community initiative, knowledge and resources, and leverage national policies and programmes to achieve resilience. Call 5: Encourage meaningful participation and support representation of women, children and youth, and persons with disabilities in leadership role for disaster risk reduction	Priority 4: Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction	Section 4 of the Civil Defence Act, 1968 envisages the creation of Civil Defence Corps in all states. In a state like Kerala where the local community involvement in preparedness and response to disasters are high, creation of Civil Defence Corps will formalize the First Responder structure.
2	Strengthening State Disaster Response Force	Call 6: Improve preparedness for disaster recovery by strengthening institutional frameworks, establishing standards, and enhancing capacities to ensure that disaster recovery integrates risk reduction measures to build back better.	Priority 3: Investing in disaster risk reduction for resilience	As recommended by NDMA, KSDMA, through the Home Department, initiated the task of setting up the State Disaster Response Force. This specialised force of 100 men is presently in an immature stage and requires significant strengthening.
3	Strengthening Kerala Fire and Rescue Services			The Kerala Fire and Rescue Services is the main stay of Disaster Response in the State. While they are capable of handling a multitude of events, the exposure of the Force to international fire fighting techniques and capabilities require to be improved upon. Master trainers trained in specialized skill sets with

				international and national exposure are required as a permanent capacity of the Force.
4	Strengthen the network of Emergency Operations Centres	Call 3: Strengthen national and local governance of disaster risk reduction to ensure coherence among policies, institutional arrangements across sectors, with representation of stakeholders in line with national circumstances and policies.	Priority 3: Investing in disaster risk reduction for resilience	The command and coordination ability of the State has been improved by the establishment of SEOC and networks of DEOCs. It is necessary that these institutional setups are maintained and made more efficient to ensure coordinated response and management of disasters
5	Strengthen instrumented monitoring and science and technology for disaster risk reduction	Call 11: Promote application of science & technology, and research for evidence-based disaster risk reduction policies, practices and solutions, including through international cooperation.	Priority 1: Understanding disaster risk	Several technological advancements have come about in the domain of disaster risk reduction. Experimental implementation of such technology and localisation of such technology will promote its popular use in the state.
6	Mainstreaming disaster risk reduction into development planning	Call 2. Ensure that policies and practices reflect an understanding of disaster risk. More specifically, collect and share risk information for pre-disaster risk assessment, risk prevention and reduction through development, and appropriate preparedness for effective response to disasters.	Priority 2: Strengthening disaster risk governance to manage disaster risk	Vide Section 38 of the Disaster Management Act, 2005, mainstreaming DRR into development planning is a statutory and obligatory requirement. For the purpose, the State DM Plan has envisaged that there be a virtual cadre for DM in all departments in the State and all that all departments prepare their disaster management plans in accordance with the State DM Plan.
7	Updating Hazard, Vulnerability and Risk Assessment (HVRA) of the state and the District and State	Call 4. Increase investment in disaster risk reduction for resilience including in	Priority 1: Understanding disaster risk	The State and District DM Plans and the HVRA needs annual updation. It is a continuous and constantly evolving

	Disaster Management Plans	multi-hazard early warning systems and dissemination channels; contingency planning that engages all people to further strengthen disaster preparedness.	process that needs further adjustments in the event of new and emerging threats. Focus will also be in ensuring local self government level DM plans in all urban areas in the State.

CHAPTER 7
RECOMMENDATIONS

65. The Working Group recommends the following action points:

1. Improvement in weather data collection, and advance in observational, communicational and analytical capabilities and enhancement of observational networks throughout the state is an essential need. It is eminently desirable that such data collection efforts are publicly funded and accountable and that data is publicly accessible without any future threat of proprietary control, while drawing on the benefits of complementary efforts by the Indian Metereological Department, Govt of India and other private players.
2. Climate change projections for the state of Kerala have to be further studied, developed and sharpened for deriving information, data and predictions at the local scale using the methods of climate modelling known as dynamical downscaling while continuing to use statistical downscaling methods where they are applicable.
3. Estimation of the contribution to sea level change along the coast due to local land rebound/subsidence through dedicated GPS based observations is necessary. This observation information can also assist in studies on groundwater depletion for the state.
4. The State Action Plan on Climate Change (SAPCC) needs to be revised and updated keeping in mind new scientific developments in a number of related areas taking into account also developments in climate change governance at the national and international level. Specifically such a review must be undertaken with a long-term view to learn more about climate change itself with respect to physical parameters and its impact on geo sphere and biosphere, focusing on indentified key sectors, address enhanced natural disaster induced impacts in the short/medium term. The review must also pay adequate attention to the link between development and the mitigation of climate and disaster risk/
5. The SAPCC revision could be carried out with the following criteria in mind: (a) To ensure that the SAPCC is prepared and owned by institutions in Kerala; (b) To subject the process of preparation of the SAPCC to peer review at different stages with the review process monitored by an Advisory Committee with national level experts; and (c) To carry out focussed studies and arrive at specific areas of intervention.
6. A special effort is required to estimate the costs associated with climate and disaster risks and their mitigation in specific detail, sectorally and by agro-ecological zones. This requires detailed exercises to be carried out by a number of departments of the government. Current ad hoc methods must be substituted by such detailed studies for determining more accurately the costs of climate change adaptation in particular. Over the period of the 13th Plan such studies must be carried out in all departments, covering at least all the main functions and sectoral responsibilities of the departments. Alongside such estimates a methodology should also be developed across all departments to ensure that climate and disaster risks are adequately factored in all development activities.
7. The Institute for Climate Change Studies should be strengthened with clear action plan on research priorities. The Institute must also be the co-ordinating centre in providing the appropriate knowledge inputs to the Directorate of Environment and Climate Change in carrying out specific tasks, schemes and programmes, relating particularly to climate change. The Institute for Climate Change Studies must periodically collect and review (preferably on an annual basis) new and improved knowledge resources on climate change in Kerala and its impact across different sectors so that development efforts are kept abreast of the latest knowledge inputs in relevant sectors.

8. The Directorate of Environment and Climate Change needs effective strengthening to carry out its mandate and be the co-ordinating centre of all efforts to direct work on climate change in Kerala across all departments of the government.
9. The Directorate of Environment and Climate Change and the Institute for Climate Change Studies could together develop a knowledge portal for effective data sharing on issues related to climate change and hydro-meteorological disasters.
10. Disaster management covers a vast array of sectors and particular activities in society. It is essential therefore to prioritise the action required in different sectors. Immediate and urgent needs must be identified in priority sectors that must be attended to through purchase of equipment, formulating and implementing techno-legal measures such as regulations and codes, with a suitable monitoring framework and enhancing technical capabilities of practitioners associated with these sectors. At the same time, disaster mitigation, recovery procedures and disaster risk reduction measures must be routinely integrated into the work of all sectors of the government at all levels. Systematic effort over a definite time-frame is required to achieve this goal.

REFERENCES/BIBLIOGRAPHY

Allison EH, Adger WN, Badjeck MC, Brown K, Conway D, Dulvy VK, Halls A, Perry A, Reynolds JD (2004) Effects of climate change on the sustainability of capture and enhancement fisheries important to the poor: analysis of the vulnerability and adaptability of fisher folk living in poverty. Fisheries Management Science Programme, DFID, UK, Project Summer Report, pp 21

Bahadur, A., E. Lovell, and F. Pichon (2016), "Strengthening Disaster Risk Management in India: A Review of Five State Disaster Management Plans", Overseas Development Institute.

Brander KM (2007) Global fish production and climate change. Proceedings of National Academy of Sciences of the USA 104: 19709-19714

CMFRI (2011) Annual Report 2011-11. Central Marine Fisheries Research Institute, Kochi, 163 pp.

CMFRI (2016). Assessment of relative vulnerability of Indian marine fishes to climate change. Special Publication, Central Marine Fisheries Research Institute, Kochi (in press).

Das PK and Radhakrishna M (1993) Trends and the pole tide in Indian tide gauge records. Proc. Indian Acad. Sci., 102: 175-183

Dinesh Kumar PK (2000) Studies on the impact of selected sea level rise scenarios on the coast and coastal structures around Cochin. Ph.D. Thesis, Mangalore University, Mangalore, India, 125 pp

Dubash, N.K. and A. Jogesh (2014), "From Margins to Mainstream? State Climate Change Planning in India", *Economic and Political Weekly*, XLIX (48), November.

Dubash, N.K., N.B. Joseph (2016), "Evolution of Institutions for Climate Policy in India", *Economic & Political Weekly*, LI(3), January.

Emery K.O and Aubrey DG (1989) Tide gauges of India. *J. Coast. Res.*, 5: 489-500

FAO (2008)Summary proceedings of Workshop on Climate Change and Fisheries and Aquaculture : "Options for decision makers". Food and Agriculture Organisation, Rome, pp 6

Handisyde NT, Ross LG, Badjeck MC, Allison EH(2005)The effects of climate change on world aquaculture: a global perspective. Department for International Development, UK, pp 151

KSDMA, 2016; Kerala State Disaster Management Plan 2016 approved vide GO (Rt) No. 3667/2016/DMD dated 9th September 2016. Published by Kerala State Disaster Management Authority, Government of Kerala, Thiruvananthapuram. URL: http://disasterlesskerala.org/wp-content/uploads/2016/11/Kerala-SDMP-Version-September-2016.pdf

O'Brien, K., Leichenko, R., Kelkar, U., Venema, H., Aandahl, G., Tompkins, H., Javed, A., Bhadwal, S., Barg, S., Nygaard, L., West, J. (2004), "Mapping Multiple Stressors: Climate Change and Economic Globalization in India', *Global Environmental Change*, 14, 303–313.

Pervin, M., Sultana, S., Phirum, A., Camara, I.F., Nzau, V.M., Phonnasane, V., Khounsy, P., Kaur, N., and Anderson, S. (2013), "A Framework for Mainstreaming Climate Resilience into Development Planning", IIED Working Paper, Climate Change, November.

Vivekanandan E (2011) Climate change and Indian marine fisheries. Policy Brief 3, CMFRI Special Publication, 105: 97 pp.

ANNEXURE 1
CLIMATE VARIABILITY AND PROJECTIONS IN KERALA

Preamble

Comprehensive understanding and accurate prediction of climate are crucial for decision-making in agriculture, water resource management, disaster management, and for various other socio-economic sectors. Increasing network of observations of weather parameters, coastal/oceanic variables, hydrological parameters and inundation maps and advanced skillful modelling framework for accurate climate prediction and climate change projection, are useful for the preparedness to face the challenges thrown by climate variability and climate change. Increased incidence of extreme events such as floods, droughts and storms will affect the safety and efficiency of fishing operations and increase damage and disruption to coastal and riparian homes, services and infrastructure. Sea level rise and other large-scale environmental changes will have unpredictable effects on coastal environments and livelihoods.

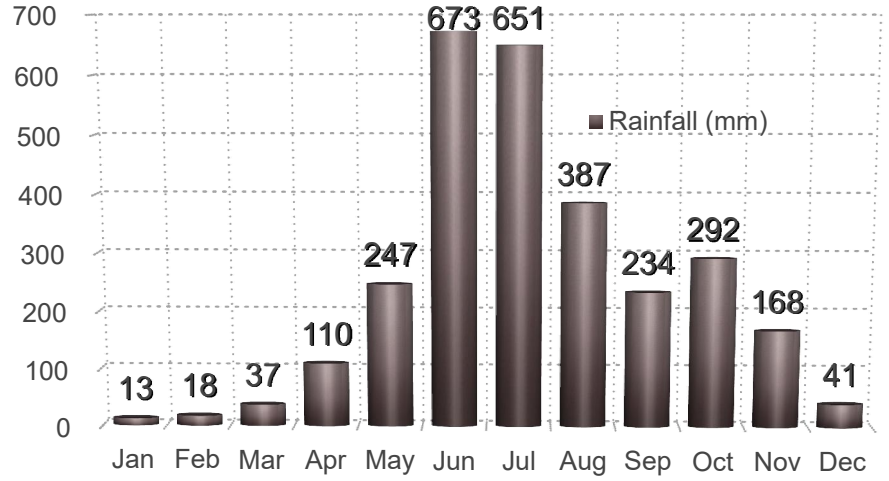
Kerala Climate, Variability and Change

Kerala is characterized by monsoonal climate, which is controlled by its orographic features such as mountains and Western Ghats, coastline, vegetation and water bodies. The average height of the Western Ghats in Kerala is about 950m, but it attains height of 1800 to 2600 m at certain places. Floods and landslides are common phenomena during the rainy season. Out of the 44 rivers, many originate from Western Ghats. Three rivers are east flowing as tributaries to the Kaveri while all others are west flowing. These rivers dry up or thin out during the dry season since all of these are rain fed. In addition, inland water bodies influence the climate of its neighborhood. The largest is the Vembanad lake stretching an area of 200 km^2. Five rivers drain into this lake which open into the Arabian sea at Kochi. Other major lakes are Kayamkulam (60 km^2), Ashtamudi (50 km^2) and Sasthamkota (4 km^2) which is the only natural fresh water lake.

Rainfall

The annual rainfall over Kerala comprises rainfall received during the winter, pre-monsoon, southwest monsoon and post monsoon/north-east monsoon season, with their contribution to the total as 1%, 13.8%, 68.1% and 17.1% respectively. The state receives bountiful rain with annual average rainfall which is about 2.5 times more than that of all-India average. The annual variation of rainfall in Kerala (Fig. 10) shows that South-West (SW, from June to September or JJAS) and North-East monsoon (NE, from October to November or ON) are the two monsoon seasons of the state, of which SW monsoon is the dominant rainy season.

Figure 10 *Annual variation of climatological rainfall of Kerala (1901-2012).*

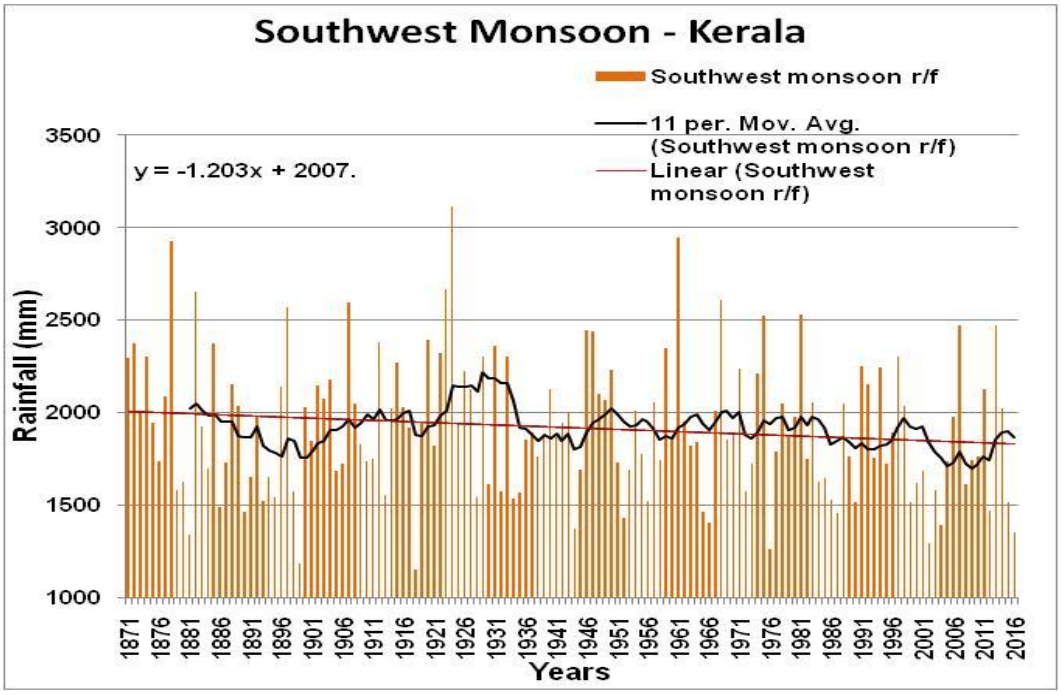


Source Weather and Plant Health Management in Kerala, KSPB, Govt. of Kerala, 2015

The annual amount of rainfall shows considerable spatial variation from north to south with the northern region receiving 380 cm whereas the southern region receiving about 180 cm. Since about 70% of the annual rainfall is received during the southwest monsoon season, i.e., the summer season of June-September, the variability of the southwest monsoon is crucial for the state's economy.

There is a long-term insignificant decreasing trend in the annual mean rainfall over Kerala during the last 146-year period. Whereas, a significant declining trend in annual rainfall is noticed from 1965 onwards. A decrease of 27 mm only was noticed during the study period of 146 years as against the normal rainfall of 2837 mm whereas a decline of 338 mm was noticed during the period of last 100 years as against the normal rainfall of 3025 mm. A decreasing trend of 15% in the annual rainfall is noticed in the last decade. A relatively wet period (excess rainfall) was seen in earlier decades from 1900 to 1980. Observed rainfall trend over Kerala shows that there is significant decrease in southwest monsoon rainfall in recent times. Consistently, the southwest monsoon rainfall is decreasing at the rate of 12.03 mm per decade (Fig. 11). Although the northeast monsoon rainfall depicts significantly increasing at the rate of 6.6 mm per 10 years, it is not sufficient to offset the decreasing trend in annual rainfall.

Figure 11 *Yearly SW monsoon rainfall from IMD data for Kerala. Linear trend is also shown*



Source IITM, Pune

Temperature

The diurnal and seasonal variation of the temperature is mainly determined by the location, height and its proximity to ocean. The variation is small along the coast and larger over interior and high terrain. The surface temperature found to drop with the onset of monsoon. The average temperature and its diurnal variation is the lowest in this season except over the interior high terrain (Table 5).

Table 5 *Temperature (Normal) pattern over Kerala*

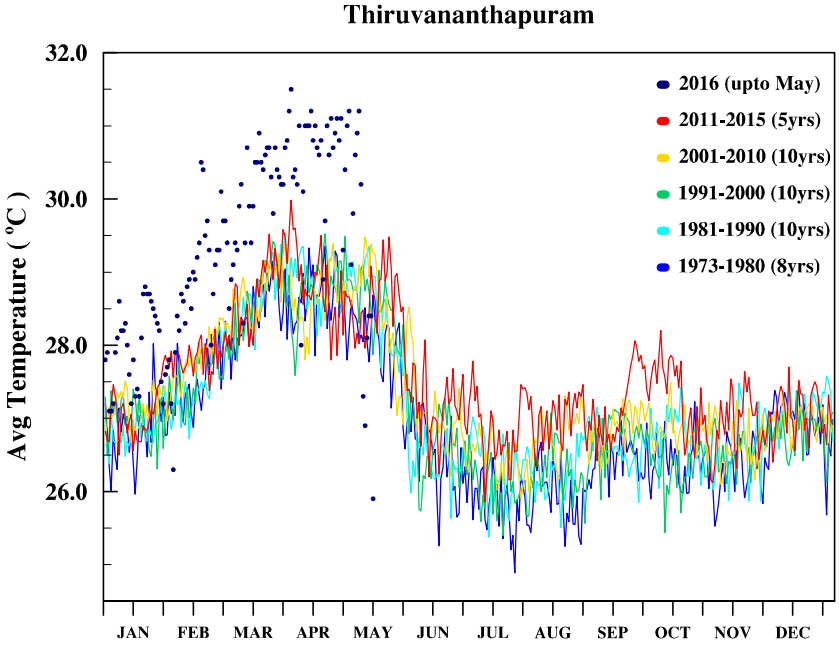
Station	January			April			July			October		
	Max	Min	Range	Max	Min	Range	Max	Min	Range	Max	Min	Range
Thiruvananthapuram	33.3	20.1	13.2	34.3	22.8	11.5	31.2	21.7	9.5	31.8	22.0	9.8
Kochi	32.5	21.1	11.4	32.8	23.0	9.8	29.9	22.1	7.8	30.8	22.5	8.3
Palakkad	35.4	19.8	15.6	39.5	21.9	17.6	30.5	21.1	9.4	33.3	21.8	11.5
Kozhikode	33.0	19.8	13.2	34.3	22.8	11.5	30.9	21.9	9.0	32.3	22.1	10.2
Mangalore	34.1	19.5	14.6	33.6	22.9	10.7	30.7	21.3	9.4	32.0	21.9	10.1

Source India Meteorological Department, Pune

The climate of Kerala is changing in ways that can be attributed to human-caused emissions of GHGs. The surface temperature over the state is warming (Fig. 12). Average maximum and minimum temperatures for the last decade were the highest in the state from 1901 through 2007. This increasing trend is clear in both annual mean and the mean of SW monsoon season (Fig. 12), for both maximum

temperature (T_{max}) and minimum temperature (T_{min}). It is also to be noted here that there is a close linkage between rice grain yield and T_{min} with a tendency for reduction in yield with increase in the T_{min}.

Figure 12 *Mean annual variation of average temperatures averaged over different periods from 1973 to 2015 and 2016, at Thiruvananthapuram. Temperatures are increasing in recent period and 2016 is the warmest.*



Source GHCN, NOAA

Simulation and Prediction

With the advent of the high-performance computing resources and advancement in data assimilation techniques along with improved state-of-the-art numerical models, considerable skill has been achieved in short-to-medium range (3 days to 10 days forecast lead times) forecasting. In addition to short-range forecasts, extended range forecasts (15-20 days forecast lead time) for forecasting of Indian summer monsoon features such as the onset and withdrawal phases of monsoon, active and break rain spells and the extreme weather episodes can now be predicted with increased accuracy. But, the skill in seasonal prediction (forecasting for a season) of Indian summer monsoon rainfall by current suit of numerical models need substantial improvements to achieve the desired application accuracy.

Advances in climate modelling and computing power now provide the opportunity for utilizing global general circulation models (GCMs) at very high-resolution for projections of future climate and extreme events. High resolution GCM in capturing regional characteristics of climatological summer monsoon rainfall and its frequency distribution, and mean annual variation of rainfall over the region. For example, ultra-high resolution global climate model at a horizontal resolution of 20-km shows high fidelity in simulating present-day climate of the state of Kerala (ref. weather and plant health management in Kerala, Govt. of Kerala, 2015).

Further, for application for the state of Kerala, a nested combination of a GCM and a regional climate model (RCM) can be used. For example, a nested configuration of National Centre for Atmospheric Research Community Earth System Model (NCAR CESM) or National Centre for Environmental Prediction's (NCEP) operational seasonal forecast model Climate Forecast System (CFS) version-2 GCM (NCEP CFSv2) and Weather Research and Forecasting (WRF), as a multi scale modelling and simulation framework can be implemented on HPC for dynamical downscaling with focus on Kerala. Using this setup, we can develop computationally efficient nesting of a global General Circulation Model (GCM) that has a reasonable skill in representing precipitation over the Indian region with a high resolution

regional climate model (RCM) configured for the Kerala region. A non-hydrostatic WRF model with three domains nested into the GCM down scales precipitation forecasts over the state to district level and to sub-district level over the state of Kerala. For each case, ensemble downscaling forecasts can be configured with different schemes of microphysics, cumulus, land surface and radiation in WRF at very high resolution up to ~3-km. For forecasts, initial and time varying lateral boundary conditions of surface, three-dimensional atmospheric fields and SST for the RCM can be obtained from the GCM.

Short-range forecast

The Kerala coast frequently encounters thunderstorms during the pre-monsoon months (March-May), and short-term deterministic nowcasts with a few hours lead-time will be highly useful. Assimilation of in-situ, radar based and satellite observations can considerably improve the accuracy of nowcasting variables related to thunderstorms. However, suitable resolution to realistically represent the topographical and vegetation heterogeneities of the state, and adequate upper air observations at the meso-scale (2-20 km) resolution for initialization of the model are necessary.

Medium-range forecast

As the adverse impact of droughts is huge for farmers, the farming strategies recommended by experts need to be reassessed and the appropriateness of strategies adopted by the farmers given the rainfall and temperature variability experienced by the locality, need to be relooked. The farmers' capability to withstand the impact of a drought has substantially decreased in the recent decades. Hence adopting strategies which can minimize the loss during droughts and maximize production in other years, through advices on correct sowing window, combination and proportion of inter-crops or providing the probability distribution of rainfall over the intervals of the phenolophases of crops. Traditionally, the farmers in some localities do important tasks coinciding the time scale of 'nakshatras', hence it would be beneficial to provide the forecasts focusing on this time scale.

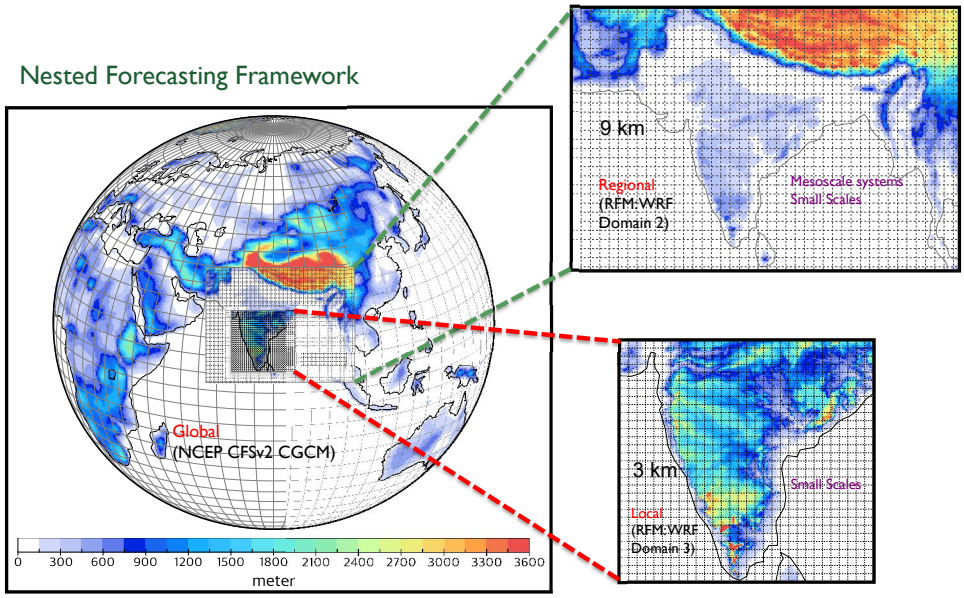
Long-range/Seasonal forecast

A nested combination of National Centre for Environmental Prediction's(NCEP) operational seasonal forecast model Climate Forecast System (CFS) version-2 GCM (NCEP CFSv2) and Weather Research and Forecasting (WRF), as a multi scale modelling and simulation framework, can be implemented for experimental forecasts at multiple lead time scales (short to extended range to seasonal time scales) with special emphasis on extreme events. Using this setup, we aim to develop computationally efficient nesting of a global Coupled Ocean-Atmosphere General Circulation Model (CGCM) that has a reasonable skill in representing precipitation over the Indian region with a high resolution regional forecast model (RFM) configured for the Kerala region (Fig. 13). The non-hydrostatic WRF model with three domains is nested into NCEP CFSv2 global coupled ocean atmosphere model at T574 resolution to downscale precipitation forecasts over continental India to district level and to sub-district level over the state of Kerala. For each case, ensemble downscaling forecasts can be configured with different schemes of microphysics, cumulus, land surface and radiation both in CFS and in WRF at very high resolution up to ~3-km. For forecasts, initial and time varying lateral boundary conditions of surface, three-dimensional atmospheric fields and SST for the RFM are obtained from the CGCM.

Nesting with the regional forecast model helps to better represent small scale land-atmosphere, snow-atmosphere and air-sea interactions, orographic and land-sea processes and aerosol-radiation feedbacks etc. Hence, this framework with appropriate initialization and with suitable high horizontal and vertical

resolutions will have sufficient capability to assist in understanding the extreme events, their recent trends and underlying mechanisms, in addition to useful forecasting applications.

Figure 13 *Schematic of multi scale nested modelling framework for short to extended range forecasting. The stand-alone global model can also be used for seasonal forecasting, whereas the nested configuration can give shorter timescales forecasts at district to sub-district level.*



Major Gap Areas

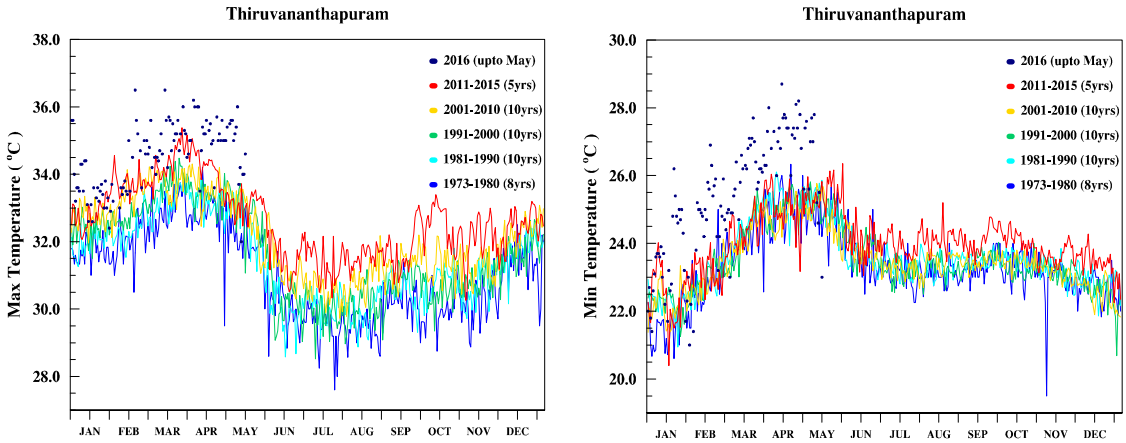
1. One of the major challenges in numerical weather prediction/forecast models, is the availability of the accurate dynamically consistent initial state. The accurate initial condition preparation is associated with the accurate data assimilation system, which in turn depends on the accurate methodologies of data assimilation, model specifications, and in great extent with accurate observation. Hence, development of additional weather parameters' observational capabilities along with state of the art instrumentation and technology is the need of the hour. Expansion of the coverage of meteorological observations over the state with real time archiving of the observations is crucial for agricultural, meteorological, and hydrological applications, and planning.
2. Further enhancement of weather radars and enhanced lightning observational network in the state are needed.
3. In addition, a rapid decision support system blending the satellite, radar and augmented surface observation network is also need to be in place for the effective nowcasting of weather events.
4. In order to reduce the uncertainty in the prediction system, the forecasting system should be considered to an ensemble forecasting system.
5. Seasonal forecasting models are now in testing phase, and need more improvements in terms of its own components as well as better understanding of the control on the remote forcings.
6. Further, studies can be initiated on the remote forcings (extreme ElNino/LaNina like conditions) and its influences on the state's seasonal climate conditions (e.g. state land use change and its influence on the seasonal climate, influence of air-sea interaction etc.).

7. A mechanism for collecting feedback from farmers and tailor the weather advisories, need to be considered (e.g., field level forecast verification, economic impact assessment of agro-meteorological advisory one for specific crops).

Climate Change and Projections

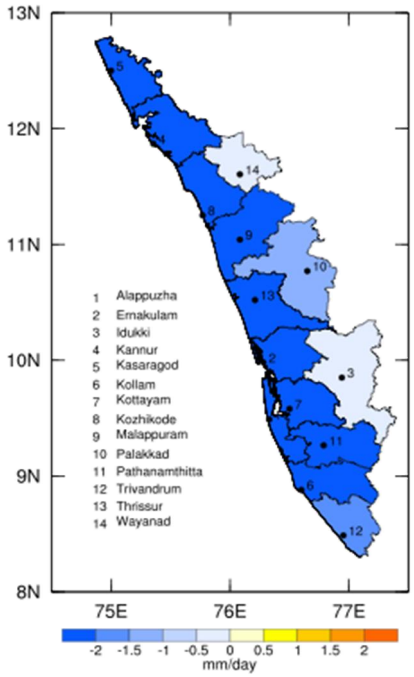
Maximum, minimum and average temperatures in the state has been consistently warming and 2016 happens to be the warmest on record (Fig. 14). Associated with this the greenhouse gas (GHG) concentration have also crossed the limit of 400 ppm, which would have disastrous effect on agriculture. Concurrently, the farmers are facing challenges of natural resource degradation, high input costs and frequent weather fluctuations due to anthropogenic climate change (e.g. climate change and its impact on plantation sector).

Figure 14 *Mean annual variation of maximum and minimum temperatures averaged over different periods from 1973 to 2015 and 2016, at Thiruvananthapuram. Temperatures are increasing in recent period and 2016 is the warmest*



Source: GHCN, NOAA

Figure 15 *District-wise difference in SW monsoon rainfall between future projection and present-day simulation of a 20-km model*



Source Weather and Plant Health Management in Kerala, KSPB, Govt. of Kerala, 2015

At the end of the 21st century, the model at the district-level, predicts a significant decrease in precipitation over Kerala (Fig. 15). In addition, there is large spatial heterogeneity within the state.

Projections in Local Scales

Regional-scale climate information can be obtained directly from global models, e.g., from Intergovernmental Panel for Climate Change, 5th Assessment Report Climate Model Inter comparison Project (IPCC CMIP5) models. However, their horizontal resolutions, the highest being ~120km, is often too low to resolve features that are important at regional scales, for example for the state of Kerala. High-resolution atmosphere alone climate models (AGCMs), variable-resolution global models, and statistical and dynamical downscaling techniques (as shown in Fig. 15) are used to overcome this issue, and to generate region-specific or local climate information. Dynamical downscaling techniques vary in terms of the models used, the way of nesting and frequency of nesting communication. Downscaling techniques, their applications, and the community using them are broad and varied, and is a growing. It is important however that these techniques, and the results they produce, are assessed and evaluated. Coordinated efforts are underway to objectively assess and inter compare various downscaling techniques (e.g., Coordinated Regional climate Downscaling Experiment, CORDEX).

Meanwhile, with higher confidence, climate change information can be obtained using very high resolution global AGCMs with resolution of ~20 km. The climate change projections at block levels or at agro-ecological unit level should be the focus and Kerala government should encourage studies to further refine these projections through a regular monitoring mechanism in a timed manner. In addition, the state should implement strategies for assimilating the feedbacks from user communities to refine these projections and projection-based regional climate change information.

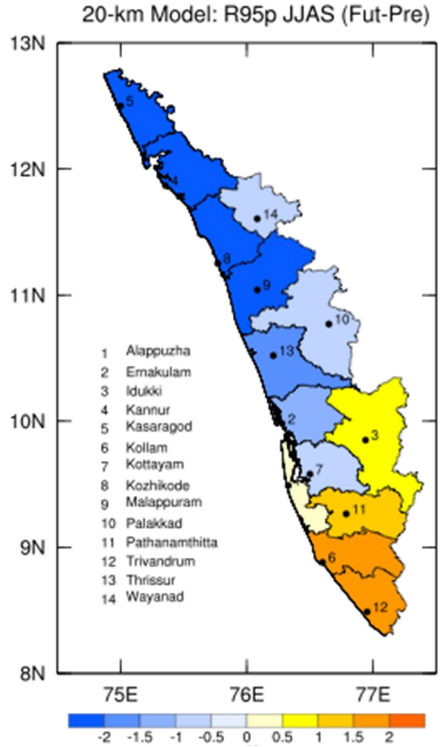
Extreme Events

Extreme events are found to be increasing in recent times. It is important to study the underlying dynamics and the orographic influence on them, role of surface processes and sub seasonal variability,

and the impact of slowly varying boundary conditions such as soil moisture and sea surface temperature, in order to predict these extreme events. In the implemented nested modelling framework, the global model is used to simulate the low frequency modes of tropical climate variability such as El Nino Southern Oscillation (ENSO), Equatorial Indian Ocean Oscillation (EQUINOO), synoptic scale variability, and annual to seasonal to sub seasonal variations.

Extreme rainfall projection shows decrease over most parts except the southern districts (Fig. 16). Over the northern parts, the reduction in mean rainfall and wet events will occur along with an increase in the number of hot events.

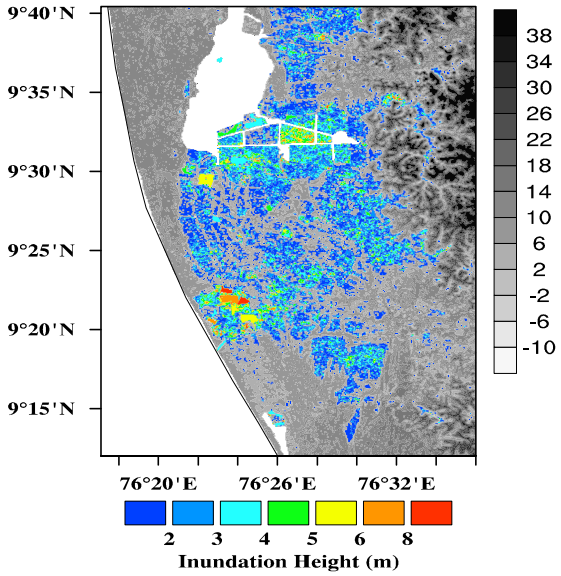
Figure 16 *District-wise changes in number of days in JJAS with precipitation greater than 95 percentile (R95p) between present and future simulations of 20-km model*



Source Weather and Plant Health Management in Kerala, KSPB, Govt. of Kerala, 2015

First hand estimation of inundation maps especially for the state's coastal regions, in circumstances of extreme rainfall or natural disasters such as cyclones, is highly necessary for efficient planning of strategies to adapt to the changing climate where extreme rainfall events are expected to increase in future.

Figure 17 *The inundation map for Kuttanad region due to extreme rainfall*



Source Model at CSIR-4PI

For example, a first order estimation of possible inundation of Kuttanad area when an extreme rainfall occurrence of magnitude 100 mm/day is shown in Fig. 17. As per this estimation about 36% of the land area will be inundated by 1-4m, by an extreme rainfall event with rainfall of 100 mm/day.

In addition, there are important issues for the state such as the estimation and projection of sea level change along the coast due to climate change. Incorporation of local land rebound/subsidence corrections through dedicated GPS based observations is necessary to correct the sea level change estimations, for coastal planning. This observation information can also substantiate studies on groundwater depletion.

Action Plans

Efforts are needed in the following areas, the priority of which are highlighted:

1. Improvement in observation data collection – Advancement in observational, communicational and analytical capabilities and enhancement of observational networks.
    1. Improve the understanding of multi scale convective systems and land surface processes.
    2. Assimilate the information in agricultural, hydrological and coastal management applications
2. Climate change projections for the state using dynamical downscaling for deriving information at local scale.
3. For the state, implementation of the ensemble system of a skillful forecast model, most importantly global models at fine grid resolutions (horizontal grid sizes of ~ 10-km for short range, ~20-km for extended range, and ~40-km for seasonal prediction) would be highly useful to provide probabilistic forecast guidance down to district level.
    1. Improving predictability of mesoscale convective systems, intra seasonal variations and severe weather systems through process studies needs to be attempted.
    2. Efforts are required to reduce the systematic biases in seasonal forecast models by
        1. Better representation of low clouds, cloud microphysical properties and land surface processes, and
        2. Reducing ocean model biases through improved ocean mixing processes in the model.
    3. Development of comprehensive region-specific data assimilation in the operational forecasting system.
    4. This necessitates research to improve model physics suitable to grid refinements.
    5. Algorithms to combine and assimilate available state-specific high resolution information from all observation datasets viz., radar, satellite, surface observations, and automatic weather report information, within a small nowcasting period for localized severe weather updates to within the available time for extended range forecasting, along with a timely dissemination of weather information for public safety.
4. The development of alternative techniques using the generalized linear model and genetic algorithms for the optimal selection of predictors in the forecasting procedures needs to be encouraged.
5. Preparation of inundation maps with respect to extreme rainfall occurrences for the coastal areas.
6. Estimation of contribution to sea level change along the coast due to local land rebound/subsidence through dedicated GPS based observations. This observation information can substantiate studies on groundwater depletion for the state.
7. For the state's coastal and high-range areas, organized efforts to develop information and knowledge systems and adaptive measures which enable vulnerable communities to build

resilience to risks induced by changing weather and climate are essential in the current times of extreme climate fluctuations.

ANNEXURE 2
DIRECTORATE OF ENVIRONMENT AND CLIMATE CHANGE
MAINSTREAMING CLIMATE RISK UNDER PLAN AND CAPACITY BUILDING

Padma Mahanti
Director, DoE & CC

As the nodal department of the State on climate change related activities, the Directorate of Environment and Climate Change proposes to mainstream climate risk through the implementation of State Action Plan on Climate Change (SAPCC). The department has started taking steps to form and establish the Climate Change Cell (CCC), as recommended in the SAPCC and directed by State Level Steering Committee (SLSC).

The CCC will help to ensure the effective management, coordination and monitoring of climate change actions including SAPCC. It will support the Government of Kerala in responding to Global Climate Change by building capacities for the Climate Change Actions (mitigation and adaptation), so as to make it a climate resilient state through improved climate change governance and services linking climate science, policies and people. The Cell will be the nodal body in DoE & CC for informing and supporting various departments and agencies to embed adaptation and mitigation measures within their action plans. It will also be secretariat for SLSC. Presently, Climate Change Focal Teams from each stakeholder department is formed to coordinate the activities of climate change for the respective sectors. The cell will develop and implement knowledge management and capacity development systems, access local, national and international climate finances for the effective interventions to make the state climate resilient and plan, coordinate and monitor the climate change related actions, programmes and policies in the state together with the various sectoral departments, agencies and institutions. The following activities are proposed:

Capacity Development

DoE & CC with the support of Climate Change Innovation Programme (CCIP) has organised various sensitization and training programmes and workshops. A rapid need assessment for training requirement and a draft training module is prepared.

1. It is proposed to hold in a phased manner several rounds of orientation / training programmes at various levels. The first round will be for the Climate Change Focal Team from the 34 SAPCC implementing agencies. The programmes will soon be rolled out.
2. The next level of training will be for the Local Self Governments. This will be coordinated with the support of Kerala Institute of Local Administration (KILA).
3. It is also proposed to organize national/state workshops on "Climate Change" to generate awareness, sensitization and disseminate the various activities undertaken by the department also to develop technical papers on climate change, in collaboration with relevant departments, agencies and institutes.

Knowledge Management

Under knowledge management, the department proposes to undertake the following activities.

1. To develop a knowledge management strategy.
2. To develop a knowledge and information repository of climate change to strengthen the relations between scientists, educators, environmental NGOs and policy makers. This will be through the development of an interactive web portal on climate change

3. To Develop a Management Information System (MIS) encompassing all climate change related programmes and projects within the state.
4. To develop a database management system to comprise data related to the SAPCC and its monitoring and other climate change related data. It will include the assessment of the data requirements of all stakeholders, from various sources and synthesize them as per the requirements and disseminate.

Climate Finance

DoE & CC is tracking national and international climate finance opportunities and disseminating the information to various stakeholder departments and agencies. DoE & CC has taken the initiative to mobilise climate finance from NAFCC, GCF and CCAP with the technical support of CCIP. Under NAFCC of MoEF & CC, the Fisheries Department secured INR 25 crores last year. This year one concept note on Palakkad gap has been submitted for Green Climate Fund with a total amount of INR 4.058 million of which INR 2.414 million as GCF grant. A second concept note on Coastal Resilience and Coastal Health for GCF is under preparation. Another proposal is being developed for accessing the Climate Change Action Programme funds under MoEF & CC.

Implementing SAPCC

The following implementations are:

1. DoE & CC undertook a review of the status of SAPCC. Now, under the direction of SLSC, the department has taken initiatives to update SAPCC. A state level plan is being prepared for the implementation of SAPCC.
2. A vulnerability and adaptation assessment in health sector is being undertaken to develop surveillance, forecasting and planning system for health sector on climate change with the technical support of CCIP.
3. It is proposed to develop a Heat Action Plan (focusing on health) and Coastal Climate Action Plans as pilots in selected vulnerable coastal local governments with the technical support of CCIP.

ANNEXURE 3
INSTITUTE FOR CLIMATE CHANGE STUDIES

Introduction

Climate Change

Climate Change has been recognised as a global phenomenon with innumerable local impacts spanning across different scenarios and spans of life from ecological to socio-economic aspects. It poses an emerging challenge to sustainability of social and economic development, livelihoods, habitat of communities, and environmental management. Climate change may be due to natural internal processes or external forcing, or to persistent anthropogenic changes in the composition of the atmosphere or in land use. Anthropogenic activities over the last century have contributed towards increase of atmospheric concentration of the greenhouse gases (GHGs) and thereby led to an enhancement of natural greenhouse effect. Increase in concentration of the greenhouse gases in the atmosphere has led to the warming of the earth's surface and atmosphere and thereby threatening to change the climate of the entire earth system. Increased levels of these gases beyond their natural levels due to uncontrolled human activities such as burning of fossil fuels, increased use of refrigerants and enhanced agricultural activities caused climate to change to the present form.

Challenges

India faces many challenges with regard to climate change, such as serious droughts in one region and dangerous floods in another. The State of Kerala is specifically vulnerable to the changing climatic dynamics owing to its location along the sea coast and steep gradient along the western slopes of the Western Ghats. Though the State has been blessed with rich natural resources such as, forest, biodiversity, water resources and mineral resources, deterioration is felt in recent years which evidently had far reaching consequences. The forest resources has declined at an unprecedented rate, especially in the highlands of Kerala with its rolling topography and heavy rainfall, soil erosion continued unabated leading to reduced soil quality and low productivity. Many of the rivers are drying up. Decrease in rainfall and change in basin ecology lead to perennial river of Kerala to non-perennial one. River water quality is further affected by urban and industrial effluent discharge and lack of sanitation in the rural areas. Reclamation of wetlands is another factor adding to the ecological transformation of the State. High population density and high state of urbanisation result in high per capita energy needs and carbon intensity. Unregulated backwater tourism and eco-tourism in the ecologically fragile lands also become an issue. The rapidly expanding infrastructure development in the state as well as large proportion of goods and traffic movements through road transport has been a cause of increasing quantum of carbon based emissions in the state. Therefore, the current knowledge is that Climate Change in Kerala will lead to enhanced threats from natural hazards linked to the atmosphere and ocean processes, besides stressing the availability of water and health of our key natural and managed ecosystems. It has already faced various types of developmental and environmental pressures and issues.

Major Initiatives in Kerala

In Kerala, Climate Change has become an agenda for development planning in recent years. Kerala has adopted State Action Plan on Climate Change (SAPCC) in 2014, which is largely led by the National Action Plan for Climate Change as far as mitigation efforts are concerned. The SAPCC has identified specific vulnerabilities under the key sectors – agriculture, animal husbandry, water resources, forest and biodiversity, fisheries and coastal resources, health, energy, urban front and transportation, and tourism

sustainability. The SAPCC envisaged Climate Change Strategies need to be integrated in development planning process in the state placing the Climate Change concerns at the forefront of sustainable development thereby improving the quality of life of the people of the state. A total of 127 key priority activities with action programmes covering the entire spectrum of problems associated with the state were identified under the nine key sectors for implementation. The establishment of the Institute for Climate Change Studies (ICCS) is in the wake of SAPCC to face the challenges of Climate Change in Kerala.

ICCS – Present Status

Objectives

The Institute for Climate Change Studies (ICCS) is an autonomous research organisation established under the Department of Environment, Government of Kerala, vide GO (MS) No. 03/2014/Envt dated 21.02.2014 (copy of the GO attached as Appendix 1). The Institute, which was registered under the Travancore Cochin Literary, Scientific and Charitable Societies Registration Act 1955, started functioning at Kottayam on 01 August 2014. The general objectives of ICCS are focussed research on state specific impacts of climate change on water, agriculture, forestry, biodiversity, sea level rise, natural hazards, health and socio-economic scenario of the State; and propose appropriate action for climate change management and adaptation strategy on various sectors and zones of the State. The ICCS is expected to act as the State Level Apex Agency for climate change research and advocacy; to assist the Government of Kerala in achieving coherence between strategies on climate change and help in the implementation of the State Action Plan on Climate Change; to assist the Government of Kerala in prioritizing financial allocation for climate change adaptation and resilience building; to perform as the knowledge centre on climate change; and to conduct capacity building programmes on Climate Change Adaptation and Mitigation for stakeholders like, functionaries of local self-government organisations, NGOs, and academic institutions.

Organisational Structure

Chief Minister of Kerala is the chairperson of the Governing Body of ICCS, and the Minister for Environment is the chairperson of the Executive Committee. Director, ICCS, is the Member Secretary of both the Committees. The Scientific and Academic Council with experts in the climate change related sectors, constituted under the chairmanship of the Director, ICCS, is the research and academic policy making body. The Director is the Chief Executive Officer of the Institute. The Scientific and Academic Council (SAC) will be the research and academic policy making body of the Institute. This Council shall have the powers to sanction the research and academic programmes of the institute and can approve temporary research and technical posts required for the smooth conduct of such programmes.

Ongoing Projects

Research projects carried out by ICCS at present are – (i) Palaeo climate records in the High Ranges of Kerala funded by Environment Department (2 year project started during 2015); (ii) Climate Change impacts and the prevalence of vector-borne diseases in Kerala funded by Environment Department (2 year project started during 2015); and (iii) Vulnerability of Vembanad-kol Ramsar Wetland to Climate Change funded by Kerala State Council for Science Technology and Environment (2 year project started during 2016). Capacity building programmes on climate change disaster risk reduction have been undertaken with the funding of Environment Department (one year project started during 2015), focussing mainly on the officials and elected representative of local self-government institution, which is carried out as effective step towards mitigating Climate Change disaster risk at the local level. The

Department of Science and Technology, Government of India, under National Mission on Strategic Knowledge for Climate Change, has sanctioned Rs 2.5 crore to ICCS, recently, for setting up a Climate Change Knowledge Centre for the State (sanctioned during November 2016).

Palaeo Climate Records in the High Ranges of Kerala. The project was started during September 2015. The main objectives of the study are – (i) to prepare a detailed depositional framework of the Quaternary deposits the High Ranges; (ii) to document the carbon sequestration in the Late Quaternary deposits; (iii) to unfold the Later Quaternary Climate Changes/events and landform evolution; and (iv) to unravel the palaeoclimaticand palaeoecological conditions responsible for the evolution of Western Ghats during Quaternary Period. Preliminary fieldwork was carried out in 13 suitable sites and 74 soil samples were collected. Soil analysis was carried out for the parameters namely Organic Carbon, Potassium, Phosphorus, Calcium and Magnesium. Cluster analysis was carried out using a software PAST. In the non-constrained cluster analysis of Organic Carbon, similarity on Organic Carbon content was analysed across the sites of soil samples up to the depth 60 cm. Meesappulimala samples which have higher carbon content showed more similarity in the cluster analysis. The result of Meesappulimala was compared with the organic carbon content of Eravikulam National Park, which was published by Kerala Forest Research Institute. A consultative workshop of the experts in the sector was conducted on 14 July 2016 for reviewing the work plan and outcome of the project. An interim report was been prepared on the project after completion of one-year.

Climate Change Impacts and the Prevalence of Vector-borne Diseases in Kerala. The project started during the month of January 2016. The State is believed to be one of the hotbeds of communicable diseases, due to its geographical location, topography, tropical weather patterns and varied land use. All vector borne disease outbreaks can be linked to climate variability in recent times. The case of dengue outbreaks in the State can be taken as an example. Therefore the current study explores the linkage between vector-borne disease incidences and cases and the local weather parameters like temperature, relative humidity, and rainfall for the past 10 years of Alappuzha, Kottayam and Pathanamthitta districts. The study proposes to develop a database on vector-borne diseases as part of Health Information System, and to create awareness on climate change related health impacts and its mitigation strategies among people at large. Collection of data from the Kottayam district and the analysis of the data collected have been completed. Data have been collected from 79 Government health institutions of the district. Interim Report on Kottayam District has been prepared. Data from health institutions of Pathanamthitta is ongoing and the details have already been collected from 37 health institutions. As per the Interim Report, a total of 4036 cases of vector-borne diseases were reported in the Kottayam District during the period from January 2001 to December 2015. Dengue cases were the highest reported (n=2663), followed by Leptospirosis cases.

Vulnerability of Vembanad-kol Ramsar Wetland to Climate Change. Major objectives of the Study are: to identify issues related to climate change affecting the Vembanad-kol wetland system; to delineate the human caused factors that act as a risk addition in the climate change scenario of the wetland system; to identify climate change hotspots which are vulnerable in the Vembanad-kol region; to measure the adaptive capacity of the people of the region, and to develop short-term and long-term climate change adaptation strategies; and to develop a common framework for vulnerability assessment of coastal wetlands of Kerala by integrating socio-economic, and ecological factors. It is also intended to create awareness among all stakeholders in the Vembanad-kol and related regions about climate change, its local impacts, and adaptation measures. Awareness creation among various stakeholders is continuing in the immediate lake catchment, as KSCSTE has sanctioned fund only for the purpose initially.

Training Project on Climate Change Disaster Risk Reduction. Capacity building programmes have been taken up by ICCS on "Climate Change and Related Disaster Risk Reduction" for the elected representatives and officials of Local Self Government Institutions in the rural and urban level. The programmes are intended for sensitising the participants on perspectives of climate change, disasters that could happen due to climate change in the State, and adaptation/mitigation measures possible at the local level. A total of 22 training programmes were conducted at various districts participating Corporation Mayors, Municipal Chairmen, Block Panchayat Presidents, Gram Panchayat Presidents and concerned officials during 2016. 1825 persons attended the programmes so far.

Establishing Climate Change Knowledge Centre. The Department of Science and Technology, Government of India, has sanctioned financial assistance of Rs 2.48 crore to ICCS for setting up the Climate Change Knowledge Centre in Kerala State, under the National Mission on Strategic Knowledge for Climate Change. The main aims of the five-year project are (i) to build data-bank and knowledge repository for storing and retrieving Climate Change information at the state level to be useful to all sectoral line departments/agencies/universities, general public, etc; (ii) to establish a network with various stakeholders within the State; (iii) to assess risk and vulnerability due to Climate Change in the State and to develop bench mark/assessment relevant for all adaptation and mitigation sectors; (iv) to develop capacity building for all relevant departments/agencies and stakeholders to create awareness on Climate Change and develop capabilities to handle various issues; and (v) to develop a web portal for assisting decision makers in framing appropriate policy interventions in the activities of various departments/agencies. In fact, the Knowledge Centre seeks to establish link between Climate Change Sciences and knowledge base to policy makers, planners, etc. to support strategic planning of government policies, to cope up with Climate Change risks and vulnerabilities. This will be achieved by main-streaming Climate Change Knowledge into development and planning process and strengthen activities of the Government at grass root level as envisaged in the State Action Plan on Climate Change. Actions have been initiated to start the project.

Monthly Newsletter 'Kerala Climate'. A monthly newsletter 'Kerala Climate' is brought out by ICCS for disseminating the news on activities of ICCS and outcomes of Climate Change related studies carried out by various academic organisations in the State. Copy of the November Issue of the Newsletter is attached as Appendix 2.

Workshops, Seminars and Other Programmes.

1. Report preparation Workshop on Climate Variability in Kerala: Climate Change Perspectives at Thiruvananthapuram, on 21 November 2016, jointly organised with India Meteorological Department and Kerala State Disaster Management Authority
2. Seminar on Ozone and Climate: Restored by a World United, at Kottayam, in association with Mount Carmel Higher Secondary School on 23 September 2016 as part of International Ozone Day 2016
3. Workshop on Climate Change and Technological Advancements at Kottayam on 04 May 2016, organised in association with Kerala State Council for Science Technology and Environment
4. Workshop on Climate Change and Water: Way Forward in Management Strategy for Kerala, at Kottayam on 22 March 2016, organised jointly with Centre for Water Resources Development and Management
5. Workshop for school children, at Kottayam, as part of the International Ozone day 2015 (16 September), participating 20 schools in and around Kottayam.
6. Workshop on Climate change and its impacts, at Kottayam during November 2014, organised jointly by MG University, and Health Safety and Environment group, BARC

7. Tree for Tomorrow Campaign at Eraviperoor and Kuttoor Panchayats, Pathanamthitta, during June 2016, jointly with Eraviperoor and Kuttoor Gram Panchayats, Pathanamthitta District Administration, Citizens India Foundation, Forest Department, State Biodiversity Board, Education Department, Public Works Department, Rural Development Department, Agriculture Department, NREGS, and Kudumbasree
8. River walk on the banks of Meenachil River on 13 November 2015, in connection with the Conference of Parties (COP 21) meeting at Paris, participating students and teachers from different schools at Kottayam
9. Photo exhibition on environmental protection and climate change at BCM College, Kottayam, as part of World Environment Day 2015 during 04 – 05 June 2015

Staff in Position

The present Director of ICCS has been appointed by the Government for a period of two years on contract. All other scientific/technical/administrative staff are also working on contract or daily wage basis with the permission of the Executive Committee of ICCS. Project Scientist, Junior Research Fellows, and Technical Assistants in the research projects are appointed for the project period. Majority of the administrative staff are at present working on daily wage basis. Details of Staff in position at present are furnished in Table 6.

Table 6 *Staff in position in ICCS*

Sl. No.	Position	Contract or Daily Wage	Number
	Scientific and Technical Staff		
1.	Director	Contract	1
2.	Technical Expert	-do-	1
3.	Project Scientist	-do-	1
4.	Junior Research Fellow	-do-	3
5.	Technical Assistant	-do-	5
	Administrative Staff		
6.	Junior Accountant	-do-	1
7.	Office Assistant	Daily Wage	1
8.	Data Entry Operator	-do-	1
9.	Training Assistant	-do-	1
10.	Attender	-do-	1
11.	Night Watcher	-do-	1
Total			19

Utilisation of Funds

A total amount of Rs 179,89,504/- was granted to ICCS from Environment Department (Ecology and Environment), from inception, under Head of Account 3435–04–104–98, for meeting Infrastructure Development and Establishment Costs, carrying out Research Projects, and conducting Training Programmes during 2014 – 2016. A total amount of Rs 118,82,796/- was spent for the purpose for which the amount was sanctioned, and an amount of Rs 68,35,097/- was kept as balance as on 31 October 2016. The balance funds of Rs 68,35,097/- are to be used for carrying out the ongoing research projects which are to be completed in 2017, and for meeting expenses towards completing training programmes for LSGIs on Climate Change and Disaster Risk Reduction.

SWOT Analysis

Strength Weakness Opportunities and Threats (SWOT) Analysis was conducted in consultation with the a few members of Executive Committee of ICCS, existing staff members, well-wishers, etc.

Table 7 *Result of SWOT Analysis*

Strength	Weakness
- Climate Change Adaptation and Mitigation have been considered as a priority issue by the Government - Need for the Institute is well perceived by the Government, as Kerala is prone to Climate Change - Only Institute in the Country established under a State Government - Institute was established in 2014 with clear objectives and programmes - Institute has attracted funds for specific research and capacity building projects - Already established strong linkages with regional, national, and international agencies in the domain of climate change, including research institutes and universities	- No permanent staff - No permanent building - Though Budget Head allotted, no allocation of funds in the Head - Because of the lack of permanent scientists, funds from national and international agencies cannot be attracted for research projects
Opportunities	**Threats**
- Department of Science and Technology, Government of India, has agreed to fund the Institute to establish Climate Change Knowledge Centre which envisages to have a reference library on climate change subjects - Since the Budget Head is allotted, allocation of funds is made easy - Creation of permanent posts is under consideration of the Government - Interest is shown by institutes and agencies in the State which are carrying out studies on different aspects of Climate Change in isolation, for coordinated projects - ICCS can act a repository of information on climate change, including biostatistics - State Action Plan on Climate Change is active in the State - Large scope is there for conducting capacity building programmes on climate change for worst affected places in India and abroad	- Delay in creating posts has led to loss of momentum of ICCS - Non-release of Non-Plan Funds incapacitates ICCS to meet establishment charges - Sustainability of ICCS is affected due to lack of space and permanent building, lack of permanent staff and non-release of non-plan funds

As observed from the SWOT Analysis, it is clear that ICCS has an enabling environment for carrying out effective research and development activities, which is the major 'strength' of it. Enough 'opportunities' are also there. Besides the ongoing research and capacity building projects, ICCS will be starting soon the project to establish a Climate Change Knowledge Centre funded by the Science and Technology Department of Government of India. Though a few universities and academic institutes in Kerala are conducting studies on Climate Change related topics, they are scattered, not networked, and mainly focussed on food and agriculture, veterinary and animal husbandry, forests and biodiversity, and marine diversity and fisheries. Public health, energy, Green House Gases emission, wetland vulnerability, ecosystem, urbanisation and heat islands, inland fisheries, awareness creation and capacity building, etc. which are directly linked to Climate Change in Kerala are understudied/unexplored, on which studies are planned by ICCS. But the major constraint or 'weakness' of ICCS is that it does not have any permanent

staff, barring one or two, experienced hands also are not there. This incapacitates the Institute in attracting large funds from national and international agencies.

Steps for Revamping ICCS

Though permanent staff and building are the prerequisites for full functioning of any organisation, as it may take some more time in the case of ICCS, we have to think about alternate system to overcome the situation till permanent systems are in place. Therefore, suggestions are put forward for immediate strengthening of ICCS, in addition to permanent set up, for fruitful functioning.

Permanent Land/Building and Staff

Since there is no Government land available, based on the orders issued, the District Administration, Kottayam, has been approached for negotiated purchase of five acres of land at Chingavanom, Kottayam, which according to District Administration is under processing. An amount of Rs 2000 lakh is required for purchase of land and for constructing building.

Permanent Scientists and Staff

Request submitted vide letter No. ICCS/A2/102/2014 dated 07.01.2016, for creation of 26 posts (16 Scientific and Technical staff, and 10 Administrative Staff) is under consideration of the Government. Government have recently constituted committee to consider the proposal. Details of the staff proposed are given in Table 8.

Allocation of Non-Plan Funds

Though Head of Account was allotted for ICCS (3435-04-104-97(P), funds are not provided in the Account. Funds are routed through the Directorate of Environment and Climate Change under 'Ecology and Environment'. When the payment of the staff working under the research projects are provided from the project funds, payment to the other staff (mostly ministerial staff) is made from the provision of Ecology and Environment, under 'Climate Change' for strengthening infrastructure facilities, as funds are not allocated for meeting establishment charges. Therefore, necessary steps may be taken for allocating funds in the Budget Head (Plan and Non-Plan) provided for ICCS. For meeting salary and other costs, an amount of Rs 1000 lakh may be allocated for the five years.

Table 8 *Details of proposal submitted for creation of posts*

No.	Position	Scale of Pay	Number of posts
	Scientific and Technical Staff (CSIR Scale)		
1.	Director	Rs 37,400 – 67,000 + 10,000	1
2.	Scientist F	Rs 37,400 – 67,000 + 87,000	1
3.	Scientist E1	Rs 15,600 – 39,100 + 7,600	1
4.	Scientist C	Rs 15,600 – 39,100 + 6,600	2
5.	Scientist B	Rs 15,600 – 39,100 + 5,400	2
6.	Technical Officer Grade V	Rs 15,600 – 39,100 + 6,600	1
7.	Technical Officer Grade IV	Rs 15,600 – 39,100 + 5,400	1
8.	Technical Officer Grade III	Rs 9,300 – 34,800 + 4,200	2
9.	Technical Officer Grade II	Rs 9,300 – 34,800 + 4,200	2
10.	Technical Assistant Grade IV	Rs 9,300 – 34,800 + 4,200	3
	Administrative Staff (State Scale)		
11.	Administrative and Finance Officer	Rs 44,640 – 58,640	1
12.	Head Accountant	Rs 14,620 – 25,280	1
13.	Office Assistant (Accounts)	Rs 9,940 – 16,580	1
14.	Officer Assistant (General)	Rs 9,940 – 16,580	1
15.	Confidential Assistant	Rs 10,480 – 18,300	1
16.	Lower Division Typist	Rs 9,940 – 16,580	1
17.	Data Entry Operator	Rs 11,62020,240	1
18.	Attender	Rs 8,500 – 13,210	2
19.	Driver	Rs 9,190 – 15,780	1
Total			**26**

Temporary Arrangement: Appointment of Consultant Scientists

As observed from SWOT Analysis, the major step to be taken up for revamping ICCS is the appointment of a few experienced scientists and other staff. It may take some more time for the processing. In this situation, it is suggested that a few Consultant Scientists, preferably those who had retired from scientific/academic organisations, may be appointed urgently. There are several scientists involved in climate change related research/studies in Kerala (atmospheric science, earth sciences, ecology and environment, and related fields), who have retired recently from active service, interested to collaborate with ICCS in research/studies. For the time being permission may be granted to appoint four Consultant Scientists initially for a period of one year. An amount not less than Rs 50,000 may be given monthly to each one as remuneration.

Projects and Programmes

In addition to research projects, ICCS will have to give focus on developing consultancy projects, developing adaptation and mitigation strategies, preparation of projects for carbon credits, preparation of reports by synthesising published works on Climate Change research, documentation of traditional knowledge relating to Climate Change, etc. Therefore, following projects are suggested for taking up by ICCS individually, or in association with other research organisations, utilising the Plan Fund allocated under 'Ecology and Environment – Climate Change':

Table 9

No.	Title of the project/programme	Amount in lakh Rs
1.	An investigation into rural-urban transitional fussiness and consequent impact on micro-climate	40.00
2.	Climate variability land phenology of endemic plant species in new Amarambalam reserve forest of Nilgiri Biosphere Reserve - Study	30.00
3.	Restoration of selected afforested area of Kerala – A bio geophysical paleo climatic study	70.00
4.	Devise and implement action plan for Participatory Climate Change Management (valuate carbon footprints of educational institutions, local self-government institutions, etc, identify vulnerability at local level, develop Adaptation and Mitigation strategies and work out action plans, implement participatory programmes for reducing carbon emission coordinating Government/non-governmental organisations)	300.00
5.	Development of strategy and protocol for carbon budgeting towards carbon neutral urban and rural local bodies in Kerala	30.00
6.	Evaluation of programmes and projects of local bodies/government institutions in Kerala in terms of climate change	20.00
7.	Preparation of Baseline Reports specifying details of vulnerability issues, etc.in various sectors like Agriculture, Animal Husbandry, Fisheries and Coastal System, Forest and Biodiversity, Water Resources, Health, Energy, Urban Front and Transport Sector, Tourism, and IEC, Knowledge Management and Local Governance, based on vulnerability study, etc.	150.00
8.	Vulnerability of selected Rivers and Wetlands of Kerala to Climate Change – Study (five rivers and five wetlands)	200.00
9.	Study on traditional knowledge relating to Climate Change in Kerala	20.00
10.	Capacity building of stakeholders and IEC activities targeting general public on Climate Change Adaptation, including workshops/seminars/ training programmes and stakeholder consultation	600.00
	Total	**1460.00**

Conclusion

As pointed out in the SAPCC, vulnerability to climate change can be considered to be high in the State due to unique social, economic, environmental and physical conditions that amplify susceptibility to negative impacts and contribute to low capacity to cope with and adapt to climate related hazards. Taking specific issues faced by the State definite steps have to be taken up for climate change adaptation and mitigation. The ICCS is expected to act as the State Level Apex Agency for climate change research and advocacy and to assist the Government in achieving coherence between strategies on climate change and help in the implementation of SAPCC. Revamping of ICCS is required to achieve this. As mentioned above, an amount of Rs 44.60 crore is required to meet Plan and Non-Plan expenditure of ICCS during 13th Five-Year Plan period. Details as below:

Table10

Plan	
R&D Projects/Programmes	Rs 1460 lakh
Land and Building	Rs 2000 lakh
Non-Plan	
Staff, Establishment, etc.	Rs 1000 lakh
Total	**Rs 4460 lakh**

Though a few universities and academic institutes in Kerala are conducting studies on Climate Change related topics, they are scattered, not networked, and mainly focussed on food and agriculture, veterinary and animal husbandry, forests and biodiversity, and marine diversity and fisheries. Public health, energy, Green House Gases emission, wetland vulnerability, ecosystem, urbanisation and heat islands, inland fisheries, awareness creation and capacity building, etc. which are directly linked to Climate Change in Kerala are understudied/unexplored, on which studies are planned by ICCS. Also the Institute will have a space of its own and a role to play for the effective intervention in sustainable policy framing. It can help in availing the national and international funds for the adaptation and mitigation programmes of the State. It is sure that, since Paris Climate Change Agreement and the Nationally Determined Contribution (NDC) are the talks of the hour, there will be routing of scientific and technological resources and financial resources from the developed world. For this transfer to be materialised, there should be proper assessment of the current scenario in terms of GHG emissions and other forcing. ICCS can carry out the task and give timely report as part of monitoring in coherence with NDC. The Institute shall be an effective knowledge arm and decision support agency of the Directorate of Environment and Climate Change (DoECC), as envisaged in the Government Order establishing ICCS.

ANNEXURE 4
CIVIL SOCIETY AND LOCAL GOVERNANCE

CIVIL SOCIETY AND VOLUNTARY ENGAGEMENT IN CLIMATE CHANGE AND DISASTER MANAGEMENT OF KERALA STATE

Introduction

Sustainable development of the communities has become an important part in the present context where the voluntary organizations played a crucial role in defining the identity. Various factors and influences have considered for these influxes in the society pervasively dominated for the catalytic changes in mitigating the existing inequalities in the communities and social groups. A significant role of these voluntary organizations created a transit understanding in the various attributes of social arenas such as change, development and establishing equity and justice intrinsically.

In the context of global, national, regional and local initiatives, the voluntary action of these organizations accumulated tremendous energies in identifying various methods where the social- economic-political and environmental transformations took place and the role of such voluntary actions become focal considerations.

The subject matter of voluntary action in the development context has surfaced in the third word largely because the civil societies have identified the societal needs easily through its interventions, mobilizations, structural organizations and various other norms and values. In the current context, the involvement of the organizational capacities are increasingly demonstrating a convincing evidence of determination and dynamism voluntarily at the grass root level as social action in a right based approach.

In the last two decades the world's diverse economies and societies have undergone historical transformations of unprecedented breadth and depth. This new world stage has generated special concern among governments and diverse voluntary actors on the kinds of development and social changes in the rural communities. The impact of change is tremendous. Although the Third Sector has shown significant advances in attaining more just and inclusive societies, there remain enormous practical and theoretical challenges that demand multi-disciplinary approaches and new strategic alliances among those engaged in development and change through effective voluntarism in rural communities. International, National and local perspectives on the context of decentralized local governance on this sector reveal a clear vision in defining the role of the voluntary sector to be an effective agent of social change and inclusive development.

Civil Society Engagement

Civil society organizations formal and informal in nature have created social and civic engagement in the society through it continuous involvement of the development and humanitarian services. Non-Governmental Organizations Voluntary Agencies, Community Based Organizations, Self Help Groups, Arts and Sports, Rural Libraries and other people's organizations have driven the catalytic change of the society and also in moulding and defining the structure and public voice of the marginalized and vulnerable sector of the society. Networking of these groups in a systematic framework of action can help the overall achievement of target groups' interventions. Identification, accreditation and involvement of these groups from local to state level will trigger the immediate and responsible results in disaster and climate change preparedness of the state. Action will be taken to identify and network the agencies working at the local self-governance level to the state platforms. These civil society organizations formal

and informal can support the programmes and projects of the policy initiatives of the state. Proper monitoring and evaluation at all level can support the participation of the civic engagement in its full capacity.

Voluntary Engagement

The climate change and disaster management initiatives require huge involvement of voluntary engagement in all levels. Actually the trained volunteers are the power house of any emergency response and humanitarian services. Kerala has the immense potential of voluntary development and engagement in various environmental and development platforms. Systematic and creative capacity building of the volunteers at various levels will ensure the successful coordination of services in climate change and disaster management services of the state which requires a solid platform for the gathering. The voluntary engagement will start from the village level and which will be moulded on successful and hierarchical modulation through the mother NGO platforms. The mother NGOs selected at the state and district level will coordinate and enhance the capacities of the volunteers for the entire local self- governments in the state. Proper mechanism for selection and accreditation of credible NGOs will be mooted and sustained initiatives launched.

Registry of Infrastructure and Expertise

Kerala has a great potential of experienced experts and infrastructure in civil society organizations. They have practiced various models of community mobilizations, climate smart agriculture and disaster preparedness in various seasons and disaster contexts. A registry of all the existing infrastructure and experts in all sector of climate change and disaster management will be collected, collated and compiled for the capacity development in the sector.

Engagement of third sector in Local Self-Governments

The initiatives for engagement of third sector in Local Self-Governments will be launched with suitable consultation and expedition in sustaining the role of all dynamism at the grass root level. Mechanism will be developed to identify and coordinate the fruitful results of third engagement from LSG level to the whole state level missions of climate change and disaster management projects and programmes. Schemes and campaigns in the sector will be developed and all participation of peoples and third sector involvement with a vision of sustainable, demonstrable and responsive engagement of volunteers and civil society organizations.

ANNEXURE 5
DISASTER MANAGEMENT –KSDMA

Introduction

The Disaster Management Act, 2005 (Central Act 53 of 2005) mandates the establishment of the State Disaster Management Authority, State Executive Committee and District Disaster Management Authorities.

Accordingly the Government of Kerala framed the Kerala State Disaster Management Rules, 2007 vide *Kerala Extraordinary Gazette S.R.O No. 201/2007 dated 1st March 2007 (amendments vide S.R.O No. 583/2013 dated 17th July 2013 and S.R.O. No.263/2016 dated 2nd March, 2016)* and notified the State Disaster Management Authority, the State Executive Committee, and the District Disaster Management Authorities. The State Authority is chaired by Chief Minister and convened by Additional Chief Secretary, Revenue and Disaster Management. The Chief Secretary (*inter alia Chairperson of the State Executive Committee*) is the Chief Executive Officer of KSDMA. The other ex-officio members are Hon'ble Minister for Home and Vigilance, Hon'ble Minister for Agriculture, Additional Chief Secretary, Home and Head of State Emergency Operations Centre who is inter alia the Member Secretary of the Authority.

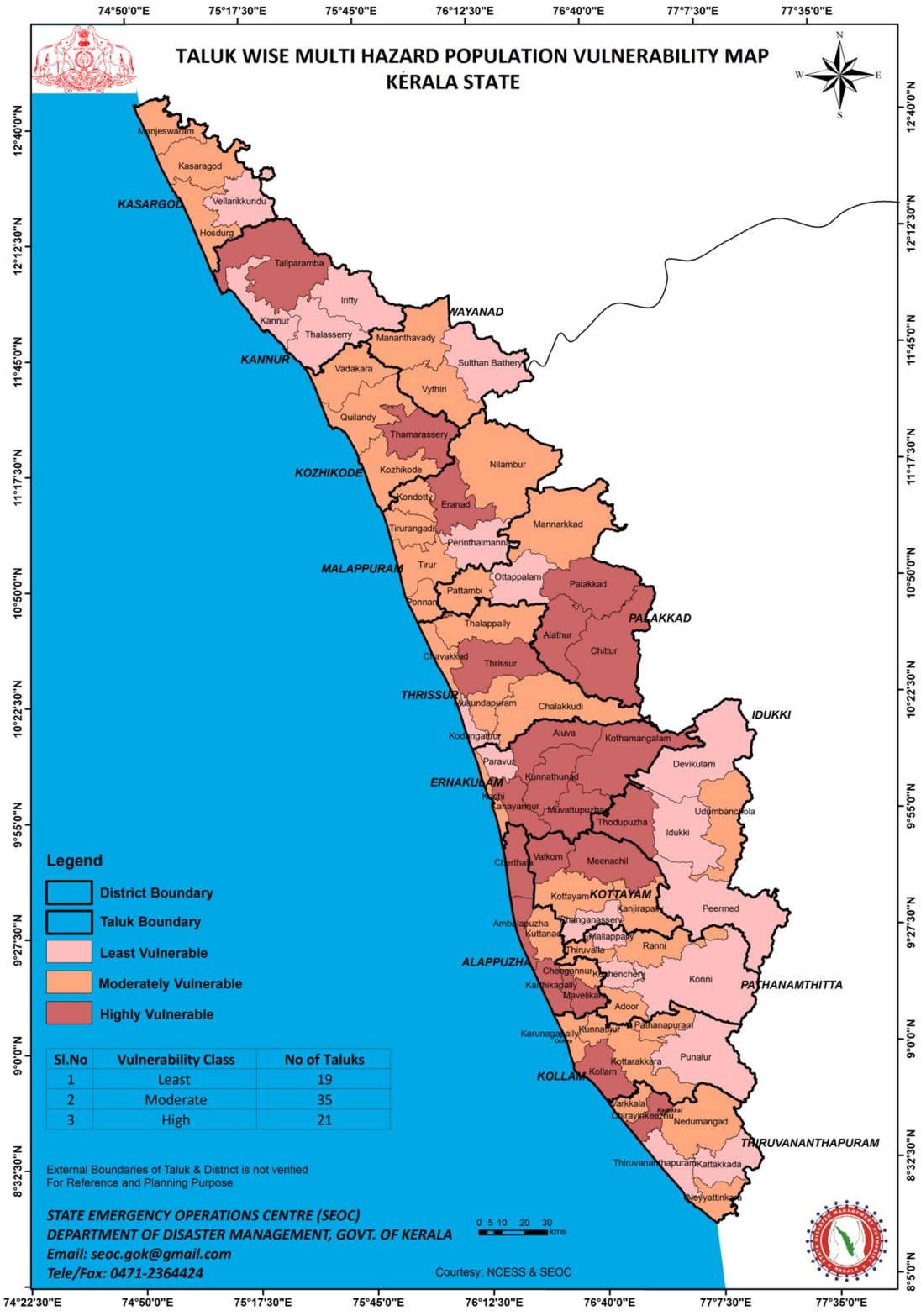
Section 23 (1) of the DM Act, 2005makes it mandatory for every State to have a State Disaster Management Plan (SDMP) for every State and vide Section 23 (6) 'appropriate provisions shall be made by the State Government for financing for the measures to be carried out under the State plan'. KSDMA has approved the State Disaster Management Plan for the period 2016-17 and the same has been approved by the Government vide GO (Rt) No. 3667/2016/DMD dated 9th September 2016. The plan also lays a perspective for disaster risk reduction in the next 5 years in line with the SENDAI framework for disaster risk reduction adopted by India and for the period 2015-30.

Vulnerability Assessment of Kerala

Kerala is multi hazard prone. The State is prone to 17 Natural Hazards and 22 Anthropogenic Hazards that has disaster potential. The list of these hazards may be found in annexure 1.

Based on the multi-hazard vulnerability assessment, Kerala has identified 21 highly vulnerable taluks and 35 moderately vulnerable taluks. Focus shall be primarily to empower the administrative systems and communities of these taluks to prepare effectively for disaster risk reduction from an 'all hazards perspective' as directed by Government of India. Figure 18 shows the multi-hazard vulnerability of Taluks of Kerala.

Figure 18 *Multi-hazard vulnerability of Kerala*



Based on the inputs from *Surakshaayanam* 2012 (International Workshop on Disaster Risk Reduction and Contingency Planning held at Thiruvananathapuram), a detailed 5 year plan was prepared and approved vide Ltr. No. 5660/2011/PPSD/SPB dated 26-11-2012 by the Planning Board for the 12th Five Year Plan period. This plan contained 7 sub-heads with detailed plans for disaster risk reduction and response. Financial utilization from 2012 to 2016 (4 years) is given below:

Table 11

Sub-head	Amount expended in ₹ (2012-16)
Construction of KSDMA Headquarters	2,70,40,000
Strengthening Emergency Response Capabilities	6,93,67,000
Strengthening Institutional Arrangements for Disaster Management	98,46,000
Implementing State and District Disaster Management Plans	44,64,000
Science and Technology for Disaster Risk Reduction	8,27,000
Natural Hazard Mitigation and Management	2,08,49,000
Anthropogenic Hazard Mitigation and Management	36,00,000
Total	13,59,90,000

Construction of KSDMA Headquarters

The headquarters of KSDMA is being built in Survey No. 90, Thycadu Village, Thiruvananthapuarm in line with Section 7 of KSDMR, 2007. The headquarters building is primarily to house the State Emergency Operations Centre (SEOC). The SEOC was operationalized with the financial support of 13th Finance Commission grant-in-aid. The building was designed by Padmashree Architect Sankar and constructed by M/S Habitat Technology Group by including traditional architecture and modern functional requirements. Once commissioned, the building will integrate all project implementation units of KSDMA under one roof. The project costs ₹7.68 crores from the State Budget. The construction started in May 2015 and is expected to be completed by May 2017.

Strengthening Emergency Response Capabilities

1. Funds from this subhead were allotted for training and capacity building of State Disaster Response Force constituted as per the direction of Government of India under the Home Department. Various training programmes were carried out for SDRF with the help of National Disaster Response Force.
2. Funds were allotted to all District Disaster Management Authorities for setting up District Emergency Operations Centres with staff from three departments namely Revenue, Police and Fire and Rescue Services in a 24 x 7 mode. Necessary facilities to be available in DEOC

was identified and compiled into a handbook and made available to the districts based on which DEOCs were setup in all 14 collectorates.

Strengthening institutional arrangements for disaster management

1. KSDMA, DDMAs, SEOC and DEOCs do not have any non-plan allocation for meeting establishment costs. Hence funds from this sub-head are primarily utilized for meeting the establishment costs of these offices including travel and communication expenses. Funds were also given to various autonomous institutions for conducting workshops and seminars in line with the decisions of the State Executive Committee.

Implementing State and District Disaster Management Plan

1. Funds were given to districts for implementing various activities as per the approved district disaster management plans. Various training programmes, mock drills and capacity building exercises have been undertaken utilizing these funds.

Science and Technology for Disaster Risk Reduction

1. Funds were utilized for purchase of various datasets including weather, satellite images etc. for addition to the database of SEOC. Automated weather stations for deployment at selected locations were also bought and are being used by SEOC for experimental purposes.

Natural Hazard Mitigation and Management

1. Funds were utilized under this subhead for financing the establishment of a coastal hazard monitoring station at Valiyathura, Thiruvananthapuram to National Centre for Earth Science Studies. A model project under the umbrella scheme called 'Jalavarshini – a drought risk reduction scheme of KSDMA' was awarded to National Centre for Earth Science Studies to create a perennial water source at Vadakarapathy, Palakkad district. Funds under the scheme were also given for cleaning and revitalization of a selected tank (chira) at Ernakulam based on the request for DDMA Ernakulam. Funds were also utilized to support 'Mazhapolima – a model rain water harvesting project of KSDMA' implemented in Thrissur by DDMA Thrissur.

Anthropogenic hazard mitigation and management

1. Under this subhead extensive training programmes were conducted for police, revenue and fire and rescue services in petro-chemical transportation accidents. A Malayalam handbook was prepared with standard operating procedures for risk reduction of petro-chemical transportation accidents. Funds were provided to transport department for establishing GPS based monitoring of all LPG tankers entering into the state.

Table 12 Annual Plan of 2016-17

Sl. No.	Approved sub-components	Cost (₹ in lakhs)
1	Construction of building for State Disaster Management Authority	210
2	Strengthening emergency response capabilities	
	2.a Support to district disaster management authorities	30
	2.b Emergency response training to medical doctors implemented by Health and Family Planning institute	30
	2.c Emergency communication network for Fire Force	25
3	Strengthening of institutional arrangements for Disaster Management	
	3.a Grant-in-aid for capacity building training	63
	3.b Establishment costs of KSDMA	52.5
	3.c Grant-in-aid for Civil Defence Institute	17
4	Implementing State and District Disaster Management Plans	0
5	Science and technology for Disaster Risk Reduction	0
6	Natural hazard mitigation and management	
	6.a Drought risk reduction – Vadakarapathy water harvesting project implemented by NCESS	30
	6.b Soil piping research – continuation of investigations and development of mitigation solutions implemented by NCESS	30
	6.c Landslide risk reduction – Thiruvambadi Grama Panchayath, Kozhikode implemented by Christ College, Irinjalakkuda	12.5
7	Anthropogenic hazard mitigation	0

It may thus be noted that the utilization of the plan funds of KSDMA are mostly for preparedness activities as against response and mitigation, for which separate funds are available outside the state plan. It may also be noted that the foot print of KSDMA on state exchequer is kept minimal including for establishment costs as funds are mostly attracted through innovative project proposals directly from the National Disaster Management Authority, Government of India and International NGOs.

Proposed schemes for 2017-2022

The State Disaster Management Plan 2016, in Section 8.7 has identified 7 broad themes under the SENDAI framework of action for disaster risk reduction in the state in the 13th five year plan period. These themes were also subsumed into the New Delhi Declaration 2016 as adopted in the Asian Ministerial Conference for Disaster Risk Reduction. For achieving the long term (15 years) goals as laid out in the 'Asian Regional Plan for implementation of the SENDAI Framework for Disaster Risk Reduction, 2016', the National Disaster Management Plan 2016, and the 'calls on governments' as in the New Delhi Declaration, KSDMA has formulated the 7 broad themes and have matrix linked each theme to a specific call as in the New Delhi Declaration, for implementation, as given below:

Table 13

Sl. No	Broad themes for implementation in 2017-22 state plan scheme of KSDMA	Call on Government in New Delhi Declaration 2016	SENDAI priority	Requirement
1	Community based disaster risk reduction – formation, training and capacity building of Civil Defence Corps in Kerala	Call 10: Strengthen inclusive collaboration at the local level to build on community initiative, knowledge and resources, and leverage national policies and programmes to achieve resilience. Call 5: Encourage meaningful participation and support representation of women, children and youth, and persons with disabilities in leadership role for disaster risk reduction	Priority 4: Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction	Section 4 of the Civil Defence Act, 1968 envisages the creation of Civil Defence Corps in all states. In a state like Kerala where the local community involvement in preparedness and response to disasters are high, creation of Civil Defence Corps will formalize the First Responder structure.
2	Strengthening State Disaster Response Force	Call 6: Improve preparedness for disaster recovery by strengthening institutional frameworks, establishing standards, and enhancing capacities to ensure that disaster recovery integrates risk reduction measures to build back better.	Priority 3: Investing in disaster risk reduction for resilience	As recommended by NDMA, KSDMA, through the Home Department, initiated the task of setting up the State Disaster Response Force. This specialised force of 100 men is presently in an immature stage and requires significant strengthening. The Kerala Fire and Rescue Services is the main stay of Disaster Response in the State. While they are capable of handling a multitude of events, the exposure of the Force to international firefighting techniques and capabilities require to be improved upon. Master trainers trained in specialized skill sets with international and national
3	Strengthening Kerala Fire and Rescue Services			

				exposure are required as a permanent capacity of the Force.
4	Strengthen the network of Emergency Operations Centres	Call 3: Strengthen national and local governance of disaster risk reduction to ensure coherence among policies, institutional arrangements across sectors, with representation of stakeholders in line with national circumstances and policies.	Priority 3: Investing in disaster risk reduction for resilience	The command and coordination ability of the State has been improved by the establishment of SEOC and networks of DEOCs. It is necessary that these institutional setups are maintained and made more efficient to ensure coordinated response and management of disasters
5	Strengthen instrumented monitoring and science and technology for disaster risk reduction	Call 11: Promote application of science & technology, and research for evidence-based disaster risk reduction policies, practices and solutions, including through international cooperation.	Priority 1: Understanding disaster risk	Several technological advancements have come about in the domain of disaster risk reduction. Experimental implementation of such technology and localisation of such technology will promote its popular use in the state.
6	Mainstreaming disaster risk reduction into development planning	Call 2. Ensure that policies and practices reflect an understanding of disaster risk. More specifically, collect and share risk information for pre-disaster risk assessment, risk prevention and reduction through development, and appropriate preparedness for effective response to disasters.	Priority 2: Strengthening disaster risk governance to manage disaster risk	Vide Section 38 of the Disaster Management Act, 2005, mainstreaming DRR into development planning is a statutory and obligatory requirement. For the purpose, the State DM Plan has envisaged that there be a virtual cadre for DM in all departments in the State and all that all departments prepare their disaster management plans in accordance with the State DM Plan.
7	Updating Hazard, Vulnerability and Risk Assessment (HVRA) of the state and the District and State Disaster	Call 4. Increase investment in disaster risk reduction for resilience including in multi-hazard early	Priority 1: Understanding disaster risk	The State and District DM Plans and the HVRA needs annual updation. It is a continuous and constantly evolving process that needs further

Management Plans	warning systems and dissemination channels; contingency planning that engages all people to further strengthen disaster preparedness.	adjustments in the event of new and emerging threats. Focus will also be in ensuring local self government level DM plans in all urban areas in the State.

The 13th Five-Year State Plan Schemes of KSDMA are based on the statutory decisions in the following meetings and the consultations held on various days as given below:

1. State Disaster Management Plan, approved in the joint meeting of State Executive Committee and Kerala State Disaster Management Authority chaired by Hon'ble Chief Minister on 07-09-2016
2. State Executive Committee meeting chaired by Chief Secretary on 20-102-106
3. Crisis Management Committee meeting held on 01-11-2016
4. Meeting of the sub-group constituted vide Order No. 300/2016/AGRI (W10)/SPB dated 21-10-2016 held on 7-11-2016
5. Recommendations of the workshop on Climate Variability in Kerala: Climate Change Perspectives held on 21-11-2016
6. Meeting of the sub-group constituted vide Order No. 300/2016/AGRI (W10)/SPB dated 21-10-2016 held on 22-11-2016

Community based disaster risk reduction – Creation of Civil Defence Corps

Kerala's long history of decentralisation and strong social fabric is an opportunity for increasing community resilience by participatory community based disaster risk reduction programmes. In order to institutionalise and sustain community based disaster risk reduction initiatives the KSDMA has decided to create and strengthen the Civil Defence Corps which is mandatory under Section 4 of the Civil Defence Act 1968. In line with the call to Governments in the New Delhi Declaration 2016, participation of women, and involvement of trained volunteers from the ongoing project of KSDMA on "Strengthening Emergency Response Capabilities of Differently Abled", collaboration with student forces such as NSS, NCC, Scouts and Guides, Student Police Cadets and reputed non-governmental organizations allied in the NGO partnership programme of KSDMA are to be ensured in the scheme. NGOs that have shown commitment to Disaster Management are identified in section 5.40 of the State Disaster Management Plan, 2016. An expression of interest from reputed NGOs for state-wide partnership in sectoral engagement in Disaster Management is at the final stage of processing. This partner NGOs will be expected to provide expert pools for voluntary training.

The disaster management initiatives require huge involvement of voluntary engagement in all levels. Actually the trained volunteers are the power house of any emergency response and humanitarian services. Kerala has the immense potential of voluntary development and engagement in various environmental and development platforms. Systematic and creative capacity building of the volunteers at various levels will ensure the successful coordination of services in climate change and disaster management services of the state which requires a solid platform for the gathering. The voluntary engagement will start from the village level and which will be moulded on successful and hierarchical modulation through the mother NGO platforms. The mother NGOs selected at the state and district level will coordinate and enhance the capacities of the volunteers for the entire local self- governments in

the state. A registry of NGOs and professionals involved in Disaster Risk Reduction initiatives are being prepared by SEOC for updating the Indian Disaster Resource Network database.

The State has already established the Civil Defence Institute at Thrissur with financial support from Government of India. One time grant for initiating the training programmes have also been made available by Government of India.

However, funds are necessary for institutionalising and sustaining the Civil Defence Corps and the Institute. The proposal is herein to support a five year long targeted action plan for mainstreaming, institutionalizing and sustaining Civil Defence Corps in Kerala. The target is to at least have 50 trained volunteers in the identified highly and moderately vulnerable Taluks and 25 trained volunteers in the least vulnerable taluks. Primary focus will be on creating and activating Civil Defence Corps in the highly vulnerable taluks. At this rate 1050 volunteers will be needed in 21 highly vulnerable taluks, 1750 volunteers in the moderately vulnerable taluks and 475 volunteers in the least vulnerable taluks. A networking with the flagship missions of the State such as Kudumbashree, Haritha Keralam and Student Police Cadets will ensure that the tasks are converged and majority of volunteers chosen may be those from these flagship programmes.

The Civil Defence Corps needs to be trained in the following:
Box 2

HEADQUARTERS SERVICE	FIRE FIGHTING SERVICE
WARDEN SERVICE	TRAINING SERVICE
COMMUNICATION SERVICE	RESCUE SERVICE
CASUALTY SERVICE	SALVAGE SERVICE
WELFARE SERVICE	DEPOT & TRANSPORT SERVICE
CORPSE DISPOSAL SERVICE	SUPPLY SERVICE

Depending on the interest and ability of the volunteers as identified by the trainers, they may be assigned to the specific service. The training will be completed at the Civil Defence Institute with a certification in a collaborative manner involving the National Disaster Response Force, the Fire and Rescue Services, Police, Health, Civil Supplies and SDMA. The implementing agency of the scheme will be as decided by the State Executive Committee of KSDMA.

Funds are required for the formation, training and sustenance of the Corps as given below:

Table 14

Period	Item	Deliverable
2017-18	Formation of Civil Deference Corps – administrative expenses	Setting up the Office of the Director, Civil Defence and the Office of District Controllers of Civil Defence
	Establishment costs of Civil Defence Institute	The Institute needs to be furnished with necessary facilities for conducting the training including construction of boundary wall and road repair. Funds are also needed for the staff to be posted in the institute as decided by the State Executive Committee of KSDMA
	Training of Civil Defence Corps executives	Training of Deputy Controller, Civil Defence (District Fire Officer) and Panchayath Level Wardens (Selected through an open call on a voluntary basis, as master trainers) in Civil Defence @ 30 trainers per district selected from enlisted NGOs. A total of 434 trained men for setting up the Civil Defence Corps in the State will be created through the programme
2018-22	Civil Deference Corps – administrative expenses	Establishment cost of the Office of the Director, Civil Defence and the Office of District Controllers of Civil Defence @ 5 lakhs/year
	Establishment costs of Civil Defence Institute	Basic establishment costs including staff salaries (on contract) and consultants will be needed for the institute's continued functioning for at least 5 years before non-plan allocation is made available
	Training of Civil Defence Corps Volunteers	From the second year onwards, after the actual formation of the Civil Defence Corps through volunteer participation including women and children as approved by the DDMAs and the SEC.
2017-22	First Responder Emergency Kit	@ ₹5000/kit as approved by Government of India, emergency kits will be supplied to the trained volunteers for emergency response. The members of civil defence force will be certified medical first responders @ 4000 trained first responder Civil Defence Corps

Measurable Deliverable: Institutionalised Civil Defence Corps in all urban areas of the State ready for deployment as first responders in the event of minor and major accidents and disasters.

Strengthening State Disaster Response Force

The Disaster Management Act, 2005 has made the statutory provisions for the constitution of the National Disaster Response Force (NDRF) for the purpose of specialized response to natural and man-made disasters. Likewise every State shall have a State Disaster Response Force (SDRF) for the purpose specialized response. The State has constituted SDRF with 100 men vide GO (Ms). No. 262/2012/Home dated 17-10-2012. The SDRF is envisaged as a specialized force that would undertake specialised disaster response activities particularly related to Chemical, Biological, Radiological and Nuclear disasters, mass-gathering related stampedes and rescue from deep waters (marine and inland). Currently, the SDRF lacks sufficient training and equipment for training to keep the force under constant preparedness. The force is directly under the control of Home Secretary in her capacity as Member to KSDMA. Salary for the 100 men is provided from the Home Department. The Crisis Management Group for Anthropogenic

Hazards chaired by Home Secretary, in its meeting held on 1-11-2016 has directed the State Police Chief to take steps to place the SDRF at Mankattuparamba, KAP IV, Kuttikkanam KAP V and Adoor, KAP III. Each team will have 10 members of Fire and Rescue Services too.

The funds may be provided to SDRF for the following activities:

Table 15

Period	Item	Deliverable
2017-22	Advanced training at Federal Emergency Management Agency, USA	5 master trainers trained atFEMA, USA
	Advanced training in College of Military Engineering, Pune	25 men Certificated in 'Joint Services Disaster Management Course for Jawans' for ensuring interoperability of forces
	Advanced training with NDRF	25 men at Border Security Force Institute of Disaster Response (BIDR). Training topics: • Medical First Responder (MFR) • Collapse Structure Search and Rescue (CSSR) • Nuclear, Biological and Chemical (NBC) Emergencies • Flood Water and Cyclone Disaster Management
	Basic and Advanced diving course at Kochi Naval Base	100 men – Kerala experiences about 1500 drowning deaths in a year. By increasing the number of trained human resource in deep diving, the requirement of involving central forces in response could be substantially brought down.
	Basic trauma care, first aid and emergency medical training	100 men – Training at Health and Family Welfare Institute, Thiruvananthapuram or as recommended by the Directorate of Health Services. Periodic refresher course may also be conducted with these funds.
2017-22	Administrative support	A token provision for basic administrative requirements
2017-22	Purchase of training and response equipment	Purchase of mannequin, first aid kits, water testing kits, chemical content testing kits, LED high-mast lights, tents, inflatable boats, deep diving SQUBA kits, under water torch lights and cameras, tube camera, infrared camera, breathing masks, oxygen masks etc., for training and immediate response purposes
Measurable deliverable: An elite 100 men state disaster response force in three regions of the state ready for deployment as second line of defence in the event of major calamities		

Strengthening Kerala Fire and Rescue Services

Fire and Rescue Services of Kerala are the main stay of disaster response in the State. The Kerala Fire Force department started working as a separate department since 1963. In 1982 the name of the Director of Fire Force was renamed as 'Commandant General, Home Guards, Civil Defence and Fire Force'. Considering the rescue works under taken by this Department and significance in that area, this department had been renamed as 'Kerala Fire & Rescue Services' in 2002. There are 14 District Offices (Assistant Divisional Offices in each Districts) and 5 Divisional Offices in Thiruvananthapuram, Kottayam, Ernakulam, Palakkad and Kozhikode and 1 Assistant Divisional Officer in Kerala Fire and rescue Services Academy. Motor Transport wing is established in Headquarters, Academy and five

Divisional offices. The Department is in a stage of modernisation and development so as to provide better service to the public in all emergency situations.

KSDMA envisages that the Fire and Rescue Services of Kerala are on par with the world's most renowned fire departments namely that of the USA, Germany and the Netherlands. Although Fire and Rescue Services have fundamental training programmes under the routine training schemes of the department, advanced training is needed to ensure that the services rendered are world class.

Accordingly, KSDMA intends to support and develop Fire and Rescue Services as 'all disasters' force. This implies that the Fire and Rescue Services needs comprehensive and advanced training in facilities related to disaster management, globally and nationally. Between 2010 and 2015 about ₹25 crores was given to Fire and Rescue Services by KSDMA for purchase of specialised response equipment.

Fire and Rescue Services have about 4500 sanctioned posts. Allocations for specialised 'all disasters' training is proposed below at selected facilities, globally and nationally.

Table 16

Period	Item	Deliverable
2017-22	Advanced training at National Fire Academy, USA	5 master trainers trained at National Fire Academy, USA
	Advanced training in College of Military Engineering, Pune	25 men Certificated in 'Joint Services Disaster Management Course for Jawans' for ensuring interoperability of forces
	Advanced training with NDRF	25 men at Border Security Force Institute of Disaster Response (BIDR). Training topics: • Medical First Responder (MFR) • Collapse Structure Search and Rescue (CSSR) • Nuclear, Biological and Chemical (NBC) Emergencies • Flood Water and Cyclone Disaster Management
	Advanced diving course at Kochi Naval Base	400 men – Training at Kochi Naval base may require to be carried out in batches over a period of 4 years. Kerala has over 1500 drowning deaths. It is the diving team of Fire and Rescue Services that has the operational ability at night. Hence Fire and Rescue Service diving team needs to be strengthened
Measurable deliverables: Fire men with international exposure in world class fire-fighting techniques.		

Strengthening the network of Emergency Operations Centres

Kerala has a strong network of District Emergency Operations Centres (DEOC) in all District Collectorates and are linked to the State Emergency Operations Centre (SEOC) maned with professional expertise and presence of 3 departments, they being the Police, Fire and Rescue Services and Revenue, in a 24 x 7 mode. The State Emergency Operations Centre is moving to a separate 20,000 ft² building. These Centres that are statutorily required are the nerve centres of disaster management in the State and are being equipped as provided in the Handbook of Emergency Operations. The SEOC is implementing an end-to-end decision support system with predictive capabilities built upon direct inputs received as server exchange from IMD, INCOIS, SkyMet and NOAA observatories, Standard Operating Procedure

administration and emergency event management with the financial support of National Disaster Management Authority and Ministry of Home Affairs, Govt. of India. The system development is ongoing with abilities for addressing 'disasters with early warnings' and 'disasters without early warnings' as defined in the State Disaster Management Plan. The system accommodates anthropogenic and naturally triggered hazards that have the potential for resulting in disasters. The SEOC is already a fusion centre of digital multi departmental data and the process of upgrading the DEOCs which such abilities are ongoing.

Requirement of funds for maintaining SEOC and DEOCs are minimal as necessary funding is available from Government of India for majority of activities. Hence funds are requested only for specialised training programmes and basic establishment costs.

Table 17

Period	Item	Deliverable
2017-22	Administrative expenses of SEOC and DEOCs	Expenses related to administrative requirements, furnishing, maintenance & upgradation (software & hardware), travel costs and professional services
	Communication expenses of SEOC and DEOCs	Maintenance and upgradation of service charges of VSAT, GSM and fixed lines based communication networks
	Popularising existing mobile applications for early warning and weather applications in the State, particularly amongst fishermen	Several early warning applications are available from National Agencies which works on mobile phones which provides necessary early warning to the public. The requirement of these funds is for popularising these applications such that the warning messages issued by Central Agencies, SEOC and DEOC reach a larger community.
	Specialised EOC management training	The EOCs of Kerala are moving on to a digital intelligent Decision Support System built with world class IOC management tools. Training necessary staff in EOC management as identified in the Handbook on Emergency Management is required
Measurable Deliverable: Sustained maintenance of SEOC and DEOCs with fail proof communication systems and intelligent operations ability		

Strengthen instrumented monitoring and science and technology for disaster risk reduction

The axiom 'knowledge is power' is central to Disaster Risk Reduction (DRR). Reducing vulnerability requires increasing knowledge about the presence, imminence, and consequences of natural and technological hazards, and empowering individuals, communities, and public agencies with that knowledge to lower risk before, and respond effectively after, hazard events. Increasing this knowledge depends on focusing science and technology investment to improve disaster resiliency at all stages of disaster management by identifying and meeting needs and closing knowledge gaps wherever possible.

KSDMA already maintains a high end seismic monitoring system deployed across the state. The KSDMA is also in engagement with Agriculture Department and Revenue Department for ensuring a robust weather monitoring system in a Public-Private Partnership mode with minimal expense for the State. Financial support desired is primarily for data and experimental projects.

Table 18

Period	Item	Deliverable
2017-22	Experimental pilot projects for early warning and risk reduction	**Proposed technology experimentation projects** • Lightning detection and early warning system – successfully implemented in Bihar by BSDMA • Earthquake P wave detection and alert system for integration into the existing seismic monitoring network – Developed by the GFZ-German Geo Research Centre, Potsdam, Germany and deployed in Haryana by HSDMA and Baba Atomic Research Centre **Proposed projects under 'Jalavarshini' scheme of KSDMA** • Atmospheric Water Maker – humidity condensation based fresh water extraction equipment • Experimental deployment and localisation of rubber check dams – Rubber Board has agreed to take up the experimental deployment and localisation task. Funding is required for this experimental deployment and localisation to support the Rubber Boards product development team (Ltr. No. 42830/K3/2016/DMD dated 15-10-2016 - Direction by Hon'ble Chief Minister in the meeting held on 13-10-2016)
	Issue based investigation and solution seeking projects	The SEOC of KSDMA is often tasked with requests for undertaking scientific investigations and propose remedial/mitigation measures for various anomalous events occurring in the state. The inputs from such reports are also used in the DM plans
Measurable deliverables: Identification of successful modern technology for disaster risk reduction and operational use of such systems if proven useful		

Mainstreaming disaster risk reduction into development planning

Mainstreaming of disaster management implies the methods and means of integrating disaster risk reduction measures into development plans. A state level consultation meeting was held on 7th July 2015 with the involvement of various stakeholder departments with the support of UNDP. The attempt here is to ensure that development plans of various departments understand and account for disaster risk reduction. This can be achieved by ensuring that all departments have departmental disaster management plans with specific financial allocation for implementing/ensuring disaster risk reduction in the particular sector which is statutorily required under Section 39 (c) of the DM Act, 2005. Specific template for preparing the Departmental Disaster Management Plans has been issued to all major stakeholder departments in the State and these guidelines are enclosed as Annexure 9 in the State Disaster Management Plan 2016. The major administrative establishment of administering disaster risk reduction plans and policies in the State is the Office of KSDMA. Funding is necessary for its establishment costs and to complete the construction of the Headquarters Building.

Table 19

Period	Item	Deliverable
2017-22	Completion and furnishing of the HQ of KSDMA (*Continuing Scheme*)	Approved vide GO (Ms) No. 453/2014/DMD dated 30-10-2016 for a total cost of ₹768 lakhs for construction of KSDMA HQ. Construction is expected to be completed by March 2017 and furnishing is expected to be completed by 2018.
	Support to Departments for preparing the Departmental Disaster Management Plans	In total, 22 departments have been identified in the State DM Plan as specific stakeholders in Disaster Management in the State. Necessary templates for the preparation of these plans are provided in the State DM Plan. KSDMA intends to complete the preparation of Departmental DM Plans
	Establishing Virtual Cadre in stakeholder departments for Disaster Risk Reduction	It has been decided by the Government to create a virtual cadre in the identified 22 stakeholder departments for disaster risk reduction. The proposal has been formalized under Section 5.3 of the State DM Plan. The approach is to have 15 officers with at least 20 years remaining service in all departments (1/district and 1 in the State) specifically identified and notified as a virtual cadre for DM. Training programmes, capacity building and management will be specifically addressed to the staff of this virtual cadre. The virtual cadre will also act as the master trainers of the particular department
	Information, Education and Communication programmes including 'Towards a Safer State' series of conferences and workshops	Under Section 22 (i) of the DM Act, 2005, IEC activities are important and needs to be sustained routinely based on the hazard seasonality matrix in the State DM Plan. KSDMA has to regularly propagate messages regarding disaster risk reduction measures through radio, television, print media and print necessary brochures and
	Administrative expenses of Office of KSDMA	KSDMA does not have non-plan allocation and is permitted to utilize administrative expenses, salary and other emoluments, travel and travel allowances etc. from the Plan Funds for the sanctioned posts and contract posts of the office of KSDMA and SEOC.

Measurable Deliverable:

1. Virtual cadre of 15 individuals in identified stakeholder departments
2. Departmental Disaster Management plans in identified stakeholder departments

Updating Hazard, Vulnerability and Risk Assessment of the State and updating the district and state disaster management plans

Kerala has prepared the State and District Disaster Management Plans with Taluk level Hazard and Vulnerability Assessment. Total risk and cumulative risk of the 39 hazard types identified in the State DM plan with due consideration of existing resilience capacity, needs to be undertaken. Methodology for risk assessment and the parameters to be considered in Kerala have been identified and utilized in five city corporations and a selected coastal village in Thrissur under the National Cyclone Risk Mitigation Project. This is also hosted online with online query support in a geo-spatial environment. Inputs from these

assessments have been used to complete and release the City Disaster Management Plan of Thiruvananthapuram.

KSDMA intends to extend this process to 87 municipalities and 5 city corporations in the State. Orientation and training funds have already been provided to these local self-governments. Presently collateral data required for Hazard, Vulnerability and Risk Assessment (HVRA) is available only in multiple resolutions. For five city corporations, partial data is available in cadastral scale. Improvement in this base data is depended on the availability of high resolution datasets from Central Agencies. KSDMA desires to purchase the latest high resolution satellite images (Compass, TerraX, Quickbird) of five city corporations and 87 municipalities for which funds are available from external source. However, services of multiple agencies (NCESS, KSREC, ICCS, KFRI, CWRDM, Universities, NGOs, Companies etc.) are required for extracting the desired information for conducting a detailed HVRA within a short period of time for which funds are required. INCOIS already has a project of conducting the HVRA of coastal areas. However, this is limited to selected areas. KSDMA desires to collaborate with INCOIS for extending this project to other coastal areas of the State.

KSDMA regularly updates and maintains the National Database on Emergency Management (NDEM). The results of these activities will be brought under the NDEM platform and utilized in the DSS of the SEOC for disaster risk reduction planning and emergency management.

Table 20

Period	Item	Deliverable
2019-21	Data extraction services	Human resource and services delivery cost to identified agencies for extraction of desired Geo-information from high resolution satellite images and collateral data collection
2018-20	HVRA of Coastal Areas	Collaboration with Indian National Centre for Ocean Information Services for conducting detailed HVRA assessment and 3D mapping of coastal areas. This assessment will provide detailed information at household level along the coastal areas which will also be utilized for Coastal Security
2017-22	Annual updation of State and District DM Plans and development, updating and printing Standard Operating Procedures	It is mandatory that the State and District DM plans are annually updated/reaffirmed.

Measurable Deliverables:

1. Annually updated/re-affirmed state and district disaster management plans
2. High resolution vectorised geo-information for the NDEM platform and the SEOC DSS

Conclusion

KSDMA being a multi-departmental statutory body has to coordinate and implement disaster risk reduction measures through 22 identified stakeholders as envisaged in the State Disaster Management Plan. From the overall funding available to KSDMA, State Plan schemes are utilized primarily for preparedness measures. Only those schemes that do not have funding from other sources are enlisted and

identified for financial support herein. A project of cost requirements for each of these items are given in the table below.

Table 21

Sl. No	Sub-head	Requirement for 2017-22 (₹ in lakhs)
1	Community based disaster risk reduction – Creation of Civil Defence Corps	430
2	Strengthening State Disaster Response Force	785
3	Strengthening Kerala Fire and Rescue Services	775
4	Strengthening the network of Emergency Operations Centres	300
5	Strengthen instrumented monitoring and science and technology for disaster risk reduction	400
6	Mainstreaming disaster risk reduction into development planning	960
7	Updating Hazard, Vulnerability and Risk Assessment of the State and updating the district and state disaster management plans	450
Grand total		4100
		Rupees Fourty One Crores only

Table 22 *Identified Hazard types in Kerala in Section 2.2 of the State Disaster Management Plan*

Sl. No	Category	Type
1		Flood (Riverine, Urban and Flash Floods)
2		Landslides (includes debris flows, rock fall, rock avalanche, rock slide, landslips and mud slips)
3		Drought
4		Coastal hazards (High waves, Storm surges, *Kallakadal,* Tsunami, Salt Water Intrusion, Coastal erosion*)*
5		Wind (Cyclone, Gustnados, Gusty winds)
6		Lightning
7		Earthquakes
8	Natural Hazards	Human epidemics
9		Plant disease epidemics and pest attack on crops
10		Avian epidemics
11		Animal epidemics
12		Pest attack of human habitations
13		Forest Fire
14		Meteorite/asteroid impacts
15		Soil Piping
16		Heat wave/sunburn/sunstroke
17		Natural background radiation
1		Stampedes
2		Fire cracker accidents
3		Petro-chemical transportation accidents
3		Industrial accidents
4		Dam break
5		Dam spillway operation related floods & accidents
6		Oil spill
7		Road accidents involving civilian transport vehicles
8		Human induced forest fire
9		Human-animal conflicts
10		Fire accidents in buildings and market places
11	Anthropogenic Hazards	Boat capsizing
12		Accidental drowning
13		Building collapse
14		Hooch accident
15		Air accidents
16		Rail accidents
17		Terrorism, riots and Naxalite attacks
18		Nuclear and radiological accidents
19		Space debris impacts
20		Biological accidents
21		Occupational and recreational area related hazards
22		Accidents in Armed Forces premises
23	Disasters outside State's administrative boundaries, affecting Keralites	

ANNEXURE 6
DISASTER MANAGEMENT –ILDM

NEED FOR MORE VIRTUAL SYSTEMS IN PLACE FOR BETTER MANAGEMENT OF DISASTERS, RATHER THAN INSTITUTIONS AND POST CREATIONS

Disaster response is a time limited complex operation requiring additional resources, expert man power and timely coordination of response agencies. The District collector, being the Incident Commander for disaster management in a district, has to control and coordinate various departments, agencies and resources under extreme climatic situations as well as a at difficult terrains. The success of emergency management depends on the effectiveness in coordination that comprised of identifying emergency response resources and supplying it with least lapse time.

The current practice of emergency management relies on centralized institutionalized control rooms and Emergency Operation Centres at state capitals in contrast to the field operations in districts headed by the District Collector. A disadvantage of the system would be the limited access of District Collectors to resources as the repository of resources are operated at the State Level and the DCs have to run back to the State server for all information. Decentralization of information about SOPs and resources at district and Taluk Level would be the ideal solution for time bound and effective emergency management.

Objective

1. To enable the District Collectors in handling an emergency in his jurisdiction from anywhere in the world
2. Reduce time gap between the incident and SOP based response
3. To empower the District Collectors to command and control staff, departments and resources
4. To develop a virtual calamity control system in which all resources, critical facilities and emergency service agencies are controlled through an online/m-governance system

Component of the System

Resources

1. Geo-tagged Static resources- Infrastructure
2. Geo-tagged Dynamic resources- Emergency response equipments and machineries
3. Human Resource can be pooled from the R & D Division of ILDM

Real-time information on Facilities

Hospitals, specializations, no of beds available etc

Traffic Management

Real time traffic density from Google traffic

Inter-departmental coordination

1. Video conferencing with nodal officers of departments
2. Specified roles and responsibilities of nodal departments

Mobile application

End user based data updation

Risk Assessment should be Scientific and Not Arbitrary

The current risk assessment methodology in Kerala is highly unscientific and crude as the same is based on the extent of "relief amount disbursed" as revealed in the last meeting. This should be made more scientifically involving knowledge inputs of local community about the past incidences of disasters. The "GRAMA SABHAS" shall be involved in this data collection process rather than NGOs, which might bring-in biased observations and future criticisms.

Synergy shall be Ensured by Avoiding Duplication of Work

The various activities of the concerned departments and agencies shall be synergically siphoned to create a common resource pool of information, so that virtual systems can directly gather data from the metadata. For this the better option for the State is to streamline the plan fund activities specific to different agencies rather than depending on few agencies which are left to the whims and fancies of the decision makers present in such agencies.

ANNEXURE7

CONSTITUTION OF WORKING GROUP ON CLIMATE CHANGE AND DISASTER MANAGEMENT

PROCEEDINGS OF THE MEMBER SECRETARY
STATE PLANNING BOARD
(Present: Sri V S Senthil IAS)

Sub: Formulation of 13th Five Year Plan – Constitution of Working Groups – reg.

Ref: Note No. 260/2016/PCD/SPB dated 06.09.2016 of the Chief (i/c), Plan Co-ordination Division, State Planning Board

Order No. 300/2016/AGRI (W10)/SPBDated:19.09.2016

As per the reference cited, State Planning Board has constituted Working Group on 'Climate Change and Disaster Management**'** to formulate the draft proposals in the sector for inclusion in the Thirteenth Five Year Plan.

The Working Group on **'Climate Change and Disaster Management'** is hereby constituted with the following members.

Chairperson

Sri T Jayaraman, Member, State Planning Board

Members

1. Sri N Padmakumar IAS, Director, Institute of Land and Disaster Management (ILDM), Thiruvananthapuram
2. Sri S Sudevan, Director(i/c), IMD, Thiruvananthapuram
3. Dr KG Thara – Former Member, SDMA , Thiruvananthapuram
4. Dr George Chackacherry, Director, Institute of Climate Change, Department of Environment and Climate Change, Deepthi Nagar, Kanjikuzhi, Kottayam
5. Dr K Rajendran, Group Head and Coordinator, Multiscale Modelling Programme, CSIR, 4th Paradigm Institute, Former CMMACS, Bengaluru.
6. Dr E Vivekanandan – Former Scientist CMFRI, 9-Sarathy Nagar, 5th Street, Velachery, Chennai
7. Dr K S Kavi Kumar – Madras School of Economics, Chennai
8. Sri Shekhar Kuriakose, Member Secretary, Kerala State Disaster Management Authority, Thiruvananthapuram
9. Fr Bovas Mathew - Director, Malankara Social Service Society, Pattom, Thiruvananthapuram
10. Dr K B Hebbar, Head, Plant Physiology, Central Plantation Crops Research Institute, Kasaragod
11. Sri Baiju Kurup, DGM, NABARD, Thiruvananthapuram
12. One expert through Director, NCESS on coastal processes and sea-level rise.

Convener

Dr P Rajasekharan, Chief (Agriculture), State Planning Board

Co-Convener

Smt C K Santhakumari, Joint Director, State Planning Board

Terms of reference

1. To review the development of the sector with emphasis as to progress, achievements, present status and problems under its jurisdiction during the 11th and 12th Five Year Plan periods.
2. To evaluate achievements with regard to the plan projects launched in the sector, both by the State Government and by the Central Government in the State during these plan periods.
3. To list the different sources of data in each sector and provide a critical evaluation of these data sources, including measures for improvement.
4. To identify and formulate a set of output and outcome indicators (preferably measurable) for each sector and base the analysis of the previous plans on these indicators.

a) To outline special problemspertaining to specific sectors of concern including infrastructure, the likely impact of climate change in specific sectors in agriculture (broadly defined) and impact of sea-level rise and other climate impacts on coastal regions and ecosystems ,

b) To suggest specific measures and schemes for knowledge generation and/or specific action as appropriate in these sectors,

c) To critically review existing resource mobilisation for climate change action and suggest guidelines for future resource mobilisation including multilateral and national climate funds,

d) To suggest measures and schemes to utilise short-term and medium forecasting and extreme event warnings for various sectors including agriculture and disaster mitigation e) To examine issues in the implementation of disaster management plans from current experience at the state, district and panchayat levels, including measures to modifyexisting plans as appropriateand

f) To suggest measures for developing a comprehensive cultureofrisk mitigation and safety including the incorporation of climate and other disaster risks into project planning on a regular basis.

5. To suggest, in particular, a set of projects that can be undertaken during the 13th Plan period in the sector.

6. The Co-Chairperson is authorised to modify terms of reference with approval of State Planning Board. The Co-Chairperson is authorised to invite, on behalf of the Working Group, experts to advise the Group on its subject matter. The non-official members of the Working Group will be entitled to travelling allowances as are applicable to class I officers of the Govt. of Kerala. The class I officers of GoI will be entitled to travelling allowances as per rules if reimbursement is not allowed from Departments.
7. The working group will submit its draft report by 1st December 2016 to the State Planning Board.

Sd/-
Member Secretary

To

The Person concerned
The Sub treasury Officer, Vellayambalam

Copy to:-

The Accountant General, Kerala (A&E) with C/L
All Divisions, State Planning Board
PS to VC
PA to Member Secretary
Stock file

Forwarded by order
Sd/-
Chief (Agriculture)

PROCEEDINGS OF THE MEMBER SECRETARY
STATE PLANNING BOARD
(Present: Shri V S Senthil, IAS)

Sub: Formulation of 13th Five Year Plan – Constitution of Working Group on **Climate Change and Disaster Management** – Revised order - issued – reg.

Ref: (1) Order No. 300/2016/AGRI(W10)/SPB dated19.09.2016
(2) Order No. 300/2016/AGRI(W9)/SPB dated19.09.2016
(3) Order No. 300/2016/AGRI(W8)/SPB dated19.09.2016

Order No. 300/2016/AGRI (W10-R)/SPB dated27.09.2016

As per order under first reference cited, State Planning Board has constituted Working Group on 'Climate Change and Disaster Management**'** to formulate the draft proposals in the sector for inclusion in the Thirteenth Five Year Plan, with Sri T Jayaraman, Member, State Planning Board as Chairperson of the Working Group.

Smt Padma Mahanti IFS, Director, Environment Department has been included as a Member in the Working Group on Biodiversity and Environment as per reference second and third cited, but not in the Working Group on Climate Change and Disaster Management.

In the above circumstances Smt Padma Mahanti IFS, Director, Environment Department is hereby included as an additional member in the Working Group on Climate Change and Disaster Management.

Order under reference first is modified to this extend

Sd/-
Member Secretary

To

The Person concerned
The Sub treasury Officer, Vellayambalam

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PA to Member Secretary
Stock file

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Sd/-
Chief (Agriculture)

PROCEEDINGS OF THE MEMBER SECRETARY
STATE PLANNING BOARD
(Present:Shri.V S Senthil, IAS)

Sub: Formulation of 13th Five year Plan- Constitution of Working Group on **Climate Change and Disaster Management**-Revised order- issued-reg.

Ref: 1. Order No. 300/2016/ AGRI (W10)/ SPB dated 19.09.2016
2. Order No. 300/2016/ AGRI (W10-R)/ SPB dated 27.09.2016.
3. Note No.175/2016/PPD/SPB dated 4.10.2016

Order No.300/2016/AGRI (W10)/SPB dated.21.10.2016

As per order under first reference cited, State Planning Board has constituted Working group on Climate Change and Disaster Management to formulate the draft proposals in the sector for inclusion in the Thirteenth Five Year Plan, with Sri T Jayaraman, Member, State Planning Board as Chairperson of the working Group.

As per order under 2nd reference, revised order is issued by including Smt Padma Mahanthi IFS, Director, Environment Department as an additional member in the above working group.

As per direction under reference 3rd cited ,the following members were Co-opted for constituting a Disaster Management subgroup within the working group already constituted for climate change& Disaster management.

Members

1. Sri Prasad, Director, Fire and Rescue, Thiruvananthapurm
2. Sri Ajith, Assistant Commandant, State Disaster Reduction Force (SDRF),RRRF, Thiruvananthapuram Wing
3. Sri Surendran IPS, Assistant Inspector General of Police, Coastal Police, Thiruvananthapuram
4. Sri G Shankar, Scientist G (Rtd), NCESS, 29 Pallavi, Ulloor lane, Jagathy, Thiruvananthapuram

In the above circumstances, a subgroup on Disaster Management is hereby constituted with the above persons as members within the working group on Climate Change and Disaster management already constituted.

Order under reference 1st cited is modified to this extend.

Sd/-
Member Secretary

To

The Persons concerned
The Sub Treasury Officer, Vellayambalam

Copy to:-

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All Divisions , State Planning Board
PS to VC
PA to Member Secretary
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Sd/-Chief (Agriculture)