KERALA STATE DISASTER MANAGEMENT PLAN

'towards a safer State'

2016

Kerala State Disaster Management Plan

2016

Published under Section 23 (1) of the Disaster Management Act, 2005 (Central Act 53 of 2005)

Towards a Safer State…

Edition
First
15th September 2016; Pages: 164

Published by
Kerala State Disaster Management Authority
Department of Revenue and Disaster Management
Government of Kerala

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This document was prepared with the financial support of National Disaster Management Authority

Approved in the joint meeting of State Executive Committee and Kerala State Disaster Management Authority on 07-09-2016
[GO (Rt) No. 3667/2016/DMD dated 9th September 2016]

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Abbreviations

CDRRG	Chemical Disaster Risk Reduction Guidelines, 2012
CMG	Crisis Management Group
DDMA	District Disaster Management Authority
DDMP	District Disaster Management Plans
DEOC	District Emergency Operations Centre
DM Act, 2005	Disaster Management Act, 2005 (Central Act 53 of 2005)
DMD	Disaster Management Department, Government of Kerala
DRR	Disaster Risk Reduction
ESFP	Handbook on Disaster Management – Volume 2 – Emergency Operations Centres & Emergency Support Functions Plan, Kerala, 2015
FSOP	Standard Operating Procedure for Festival Disasters – Safety in Religious Mass Gatherings, 2015
HDI	Human Development Index
HSAK	Handbook on Disaster Management – Volume 1 – Hazard Susceptible Areas of Kerala, 2014
HVRA	Hazard, Vulnerability and Risk Assessment
ILDM	Institute of Land and Disaster Management
IMD	Indian Meteorological Department
INCOIS	Indian National Centre for Ocean Information Services
ISGN	Indian Seismic and GNSS (Global Navigation Satellite System) Network
KSDMA	Kerala State Disaster Management Authority
KSDMP	Kerala State Disaster Management Plan
KSDMPo	Kerala State Disaster Management Policy
KSDMR	Kerala State Disaster Management Rules
MAH	Major Industrial Accident Hazard
MDM	Manual for Drought Management, 2009, Ministry of Agriculture
MHA	Ministry of Home Affairs, Government of India
MHACMP	Crisis Management Plan 2016 (Part 1), Ministry of Home Affairs, 2016
NDEM	National Database on Emergency Management
NDMA	National Disaster Management Authority
NDMP	National Disaster Management Plan
NDMPo	National Disaster Management Policy
NDMS	National Disaster Management Services
NDRF	National Disaster Response Force
NDRF Norms	National Disaster Response Fund Norms
NDRFSOP	Standard Operating Procedure for the deployment of National Disaster Response Force, 2015
RDMP	Railway Disaster Management Plan, 2016
SDMF	State Disaster Mitigation Fund
SDRF	State Disaster Response Force
SDRF Manual	Manual on Administration of State Disaster Response Fund and National Disaster Response Fund published by Ministry of Home Affairs, Government of India, 2013
SDRF Norms	State Disaster Response Fund Norms
SEOC	State Emergency Operations Centre
TCDMP	Thiruvananthapuram City Disaster Management Plan, 2015
UNDP	United Nations Development Programme
URR	Urban Risk Reduction
VHF	Very High Frequency

ACKNOWLEDGEMENT

Completing the very first State Disaster Management Plan following all due official procedures were a laborious task which required tremendous coordinated efforts and institutional inputs. All Departments and Research and Development Institutions in the State supported the effort.

Efforts were made since 2010 by some institutions to complete this task although without official endorsement of Kerala State Disaster Management Authority (KSDMA) and State Executive Committee (SEC) of KSDMA. The nearest that the state reached to a State Disaster Management Plan was the completion and publication of a State Disaster Management Plan Profile by the project team of Govt. of India (GoI) – United Nations Development Programme (UNDP) funded Disaster Risk Reduction Programme, in 2010.

It was in 2010 that National Disaster Management Authority (NDMA) supported the state financially to prepare and publish the plan. The task of completing the State and District Disaster Management Plans were assigned to the Kerala State Emergency Operations Centre (SEOC) by the SEC in 2013. SEOC could not have completed this plan without the audacious support of the Chairman (Hon'ble Chief Minister) and Vice Chairman (Hon'ble Minister for Revenue) of KSDMA. This plan would not have seen the light of the day if the members of KSDMA and SEC did not recognize the importance and supported the cause.

Several individuals deserve special mention in the sustained efforts towards reaching this landmark. This plan would not have been possible without the guidance of some stalwarts and hence we specially acknowledge them herein.

We, Team SEOC, is extremely grateful to Mr. S.M Vijayanand IAS, Chief Executive Officer of KSDMA (*inter alia* Chief Secretary) and Mr. P.H Kurian IAS, State Relief Commissioner (*inter alia* Principal Secretary, Revenue and Disaster Management) for having supported us strongly in completing this plan and placing it before the KSDMA for seeking its approval.

It was the vision of Dr. Nivedita P. Haran IAS (Rtd) former Additional Chief Secretary, Revenue & Disaster Management which led the State to have achieved this milestone. She created and nurtured the State Emergency Operations Centre (formerly HVRA Cell) as the technical and scientific arm of KSDMA directly under the State Relief Commissioner (Principal Secretary, Revenue and Disaster Management) and the SEC, which ensured that sustained and

scientific efforts are made towards disaster risk reduction in the state, which eventually lead to the various projects mentioned herein and the completion of this plan.

Her vision to professionalize KSDMA was almost single handedly supported by Mr. Ajith Chacko, former State Project Officer of the GoI-UNDP DRR Programme in Kerala. He coordinated the preparation of the State Disaster Management Plan Profile 2010 and was instrumental in creating SEOC, State Disaster Response Force, guiding documents, State Disaster Management Policy and Guidelines for State Disaster Mitigation Fund.

Mr. G. Sankar, Scientist G (Rtd), National Centre for Earth Science Studies was the architect of SEC. He was the key in ensuring that SEOC has a professional set of multi-disciplinary scientific staff for planning and implementing various disaster risk reduction projects.

The contribution of Prof. Dr. Keshav Mohan, former Director ILDM and Member to KSDMA was enormous. Without his guidance and keen support, we would not have been able to complete this plan. It was his professional and academic approach which empowered SEOC to have developed into a stable organization with slim and proper administrative procedures.

Mr. Ramesh Krishnan former City Project Officer of 'Govt. of India (GoI), United Nations Development Programme (UNDP) and USAID Climate Risk Management Project in Urban Areas through Disaster Preparedness and Mitigation' in Thiruvananthapuram City and a cream of other professionals engaged by UNDP to support the state in Disaster Risk Reduction efforts paved way for highlighting the cause in the minds of general public. They combined efforts created methods for community based disaster risk reduction initiatives.

We, the team SEOC, owes its present ability to prepare State and District Disaster Management Plans to National Disaster Management Authority (NDMA) and Gujarat Institute of Disaster Management (GIDM), particularly to Dr. P.K Mishra IAS (Rtd), former Director General, Gujarat Institute of Disaster Management and Dr. R.K Dave, former Senior Consultant to NDMA who trained us in preparing the State and District Disaster Management Plans.

The guidance of Mr. K. Jose Cyriac IAS (Rtd), Mr. K. Jayakumar IAS (Rtd), Mr. E.K Bharat Bhushan IAS (Rtd), Mr. Jiji Thomson IAS (Rtd) and Mr. P.K Mohanthy IAS (Rtd) in their capacity as Chief Executive Officer (*inter alia* Chief Secretary) of KSDMA deserves special mention.

Dr. K.B Valsalakumari IAS (Rtd), Mr. Kamala Vardhana Rao IAS, Mr. T.O Sooraj IAS, Mr. Satyajeeth Rajan IAS, Mr. E.K Majhi IAS and Dr. Vishwas Mehta IAS as State Relief Commissioners (*inter alia* Principal Secretary, Revenue & Disaster Management) provided valuable inputs, specific guidance and all necessary support for the finalization of the plan. Mr. Satyajeeth Rajan IAS, with his valuable experience in National Disaster Management Authority specifically set the path of preparing the State and District Disaster Management Plans in the State.

Ms. Anjana M, Assistant Commissioner (Disaster Management) has always been a source of inspiration to the team which worked towards completing this plan.

Support of Dr. M. Baba, Dr. N.P Kurian and Dr. V.M Tiwari former Directors and Mr. John Mathai, Dr. K.V Thomas, Dr. M. Samsuddin, Dr. C.M Harish, Dr. S. Muralidas and Dr. S. Chattopadhyay, former Scientists of National Centre for Earth Science Studies was immense in ensuring appropriate data and approach towards finalizing this plan.

The support, guidance and handholding of UNDP, India, particularly the Emergency Analyst, Mr. G. Padmanabhan, was crucial in creating institutional mechanisms for disaster management in Kerala.

At all instances, writings of Dr. Muralee Thummarukudy, Chief of Disaster Risk Reduction, United Nations Environment Programme and words of Padmashree Architect Sankar, Chairman, Habitat Technology Group were guidance for this plan preparation.

Last, but not the least, we remember the contributions made by Dr. Vijith Hamsa, Ms. Vrindhanath M.C, Ms. Ninu Krishnan, Mrs. Ramshina K.V, Mrs. Ponmani K.S and Mr. Siju Thankappan former staff of SEOC, who moved on and have built their own wonderful careers.

Data for the plan were received from the National Centre for Earth Science Studies, Kerala State Remote Sensing and Environment Centre, Indian Meteorological Department, Kerala Spatial Data Infrastructure, Department of Water Resources, Kerala State Electricity Board, Directorate of Health Services, Ground Water Department and CENSUS India.

Team SEOC thank all individuals, civil society groups, NGOs, Departments and institutions who are not mentioned herein, but have contributed in one way or the other towards completing this plan.

EXECUTIVE SUMMARY

With the moto "Towards a Safer State", the Kerala State Disaster Management Authority has approved the State Disaster Management Plan 2016 as mandated by the Disaster Management Act, 2005. The document is in line with the National Disaster Management Policy 2009, State Disaster Management Policy 2010 and the National Disaster Management Plan 2016 and numerous plans and guidelines relevant to Disaster Risk Reduction as issued by the NDMA, SDMA and various Ministries of Government of India. The plan is drafted after careful customization of the SENDAI Framework (2015-30) to the local conditions of Kerala. The plan contains 10 chapters, they being:

Introduction: This chapter attempts to concisely present the broader approach towards preparing this plan. The institutional mechanism for disaster risk reduction in Kerala is enlisted in this chapter. The approach adopted for this plan may broadly be grouped into preparedness, response, recovery and mitigation.

Vulnerability of Kerala: This chapter presents 39 types of known and reported hazard types in Kerala that may turn disastrous in the event of lack of proper preparedness and risk reduction plans. Attempt has also been made towards enlisting the known occurrences of various hazard events and assesses the hazard susceptibility and vulnerability using a semi-quantitative approach. A review of available material for assessing the climate change vulnerability and consequent increase in the hydro-meteorological hazard foot print of Kerala is also included in the chapter.

Disaster Preparedness and Mitigation: This chapter presents the ongoing preparedness and mitigation projects of KSDMA. Alternate communication systems available/being setup, disaster databases, mock drills calendar etc. are in detail provided in this chapter.

Mainstreaming Disaster Risk Reduction: The plan affirms the need to mainstream DRR into development planning in the State. Checklists and guidelines for the purpose are prepared and provided in this chapter and allied Annexures, for the purpose.

Responsibilities of Stakeholders: State Government, Government Departments, Institutions, NGOs, families and individuals in Kerala has a responsibility to reduce disaster risks in the State. This chapter enlists the basic responsibilities of stakeholders in disaster risk reduction. A virtual

cadre for disaster risk reduction in the state is presented and formalized for implementation in the state.

Disaster Response and Relief: This chapter deals with the response and relief procedures and disaster reports authorized in the state.

Rehabilitation and reconstruction: This chapter contains details of disaster recovery strategy to be adopted by the state. The chapter also formalizes the dispute resolution methods to be adopted.

Financial Arrangements: Available funds and provisions of funding for disaster risk reduction in the state have been grouped for preparedness, capacity building, procurement of response and communication equipment, response, relief and mitigation. The chapter also presents a critical analysis of the utilization of funds for disaster preparedness and response in the last 5 years. The chapter also presents a method for streamlining the budgeting of State Disaster Response Fund as per the guidelines of the 14th Finance Commission. The chapter ends with presenting seven broad themes to be addressed in the next five years (2017-2022) for disaster risk reduction in the State.

Plan Maintenance: This chapter provides a brief approach towards the need for training and annual updating of the plan. Responsibilities of the same are formalized in this chapter.

References: This chapter gives details of all reference documents used for the preparation of this plan.

1 INTRODUCTION

1.1 Geography of Kerala

Kerala is geographically boarded on the west by the Arabian Sea and the east by the Western Ghats. In its north is Karnataka State and to the east is Tamil Nadu State.

Feature	Description
Area	38,863 km^2
Location	Graticule 8°18'N & 12°48'N and 74°52'E & 77°22'E
Rivers	44
Forest	11,266 km^2
Coastline	590 km
Population	3,33,87,677 (Census, 2011)
Male Population	1,60,21,290
Female Population	1,73,66,387
Population density	860 people/km^2
Population growth rate	4.9%
Districts	14
Taluks	75
Corporations	6
Municipalities	87
Villages	1664* (including group villages)
Lok Sabha Constituencies	20
Rajya Sabha Constituencies	9
Assembly Constituencies	140
Climate	Humid equatorial tropic climate; the dominant climatic phenomena being the monsoons called the South-West (June to September) and the North-East (October to December) monsoons, the former is more significant than the latter with an annual rainfall of 3104 mm mainly contributed by the South West Monsoon

Kerala has a Human Development Index (HDI) of 0.79 which is the highest in the country (Government of India, 2011).

1.2 Need for the plan

The Disaster Management Act, 2005 (Central Act 53 of 2005) of India in its Section 2 (d) defines disaster as *'a catastrophe, mishap, calamity or grave occurrence affecting any area from natural and manmade causes, or by accident or negligence, which results in substantial loss of life or human suffering or damage to, and destruction of property, or damage to, or degradation of environment and is of such a nature and magnitude as to be beyond the capacity of the community of the affected areas'*.

Kerala is multi-hazard prone. HDI being a composite index of consumption rate (proxy to purchasing power), education and health, is an indicator of the socio-economic vulnerability

of the population. The higher the HDI, the higher is the coping capacity, but greater is the cumulative loss potential and thus a higher degree of risk. Thus Kerala has a higher degree of disaster risks as compared to the rest of the country.

The Kerala State Disaster Management Plan (KSDMP) is an ever evolving document formulated under the Disaster Management Act, 2005 (DM Act, 2005) which establishes a multi-stakeholder framework for the partnership of governmental entities, non-government agencies, private sector enterprises and individuals for Disaster Risk Reduction in the State. Section 2 (e) of the DM Act, 2005 defines *Disaster Management as a continuous and integrated process of planning, organizing, coordinating and implementing measures which are necessary or expedient for*:

- *Prevention of danger or threat of any disaster*
- *Mitigation or reduction of risk of any disaster or its severity or consequences*
- *Capacity-building*
- *Preparedness to deal with any disaster*
- *Prompt response to any threatening disaster situation or disaster*
- *Assessing the severity or magnitude of effects of any disaster*
- *Evacuation, rescue and relief*
- *Rehabilitation and reconstruction*

The spirit of the DM Act, 2005 is in ensuring disaster risk reduction and thus KSDMP also focus on disaster risk reduction.

1.3 Vision

'Towards a Safer State' by:

- Affirming the Sendai Framework (2015-2030), the Disaster Management Act 2005, the National Disaster Management Policy, 2009 (NDMPo, 2009), the Kerala State Disaster Management Rules, 2007 and the Kerala State Disaster Management Policy, 2010 and the National Disaster Management Plan, 2016 (NDMP, 2016);
- Recognizing that disasters undermine the capacity of the State for sustainable development and that an effective disaster risk reduction approach requires political, administrative and financial commitment towards sustainable human development and effective management of the environment;
- Accepting that disaster resilience requires coordinated, committed and inclusive action of departments, institutions, local self-governments and civilians to develop effective strategies for preventing hazard events turning into disasters and to respond effectively to all disasters;
- Building societal capacities for disaster risk reduction by promoting and advocating a policy of sustainable development and by creating institutional awareness and enhancing

knowledge base of the hazards and effective preparedness to deal with the physical, psycho-social, economic and environmental vulnerabilities to disasters that civic society encounters;

1.4 Policy

In accordance with Section 18 (2) (a), the Kerala State Disaster Management Authority (KSDMA) has prepared the Kerala State Disaster Management Policy and published vide GO (MS) No. 240/2010/DMD dated 19-06-2010. The policy shall be revisited once in 10 years.

1.5 Theme

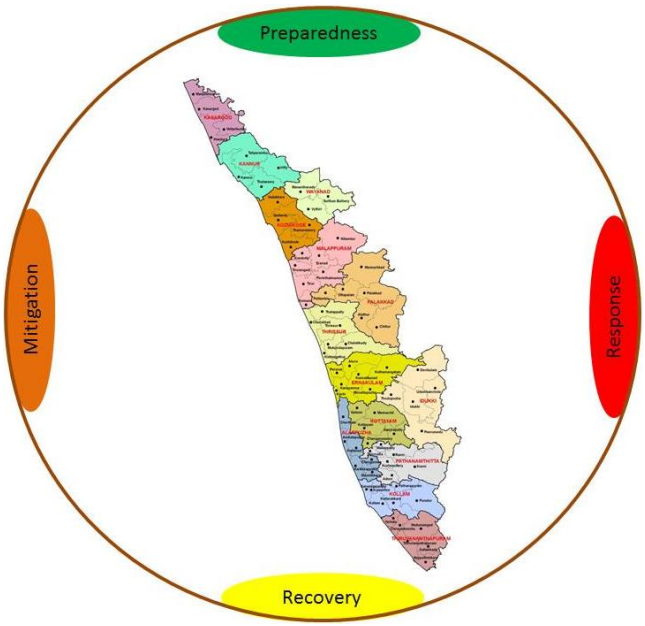
According to Section 23 (4) (a) to (f) of the DM Act, 2005, the KSDMP should deal with:

a) The vulnerability of different parts of the State to different forms of disasters
b) The measures to be adopted for prevention and mitigation of disasters
c) The manner in which the mitigation measures shall be integrated with the development plans and projects
d) The capacity-building and preparedness measures to be taken
e) The roles and responsibilities of each Department of the Government of the State in relation to the measures specified in clauses (b), (c) and (d) above
f) The roles and responsibilities of different Departments of the Government of the State in responding to any threatening disaster situation or disaster

For the purpose of KSDMP, Disaster Risk Reduction is considered as a cyclical process with four phases, they being preparedness, response, recovery and mitigation and the plan is structured accordingly covering the statutory requirements as detailed in Section 23 (4).

1) **PREPAREDNESS**: This protective process embraces measures which enable governments, communities and individuals to respond rapidly to disaster situations to cope with them effectively. Preparedness includes the formulation of viable emergency plans, the development of warning systems, the maintenance of inventories and the training of personnel. It may also embrace search and rescue measures as well as evacuation plans for areas that may be at risk from a recurring disaster.
2) **RESPONSE**: activities during a disaster such as search and rescue, such as setting up relief camps, ensuring emergency medical attention, inter-departmental coordination, crowd management, information management etc.

3) **RECOVERY**: activities following a disaster such as damage assessment, providing ex-gratia and relief assistance claims, dead-body management, immediate psycho-social care etc.



4) **MITIGATION**: embraces all measures taken to reduce both the effect of the hazard itself and the vulnerable conditions to it in order to reduce the scale of a future disaster. Therefore mitigation activities can be focused on the hazard itself or the elements exposed to the threat. Examples of mitigation measures which are hazard specific include modifying the occurrence of the hazard, e.g. water management in drought prone areas, avoiding the hazard by permanently relocating people away from the hazard and by strengthening structures to reduce damage when a hazard occurs. In addition to these physical measures, mitigation should also be aimed at reducing the physical, economic and social vulnerability to threats and the underlying causes for this vulnerability. Mitigation thus includes retrofitting of critical infrastructure by incorporating disaster resilient features, implementing long term rehabilitation (infrastructure, psycho-social and livelihood), setting-up and constantly improving permanent multi-purpose relief shelters, conducting 'lessons learned' exercises after each major calamity, revisit the disaster management plans, hazard, vulnerability and risk assessment, standard operating procedures in light of new experiences and manifestations of disasters etc.

1.6 Objectives of the Plan

According to Sendai Framework (2015-2030), priorities of action are:

1. Understanding disaster risk
2. Strengthening disaster risk governance to manage disaster risk
3. Investing in disaster risk reduction for resilience
4. Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction

In line with these priorities, the objectives of KSDMP are:

1) To identify hazards that the State is vulnerable to and quantify the potential population exposed to such hazards
2) To lay down guidelines at State level for disaster risk reduction for stakeholder departments to follow
3) To enhance disaster resilience of the State by way of capacity building at local self-government level
4) To proactively utilize print, audio, visual and social media for disaster risk reduction
5) To constantly highlight the importance of disaster risk reduction perspective in the future development goals of the State
6) To strengthen the network of emergency operations centers in the State and the Districts to function effectively as the technical and scientific backbone of disaster risk reduction in the state
7) To set up scientifically proven hazard early warning systems and monitoring systems
8) To periodically improve and ensure the upkeep of multiple communication systems ensuring critical redundancy
9) To periodically improve and update the Emergency Supports Functions Plan and Standard Operating Procedures for ensuring structured and systematic response to disasters
10) To strengthen community based disaster risk reduction initiatives at local self-government level
11) To implement mitigation activities
12) To coordinate and implement long term disaster rehabilitation activities

KSDMP is the guide for achieving the above stated objectives of preparedness, response, recovery and mitigation.

1.7 Scope of the Plan

- This plan is applicable to the jurisdictional limits of Kerala State as per Section 2 (j) of the DM Act, 2005
- This plan will be applicable to threatening disaster situations or disastrous events that may affect a community beyond its inherent coping capacity irrespective of gender, disability, age, religion, caste, race or ethnicity
- The Preparedness phase of the hazards listed in this plan will be governed by the departmental plans prepared by the respective nodal departments as statutorily obligated upon the departments vide Section 39 of the DM Act, 2005
- The Response phase of the hazards will be governed by the Handbook on Disaster Management – Volume 2 – Emergency Operations Centre and Emergency Supports Functions Plan, 2015 - Kerala (ESFP 2015). For those calamities eligible for assistance as

prescribed by the 14th Finance Commission and the State Specific Disasters, the Search and Rescue component of response phase will be governed as approved vide GO (Ms) No. 194/2015/DMD dated 20-05-2015 and GO (Ms) No. 343/2015/DMD dated 23-07-2015 from the State Disaster Response Fund (SDRF). For those calamities which are not approved as eligible for assistance under SDRF, the respective nodal departments as identified herein and KSDMPo, 2010 are to earmark separate funds for the purpose as prescribed in Section 39 (c) of the DM Act, 20015. The State Incident Commanders as approved vide ESFP, 2015 are the Chief Secretary and the Additional Chief Secretary, Revenue and Disaster Management. Different departments shall provide emergency support to the response effort as per request from the State Incident Commanders through the State Emergency Operations Centre (SEOC)

- The Recovery phase will be governed by the relief norms laid for the State Disaster Response Fund (SDRF) as prescribed by Government of India vide Letter No. 32-7/2014-NDM-1 dated 8-04-2015 and restricted only to those calamities eligible for assistance as prescribed by the 14th Finance Commission and the State Specific Disasters as approved vide GO (Ms) No. 194/2015/DMD dated 20-05-2015 and GO (Ms) No. 343/2015/DMD dated 23-07-2015. For those calamities which are not approved as eligible for assistance under SDRF, the respective nodal departments as identified herein and KSDMPo, 2010 are to earmark separate funds for the purpose as prescribed in Section 39 (c) of the DM Act, 20015
- The Mitigation phase will be governed by the guidelines for State Disaster Mitigation Fund as laid in Kerala Extraordinary Gazette S.R.O No. 5/2012 dated 2nd January 2012 and as prescribed from time to time by the State Executive Committee (SEC), the KSDMA or the Government

1.8 Authority for preparing the plan

The Disaster Management Act, 2005 is related to entry 23 (Social Security and Social Insurance) under the 7th Schedule of the Constitution of India and thus State Governments have equal obligation as the Government of India for implementing the provisions of the DM Act, 2005 to ensure disaster risk reduction in the respective jurisdictions. 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. The following documents form an integral part of the authority and legal framework of this plan.

1. National Disaster Management Policy (NDMPo, 2009)
2. Kerala State Disaster Management Rules, 2007 *(and amendments 2013 and 2015)* (KSDMR, 2007)

3. Kerala State Disaster Management Policy, 2010 (KSDMPo, 2010)

1.9 Plan development timeline

As per Section 23 (2) of the DM Act, the SDMP is to be prepared by the State Executive Committee (SEC) having regard to the guidelines laid down by the National Authority and after such consultation with local authorities, district authorities and the people's representatives as the SEC may deem fit. The SEC shall review the plan once every year and incorporate modifications to it if needed, with the approval of KSDMA. The timeline of development of Disaster Management Plans in the State are given below:

- 2007: Constituted Kerala State Disaster Management Authority
- 2010: Received funds from National Disaster Management Authority (NDMA) to prepare Disaster Management Plans
- 2010: KSDMA released Kerala State Disaster Management Plan Profile as an interim document prior to preparing the complete disaster management plan, as KSDMA did not have any professional, scientific and technical staff in 2010
- 2013 June: The SEC held on 14-06-2013 assigned the State Emergency Operations Centre (SEOC) to prepare the District and State Disaster Management Plans within a time period of two years by engaging professionals
- 2013 November: Two Members of KSDMA attended the National training for preparation of State Disaster Management Plan at Gujarat Institute for Disaster Management. NDMA circulated a new template for preparing State Disaster Management Plans in the workshop
- 2014 March: Template for preparation of Departmental Plans prepared by SEOC circulated to major nodal departments for preparation and onward submission of the plans to KSDMA for approval
- 2014 May: Professional staff for preparing the State and District Disaster Management Plan was recruited to SEOC vide GO (Rt) No. 2244/2014/DMD dated 26th May 2014
- 2015 January: Draft of the KSDMP was sent to Joint Secretary (Policy Plan) of NDMA for comments
- 2015 January: NDMA requested for comments to modify the SDMP Guidelines, 2007
- 2015 February: Comments for modification of the SDMP Guidelines, 2007 sent to NDMA
- 2015 March: Funds for preparing the State Plan provided by NDMA was released to SEOC vide GO (Rt) No. 1524/2015/DMD dated 24th March 2015
- 2015 September: Reply to the draft KSDMP was received vide Letter No. 2-52/2008-PP dated 01-09-2015 from National Disaster Management Authority

- 2015 October: District Disaster Management Plans of all fourteen (14) districts were prepared, approved by the respective District Disaster Management Authorities and the Kerala State Disaster Management Authority in its meeting held on 5th October 2015 [GO (Rt) No. 3104//2016/DMD dated 30-07-2016]
- 2015 December: Draft Kerala State Disaster Management Plan completed and kept ready for placing before the KSDMA after incorporating the changes as suggested by NDMA
- 2016 September: Kerala State Disaster Management Plan approved

1.10 Institutional arrangements and responsibilities

The DM Act, 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.

1.10.1 Kerala State Disaster Management Authority

Vide Section 3 of the KSDMR, 2007 the 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 vide Section 14 (4) of the DM Act, 2005. The KSDMA has three technically competent non-*ex-officio* members nominated by the Chairman of the Authority vide Section 3 (f) and (g) of KSDMR, 2007. Additional Chief Secretary, Revenue and Disaster Management is the Head of the Department of KSDMA vide GO (Rt) No. 2181/2016/DMD dated 23-03-2016. 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. Head of State Emergency Operations Centre is vide Section 3 (4) of KSDMR, 2007 (amendment 2016) the Member Secretary of the Authority.

The first KSDMA was constituted vide S.R.O No. 395/2007 dated 4th May 2007. Present composition of KSDMA is notified vide S.R.O No. 583/2013 dated 17th July 2013. The KSDMA shall meet at least once in a year. In times of declaration of President's rule, the Chief Executive Officer of KSDMA shall ensure the continued statutory functioning of KSDMA.

1.10.2 State Executive Committee of KSDMA

Established as per Section 20 (1) of DM Act, 2005 and Section 11 (2) of KSDMR 2007. The SEC shall meeting at least once in 3 months.

Sl. No	Designation	Role
1	Chief Secretary	Chairman
2	Additional Chief Secretary, Revenue and Disaster Management	Convener and Head of the Department of KSDMA
3	Additional Chief Secretary, Home & Vigilance	Member
4	Additional Chief Secretary, Finance	Member
5	Additional Chief Secretary, Health	Member

1.10.3 Administrative Department

- Department of Disaster Management was created vide GO (Ms) No. 18/2005/RD dated 13-01-2005. This department has two wings, they being DMD (Revenue K) and DMD (TRP Cell)
- Department of Revenue was renamed as Department of Revenue and Disaster Management in 2007 as Department of Revenue and Disaster Management vide GO (Ms) No. 240/2010/DMD dated 19-06-2010 and thus Minister for Revenue holds the portfolio of Disaster Management in the State
- DMD (Revenue K), Government Secretariat, Thiruvananthapuram is the administrative department of Kerala State Disaster Management Authority. The DMD (TRP Cell) manages the Tsunami Rehabilitation Project

Functions of the administrative department

- Administrative functions as defined in the Kerala Secretariat Manual
- Compile, approve and circulate agenda for the meetings of the State Disaster Management Authority and the State Executive Committee
- Prepare and issue the minutes of the meetings of the SDMA and SEC
- Issue necessary executive orders based on the decisions of the SDMA and SEC after necessary Government level perusals
- Allocate and approve the utilization of State Disaster Response Fund
- Allocate and approve the utilization of State Disaster Mitigation Fund
- Approve the annual working plans of various institutions under KSDMA
- Allocate and approve the utilization of State Plan for Disaster Management, Mitigation and Rehabilitation
- Decide on work distribution between the institutional functionaries of KSDMA
- Appoint officers, consultants and employees of the institutions of KSDMA

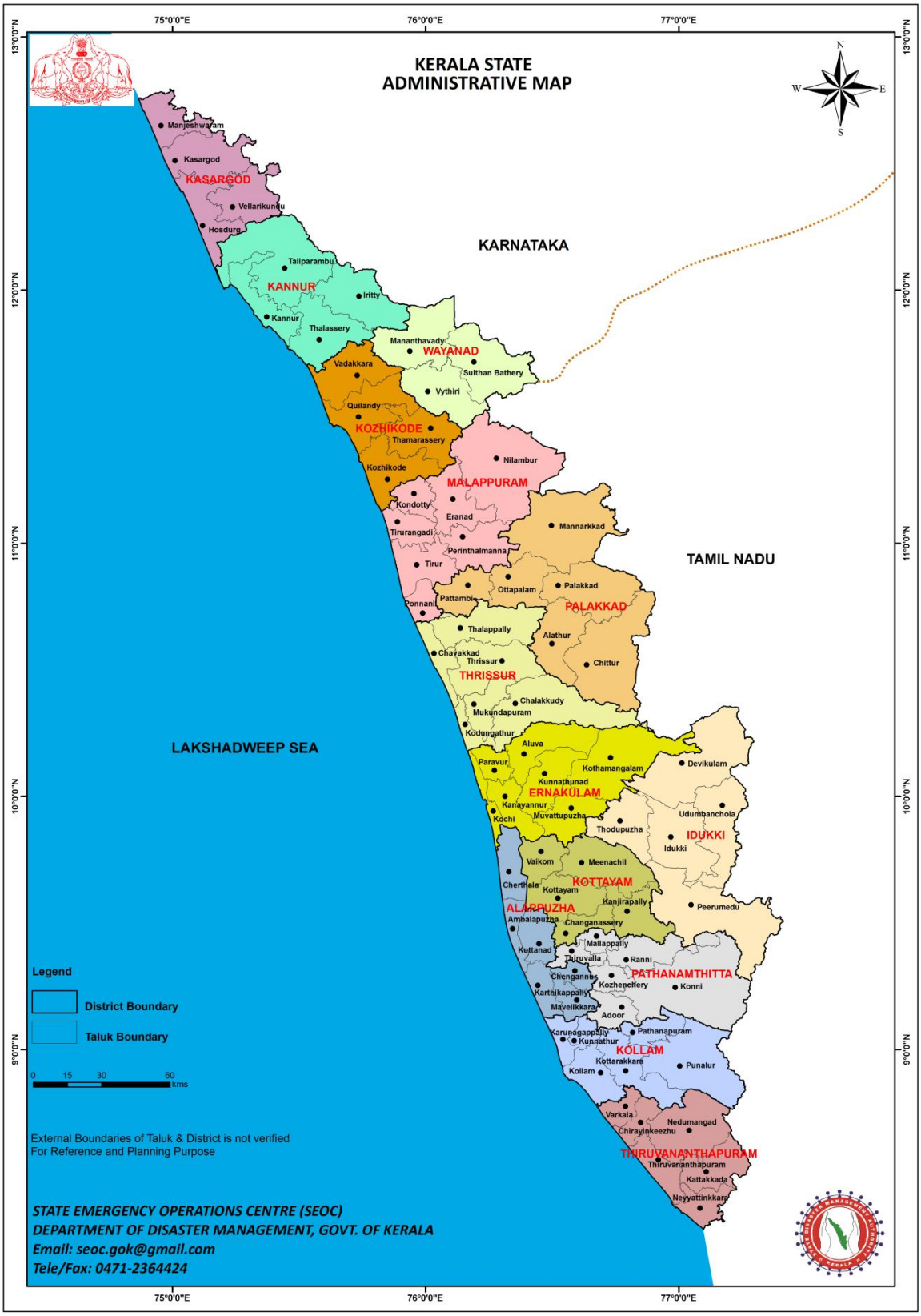


Figure 1: Administrative Boundaries of Kerala

1.10.4 Nodal Departments

At the state level, the government has assigned nodal responsibilities to specific departments for coordinating disaster-specific responses vide Section 6.5 of the KSDMPo, 2010. Preparedness, response, recovery and mitigation of a particular disaster will be as per the Departmental Disaster Management Plan prepared under Section 39 of the DM Act, 2005 of the respective department. Nodal departments and the specific disasters assigned to each department are listed in Section 5.1.

Each of these departments have their own projects under plan schemes and central schemes which contributes to the overall goal of disaster risk reduction.

1.10.5 Crisis Management Group – Natural Hazards

The State Executive Committee of KSDMA is the State Level Crisis Management Group for Natural Hazards vide GO (Ms) No. 68/2011/DMD dated 08-02-2011. The CMG shall meet once in 3 months. Annexure 1 provides important telephone numbers related to emergency operations in districts.

1.10.6 Crisis Management Group – Anthropogenic Hazards

The State Level Crisis Management Group for Anthropogenic Hazards vide GO (Rt) No. 6410/2013/DMD dated 29-11-2013 is:

Sl. No	Designation	Role
1	Additional Chief Secretary, Home and Vigilance	Chairman
2	Additional Chief Secretary, Revenue and Disaster Management	Member
3	State Police Chief	Convener
4	Inspector General of Police, Intelligence	Member
5	Commandant General, Fire & Rescue Services	Member
6	Commandant, State Disaster Response Force	Member
7	Head (Scientist), State Emergency Operations Centre	Member
8	Director, Institute of Land and Disaster Management	Member

Anthropogenic hazards that falls under the preview of this CMG includes petro-chemical accidents, festivities related accidents (including stampedes), fireworks accidents, major mass transportation (road, railway & boats) accidents, air accidents, nuclear accidents and boat capsizing.

The State Police Chief shall be responsible for the administration relating to this CMG. The CMG is expected to meet at least once in three months and the decisions shall be reported to the State Executive Committee by the Chairperson in the next meeting of SEC. This CMG shall meet at least once in 3 months for which the convener shall take the necessary initiative.

1.10.7 Crisis Management Group – Mitigation of Disasters in Mines

The State Level Crisis Management Group for Mitigation of Disaster in Mines vide G O (Rt) No. 542/14/ID dated 26-05-2014 is:

Sl. No	Designation	Role
1	Principal Secretary, Industries department	Chairman
2	Secretary, Disaster Management Department	Member
3	State Police Chief or his representative	Member
4	Director General of Fire & Rescue Services	Member
5	Director, Health Services	Member
6	Director, Mining and Geology	Nodal Officer & Member

1.10.8 Office of Kerala State Disaster Management Authority

Established vide GO (Ms) No. 400/2008/DMD dated 25-11-2008

Sl. No	Designation	Strength
1	Convener, KSDMA (*inter alia* Additional Chief Secretary, Revenue & Disaster Management) - GO (Rt) No. 2167/2016/DMD dated 19-03-2016	*Ex-officio* - Head of the Department
2	Member Secretary, KSDMA (*Ex-officio*) [*inter alia* Head, State Emergency Operations Centre]	*Ex-officio* - Administrative Head of the Office of KSDMA
3	Section Officer	1
4	Upper Division Clerk	1
5	Office Attendant (Peon)	1
6	Accountant	1

- Address: Office of KSDMA, 2nd Floor, Revenue Complex, Public Office Compound, Thiruvanathapuram, Kerala – 695033
- Tel/Fax: +91 (0) 471 – 2331345
- Email: keralasdma@gmail.com
- Website: www.sdma.kerala.gov.in
- Functioning hours: 10.00 am to 5.00 pm, 6 days a week

Functions of the Office of KSDMA:

- The functions of the Office of KSDMA are defined vide GO (Rt) No. 2181/2016/DMD dated 23-03-2016
- Prepare the annual action plan of KSDMA and utilize the funds for disaster preparedness activities made available by SEC or by the Government
- Coordinating and implementing disaster mitigation projects through DDMAs, empaneled NGOs, other departments, local self-governments, self-help groups etc.
- Collect and compile agenda from the Members of KSDMA SEC and submit to Convener for the meetings of SEC and KSDMA
- Draw and disburse State Disaster Mitigation Fund as directed by SEC

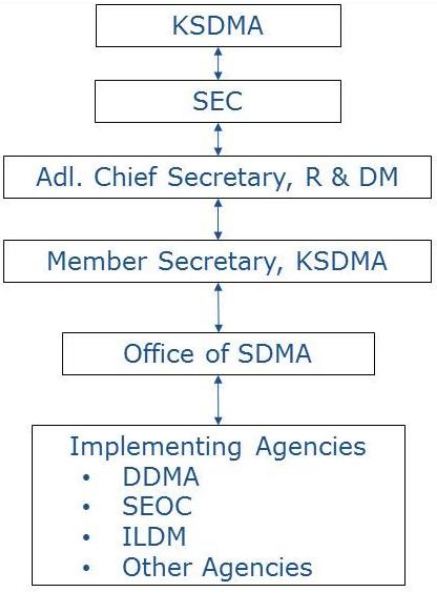
1.10.9 State Emergency Operations Centre

Established vide Section 6.8 of KSDMPo, 2010 and as provided in the *National Disaster Management Guidelines - National Disaster Management Information and Communication System, 2012* based on direction vide Letter No. 05-03/2013/NDMA/CBT (Pt) dated 7th October 2013 by National Disaster Management Authority as determined by the State Executive Committee and the Government vide powers vested on it under Section 69 and Section 16 of DM Act, 2005, respectively.

Recognizing the necessity of conducting and continuously updating HVRA in the state, the GoI-UNDP Disaster Risk Reduction Programme in collaboration with the Department of Revenue and Disaster Management conducted a consultation workshop on 4-5 October 2010. Based on the conclusions and recommendations of this national workshop, the Department of Revenue and Disaster Management in consultation with the Kerala State Council for Science, Technology and Environment created the HVRA Cell as the research and technical laboratory of KSDMA under the scientific supervision of the Centre for Earth Science Studies (CESS) in April 2011. The Cell became fully operational in March 2012.

On 20 January 2014 the Government converted HVRA Cell as the State Emergency Operations Centre (SEOC). The SEOC is also the research and technology laboratory of the SDMA and directly functions under the Additional Chief Secretary, Revenue & Disaster Management. All administrative matters related to the SEOC are made by the State Executive Committee of KSDMA. Its day-to-day affairs are managed by Head, State Emergency Operations Centre.

It is also the State Drought Monitoring Cell [GO (Rt) No. 7228/2012/DMD dated 24/12/2012]. It is staffed with a multi-disciplinary scientific team, presently 16 members strong, spread over 6 districts. The SEOC implements a number of research and data collection projects and is also entrusted with the preparation of the State and District Disaster Management Plans. It also manages the GoI-UNDP project on Enhancing Institutional and Community Resilience to Disasters and Climate Change (2013–2017), Kerala.



The SEOC is permitted to collect any data from any Government Institution in the state on a no cost basis [GO (Rt) No. 3250/2011/DMD dated 29/07/2011]. The SEOC presently functions in the Institute of Land and Disaster Management. A new building with full-fledged state-of-the-art IT & Communication network for the SEOC is being built opposite to Kanakakunnu Palace in

Thiruvananthapuram City. Once made operational, the building will house an intelligent decision support system enabling the prediction & early warning of major hydro-meteorological hazards and provide intelligent support for emergency operations.

SEOC is the 'state nodal office for the collection, compilation and analysis of any data necessary for disaster risk assessment from all government departments and institutions on a no cost basis'.

Government Orders relevant to the creation and functions of SEOC are

Government Order Number	Purpose
GO (Rt) No. 2267/2011/DMD dated 20-04-2011	Formation of Hazard, Vulnerability and Risk Assessment Cell (HVRA Cell) and approval of the Project Execution Plan
GO (Rt) No. 3250/2011/DMD dated 29-07-2011	State Nodal Office for the collection, compilation and analysis of any data necessary for disaster risk assessment from all government departments and institutions on a no cost basis
GO (Rt) No. 1941/2012/DMD dated 31-03-2012	Revised Project Execution Plan defining the roles and functions of HVRA Cell
GO (Rt) No. 7228/2012/DMD dated 24-12-2012	Declaration as State Drought Monitoring Cell
GO (Rt) No. 416/2014/DMD dated 20-01-2014	Renaming of HVRA Cell as the State Emergency Operations Centre (SEOC)
GO (Rt) No. 2167/2016/DMD dated 19-03-2016	Streamlining the functions of SEOC

The State Emergency Operations Centre is headed by State Relief Commissioner (SRC) [*inter alia* Additional Chief Secretary, Revenue & Disaster Management] as prescribed in the *National Disaster Management Guidelines - National Disaster Management Information and Communication System, 2012*. The SRC is assisted by officers of the SEOC. The day-to-day functions of SEOC are managed by a Head (Scientist) and are assisted by a trained team of Hazard Analysts. The administrative and financial functions of the SEOC are regulated by the State Executive Committee through Additional Chief Secretary, Revenue and Disaster Management as defined vide GO (Rt) No. 2167/2016/DMD dated 19-03-2016. Organogram of SEOC is as given here.

In peace time, staff of SEOC is engaged in the *peace time objectives* of the Centre, while in the time of emergencies the staff is engaged in the *emergency time objectives* of the Centre as defined in the Handbook on Disaster Management – Volume 2 – Emergency Operations Centres & Emergency Support Functions Plan, Kerala, 2015.

The SEOC is also the data fusion center and has high end Geographic Information Systems and Satellite Image Processing facilities. Advanced redundant satellite based communication network (National Disaster Management Services Project) and multi-channel terrestrial communications systems including VHF, GSM, 4G, 3G and broadband internet

connectivity. Annexure 1 provides important telephone numbers related to emergency operations in the state and districts.

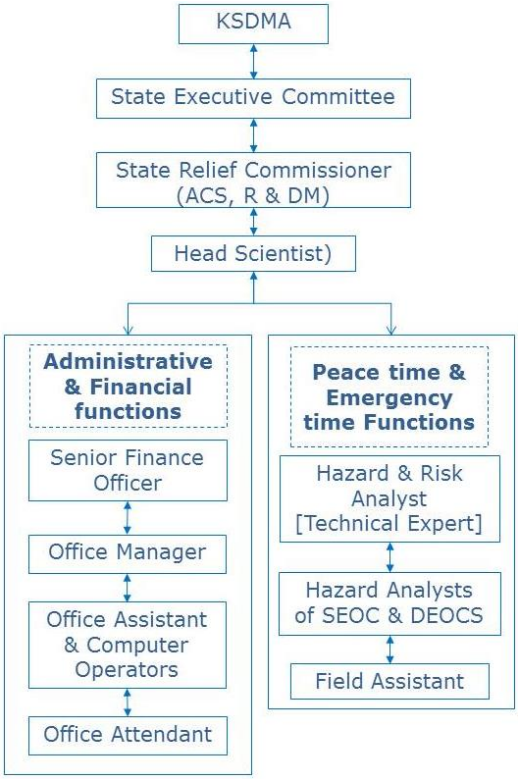
The present staff of SEOC is:

Sl. No	Designation	Strength
1	Head (Scientist)	1
2	State Project Officer	1
3	Hazard and Risk Analyst (Technical Expert)	1
4	Hazard Analysts - Three in SEOC and one each in Kollam, Idukki, Ernakulam, Thrissur, Kozhikode and Wayanad District Emergency Operations Centres	6
5	Field Assistant	1
	Designation – Non-scientific Posts	
1	Office Manager	1
2	Office Assistant	1
3	Office Assistant cum Computer Operator	1
4	Computer Operator	1
5	Office Attendant	1
6	Driver	1

- Tele/Fax: +91 (0) 471 - 2364424
- Email: seoc.gok@gmail.com
- Website: www.disasterlesskerala.org
- Functioning hours: 10.00 am to 5.00 pm (24 x 7 in Monsoon Season)

Objectives of SEOC

- Conduct and regularly update the HVRA of the state
- Prepare the State and District DM Plans
- Conceptualize and implement hazard early warning systems
- Create and maintain the disaster database of the state
- Undertake research projects on topics relevant to disaster risk reduction
- Foster research collaboration with external agencies
- Emergency Coordination
- Preparation of calamity memoranda for submission to Government of India



SEOC has published the following:

1 Hazard Susceptibility Maps of the State are accessible

from http://disasterlesskerala.org/maps/

2 Handbooks on Disaster Management and Standard Operating Procedures are accessible from http://disasterlesskerala.org/handbooks/

3 18 detailed investigation reports, particularly on anomalous natural phenomenon are accessible from http://disasterlesskerala.org/investigation-reports/

4 Scientific research outputs are accessible from http://disasterlesskerala.org/ro/

5 Calamity memoranda are accessible from http://disasterlesskerala.org/cm/

6 Disaster Management Plans are accessible from http://disasterlesskerala.org/disaster-management-plans/

7 Information Brochures are accessible from http://disasterlesskerala.org/brochures/

8 Important Government orders are accessible from http://disasterlesskerala.org/acts-rules-gos-dm-plans/

1.10.10 Disaster Management Centre of Institute of Land and Disaster Management

The Institute of Land and Disaster Management (ILDM) is the administrative training institute of Land Revenue Department. The ILDM houses the Disaster Management Centre. This Centre was created as directed by National Institute of Disaster Management for imparting training to stakeholders in Disaster Management vide GO (Ms) No. 24/2007/DMD dated 22-01-2007. This Centre is delegated with the responsibility of conducting routine trainings to stakeholder departments in Disaster Management.

The DM faculty currently has the following staff:

Sl. No	Designation	Number
1	Assistant Professors	2

- Address: Disaster Management Centre, Institute of Land and Disaster Management, Department of Revenue and Disaster Management, PTP Nagar, Thiruvananthapuram, Kerala – 695038
- Tel/Fax: +91 (0) 471 – 2365559
- Website: www.ildmkerala.in
- Functioning hours: 10.00 am to 5.00 pm, 6 days a week

Functions of the Disaster Management Centre

- Training and capacity building of various stakeholders in disaster management
- Offsite training and capacity building of various stakeholders in disaster management
- Preparation of Standard Operating Procedures for anthropogenic hazards (petro-chemical emergencies and festivities)
- Maintenance and upkeep of the disaster management department's VHF radio network in the State

1.10.11 Regional Response Centre of National Disaster Response Force

Vide GO (Ms) No. 368/2016/RD dated 24-06-2016 the State Government has allotted 5 acres of land to National Disaster Response Force (NDRF) in Thiruvankulam Village, Kanayannur Taluk of Ernakulam District. This land is for establishing the Regional Response Centre (RRC) for NDRF. The 4th Battalion of NDRF is based in Arakkonam, Tamil Nadu and this causes a delay of at least 8 hours for availing the services of the Force in Kerala. The RRC will house a team of NDRF in Kerala for reducing the response time substantially. Presently, the premises of the Civil Defense Institute, Thrissur houses a team of NDRF (47 men) and functions as the RRC until permanent facilities are established in the land allotted in Ernakulam.

1.10.12 State Disaster Response Force

Established as per GO (Ms) No. 262/2012/Home dated 17-10-2012 and GO (Rt) No. 2421/2013/Home dated 31-08-2013

- The SDRF is stationed at Pandikkad, Malappuram district
- The total strength of the force is 100. This force is under the Additional Chief Secretary, Home as Member to KSDMA. The members of the force are deployed in Thiruvananthapuram, Ernakulam, Thrissur and Kannur ranges of the Police. The members of the force are trained by National Disaster Response Force
- Address: Commandant RRRF, Kodaparambu, Pandikkadu, Malappuram
- Email: cmdtsraf.pol@kerala.gov.in
- Tel: +91 (0) 483 – 2783396, 2783397

1.10.13 Civil Defence Institute

Established vide GO (Ms) 214/2011/DMD dated 09-06-2011 in Viyoor Village of Thrissur. The Institute has one training faculty appointed vide GO (Rt) No. 1857/2016/DMD dated 02-03-2016.

The Institute presently houses the Regional Response Centre of National Disaster Response Force (NDRF). The NDRF is engaged in providing training to various stakeholder departments and functions with the training faculty of the Institute.

1.10.14 District Disaster Management Authorities

Established as per Section 25 of DM Act, 2005 and Section 14 of KSDMR, 2007 vide Kerala Extraordinary Gazette S.R.O No. 264/2016 dated 5th March 2016.

- The DDMA is a seven member body chaired by the District Collector and Co-Chaired by the District Panchayath President
- The administrative matters related to the DDMA are carried out by the Natural Calamity section of the district collectorates

- In Thiruvananthapuram, Pathanamthitta, Alappuzha, Ernakulam, Thrissur, Malappuram, Kozhikode and Kannur the Chief Executive Officer of DDMA is Deputy Collector, Disaster Management
- In Kollam, Kottayam, Idukki, Palakkad, Wayanad and Kasaragod the Chief Executive Officer of DDMA is Additional District Magistrate (ADM)/Deputy Collector (General)
- The first DDMA was formed vide S.R.O No. 977/2008 dated 22nd September 2008

1.10.15 District Emergency Operations Centre

Vide Ltr. No. 24121/K1/2014/DMD dated 22-05-2014 all District Disaster Management Authorities were directed to create District Emergency Operations Centres (DEOC) with 24 X 7 staff of Revenue, Police (with Police VHF access) and Fire & Rescue Services. This was reiterated vide Ltr. No. 29426/K1/2015/DMD dated 02-06-2015 and Ltr. No. 26378/K1/2016/DMD dated 05-05-2016. The State Executive Committee, in its meeting held on 29th January 2015 approved the ESFP, 2015 vide which necessary minimum requirements for the creation of the DEOCs were formalized. The DEOCs functions in a 100 m^2 floor area in close proximity to the Office of the District Collector in the respective collectorates.

Presently, DEOCs are functional in all Districts in the State. Telephone numbers of the DEOCs are given below:

District	Telephone Number	Email
Thiruvananthapuram	+91 (0) 471 – 2730045	deputycollectordmtvpm@gmail.com
Kollam	+91 (0) 474 – 2794004	dmdkollam@gmail.com
Pathanamthitta	+91 (0) 468 – 2322515	dmpta03@gmail.com
Alappuzha	+91 (0) 477 – 2238630	ddmaalp@gmail.com
Kottayam	+91 (0) 481 – 2562201	dmdktm@gmail.com
Idukki	+91 (0) 486 – 2232242	e6clerk@gmail.com
Ernakulam	+91 (0) 484 – 2423513	ddmaekm@gmail.com
Thrissur	+91 (0) 487 – 2362424	tsrcoll.ker@nic.in
Palakkad	+91 (0) 491 – 2512607	pkd-colt.msg@kerala.gov.in
Malappuram	+91 (0) 483 – 2736320	mlpmdmd@gmail.com
Kozhikode	+91 (0) 495 – 2371002	dmcellkozhikode@gmail.com
Wayanad	+91 (0) 4936 – 204151	deocwyd@gmail.com
Kannur	+91 (0) 497 – 2713266	dcknr.ker@nic.in
Kasargode	+91 (0) 499 – 4257700	kascoll.ker@nic.in

The DEOCs of Wayanad, Ernakulam and Idukki are linked to SEOC vide VSAT terminals funded under the National Disaster Management Services Project of NDMA. All 14 DEOCs are equipped with VHF network.

1.10.16 Taluk Control Rooms

Kerala has 75 Taluks. Taluk Control Rooms are operationalized during the monsoon season or based on the need as determined by the DEOC or SEOC. The Taluk Control Rooms functions in the Taluk Office; 63 Taluk Offices are equipped with VHF Radio Network.

1.10.17 Village Office

All Village Officers of the State have fixed Closed User Group mobile phone numbers provided by the Government. In addition, most village offices are equipped with internet facilities. Based on the hazard susceptibility, 259 villages have been selected and are equipped with VHF Radio Network.

2 VULNERABILITY OF KERALA

2.1 What is HVRA?

Hazard, vulnerability and risk assessment is the combined process of quantifying the spatio-temporal return probabilities of various hazards, the expected degree of damage that a given element or set of elements-at-risk is exposed to and the expected monetary losses when a given area is exposed to hazards within a given period of time. A disaster is when the threat of a hazard become reality, and impacts a vulnerable society (Figure 2).

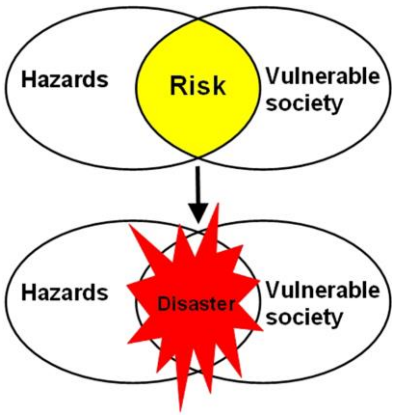


Figure 2: Risk to disaster (van Westen, 2008)

In the context of HVRA, the terms hazard, vulnerability and risk has specific definitions, they being:

- Hazard (H): is the probability of occurrence of a potentially damaging phenomenon within a specified period of time, within a given area
- Vulnerability (V): the degree of loss to a given element or set of elements-at-risk resulting from the occurrence of a natural phenomenon of a given magnitude. Usually expressed on a scale from 0 (no damage) to 1 (total damage)
- Elements at risk (E) means the population, properties, economic activities, including public services, etc. at risk in a given area
- Risk (R): the actual exposure of something of human value to a hazard, often expressed in monetary-value/time

The universally accepted method for conducting HVRA follows the guiding formula:

R = H * V * Amount

where, Amount is the monetary-value of the element(s)-at-risk.

This is pictorially illustrated in Figure 3. All this is easily said than done. There are complexities involved in all stages of this calculation, starting from hazard quantification (for example, how to calculate the return probability of epidemics, road accidents, lightning strikes etc.) to assigning a specific monetary-value to social elements at risk (for example, an ancestral temple, a tomb, a pregnant woman, etc.). All the three components of HVRA have spatial and temporal dimensions and the results if to be useful for administrators have to be spatially explicit

and thus have to be maps generated in a Geographic Information Systems (GIS) environment that provides integrated spatial analysis capabilities.

The primary objective of undertaking a HVRA is to anticipate the potential hazards and possible mitigation measures to help save lives, protect property, assets, reduce damage and facilitate a speedy recovery. The HVRA helps the policy makers, administrators and the community to make risk based choices to address vulnerabilities, mitigate hazards, and prepare for response to and recovery from hazard events. Further, in areas identified as potential hazard hotspots through HVRA, early warning systems that incorporate instrumented monitoring devices, high-end numerical predictive models and communication devices may be developed and deployed such that sufficient time may be made available to authorities for evacuation and implementing contingency measures in the eve of an impending disaster.

Risk, until recent times was considered as a burden. It is a burden when considered as a possibility of loss. But risk is a motivation for the pursuit of improvement (The World Bank, 2013). Risk assessment alone will not ensure a disaster safe society. The World Bank has identified five key insights in the process of risk management which includes:

1. Taking on risks is necessary to pursue opportunities for development. The risk of inaction may well be the worst option of all
2. To confront risk successfully, it is essential to shift from unplanned and ad-hoc responses when crises occur to proactive, systematic, and integrated risk management
3. Identifying risks is not enough: the trade-offs and obstacles to risk management must also be identified, prioritized and addressed through private and public action
4. For risks beyond the means of individuals to handle alone, risk management requires shared action and responsibility at different levels of society, from the household to the international community
5. Governments have a critical role in managing systemic risks, providing an enabling environment for shared action and responsibility, and channelling direct support to vulnerable people

Thus it is reiterated that HVRA alone will not ensure a safe society, but it is the first step towards ensuring a disaster sensitive development plan which can ensure coordinated public and private action for disaster risk reduction.

The concept of vulnerability expresses the multi-dimensionality of disasters by focusing attention on the totality of relationships in a given social situation which constitute a condition that, in combination with environmental forces, produces a disaster (Bankoff et al., 2004).

The scope of this chapter is limited to the assessment of hazards and vulnerabilities of Kerala to major disasters in a heuristic manner. Vulnerability is assessed in taluk level with respect to population density. Vulnerability assessment is restricted to population vulnerability to landslides, floods (riverine), drought, lightning and major industrial hazards. Further, number of public buildings, length of roads (PWD and Panchayath), length of railway lines, length of other communication lines etc. that may be exposed to major hazardous phenomena are also assessed. The methodology used is simple, replicable and repeatable year after year such that pragmatic relative assessment is possible. For example, flood prone area is overlaid upon the population density map of the Taluk and corresponding to the density of population the probable number of people corresponding to the flood prone area in the taluk with respect to population density is calculated. Exposure of infrastructure is also assessed in a similar manner. No attempt has been made at this time to quantify the Risk in terms of Amount or Exposure in terms of vulnerability curves as such standardisations are yet to be officially made for the country.

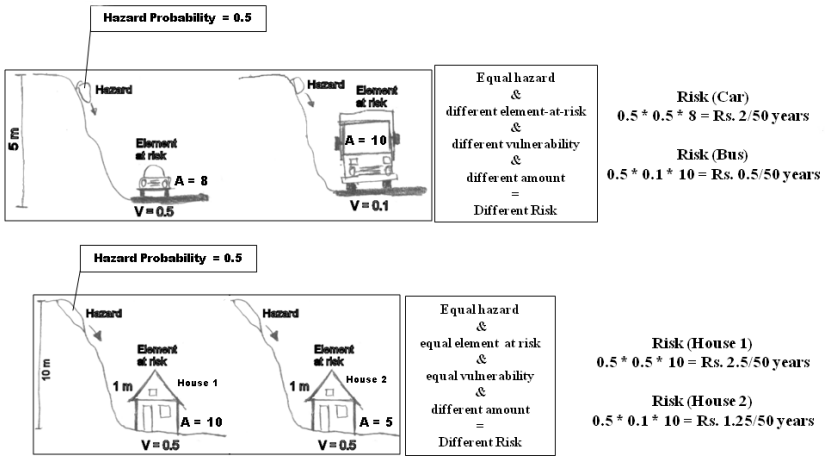


Figure 3: Pictorial representation of risk calculation (van Westen, 2008)

It is also worthy to note here that a detailed Hazard, Vulnerability and Risk Assessment is being undertaken under the National Cyclone Risk Mitigation Project and if the methodology developed deems suitable to the State, Risk Assessment will be undertaken in the coming years utilizing this methodology.

2.2 Hazard profile of Kerala

Kerala state is frequently ravaged by the disastrous consequences of numerous hazards and hence it is a multi-hazard prone State. Natural hazards are part of the natural evolutionary system of the earth which turned into 'hazards' when the human system started interacting with it. The human system itself was subjected to significant transformations over its history. These transformations and their links to the natural system have served as templates of the dynamics of naturally triggered hazards and therefore, of disasters (Alcantara-Ayala, 2002). This 'template of disasters' is particularly apparent in the state of Kerala where, within a short period of last 80 years, there has occurred a rapid socio-economic transformation from an agrarian society to a highly urbanized consumerist society. Parallel to this societal transformation, the population pressure along the coastline forced the then marginalized sections of the community to migrate from the coastal belt to the relatively inhospitable terrain of the Western Ghats (George and Chattopadhyay, 2001). A study conducted on migration suggested that in the past 80 years the coastal plains recorded a population growth of 306%, whereas the highlands, foot hills and uplands together experienced a growth of 1342% (Nair et al., 1997). This population with a density of ~819 people/km^2 (Census of India, 2001) is more or less widely distributed across all geomorphic units of the state, exposing them to multiple hazards.

Kerala is prone to high incidence of lightning, especially during the months of April, May, October and November. Apart from floods the mountain regions of the state experience several landslides during the monsoon season. It is known that a total of 65 fatal landslides occurred between 1961 and 2009 causing the death of 257 individuals (Kuriakose, 2010). Between 1871 and 2000, the state experienced 12 moderate drought years. The 570 km long coast line of Kerala is prone to erosion, monsoon storm surges and sea level rise. Land subsidence due to tunnel erosion or soil piping which is a slow hazard, is recently noticed to be affecting the hilly areas in the state. This often goes unnoticed and is a hazard with potential of causing landslides, infrastructural damages and crop loss covering vast areas in the high land regions of the state.

The high density of population of 860 people/km^2 (2011 Census), narrow roads, high density of road network, density of coastal population and the general higher standard of living of the public as compared to the rest of the country are factors that increase the vulnerability of the population to disasters.

KSDMP identifies thirty nine (39) phenomena with potential to cause disasters requiring L2 attention that the state is susceptible to and they are grouped under two categories based on the major triggering factors, they being Naturally Triggered Hazards (Natural Hazards) and Anthropogenically Triggered Hazards (Anthropogenic Hazards). Not all of these hazards turn into disasters that are 'beyond the coping capacity of the community of the affected area'.

Sl. No	Category	Type
1	Natural Hazards	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		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	Anthropogenic Hazards	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		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	

These events may occur in isolation or in tandem or as cascading events. For example, a flood may cause many factories on its banks to be inundated which may release toxic substances into rivers and contaminate flood plains.

2.3 Natural Hazard and Vulnerability Assessment

Natural hazard susceptibility of Kerala was carried out using stochastic and data driven methods with inputs from multiple sources. Susceptibility of the state to floods (riverine), landslides, lightning, coastal hazards, drought earthquakes and cyclones were assessed. A multi-hazard susceptibility map was also produced. Village wise landslide, flood, drought, lightning and earthquake susceptible areas have been identified and the same have been mapped, tabulated and circulated to district administration vide HSAK, 2014.

Anthropogenic hazards namely festival related hazard susceptibility and major industrial hazard susceptibility have been assessed and susceptibility maps have been prepared and incorporated into the district disaster management plans for response planning.

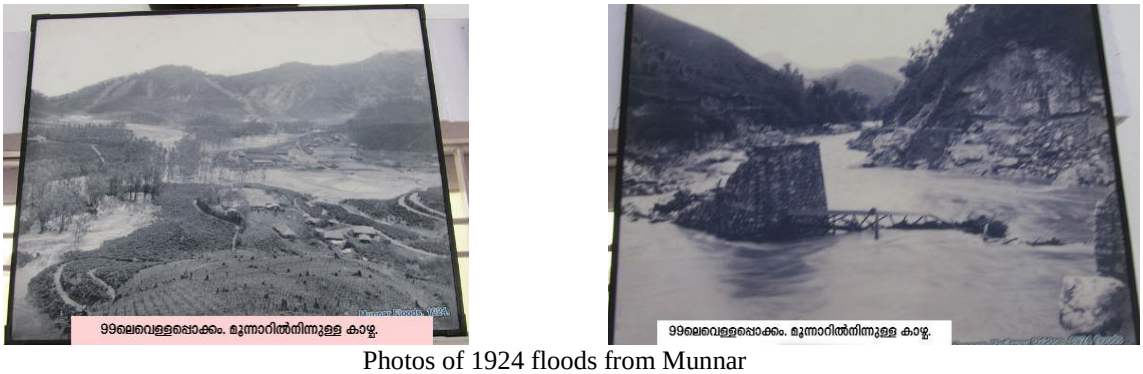
2.3.1 Floods

Floods are the most common of natural hazards that affect people, infrastructure and natural environment in Kerala. Riverine flooding is a recurring event consequent to heavy or continuous rainfall exceeding the absorptive capacity of soil and flow capacity of streams and rivers. This causes a water course to overflow its banks onto flood plains; which by definition is a relatively flat land adjacent to a natural water course, composed primarily of unconsolidated depositional material derived from sediments transported by the related stream and subjected to periodic flooding. Flood plains are therefore 'flood prone' and are hazardous if the developmental activities in them exceed an acceptable level. Frequency of inundation depends essentially on rainfall, channel slope, relative height of the banks, materials that make up stream banks and landuse in flood plain. Reclamation and settlement in floodplain areas is a major cause of flood damage in Kerala. In order to evaluate flood hazard, one has to know where floodplains are, how often and how long the flood plain is covered by water and at what time of the year flooding can be expected. Gathering hydrologic data directly from rivers and streams for many years is useful in determining the statistical frequency of flood events, but is a time consuming effort. In the absence of stream gauging records for all the rivers in Kerala that too at close intervals, a direct measurement is not possible. Since flood plains can be mapped, the boundary of this unit is commonly used in flood mitigation programmes to identify the areas where risk of flooding is significant. Hazard assessments are then based on remote sensing, damage reports and field observations. Based on the landform and process, the flood plains or the flood prone areas, are mapped on 1:50,000 scale using IRS P6 satellite images. There are several indicators of floodplain that are easily picked up from the satellite data. Smooth textured areas on either of

major streams with high reflectance are often flood plains. The presence of meandering streams, terraces, minor interspersed water bodies etc. indicate low lying areas subjected to inundation. In addition, some of the data generated while evaluating natural resources like landform, slope of the land, type of soils, hydrologic information especially disposition of streams and changes in groundwater levels are also used in evaluating flood proneness. Changing nature of the flood plains both natural and manmade, loss of vegetation in upper catchments and landuse practices that promote runoff are also taken into consideration while assessing flood proneness.

The outputs generated shows that 5642.68 km^2 of area which is 14.52% of the total area of the state is prone to floods. In Alappuzha district more than 50% percentage of area is identified as flood prone. These are mostly confined to the Kuttanad region that host seasonally waterlogged flat lands with anastomosing waterways connected to Vembanad lake. The Kole lands of Thrissur district, the coastal tracts of Ernakulam and Malappuram districts and the western part of Kottayam district flanking Vembanad Lake are other major areas prone to floods. Even though Wayanad district is located in an elevated plateau region flood prone areas are noted in the broad flat bottom valleys and flood plains adjacent to Mananthavadi River. Idukki district is the least flood prone area in Kerala owing to the rugged topography and absence of flat bottom valleys.

It is known that a fourth century flood severely damaged areas along the Periyar and people living there had to escape to safer locations, abandoning their homes and livelihoods. Available descriptions state that the flood in 1341 AD resulted in splitting of the left branch of the river into two just before Aluva. The flood silted the right branch (known as River Changala) and the natural harbor at the mouth of the river, and resulted in the creation of a new harbor at Kochi. An Island was formed during the flood, presently named Puthu-Vaipu. Causality or damage reports related to these floods are not available.



Photos of 1924 floods from Munnar

1924 Flood level marking at Puthiyakavu temple, Paravoor, Ernakulam

The worst known flood event in Kerala in the last 100 years occurred when Periyar River breeched its banks in 1924. Many districts of the present day Kerala were deeply submerged in water by this flood from Thrissur to Alappuzha and even parts of Idukki. Multiple major landslides were triggered in Karinthiri Malai probably due to toe erosion which irreparably damaged the then Munnar road. Present day road from Ernakulam to Munnar was constructed after this incident through an alternate alignment.

Frequency and magnitude of floods in the state seems to be on the rise. Factors contributing to the increase in magnitude of floods are reclamation of wetlands and water bodies, increase in impermeable built-up area, increase in roads with impervious surfaces, deforestation in the upper catchments etc. Population pressure and flood plain occupancy has resulted in exposure of life and property to floods. Urban flooding is also very common in most of the urban centres of the State. Lack of separate storm water and sewerage water drains aggravate the situation. Flash floods are common in the hilly tracts of Kerala. Most often flash floods are triggered by the occurrence of Debris Flows (landslides) during intense rainfall conditions.

Population of 27 taluks of Kerala is highly vulnerable to riverine floods. These taluks are also those having the highest population density too. Peermedu, Idukki, Devikulam and Vellarikundu taluks are the least vulnerable to flooding. The rest of the 45 taluks are moderately vulnerable. The major cities that frequently experience urban flooding are Thiruvananthapuram, Kochi and Kozhikode. Encroachment of river banks and infilling of paddy lands and wetlands are the major cause of increase in the vulnerability to floods. Even during summer most of the urban cities are getting flooded. Figure 4 shows the flood susceptibility map of Kerala. Figure 5 shows taluks of Kerala ranked as per vulnerability to floods. Details of flood vulnerability analysis are provided as Annexure 2.

Susceptible area km^2	5624
Susceptible area as % of State's total area	14.5
Major flood incident in the last 20 years	2013
Estimated damage in the floods of 2013	899 crores*
Human fatality	145*
*As per Memorandum to Government of India - Monsoon calamity loses (1st June to 31st July 2013) - Revised after the visit of the IMCT (20-23 July 2013)	

2.3.2 Landslides

The highlands of Kerala experience several types of landslides, of which debris flows are the most common. They are called 'Urul Pottal' in the local vernacular. The characteristic pattern of this phenomenon is the swift and sudden downslope movement of highly water saturated overburden containing a varied assemblage of debris material ranging in size from soil particles to boulders, destroying and carrying with it everything that is lying in its path. The west facing Western Ghats scarps that runs the entire extent of the mountain system is the most prone physiographic unit for landslides (Thampi et al., 1995). These scarp faces are characterized by thin soil (regolith) cover modified heavily by anthropogenic activity. Highlands of the region experience an annual average rainfall as high as 500 cm from the South-West, North-East and Pre-Monsoon showers. A review of ancient documents, investigation reports and newspaper reports indicates a lesser rate of slope instability in the past; 29 major landslide events that occurred in the recent past were identified through the review. The processes leading to landslides were accelerated by anthropogenic disturbances such as deforestation since the early 18th century, terracing and obstruction of ephemeral streams and cultivation of crops lacking capability to add root cohesion in steep slopes. The events have become more destructive given the increasing vulnerability of population and property (Kuriakose et al., 2009). Majority of mass movements have occurred in hill slopes >20° along the Western Ghats scarps, the only exception being the coastal cliffs. Studies conducted in the state indicate that prolonged and intense rainfall or more particularly a combination of the two and the resultant persistence and variations of pore pressure is the most important trigger of landslides. The initiation of most of the landslides was in typical hollows generally having degraded natural vegetation. It is known that continuous and high intensity rainfall of about 4 hrs may cause a steep rise in the perched water table up to critical levels in regolith filled bed rock depressions and the persistence of this level for ~10 hrs may lead to shallow landslides in the catchment (Kuriakose et al., 2008). All except 1 of the 14 districts in the state are prone to landslides. Wayanad and Kozhikode districts are prone to deep seated landslides while Idukki and Kottayam are prone to shallow landslides. A very recent study indicates that the additional cohesion provided by vegetation roots in soil is an important contributor to slope stability in the scarp faces of the Western Ghats of Kerala (Kuriakose, 2010).

It is also noted that gully forming landslides have been triggered in evergreen forest areas in the State. On 14th October, 2012 in Puthusherry West Village of Palakkad district a major

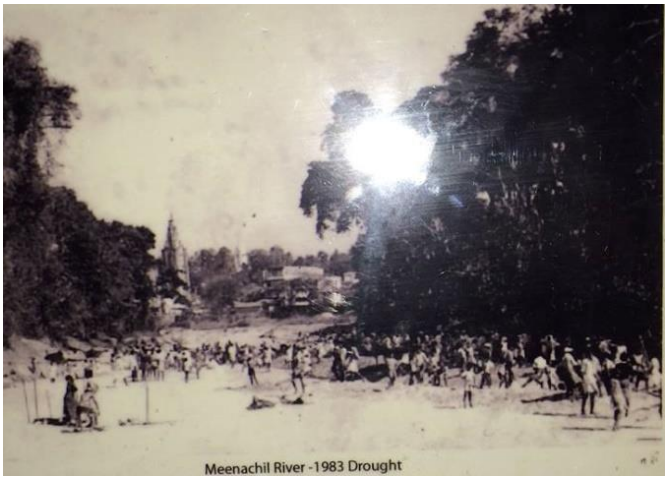
landslide covering 2.65 km^2 occurred in the forest area adjoining the Coimbatore-Palakkad railway line.

Between 1961 and 2016 a total of 295 valuable lives were lost in 85 major landslide events. The most severe, in terms of fatalities, was the Amboori landslide (Thiruvananthapuram) of 9th November 2001 that resulted in 38 casualties. Population of 10 taluks of Kerala is highly vulnerable to landslides in terms of population density; 25 taluks come under moderately vulnerable category and 14 come under least vulnerable category. Figure 6 shows the flood susceptibility map of Kerala and Figure 7 shows taluks of Kerala ranked as per vulnerability to floods. Details of landslide vulnerability analysis are provided as Annexure 3.

Susceptible area km^2	5607.4
Susceptible area as % of State's total area	14.4
Major landslide in the last 20 years	Debris flow at Amboori, Thiruvananthapuram on 10th November 2001
Human fatality	38

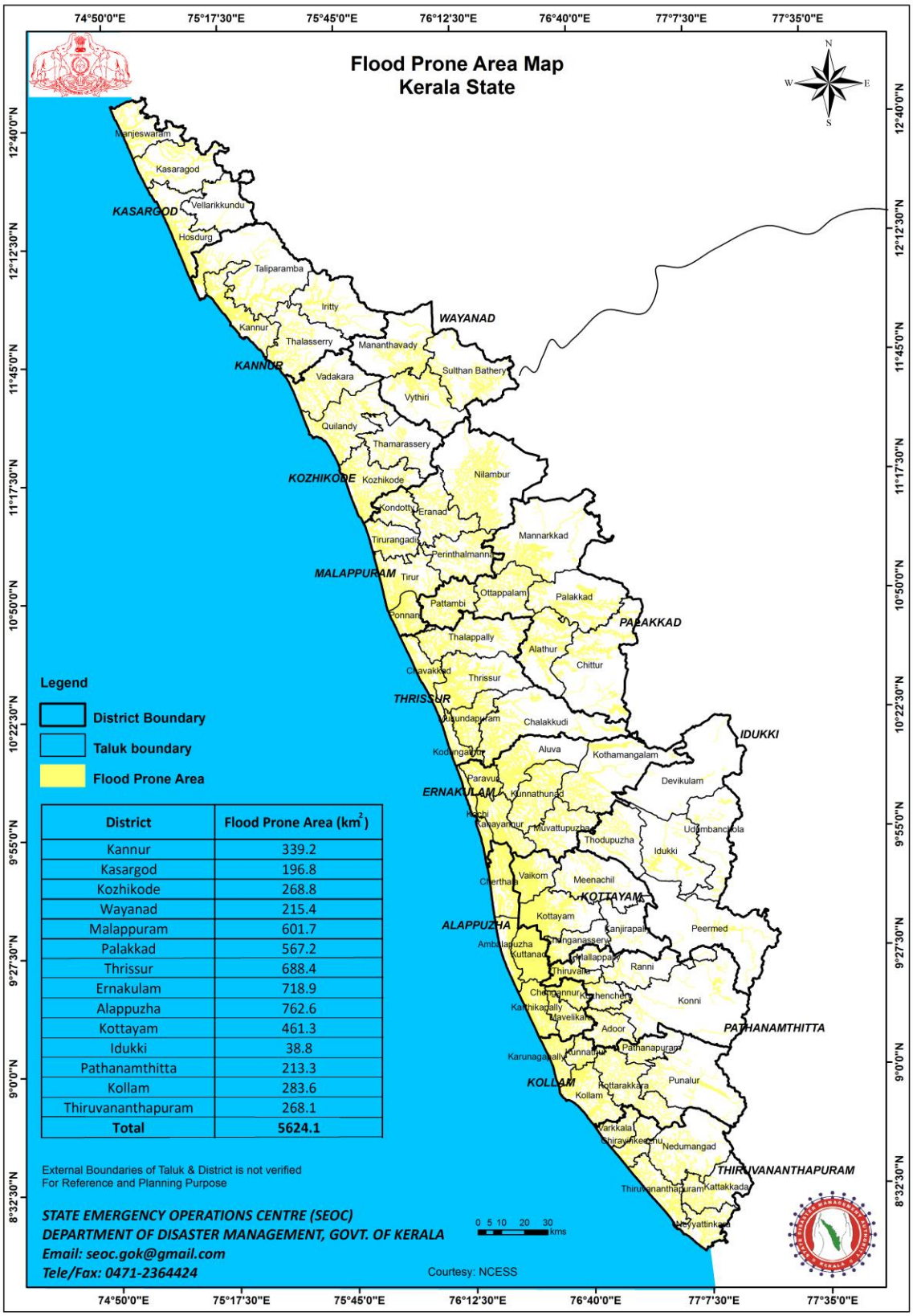
2.3.3 Drought

The State of Kerala experiences seasonal drought conditions every year during the summer months (KSCSTE, 2007). Even in the years of normal rainfall, summer water scarcity problems are severe in the midland and highland regions. With the implementation of a number of irrigation projects, the idea of drought in Kerala slowly shifted to unirrigated paddy, and upland crops. The water scarcity in summer is mainly reflected in dry rivers and lowering of water table. This adversely affects the rural and urban drinking water supply.


Meenachil River -1983 Drought

In the period 1881 to 2000, Kerala experienced 66 drought years. It is noticed that aridity index of different parts of the state has increased which is an indication of increase in the frequency of drought years.

The changes in the land and water management practices affected the fresh water availability during summer months. Although the deviation in the annual rainfall received in Kerala, in any year from the long term average is very small, there is considerable variation in the rainfall availability during the different seasons.



District	Flood Prone Area (km^2)
Kannur	339.2
Kasargod	196.8
Kozhikode	268.8
Wayanad	215.4
Malappuram	601.7
Palakkad	567.2
Thrissur	688.4
Ernakulam	718.9
Alappuzha	762.6
Kottayam	461.3
Idukki	38.8
Pathanamthitta	213.3
Kollam	283.6
Thiruvananthapuram	268.1
Total	**5624.1**

Figure 4: Flood susceptibility map of Kerala

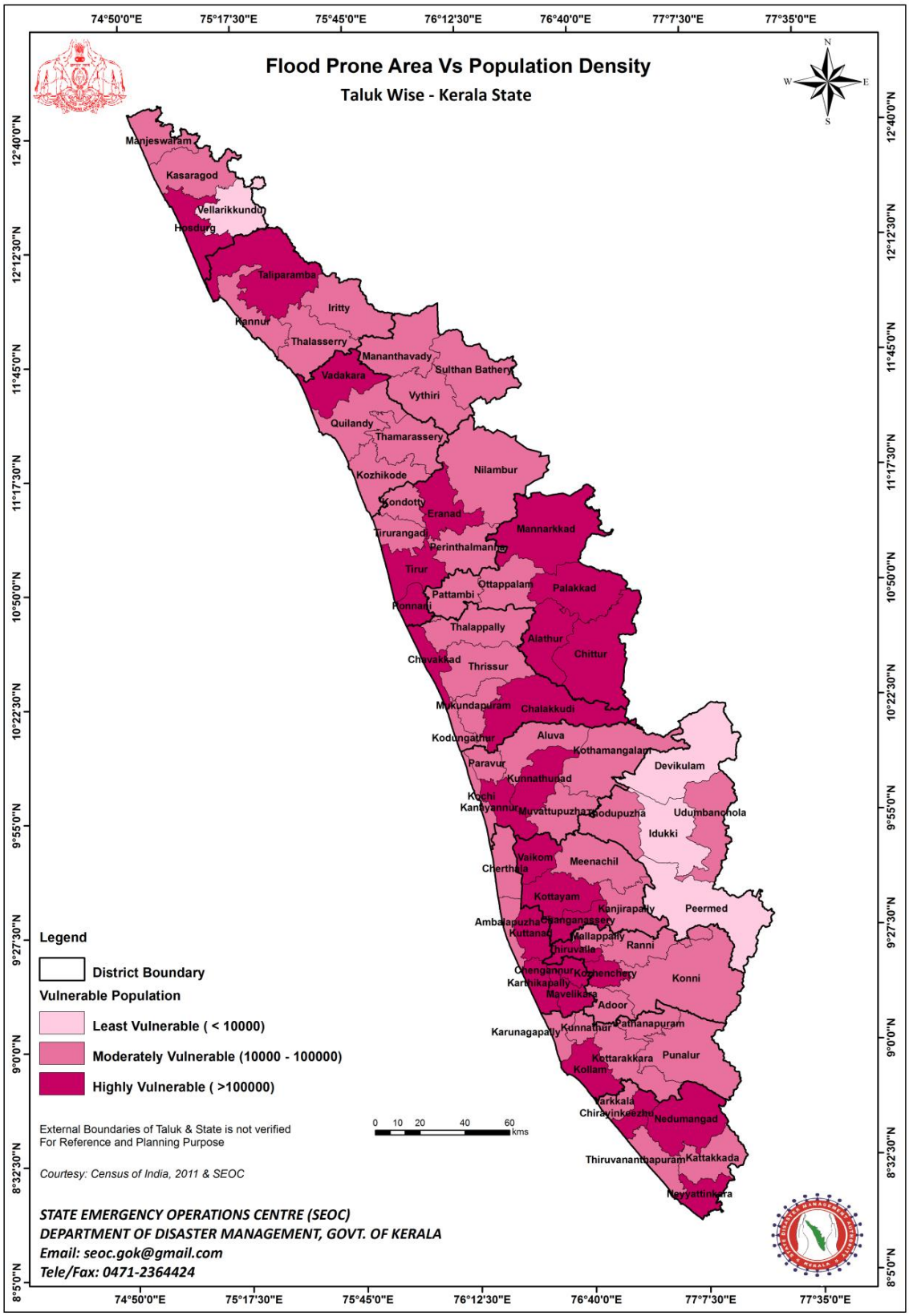
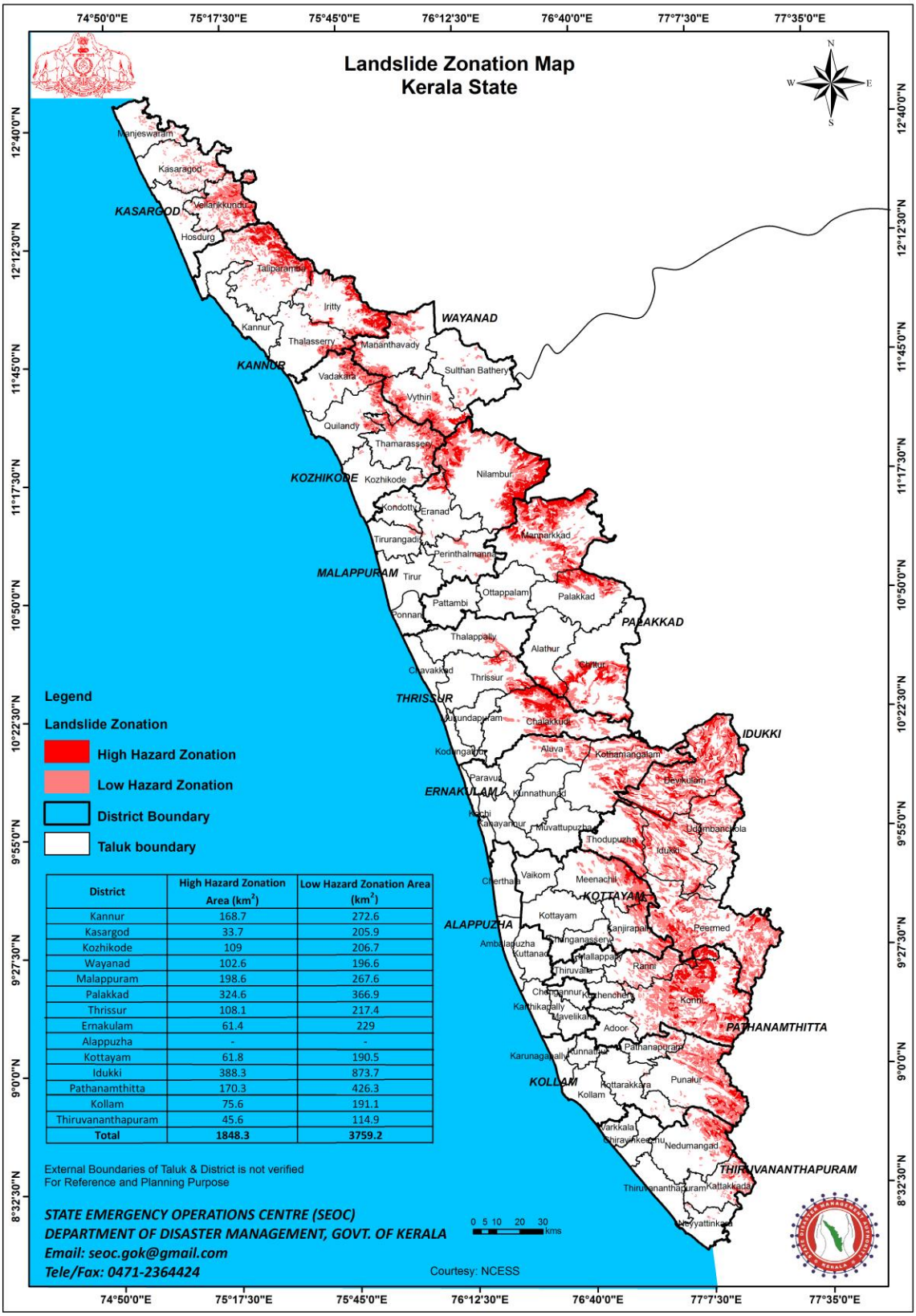


Figure 5: Taluks of Kerala ranked with population vulnerability to floods



District	High Hazard Zonation Area (km^2)	Low Hazard Zonation Area (km^2)
Kannur	168.7	272.6
Kasargod	33.7	205.9
Kozhikode	109	206.7
Wayanad	102.6	196.6
Malappuram	198.6	267.6
Palakkad	324.6	366.9
Thrissur	108.1	217.4
Ernakulam	61.4	229
Alappuzha	-	-
Kottayam	61.8	190.5
Idukki	388.3	873.7
Pathanamthitta	170.3	426.3
Kollam	75.6	191.1
Thiruvananthapuram	45.6	114.9
Total	**1848.3**	**3759.2**

Figure 6: Landslide susceptibility map of Kerala

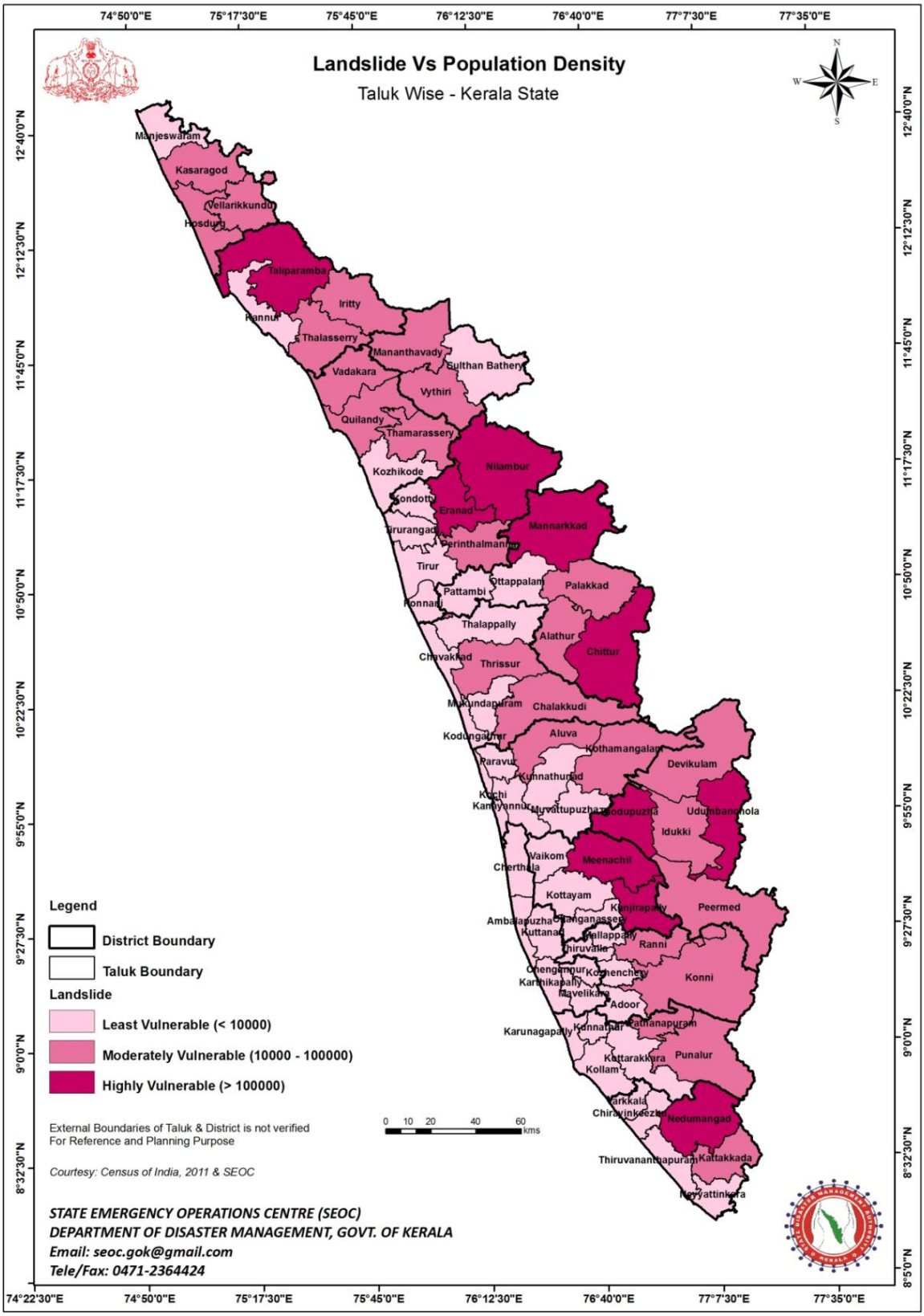
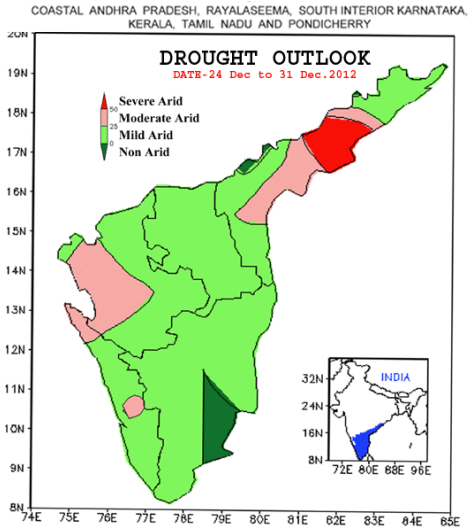


Figure 7: Taluks of Kerala ranked with population vulnerability to landslides



About 95% of annual rainfall is confined to a six-month monsoon period between June and November, leaving the remaining six months as practically dry. The trend analysis on rainfall data over the last 100 years reveals that there is significant (99%) decreasing trend in most of the regions of Kerala especially in the month of January, July and November (Nair et al., 2014). Figure 8 shows the drought susceptibility of Kerala. Drought classification was done based on the criteria followed by Indian Meteorological Department (IMD) for meteorological drought classification. Standardized precipitation index, ground water deviation from 5 year mean, MODIS-NDVI and presence of perennial water sources in a given village was considered in a heuristic model for the preparation of the map.

The map indicates that in a given season, if the rainfall deficit is:

- >10%, the area demarcated as severe drought will start experiencing drinking water shortage
- >26%, the area demarcated as moderate drought will start experiencing drinking water shortage
- >50%, the area demarcated as slight drought areas will start experiencing drinking water shortage

In the recent past, until 2012, the state had not experienced severe meteorological, agricultural and hydrological drought. A 29% deficit in the monsoon season (June to December) in 2012 lead to agricultural and hydrological drought which peaked during the period August 2012 to May 2013. For the first time, Kerala was mapped as mild to moderately arid by Indian Meteorological Department in December 2012. Prior to this, official declaration of drought had happened in March 2010 and December 2003. In 2010, 17 taluks of the state were declared as drought affected while in 2003, 7 districts, 7 taluks and 119 villages were declared as drought hit. Other known meteorological drought years were 1983, 1986, 1987, 1992, 1997, 1998, 2002 and 2004. Figure 6 shows the village wise vulnerability to drought of the state. Table below

shows the number villages that are prone to drought, in the State with and without perennial waterbodies.

District	Number of villages without WB			Number of villages with WB		
	Severe	Moderate	Drought	Severe	Moderate	Drought
Kasargod	0	21	0	0	64	0
Kannur	0	32	0	0	97	0
Kozhikode	0	24	3	0	86	4
Wayanad	19	1	0	13	16	0
Malappuram	0	49	0	4	82	0
Palakkad	0	42	0	14	101	0
Thrissur	0	77	7	1	161	8
Ernakulam	0	32	0	16	77	0
Alappuzha	11	3	0	64	13	0
Kottayam	10	22	0	25	37	0
Idukki	10	5	0	38	11	0
Pathanamthitta	19	1	0	47	1	0
Kollam	34	0	0	69	0	0
Thiruvananthapuram	39	4	0	59	11	0
Total	142	313	10	350	757	12
WB: Water Bodies						

Based on the analysis, it is evident that more than 50% of the land area of the state is moderately to severely drought susceptible. Drought is principally drinking water shortage. Water usage characteristics of Kerala (~450-500 liters/head), and the fact that the state's economy including majority of the electricity production is significantly depended on the South West Monsoon rainfall increases the vulnerability of the State to drought, particularly hydrological drought.

Susceptible area as % area of the state's total area	• Severe drought: 2.5% • Moderate drought: 63.8% • Slight drought: 23% • No drought: 10.7%
Major drought in the last 20 years	Drought 2012-13; The State Government had to officially declare drought in all 14 districts. An amount of ₹132.3 crs was expended by the state during the period from 2012 to 2014 for tackling the consequences of this drought directly from the National/State Disaster Response Fund. Indirect costs of the drought spell still remain unaccounted.

2.3.4 Forest Fire

Natural forest fires are reported in Kerala. It is usually the dry and moist deciduous forests of the state which experience forest fire. From 2009 to 2014, 18,170 hectares of forest land were destroyed by recurring forest fires in the state. Over 500 ha of forest in Idukki (Nadukani) experienced forest fire in April 2016. Most of the forest fires occur in the months from March to May.

2.3.5 Lightning

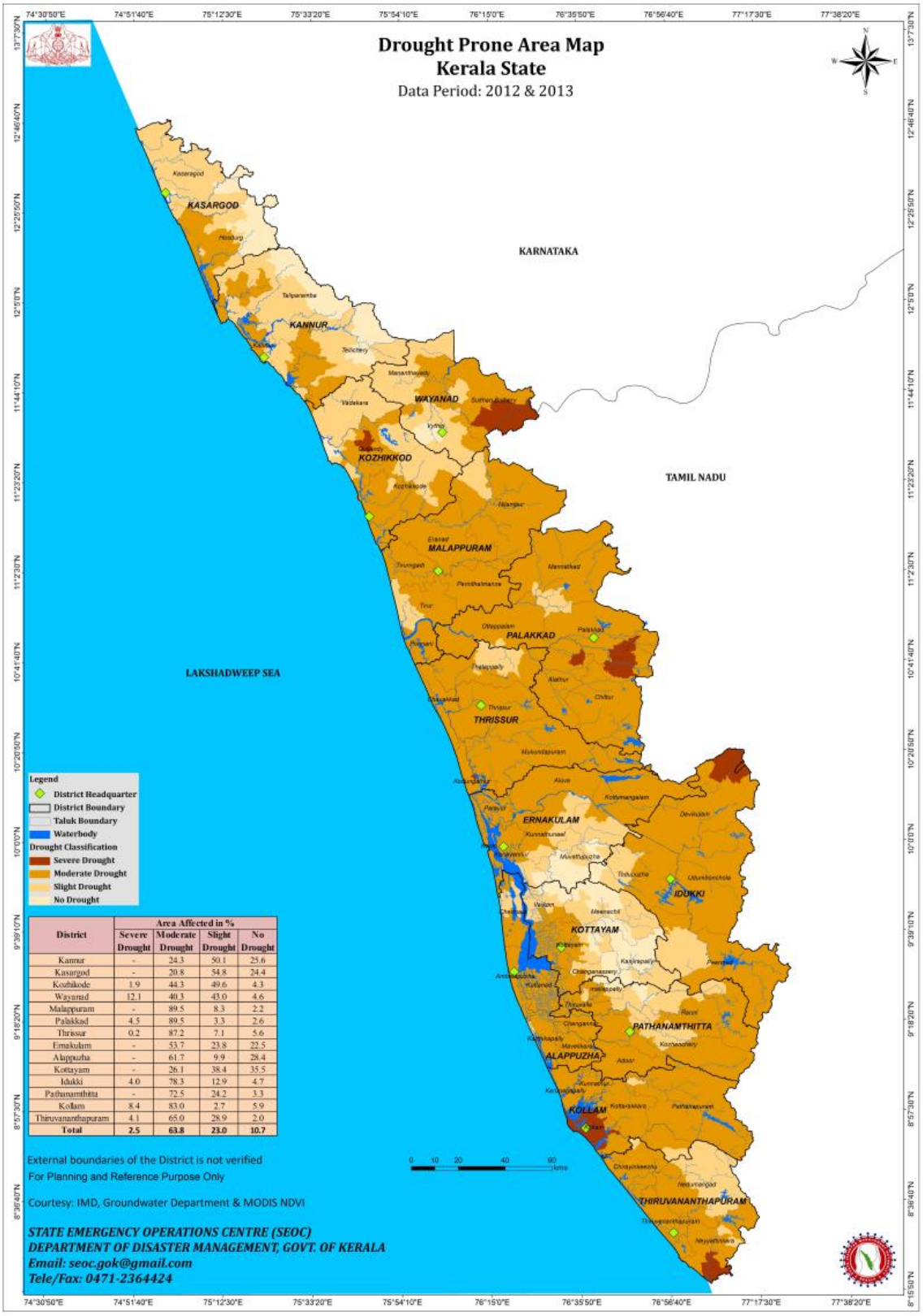
In Kerala, research on lightning has been conducted for over a decade by the National Centre for Earth Science Studies (CESS), Ministry of Earth Sciences, Government of India. The NCESS maintains a regularly updated Geographic Information Systems based database of lighting felt reports which is collected from newspaper reports or compensation claims submitted by the affected to the Department of Revenue, Govt. of Kerala. It is known from studies that Cumulonimbus (Cb) clouds produce lightning. Kerala's typical topography favors frequent Cb formation especially during the months of April-May and October-November (Murali Das, 2007; Vishnu et al., 2010).

Figure 9 shows the village wise frequency of fatal/injury causing lightning events/year. It is evident that the mid land of Kerala is significantly prone to lightning. The highlands have the least of incidence and the frequency and distribution in the low lands falls between the other two. A simple explanatory statistics derived from this database of 17 years shows that there has been on an average 71 deaths and 112 injuries due to lightning every year. Figure 10 shows that between January 2010 and May 2014, there have been 110 fatalities due to lightning in Kerala. It was noted that most of the demised and the injured due to lightning were bread earning members of relatively poor families, and often were women.

Figure 11 shows the district wise distribution of lightning incidents from which it is evident that lightning fatalities is the highest in Malappuram district, highest number of lightning hit injuries are reported from Thiruvananthapuram district and the highest number of lightning events are reported from Kannur district. It is as well apparent that no district of the state is devoid of lightning fatalities or injuries.

Property damage due to lighting is also very high in the state. Sample data from the BSNL on lightning affected telephone connections for a small period in 2002 shows that the losses were as high as about ₹20 million and the total number of subscribers affected were ~18000 (Murali Das, 2007). Lightning hits burning down several coconut palms and rubber trees are quite common in the state, but are never reported or compensated for and hence goes excluded from the database. This implies that the cumulative revenue loss due to lightning may run to a tune of several million rupees every year.

It may be noted that lightning hits on 10 or 20 cash-crop stands often devastate the economic stability of the affected farmer. Unlike elsewhere in the country, majority of the cash crop farmers of Kerala have very small land holdings (~0.7 acre) due to high population density and consequent land fragmentation, and their sole livelihood may be the earnings from these cash crops. Thus, unlike other states, the high population density, high frequency of lightning and high vegetation density supplements each other in causing more frequent lightning fatalities, injuries and property loss in the state.



District	Area Affected in %			
	Severe Drought	Moderate Drought	Slight Drought	No Drought
Kannur	-	24.3	50.1	25.6
Kasargod	-	20.8	54.8	24.4
Kozhikode	1.9	44.3	49.6	4.3
Wayanad	12.1	40.3	43.0	4.6
Malappuram	-	89.5	8.3	2.2
Palakkad	4.5	89.5	3.3	2.6
Thrissur	0.2	87.2	7.1	5.6
Ernakulam	-	53.7	23.8	22.5
Alappuzha	-	61.7	9.9	28.4
Kottayam	-	26.1	38.4	35.5
Idukki	4.0	78.3	12.9	4.7
Pathanamthitta	-	72.5	24.2	3.3
Kollam	8.4	83.0	2.7	5.9
Thiruvananthapuram	4.1	65.0	28.9	2.0
Total	**2.5**	**63.8**	**23.0**	**10.7**

Figure 8: Drought susceptibility map of Kerala

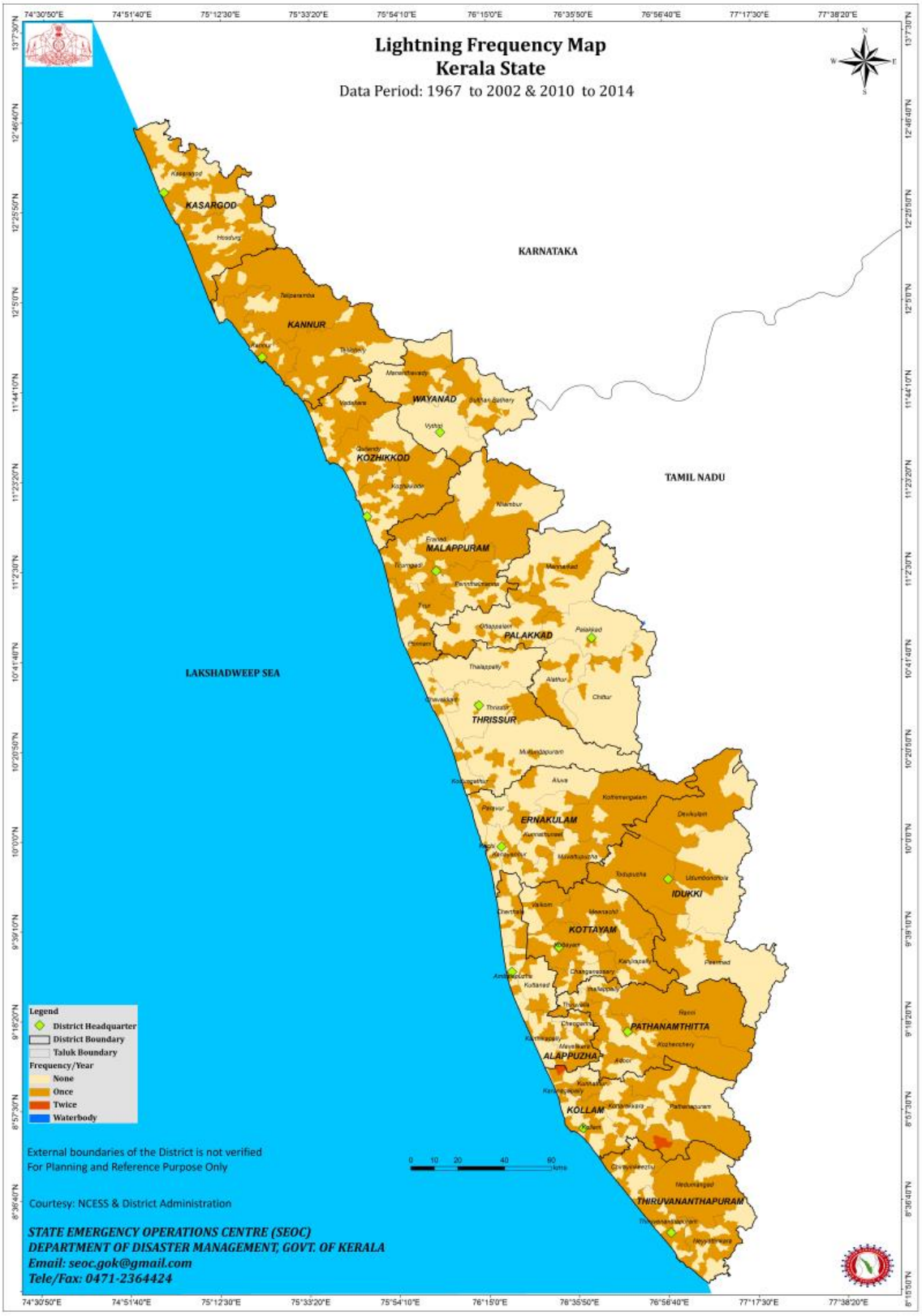
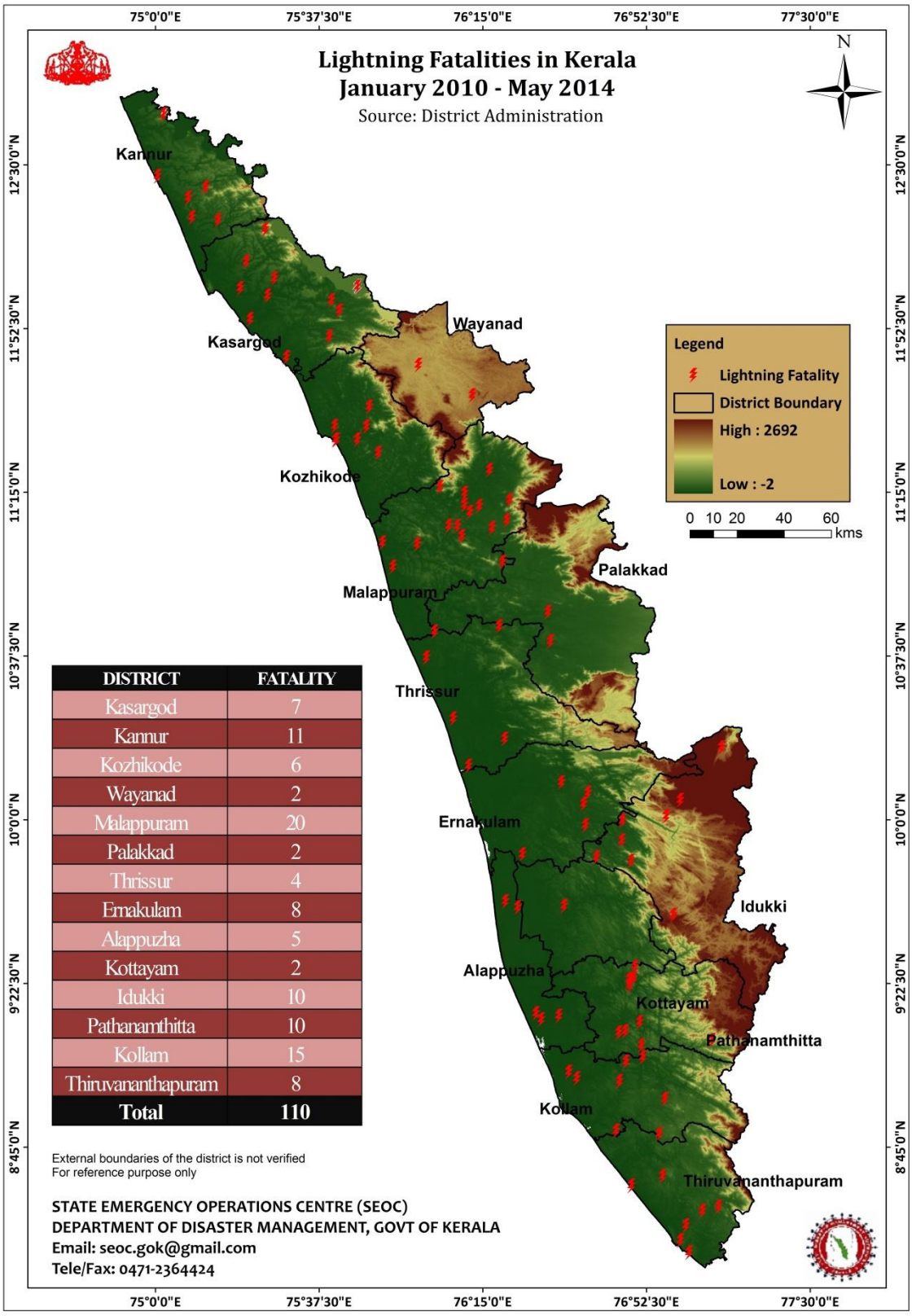


Figure 9: Lighting susceptibility map of Kerala



DISTRICT	FATALITY
Kasargod	7
Kannur	11
Kozhikode	6
Wayanad	2
Malappuram	20
Palakkad	2
Thrissur	4
Ernakulam	8
Alappuzha	5
Kottayam	2
Idukki	10
Pathanamthitta	10
Kollam	15
Thiruvananthapuram	8
Total	**110**

Figure 10: Lightning fatalities in Kerala 2010-14

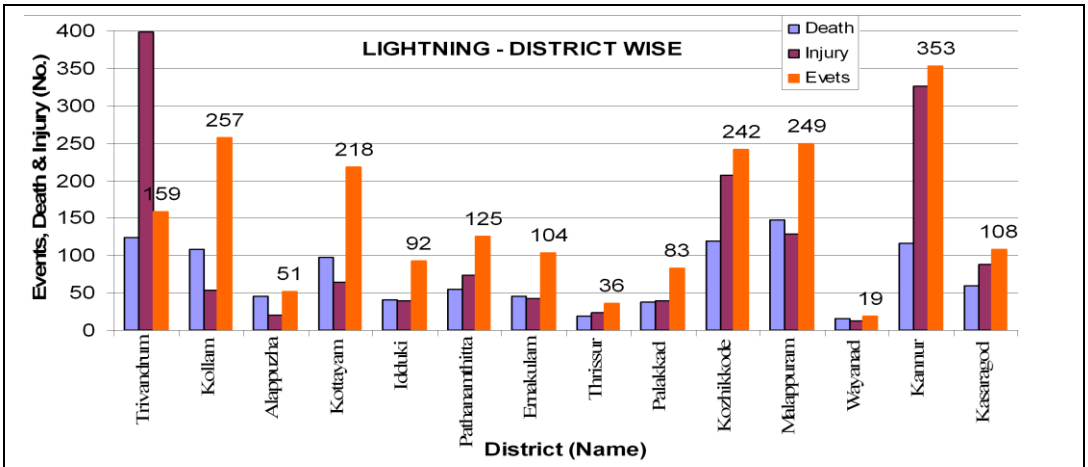


Figure 11: District wise distribution of lightning incidence in Kerala (Murali Das, 2007)

Annexure 3 shows taluk wise details of lighting hits that has caused damage to life and/or property from 1967 to 2003.

2.3.6 Coastal Erosion

The 590 km coast of Kerala is one of the most densely populated land areas in the country. This coastline is exposed to high waves, storm surges, 'Kalla kadal' and Tsunami. These natural phenomena in turn results in rampant coastal erosion and consequent beech loss.

Kalla kadal is a Malayalam word having literal meaning of 'sea thief' which is used to represent a phenomenon that occurs during the pre-monsoon season and monsoon breaks along Kerala coast, which was adopted by UNESCO to refer to sea creeping into coast because of swells generated by storms generated near Antarctica. This phenomenon occurs mostly during pre-monsoon season and sometimes during post monsoon and continues for a few days inundating low lying coasts. During high tides the water level can reach 3-4 m above Maximum Water Level (MWL).

The 'Fact sheet of shoreline changes – Kerala, National Assessment of Shoreline Change' published by the Ministry of Environment and Forests, Govt. of India (NCSCM et al., 2011) shows that a major stretch of Kerala's coastline is eroding rapidly. Statistics of hazard prone coastline of the state is given below. Salt water intrusion during the summer season due to rampant ground water exploitation and tidal effects also affects the coastal community.

Coastal erosion results in the loss of life and property of the coastal fisher population who are one of the most downtrodden communities of the state. One of the most apparent losses of property is the damages that come about to the dwelling spaces of the fisher population. Every year hundreds of houses are damaged due to the furry of the sea. Figure 12 shows district wise erosion/accretion characteristics of Kerala coast.

Department of Irrigation has identified Poovar-Vizhinjam, Kovalam-Valiathura, Perunnathuruthu to Neendakara, Kayamkulam, Ambalappuzha, Thumboli, Chellanam, Cochin Harbour, Azikkode, Kozhipram, Chavakkad, Ponnani, Kadalundi, Elathur, Tikkodi, Murad, Puthiyappa Angadi, Neelaswaram and Manjeswaram, spread along the nine coastal districts of Kerala as erosion prone.

High Erosion prone coast		Low Erosion prone coast		Storm Surge/Tsunami prone area	
215.5 km	36.6%	97 km	16.4%	263.7 km^2	0.7%
Major flood incident in the last 20 years		Indian Ocean Tsunami on 26 Dec 2004; 250 km coastline affected with sea water entering up-to 1.5 km inland; Population affected - 1.3 million; Dwelling units damaged - 17,381			
Human fatality		171			

Of the nine coastal districts, they being Kasaragod, Kannur, Kozhikode, Malappuram, Thrissur, Ernakulam, Alappuzha, Kollam and Thiruvananthapuram (from north to south), the coastline of Thiruvananthapuram district is the most prone to erosion. About 23% of Thiruvananthapuram coastline is affected by erosion. About 310 km of the coastal stretch of Kerala has seawalls, riprap revetments, groynes etc. These artificial coasts are essentially eroding coasts. The other districts that are highly prone to erosion, but are partly safeguarded by artificial means are Kollam and Ernakulam. Coastal erosion results in the loss of life and property of the coastal fisher population who are one of the most downtrodden communities of the state. One of the most apparent losses of property is the damages that come about to the dwelling spaces of the fisher population. Every year hundreds of houses are damaged due to the furry of the sea. The Tsunami of 2004 exposed the weakness of Kerala's coastal fisher population in terms of their resilience and coping capacity. An assessment of the fund release from State Disaster Response Fund (SDRF) in the 13th Finance Commission period indicates that individual beneficiaries of the SDRF are mainly clustered along the coastal areas of the State. Every year, the coastal district administrations of Kerala are forced to open a number of relief camps costing substantial loss to the exchequer. Tables below shows the statistics related to coastal erosion in Kerala from 2002 to 2012. Figure 13 shows the population vulnerability of the coastal areas of Kerala. Annexure 2 gives details of vulnerability of coastal area assets to storm surge and tsunami.

Year wise details of total land area eroded due to coastal erosion (in ha)

District	Year										Total
	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	
Kollam	0.35	0.4	1.54	0.18	0.2	0	0.15	0.1	0.57	0.12	3.61
Alappuzha	0.3	21.22	0.3	0.1	0.15	0.13	0.1	0.01	0	0	22.31
Trissur	23.49	12.31	21.09	44.26	43.93	58.53	36.24	48.03	68.6	13.28	369.76
Malappuram	5.50	5.90	3.90	5.90	5.90	5.50	5.50	5.90	5.90	6.30	56.22
Kozhikode	3	2.8	3.4	3.2	3.1	2.9	2.3	2.7	2.4	2.9	28.7
Kasargod	1.13	0.95	1.1	1.03	0.88	0.95	1.52	1.33	1.51	2.35	12.75
Total	33.7	43.58	31.33	54.67	54.16	68.01	45.81	58.07	78.98	24.95	**493.3**

Year wise details of total number of people affected due to coastal erosion											
District	**Year**										**Total**
	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	
Trivandrum	29	35	2456	29	524	194	52	579	133	213	4244
Kollam	201	240	2500	545	401	0	402	425	508	608	5830
Alappuzha	205	13517	199	236	1267	150	201	202	252	190	16419
Trissur	1731	14019	1571	1416	2693	1110	2753	1140	647	79	27159
Malappuram	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	15000
Kozhikode	120	130	350	120	130	140	110	130	150	130	1510
Kasargod	74	852	89	66	48	41	54	88	162	103	1577
Total	4057	30725	12597	4932	7278	3637	5204	4169	3490	2862	**78951**

Year wise details of area of agricultural crop area affected due to coastal erosion (in ha)											
District	**Year**										**Total**
	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	
Kollam	0	0	0	0	0	0	0	0	0	237	237
Alappuzha	1.2	170.3	1.2	0	0.2	0.7	0.7	1	0	2.5	177.8
Malappuram	2.56	2.74	3.90	2.50	3.91	3.00	2.64	2.76	3.29	3.02	30.33
Kozhikode	1.6	1.9	1.3	1.6	0.9	1.3	1	1.8	1.2	1.8	14.4
Kasargod	155	0	125	0	0	45	0	150	48	0	523
Total	160.35	174.9	131.4	4.102	5.01	50	4.34	155.6	52.49	244.3	**982.5**

2.3.7 Earthquake

India has been divided into 4 seismic zones namely zone II, zone III, zone IV and zone V according to the maximum intensity of earthquake expected. The state has been included in the earthquake Zone III, where the maximum expected magnitude is 6.5.

Though the state of Kerala had experienced several occurrences of earthquakes since the historic times, the events that occurred during the past half-century were well documented, because of the availability of seismic records. The historical as well as recent (post-1950) events compiled from various sources record the occurrence of approximately 60 earthquakes (KSCSTE, 2007). An analysis of the seismicity map indicates that most of the well-defined earthquakes have definite spatial association with some of the known faults/lineaments, which is in line with the seismicity of Peninsular shield, where the latter is confined mostly to pre-existing structures/mobile belts.

A large number of micro earthquakes or mild tremors have been recorded many parts of the State. It is well known that almost all these micro-tremors have spatial association with lineaments in the vicinity of many river channels.

Precipitation data and the occurrence of micro earthquakes showed a close correspondence however, this correlation could not be established with scientific certainty. Figure 14 shows the lineaments and earthquake events that are registered in the earthquake catalogue of Kerala. Details of taluk wise earthquake events will are given in Annexure 3.

Major earthquake in the last 20 years	Erattupetta Earthquake, 5M, 12th December 2000
No major fatality or damage has been reported due to earthquakes in Kerala in the recent past	

2.3.8 Wind

Wind speed is high along the coast of Kerala, often exceeding 50 km/hr. This causes significant damage to life and property in the state. Although cyclones have not occurred in the state, Gustnados are recurrent. Water sprouts have been reported from various coastal areas of the state.


Gustnado at Poruvazhi, Kollam, 2016

"Gustnadoes" typically appear as a swirl of dust or debris along the "gust front" of a thunderstorm. They are not directly linked with rotation in the thunderstorm itself and can form a considerable distance away from the parent storm. There is no condensation funnel or other visible connection to the cloud base. Gustnadoes account for a large number of the weakest tornado reports each year. Their localized impact and damaging effects have allowed them to be counted as tornadoes but most are probably not "true" tornadoes. The strong, straight line winds that can follow behind the gustnadoes are likely to cause more damage than the gustnadoes themselves. Gustnadoes are not visible on Doppler radar. Meteorologists do not forecast gustnadoes, but can issue Severe Thunderstorm Warnings for the gust fronts of stronger storms that are detectable on Doppler radar (IMD FAQ).

Cyclones have not affected Kerala in the recent past. However, historical records indicate that high velocity wind due to localized cyclonic or convective systems have caused damage to life and property in the coastal areas of the state. The table below shows a list of such localized cyclonic or convective systems that has caused substantial damage to property.

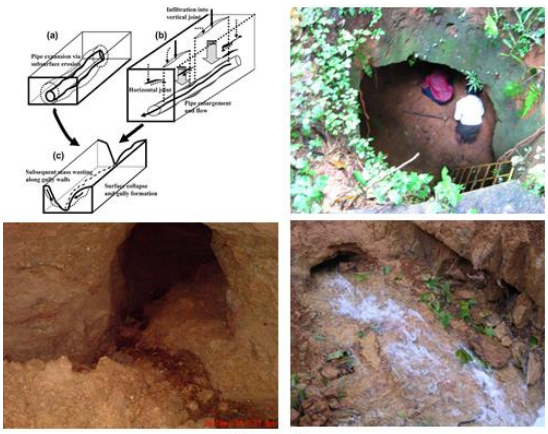
Sl. No.	Month & Year of occurrence	Panchayat (P)/Municipality (M)	Block	District	Latitude	Longitude
1	Dec-1908	Punnayur (P)	Chavakkad	Thrissur	10.65	75.99
2	Nov-1919	Muzhappilangad (P)	Edakkad	Kannur	11.79	75.46
3	Nov-1925	Vadakara (M)		Kozhikkode	11.6	75.61
4	May-1932	Parappanangadi (P)	Tirurangadi	Malappuram	11.04	75.87
5	Nov-1935	Eriyad (P)	Kodungalloor	Thrissur	10.2	76.17
6	Nov-1940	Punnayurkulam (P)	Chavakkad	Thrissur	10.67	76

7	May-1941	Elavally (P)	Mullassery	Thrissur	10.56	76.1
8	May-1941	Kadappuram (P)	Chavakkad	Thrissur	10.56	76.04
9	May-1962	Pullur-Periya (P)	Kanhangad	Kasaragod	12.41	75.13
10	Dec-1964	Ponnani (M)		Malappuram	10.78	75.94
11	Dec-1972	Atholi (P)	Balusseri	Kozhikkode	11.41	75.76
12	Nov-1977	Kalpakancheri (P)	Tanur	Malappuram	10.94	75.98
13	Nov-1978	Meppayur (P)	Melady	Kozhikkode	11.55	75.71
14	Nov-1978	Vadakkekkara (P)	Paravoor	Ernakulam	10.17	76.2
15	Nov-1984	Ulliyeri (P)	Balusseri	Kozhikkode	11.42	75.76
16	Nov-1992	Aryadu (P)	Aryadu	Alappuzha	9.54	76.36
17	Dec-2000	Panmana (P)	Chavara	Kollam	9	76.53
18	Dec-2000	Chenkal (P)	Parasala	Trivandrum	8.36	77.1
19	Oct-2014	Thrikkunnapuzha (P)	Harippad	Alappuzha	9.285	76.396
20	Jun-2016	Poruvazhi (P)	Sasthamkotta	Kollam	9.0882	76.651
21	Jul-2016	Marayur (P)	Devikulam	Idukki	10.2770	77.16138

Major single event in the last 20 years	Gustnado at Poruvazhi, Kollam on 10-06-2016
5 houses totally damaged, 44 houses partially damaged, 10 ha vegetation damage and 150 trees uprooted	

2.3.9 Soil piping

Soil piping or "tunnel erosion" is the formation of subsurface tunnels due to subsurface soil erosion. They may lie very close to the ground surface or extend several meters below ground. Once initiated they become cumulative with time, the conduits expand due to subsurface erosion leading to roof collapse and subsidence features on surface. Since it happens in the underground, in many cases the phenomenon goes unnoticed. The cavities or pipes developed below the ground grow with respect to time and affect large extents of land in the form of subsidence thereby making it not suitable for cultivation. Occasionally the subsurface flow of water can result in conduits (pipes) through relatively insoluble clastic deposits. The piping results in caving and collapse of surficial conduits. This is an important process in the head ward extension of gullies. During the last decade many piping incidences were reported from different places in Kerala. In 2005, National Centre for Earth Science Studies (the then Centre for Earth Science Studies) has investigated land-subsidence in the Chattivayal locality of Thirumeni village, Kannur, Kerala. It was found out to be due to soil piping process. This was the first major incidence reported by NCESS on soil piping. At that time it was thought that it may be an isolated incidence. But subsequently such incidences were reported from many places in Kannur, Kozhikode and Idukki. After investigating the incidences reported from



Soil Piping

places like Chattivayal (Taliparamba taluk, Kannur district), Palakkayam (Mannarkkad taluk, Palakkad district), Pasukkadavu (Vadakara taluk, Kozhikode district), Padinjareathara and Kunnamangalam Vayal (Vythiri taluk, Wayanad district), Venniyani mala (Todupuzha taluk, Idukki district) Perngasseri , Tattekkani and Karuppilangad (Thodupuzha Taluk, Idukki district) Udayagiri (Udumanchola taluk, Idukki) it was confirmed this process needs detailed studies. Figure 15 shows the soil piping affected areas in Kerala.

2.3.10 Human epidemics

The Directorate of Health Services identifies Malaria, Dengue, Chikungunya, AES/ Japanese encephalitis, Leptospirosis, Hepatitis-A, Typhoid, ADD, Cholera, H1N1 and Hepatitis-B as communicable diseases that has the potential of being an epidemic. In the past, Kerala state was mainly endemic for malaria and lymphatic filariasis. Malaria was prevalent in the hills and foothills of the state whereas lymphatic filariasis was predominant in the coastal belt. There is a noticeable upsurge of vector borne viral diseases since 1996. Japanese encephalitis (JE) first appeared in the state in Kuttanadu area in Alapuzha. Climate and geographical factors are suitable in Kerala for vector breeding. Large plantations of rubber, cocoa, pineapple, bamboo, areca nut etc. are seen throughout Kerala. Latex collection cups in rubber estates, hanging hollow cocoa fruits, pineapple leaf axils, cut bamboo stumps and fallen areca nut leaves are rich breeding sources. Elimination of these breeding sources in estates requires enormous efforts. The presence of a wide range of rodent and non-rodent reservoir hosts along with a favorable environment makes most parts of Kerala vulnerable to leptospirosis (DHS, 2016). Incidence of diphtheria has been reported in 2016 from the northern districts of Kerala.

The recent inflow of about 25 lakhs domestic migrant workers from other states of India in Kerala has changed the health and sanitation concerns in the state. The poor living conditions and poorer sanitation facilities in the largely unhygienic places where these workers live may play host to sudden upsurge of communicable diseases. Diseases not known in the recent past in Kerala have started to be reported from the State particularly amount migrant labourers; in 2015, cases of Visceral leishmaniasis (VL), known as ‘Kala Azar’ were reported amongst migrant labourers in Thrissur district.

Figure 16 shows the fatalities due to communicable diseases in Kerala.

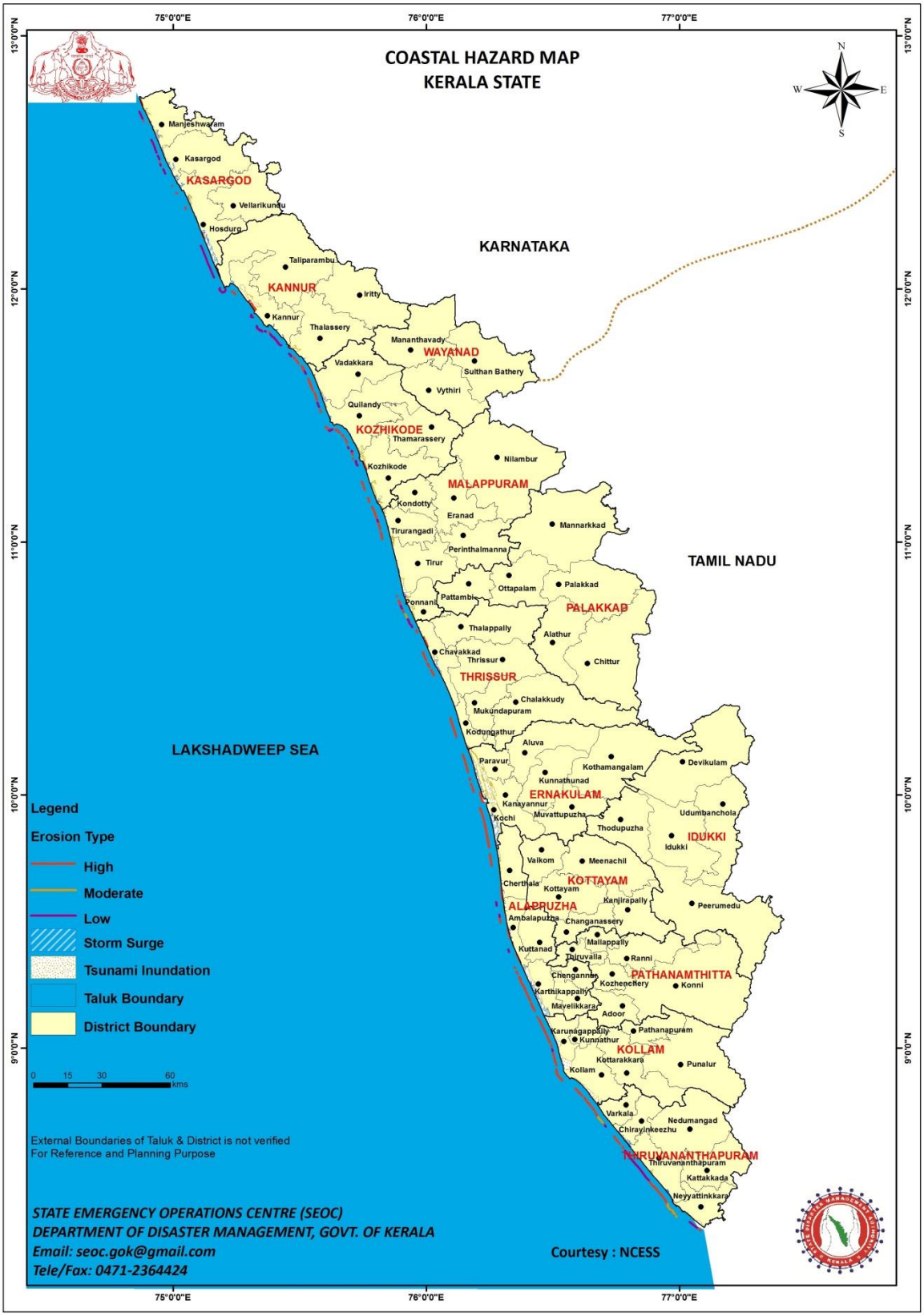


Figure 12: Coastal hazard susceptible area of Kerala

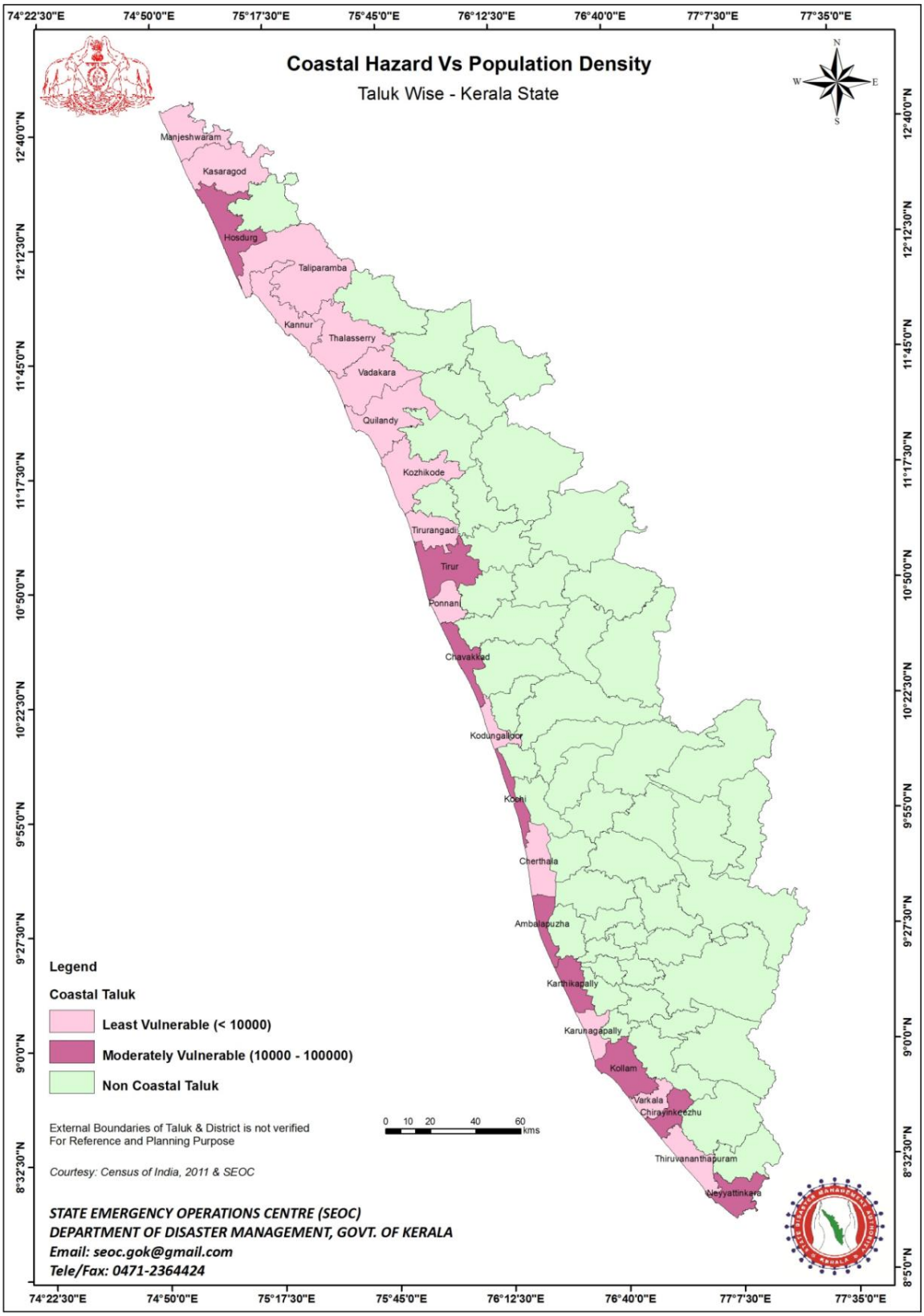


Figure 13: Coastal taluks of Kerala ranked as per population vulnerability

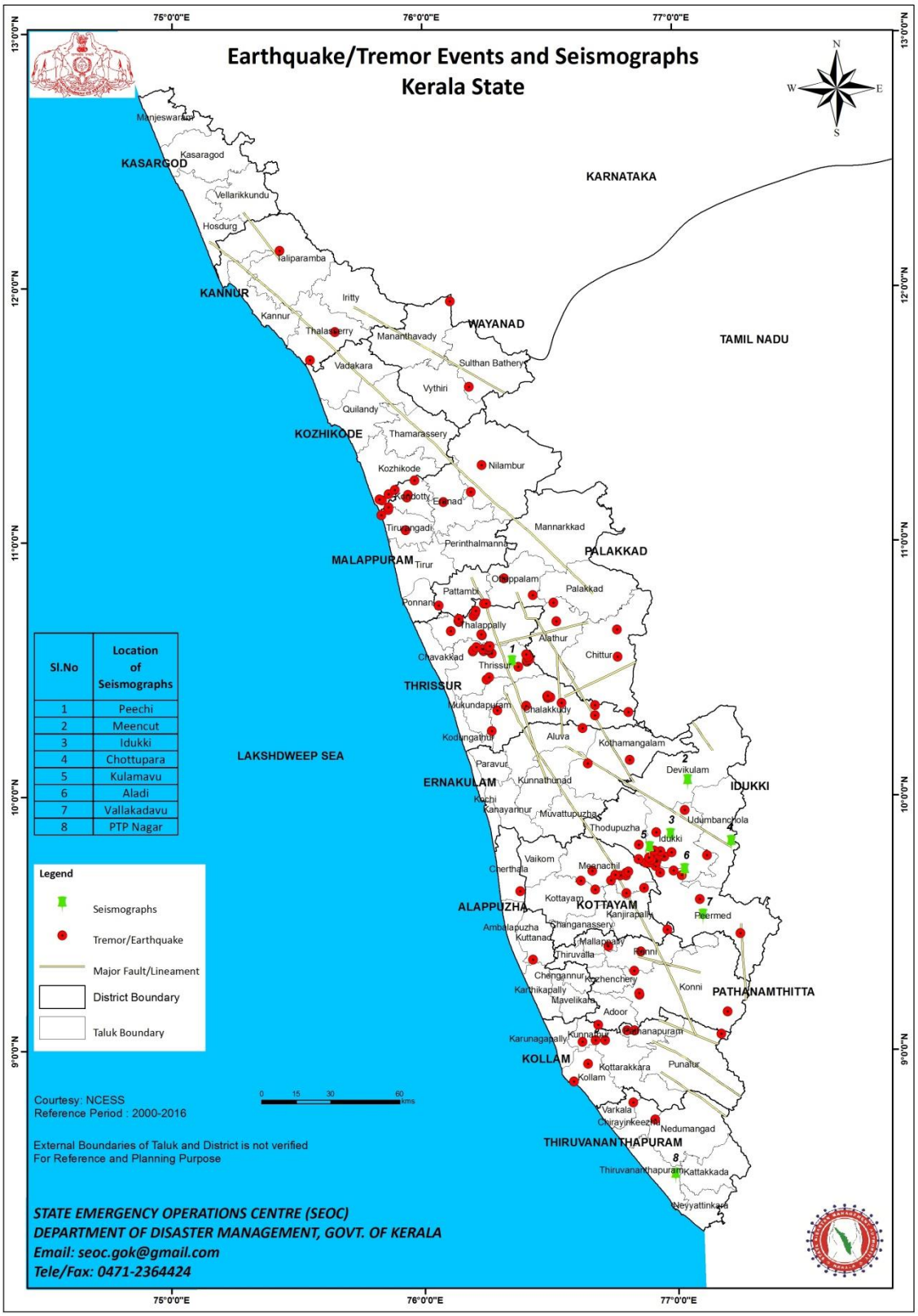


Figure 14: Lineaments and past earthquake locations in Kerala

2.3.11 Heat wave/sunburn/sun stroke

Indian Meteorological Department issued heat-wave warning on 27-04-2016 in the State. This is the first time that such a warning was issued in the State. Temperature of Palakkad district was 6°C above normal touching a record high of 41.9°C. Even maritime districts such as Alappuzha and Kozhikode experienced increase of more than 4°C above long period average on 27th April. Temperature in 2016 was 2 to 3 degree Celsius higher than normal in all districts in the State. Several sunburn incidents were reported from various parts of the State in 2016. Events of sunstroke deaths were also reported by media, however, Directorate of Health Services has not confirmed whether these deaths were as a result of sunstroke. Instances of sunburn deaths have been reported in the years of 2007, 2009 and 2010 from Palakkad.

2.3.12 Plant disease epidemics and pests

The geo-climatic conditions of the state favour the spread of plant diseases and pests. Diseases and pests that attack major crops in Kerala are given below.

DISEASE	PEST
RICE	
Blast	Stem borer
Brown leaf spot	Gall midge
Narrow brown leaf spot	Rice Bug
Sheath blight	Leaf roller
Sheath rot	Brown plant
Stack burn	Case worm
Bacterial blight	Swarming
Grassy stunt	Caterpillar
Ragged stunt	Rice hispa
	Rice thrips
	Whorl maggot
	Mealy bug
COCONUT	
Bud rot	Eriophoyidmite
Leaf rot	Rihnoceros beetle
Root (wilt) disease	Red palm Weevil
Stem bleeding	Black headed caterpiller
Grey blight	Cockchafer beetle
Thanjavore wilt	Coried bug
	Mealy bug
BANANA	
Bunchy top	Pseudo stem borer
Banana wilt (Panama disease)	Rhizome weevil
Sigatoka leaf spot	Nematodes
Kokkan	
TAPIOCA	
Cassava mosaic	Tapioca scale

	Mealy bug
	Mites
RUBBER	
Abnormal leaf fall	Scale insect
Powdery mildew	Mealy bug
Pink disease	Cockchafer Grub
Corynespora leaf disease	Bark feeding caterpillar
Bark rot	
CASHEW	
Anthracnose Dieback	Tea mosquito
	Stem & root borer
ARECANUT	
Bud rot	Spindle bug
Mahali or Koleroga	Mites
Foot rot (Anaberoga)	Inforescence caterpillar
Yellow leaf	Root bug
PEPPER	
Phytophthora foot rot	Pollu beetle
Fungal infection	Leaf gall thrips
	Soft scale
	Nematodes
GINGER	
Rhizome rot	Shoot borer
Leaf spot	
Bacterial Wilt	
COCOA	
Vascular streak die back	
Black pod	

2.3.13 Animal epidemics

More than a dozen zoonotic diseases are actively prevalent in Kerala. Notable ones are Anthrax (reported in July 2006 from Koothattukulam, Ernakulam district), Brucellosis (reported in 2010 from Wayanad), duck viral enteritis (reported in May 2013 from Manakkodi, Thrissur district), leptospirosis, Rickettsial infections, rabies, Arboviral diseases etc.

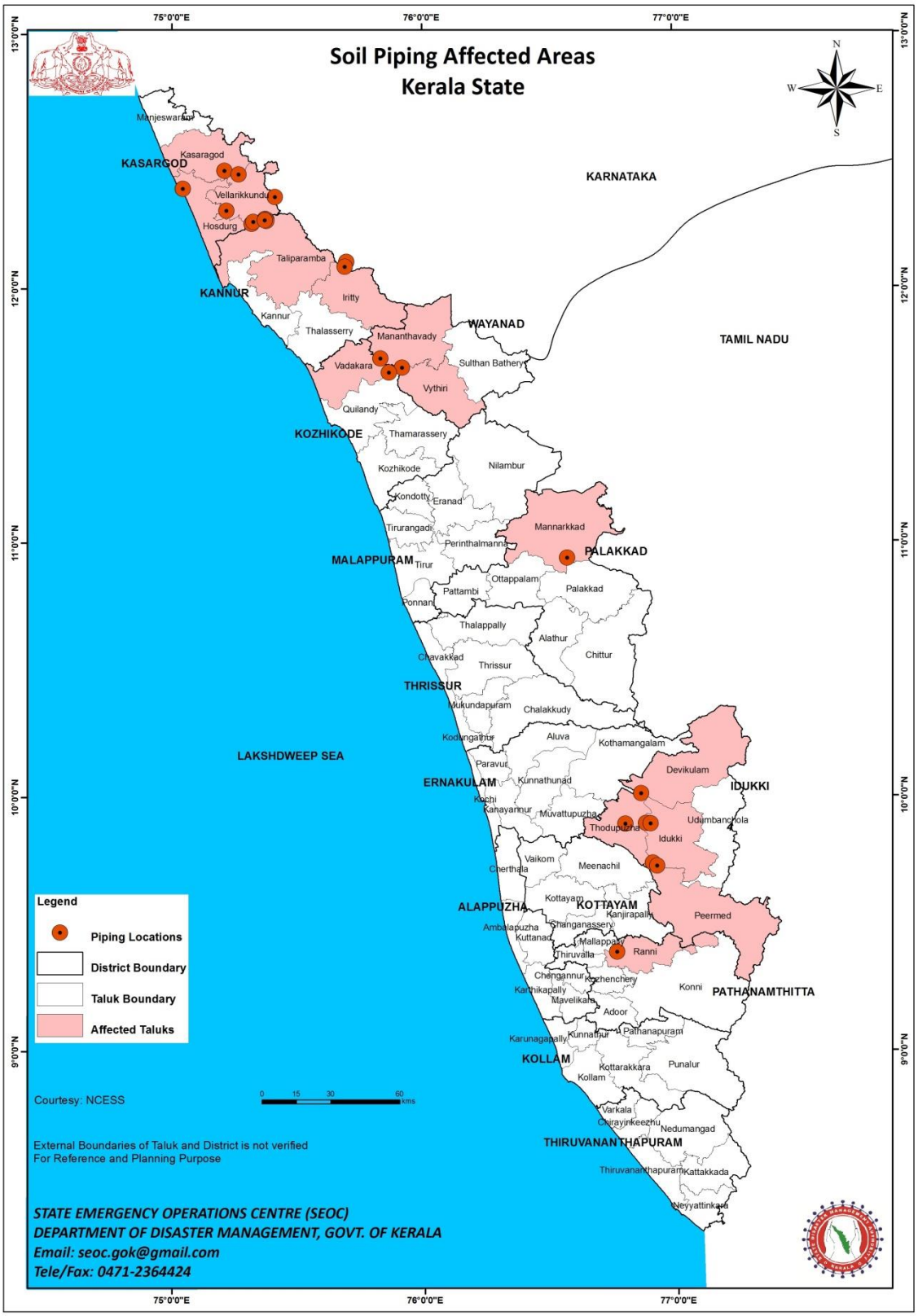


Figure 15: Soil piping affected areas of Kerala

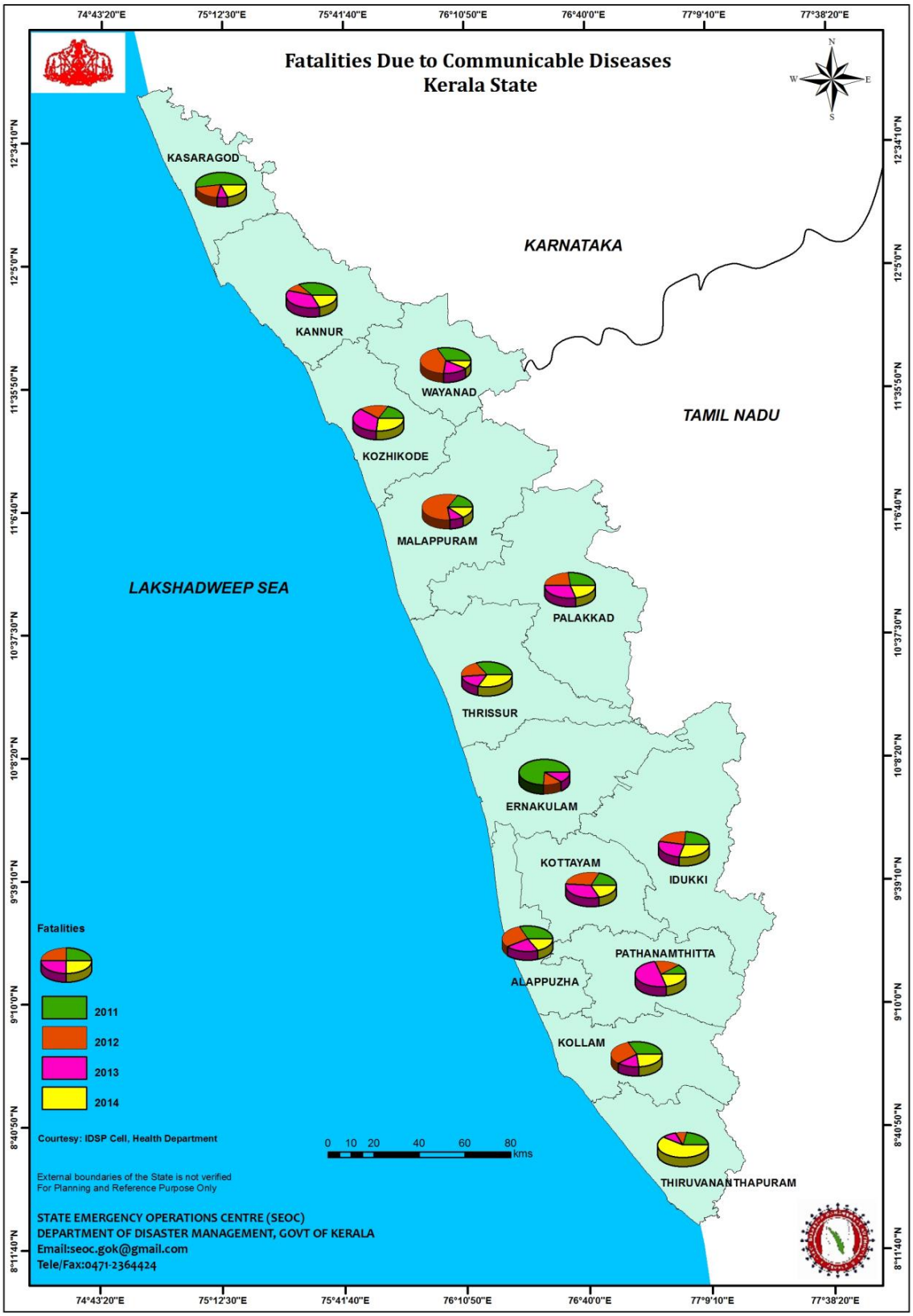


Figure 16: Fatalities due to communicable diseases in Kerala

2.3.14 Avian epidemics

The state's major paddy-growing Kuttanad region in Central Kerala reported incidents of Avian Flue (H5N1). The avian influenza was confirmed following lab tests at the National Institute of High Security Animal Diseases, Bhopal. Kuttanad, spread over three districts, has a duck population of 6 lakhs. Though the epidemic, first reported among domestic poultry in Alappuzha and Kottayam districts, had been contained, it was again reported at the government-run turkey farm in Kollam last week. Experts confirmed that the birds had died of H5N1 at the Kollam farm. The wetlands and wilderness areas of the State are among the preferred destinations of migratory birds. The possibility of outbreak of the epidemic among wild birds, especially waterfowls, cannot be ruled out. Close to 2 lakh migratory birds, particularly long distance migratory birds, visit Kerala. Around 100 species arrive by September every year and stay till April.

2.3.15 Pest attack of human habitations

Heavy infestation of Giant African snail (Achatina fulica) has been reported from Alappuzha, Ernakulam and Pathanamthitta districts and pockets in Thiruvananthapuram in 2014 and 2016. A. fulica became an invasive species in Kerala because of the few predators, hermaphroditic (having both male and female reproductive organs) nature, high rate of reproduction, hibernation capability, and generalist feeding nature.

Giant African snail is known to attack more than 500 plant species, including vegetables, coconut, cocoa, papaya, banana, arecanut, coffee, and even rubber. Though there has been nothing so far to suggest that the snail could be a disease carrier, the fact that it is a vector of the nematode Angiostrongylus contonensis causing Eosinophilic meningitis in humans is a cause for concern. In Kerala, an infestation of snails was first reported from Palakkad in the 1970s. The adult snails grow up to 20 cm in length and 250 gm in weight.

Another widely known menace to houses in the state is the Mupli Bettle which is a plant detritus eating Darkling beetle. They are mainly found in the rubber plantations of the state and are considered a major nuisance, to the point of infestations rendering some buildings uninhabitable. While these beetles do not deliberately attack people, they produce a defensive odoriferous phenolic secretion when provoked that causes skin blisters. This is most commonly triggered by accidentally squeezing a beetle. They invade homes and other buildings in very large numbers, estimates ranging up to 4.5 million individuals in a single building. They will then enter the dormant stage *en-masse*, creating beehive-like masses under the roof.

2.3.16 Meteorite/asteroid impacts


Suspected remains of meteorite recovered from Kolenchery, Ernakulam

Many residents in Kerala have reported seeing fireballs in the sky after 10:30 pm on 27th February 2015. The fireball appeared with a noise in many parts of Kerala, including Ernakulam, Thrissur, Palakkad, Thiruvananthapuram, Kollam, Kozhikode, Malappuram and Kannur. Some even reported that people felt minor earthquake in many parts of Ernakulam, including Fort Kochi, Vypin, Willington Island and Kolenchery. The analytical report from Geological Survey of India indicated that the fragments' chemical composition consist of nickel and iron ore. It is still not conclusive whether the fireballs seen in the sky are human-made space debris or mid-air explosion of meteorite/asteroid.

2.3.17 Natural background radiation

Background radiation is emitted from both natural and human-made radioactive chemicals (radionuclides). Humans are continuously irradiated by sources outside and inside their bodies. Outside sources include space radiation and terrestrial radiation. Inside sources include the radionuclides that enter our bodies in the food and water people ingest and the air they breathe. Whatever its origin, radiation is everywhere (or “ubiquitous”) in the environment.

The coastal belt of Karunagappally, Kerala, India, is known for high background radiation (HBR) from thorium-containing monazite sand. In coastal panchayats, median outdoor radiation levels are more than 4 mGy/y (Milli Gray) and, in certain locations on the coast, it is as high as 70 mGy/y. The radioactivity in Kerala increases from Kayamkulam Lake to Ashtamudi Lake, with a peak radioactivity around Chavara. Radioactive areas are easily identifiable by the presence of black monazite sand, rather than the white nonradioactive sand elsewhere. A 2002 study by geneticists from University of Cambridge along Chavara coast identified 22 mutations in the mitochondrial DNA sequences of families living in high-radiation area, where as a control population observed for the study, living in the nearby white sand area, had only one mutation. The control samples were taken mainly from four lake islands off Mukkad, and partly from the white sand seashore of Saktikulamkara (Forster et al., 2002). Figure 17 shows the locations in Kerala with significant natural radioactivity.

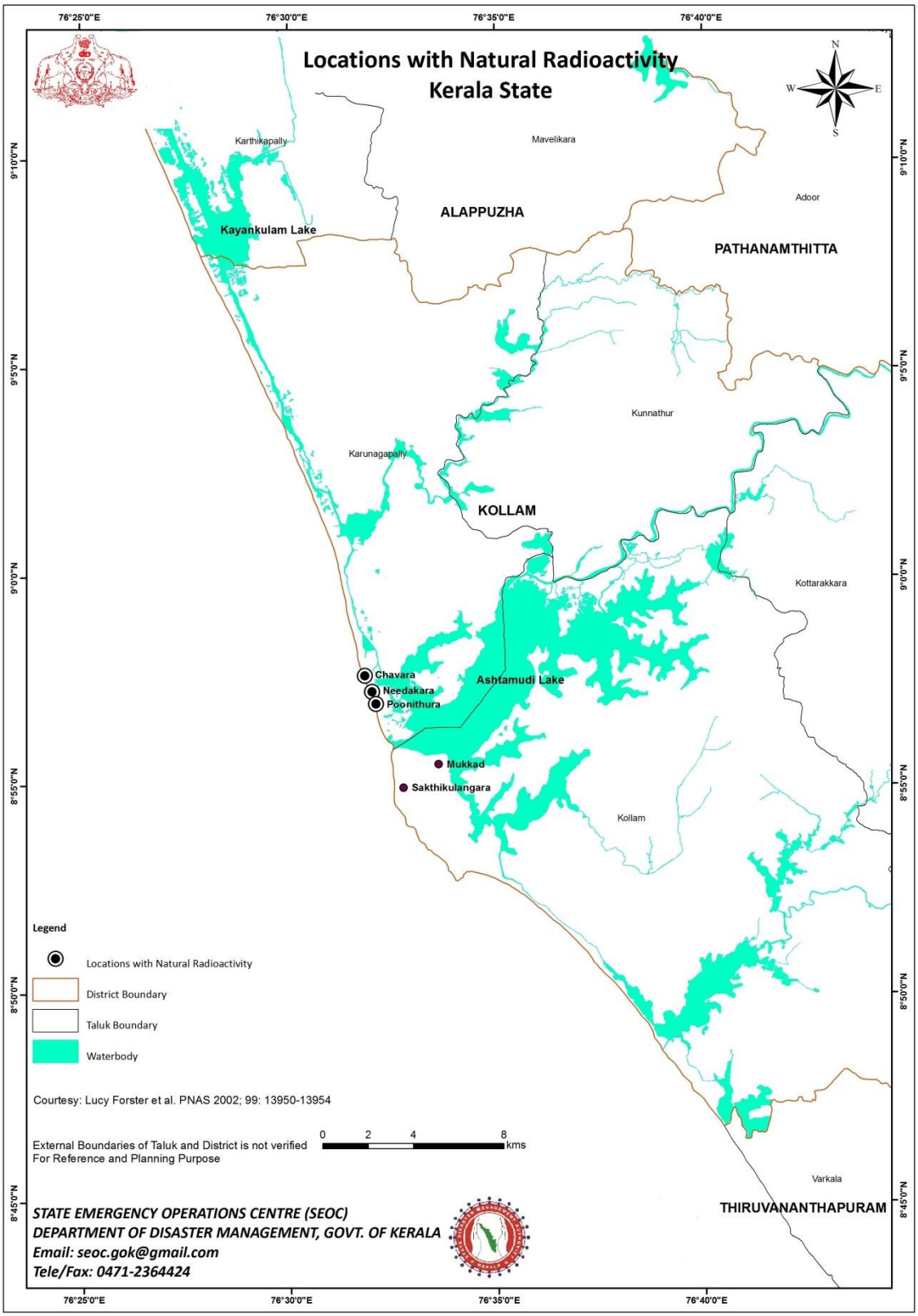


Figure 17: Locations with natural radio activity in Kerala

2.4 Anthropogenic Hazard Assessment

2.4.1 Stampedes

Most of the temples, churches and few mosques in Kerala organize annual prayers as festivals. These festivals attract huge crowds even at village level and thus have potential for occurrence of stampedes. Sabarimala pilgrimage, Attukal Ponkala and Thrissur Poram are a few among the major religious gatherings in Kerala. Apart from the religious worships, many of the festivals organize entertainment programmes, free food distribution and pyrotechnic works. Thus the venues of religious festivals become the loci for worship, entertainment and business attracting people from various religious backgrounds. The Temple festivals in Kerala also engage elephants for colorful processions and other rituals. Two major stampedes have occurred in the state in the past, they being Human stampede at hilltop near Pampa at Sabarimala in 1999 which killed 52 pilgrims and stampede on Makarajyothi day at Sabarimala in 2011 which killed 102 pilgrims.

Two major crowd related disaster events happened in Kerala in the recent past, they being, the human stampede in 1999 which occurred at Hilltop near Pamba at Sabarimala caused the death of 52 pilgrims and the death of 102 pilgrims at Pullumedu on Makarajyothi day in 2011. The stampede at the Makarajyothi view point took the lives of pilgrims from Tamil Nadu, Karnataka and Andhra Pradesh. Major religious festivals in Kerala with potential for stampedes are given in Figure 18.

2.4.2 Fire cracker explosions

Pyrotechnic displays are colorful attractions of many festival events. The attractive displays can be lethal if adequate precautionary measures are not taken. Fire and explosion at pyrotechnic production units and display points at festivals may develop as source of accidents during mass gatherings. Carelessness, negligence and ignorance from the part of organizer and firework handler can cause fatal accidents. Many casualties have been reported in Kerala related to firework accidents at religious mass gatherings. Illegal storage, manufacturing, usage,

unauthorized display agents, ignorance of safety measures etc. were the main causes in previous disasters. List of major firecracker explosions in Kerala are given below:

Year	Location	Fatality
1952	Sabarimala	68
1978	Thrissur Pooram	8
1984	Kandasamkadavu Church, Thrissur	20
1987	Jagannatha Temple, Thalassery	27
1988	Veloor Kootanmooli Temple, Thrissur	20
1988	Thrippunithura, Ernakulam	10
1989	Kandasamkadavu Church, Thrissur	12
1990	Malanada Peruviruthy Temple, Kollam	26
1997	Chiyaram firecracker unit, Thrissur	6
1998	Palakkad Kanjikode firecracker unit	13
1999	Alur Chamundikavu, Palakkad	8
2006	Thrissur Pooram	7
2011	Firecracker unit, Shoranur, Palakkad	13
2013	Panniyamkurshi, Palakkad	7
2016	Kottaram Bhagavathy Temple, Maradu, Ernakulam	1
2016	Puttingal Devi Temple, Kollam	109

2.4.3 Petro-chemical transportation accidents

Almost entire diesel, petrol and aviation turbine fuel and 45% of the LPG consumed in the state are transported through roads. Most inflammable of the fuel transported is LPG. In a bullet tanker, the LPG is transported as liquid under high pressure. On accidental release, it quickly vaporizes into highly combustible gas which can catch fire or explode, making it difficult to contain. Most gas leaks and explosions are caused by damage to the valves that control the flow of fuel from the transportation vehicle. The heavily populated areas along the sides of the National Highway in Kerala enhance the vulnerability factor.

Towards the end of 2009, an accident involving a LPG tanker at Karunagapally in Kollam claimed the lives of 12 people. In 2012, 20 people lost their lives when a LPG tanker overturned at Chala in Kannur. In the first 9-month period of 2014, around 20 accidents involving tankers happened in Kerala. Most of the accidents are reported from Malappuram, Kannur and Kozhikode districts due to the frequent transport of petro-chemicals from Mangalore to Kochi. Another hotspot of tanker accidents is the National Highway between Kayamkulam (Alappuzha district) and Karunagapally (Kollam district).

2.4.4 Industrial accidents

There are 42 Major Accident Hazard (MAH) Units in Kerala (Annexure 4). Most of the known accidents, though minor, are reported from Ernakulam district which has the highest density of industrial units in the state. Ernakulam district is the most vulnerable with 3058 km^2 exposed to industrial accidents, followed by Thrissur District. It is noteworthy that Thrissur

district itself has no MAH units as per the data from the Boilers and the Factories Department. But, any chemical disaster in the MAH units in Ernakulam district especially, border sharing units with Thrissur district, can affect an area of 2003 km^2 in the district.

There was toxic release of Cyclohexa-Pentadiene in 1985 in Kochi which affected more than 200 persons. In 2004, a toluene fire was reported from a toluene factory in Ernakulam district. On 24th October 2014, Ammonia leaked from an ice factory near Mattanchery, Ernakulam district. Most of the industrial accidents are primarily due to lack of periodical maintenance of tanks storing gas and the pipelines attached to it. On 21st May 2016, ammonia gas leakage from a barge at Champakara was spotted near Thaikkudam, Vyttila, Ernakulam district. The gas was being taken from Willingdon Island to the factory of Fertilizers and Chemicals Travancore Limited at Eloor via canal. The barge had 96 tons of ammonia. Public within 1 km radius of the leak was evacuated as a precautionary measure and the leakage was later contained. Figure 19 shows the major industrial hazard susceptibility map of Kerala. Besides, a number of small and large scale industries are also established in the state which also has the potential to cause a chemical disaster. It is reported that Ernakulam district possess the maximum MAH units in the State and the possibility of occurrence of hazards is to be considered. Annexure 5 shows the vulnerability statistics of Kerala to industrial accidents.

2.4.5 Dam break and Dam spillway operation related floods & accidents

Kerala has 58 dams listed in the Water Resources Information System of India. However, this list does not include Mullaperiyar dam. From Figure 14 it is evident that there is a higher spatial frequency of seismic activity in Kottayam-Idukki region because of the presence of several lineaments and bed rock fissures that transect these districts. These two districts suffered three earthquakes in the recent history, viz. the 1988 Nedumkandam (4.5 M), the 2000 Erattupetta (5.0 M) and the 2001 Erattupetta (4.5 M) events and the districts experience several micro-tremors (events less than 2.5 in magnitude). In 2011, between 26th July and 26th November over 22 minor tremors were reported from the immediate surroundings of the dam. These events often generate a great deal of public anxiety, especially when the disastrous consequences of earthquakes such as those in Sikkim, Wenchuan (China), Bam, Lattur etc. are all fresh in the minds of the people particularly in the minds of people living downstream of Mullaperiyar dam.

The Mullaperiyar Dam is a masonry gravity dam on the Periyar River. It is located 881 m (2,890 ft) above mean sea level, on the Cardamom Hills of the Western Ghats in Thekkady, Idukki district. It was constructed between 1887 and 1895 by Mr. John Pennycuick for Madras Presidency. Public is concerned of a dam break scenario given the age of Mullaperiyar dam, the material and technology that has been used for its construction and the possibility of reduced structural integrity that may have occurred over the last one century. Figure 20 shows the

maximum dam break flood inundation prone area map between Mullaperiyar dam and Idukki reservoir, Idukki district.

Shutter gate operation related floods are common in Kerala. In recent times, the most significant event involving mechanical failure of shutter gates was on 7th August 2012 when some of the gates of Pazhashi Barrage in Kannur failed to open, causing the flood waters to overflow the barrage for 20 hours. There was no damage to life or the dam structure, but minor property and crop loss occurred. The most feared shutter gate operation in Kerala is when the shutter gates of Cheruthoni Dam of the Idukki Group of Reservoirs are opened. Water was first released from this dam on October 22, 1981 when the water level was 2,400.99 feet and the second time the dam was opened was on November 16, 1992 when the water level was 2,402.38 feet. The water level reached the brim of shutter operation on 22nd September 2013. The original riverbed downstream this dam has been encroached upon and hence damage to property will be inevitable in the event of shutter gate operation.

On 17th September 2007 the penstock pipe carrying water from Ponmudi reservoir to Panniyar power house in Idukki district burst. Seven persons were killed and one went missing in the accident.

2.4.6 Accidental drowning

Drowning is the second biggest accident killer in Kerala, next to road accidents. According to National Crime Records Bureau about 15.2% of unnatural deaths in Kerala are due to drowning. More than 1,500 people die per year in drowning, which is the highest in India. Few notable events are:

- 28th May 2016: Five children of a family drown in Chamthachal River, Kannur
- 18th July 2016: Five college students hailing from Thiruvananthapuram drowned in the sea off Kovalam beach
- 31st October 2015: Two died in sea off the Mararikkulam beach while two others died at a temple pond at Thuravoor
- 1st May 2015: Three persons of a family from Karnataka drowned at the Kappad beach in Kozhikode
- 13th April 2014: Two girl students drowned in Cherupuzha, a tributary of Chaliyar, Kozhikode
- 26th December 2012: Five NCC cadets drowned in Periyar River at Malayatoor in Ernakulam district
- 14th May 2006: Four youths drowned at Meenmutty waterfalls, Thiruvananthapuram
- 13th October 1991: Nine students from the Dental College, Thiruvananthapuram downed at Kallar, Thiruvananthapuram

2.4.7 Oil spills

Oil spills have been reported from various parts of the coastal area of Kerala. In the last decade, oil spills have been reported from the Cochin Harbor, Ernakulam in the years 1992, 1993 and 2003. Oil spills can also occur during petro-chemical transportation accidents through road and rail. A tanker carrying Aviation Turbine Fuel from Kochi to Karipur overturned near Jyothi Theatre on the Tanur-Parappanangadi road in the early morning on 30-06-2016. The tanker had about 20,000 liters of fuel of which $1/6^{th}$ of it spill on to Canolly Canal which also caught fire. The cannal being narrow and bordered by residential buildings, the oil spill could not be contained. The presence of 18 ports and numerous boats carrying fuel increases the probability of oil spill in water sources.

2.4.8 Human induced forest fire

It is noted that human induced forest fires in Kerala are increasing, primarily due to population pressure along the boundaries of protected areas and reserved forests. Over 300 ha of forest in Wayanad experienced forest fire in March 2014 which was later found to be caused by human intervention.

2.4.9 Nuclear and radiological accidents

Radiological exposure incidents have not been reported from Kerala in the last, at least 50 years. Radiation is used for medical purposes such as Teletherapy, Brachytherapy, Cath Lab, Computed Tomography, Radiography and Fluroscopy in the State. Medical Colleges and tertiary care hospitals in the state uses radioactive materials for various treatments. Instruments used for research purposes in various science and technology intuitions also have radiation emitting materials. However, the March 2010 accident at Mayapuri Scrap Market, New Delhi was an eye opener to agencies involved in radioactive safety regulations in the country. An AECL Gamma cell 220 research irradiator owned by Delhi University since 1968, but unused since 1985, was sold at auction to a scrap metal dealer in Mayapuri on February 26, 2010. The orphan source arrived at a scrap yard in Mayapuri during March, where it was dismantled by workers unaware of the hazardous nature of the device. The Cobalt-60 source was cut into eleven pieces. The smallest of the fragments was taken by the scrap metal dealer who kept it in his wallet and two fragments were moved to a nearby shop, while the remaining eight remained in the scrap yard. Eight people were hospitalized as a result of radiation exposure, where one later died.

This incident points to the hazard potential of otherwise non-hazardous radiation sources such as X ray units, CT scanners, PET scanner, Gamma Chambers, Auto Radiography, Gas Chromatograph Units, Atomic Absorption Spectrophotometer, Microwave digestion system, CHNS Analyzer and Cyclotrones.

2.4.10 Hooch tragedies and ethanol and methanol transportation accidents

Consuming illicit liquor is prevalent amongst the rural community of the State. One of the major hooch tragedies in Kerala was in 1981 when 34 people died at Punalur in Kollam District after consuming hooch. Another tragedy occurred in the year 1982 at Vypin, Ernakulam which killed 77 people, blinded 63 and crippled 15. A major tragedy was in the year 2000 at Kalluvathukkal in Kollam district in which around 32 people died. The latest was in 2010 in which 26 people died in Vaniyambalam, Kuttippuram, and Perasannur at Malappuram. Accidents related to transportation of ethanol and methanol has occurred in Kerala. As recently as on 7-08-2016 a methanol carrying tanker met with an accident near Vengara, Malappuram district.

2.4.11 Road accidents involving civilian transport vehicles

Kerala has eight National Highways which run for about 1523.954 km and 77 State highways which have a length of 3435.717 km. Road traffic in Kerala has been on a rise at a rate of 10 to 11% per year while the carrying capacity of the roads has not increased accordingly due to shortage in availability of land. As per available data, the total number of accidents registered in Kerala in 2015 was 39,014. In 2013 and 2014, around 35,215 and 36,282 accidents were reported in the state. As many as 4,196 people lost their lives in accidents in 2015, while 4,049 perished in 2014. The data till January 2016 has revealed that as many 420 people lost their lives in around 3,688 accidents. Kerala is the third highest in the country in terms of road accidents. Experts point out that unscientific road building and ineffective traffic control system in the state has kept the number soaring. The Public Works Department has identified 216 black spots. A joint assessment by the three departments for the Kerala Road Safety Authority has found that the maximum number of accident-prone stretches, called black spots, is in Alappuzha and Ernakulam districts. While there are 34 black spots in Alappuzha, 33 of them are in Ernakulam. Places which have a history of at least three major accidents in a year have come under the category of black spots. Major accidents are those in which there have been at least two fatalities. Figure 21 shows the major black spots of Kerala.

2.4.12 Human-animal conflicts

The most common human-animal conflict in Kerala is stray dog attacks, snake bites and wild elephant attack in farms. Snake bite deaths are not uncommon in the state. A recent study by the Kerala Forest Research Institute, Thrissur revealed that 45 species of crops, including paddy, coconut palm, plantains, areca nut, coffee, oil palm, pepper, jackfruit trees and mango trees were targeted by wild animals. Crops were mostly raided by elephants, gaur, sambar, wild boar, bonnet macaque, common langur, black-naped hare and peafowl, the study pointed out. Elephants caused the most damage in Thrissur district during the last three years; 36 incidents of

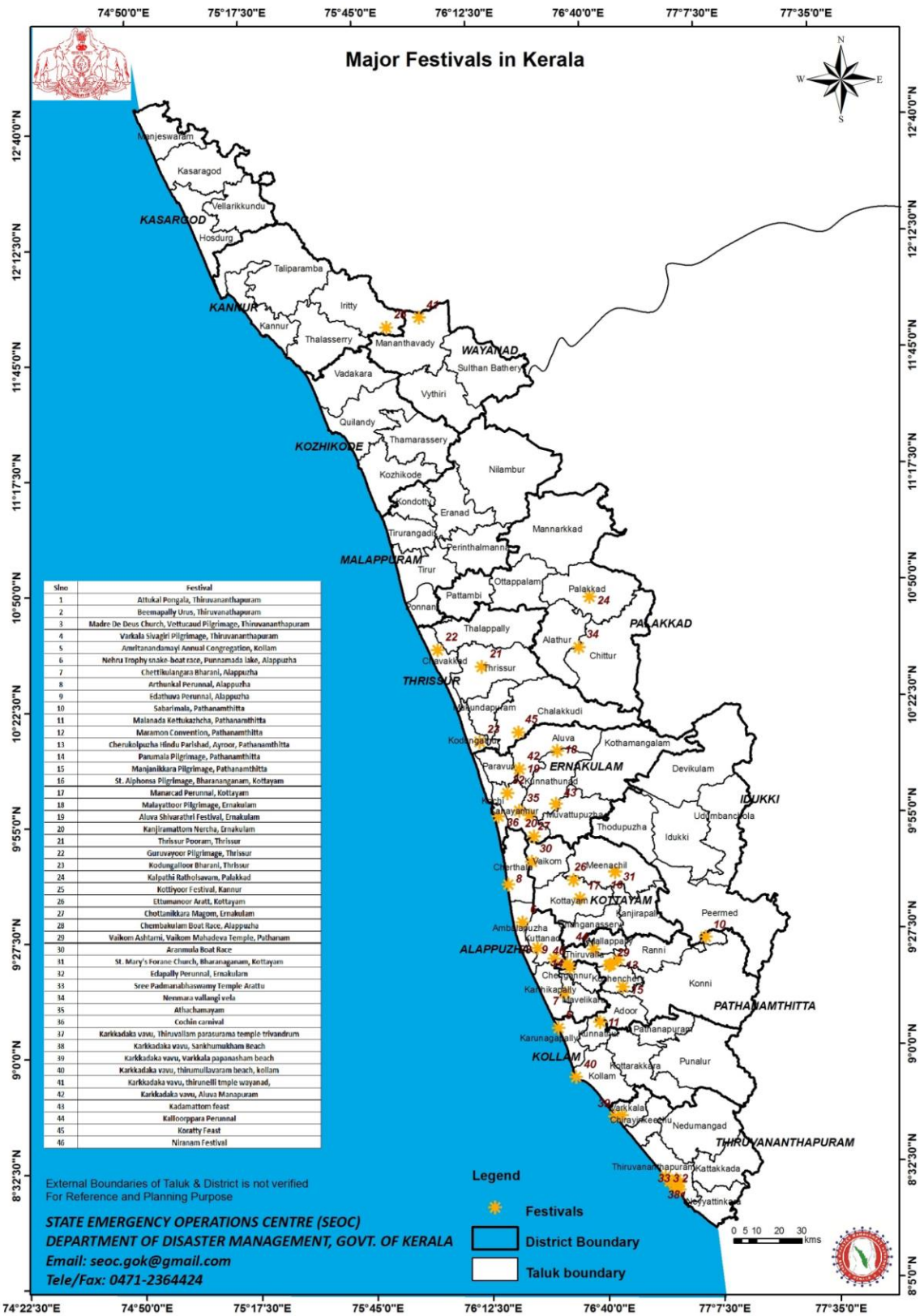
wild elephants coming into conflict with humans in Thrissur district during the last three years. The other crop raiders included wild boar, porcupine, Malabar giant squirrel and peafowl. Elephants damaged 1,990 plantains, 307 arecanut, 90 coconut trees and 225 rubber trees and other crops. The encounters occurred in the immediate fringe areas of the forest and up to 100 m from the forest boundary, according to the research findings. While the wild boar mostly fed on coconuts, plantains and tubers, porcupines settled for coconuts. They also de-barked the basal portion of the coconut trees in large numbers in Vellikulangara Forest Range.

2.4.13 Fire accidents in buildings and market places

Fires are perhaps the most frequent disaster in urban areas. Rapid urbanization in Kerala is also increasing the probability of fire accidents in market places and high raise buildings. Urban issues like high population, overcrowding, unregulated commercial activities are frequently responsible for urban fires. Fire has emerged as critical issue in Urban Planning due to rising frequency of Fire accidents, leading to huge losses of life & property. Fires can occur with the same ferocity in residential buildings, slums and squatter settlements, public places like auditoria, cinema halls, shopping malls, LPG go-downs/petrol pumps, industries, chemical handling units, etc. As recently as on 14th November 2015, fire gutted 10 shops in the Chalai Market, Thriuvananthapuram. Specialized fire engine of the International Airport had to be employed to subside the inferno. A huge blaze broke out near Kallai river bank at Muriyad, Kozhikode around 4 am on 20-03-2016. Two saw mills were completely gutted in the fire. Three shops were gutted in a fire that broke out in a shopping complex at Edavanna in Malappuram on 14-07-2016. The fire that broke out around 1.30 am was doused after three-hour-long effort

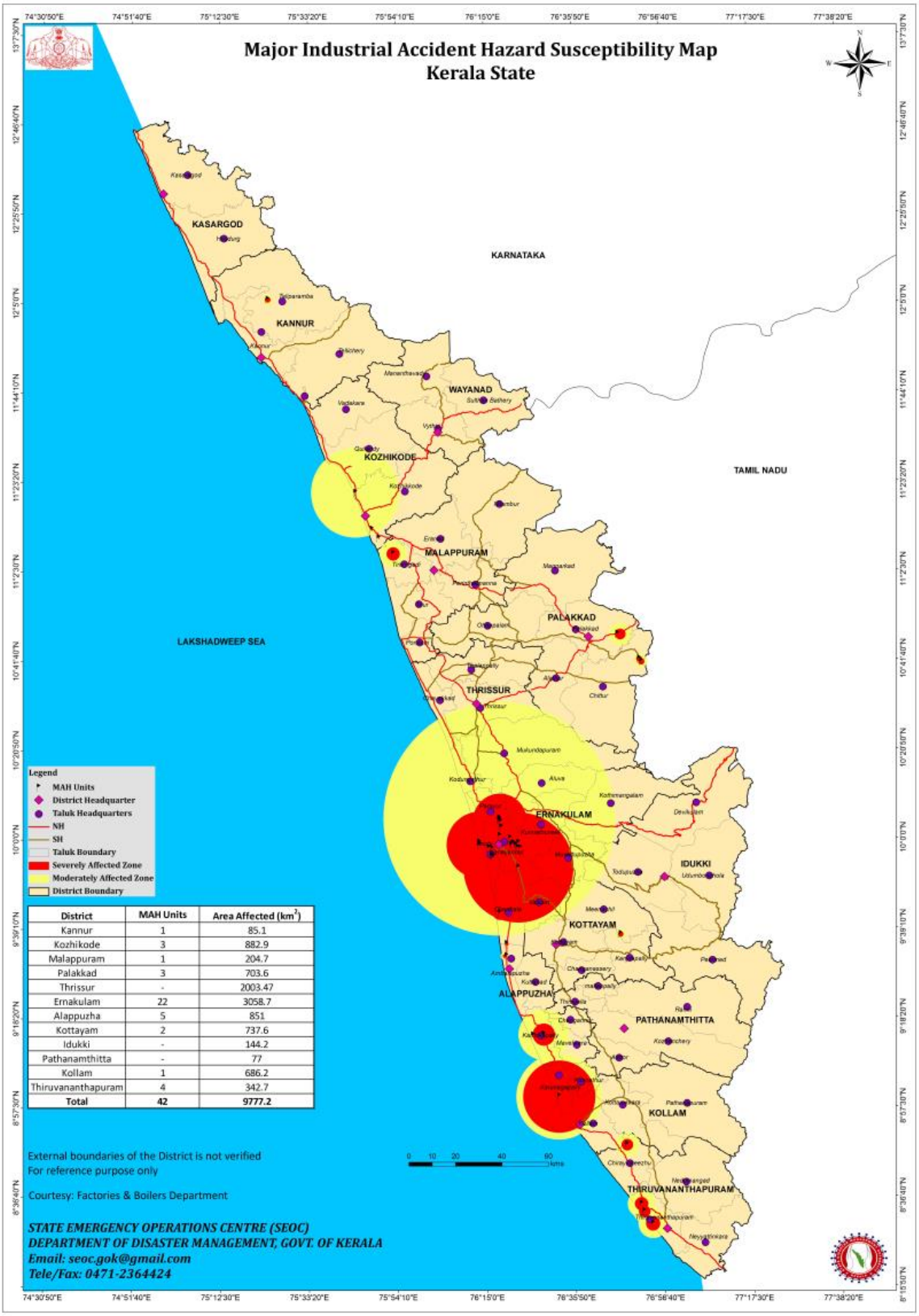
Responding forces experienced significant difficulty in ensuring prompt and efficient response primarily due to the congregation of on-looking public. In urban areas fire risk can arise from the following sources:

- Large number of closely built old timber framed buildings
- High-rise buildings with inadequate fire-fighting facilities and slums
- Commercial activities
- Small, medium and hazardous industries in suburban areas



Slno	Festival
1	Attukal Pongala, Thiruvananthapuram
2	Beemapally Urus, Thiruvanathapuram
3	Madre De Deus Church, Vettucaud Pilgrimage, Thiruvananthapuram
4	Varkala Sivagiri Pilgrimage, Thiruvananthapuram
5	Amritanandamayi Annual Congregation, Kollam
6	Nehru Trophy snake boat race, Punnamada lake, Alappuzha
7	Chettikulangara Bharani, Alappuzha
8	Arthunkal Perunnal, Alappuzha
9	Edathuva Perunnal, Alappuzha
10	Sabarimala, Pathanamthitta
11	Malanada Kettukazhcha, Pathanamthitta
12	Maramon Convention, Pathanamthitta
13	Cherukolpuzha Hindu Parishad, Ayroor, Pathanamthitta
14	Panumala Pilgrimage, Pathanamthitta
15	Manjanikkara Pilgrimage, Pathanamthitta
16	St. Alphonsa Pilgrimage, Bharananganam, Kottayam
17	Manarcad Perunnal, Kottayam
18	Malayattoor Pilgrimage, Ernakulam
19	Aluva Shivarathri Festival, Ernakulam
20	Kanjiramattom Nercha, Ernakulam
21	Thrissur Pooram, Thrissur
22	Guruvayoor Pilgrimage, Thrissur
23	Kodungalloor Bharani, Thrissur
24	Kalpathi Rathotsavam, Palakkad
25	Kottiyoor Festival, Kannur
26	Ettumanoor Aratt, Kottayam
27	Chottanikkara Magom, Ernakulam
28	Chembakulam Boat Race, Alappuzha
29	Vaikom Ashtami, Vaikom Mahadeva Temple, Pathanam
30	Aranmula Boat Race
31	St. Mary's Forane Church, Bharanaganam, Kottayam
32	Edapally Perunnal, Ernakulam
33	Sree Padmanabhaswamy Temple Arattu
34	Nenmara vallangi vela
35	Athachamayam
36	Cochin carnival
37	Karkkadaka vavu, Thiruvallam parasurama temple trivandrum
38	Karkkadaka vavu, Sankhumukham Beach
39	Karkkadaka vavu, Varkkala papanasham beach
40	Karkkadaka vavu, thirumullavaram beach, kollam
41	Karkkadaka vavu, thirunelli tmple wayanad,
42	Karkkadaka vavu, Aluva Manapuram
43	Kadamattom feast
44	Kalloorppara Perunnal
45	Koratty Feast
46	Niranam Festival

Figure 18: Major festivals in Kerala



District	MAH Units	Area Affected (km²)
Kannur	1	85.1
Kozhikode	3	882.9
Malappuram	1	204.7
Palakkad	3	703.6
Thrissur	-	2003.47
Ernakulam	22	3058.7
Alappuzha	5	851
Kottayam	2	737.6
Idukki	-	144.2
Pathanamthitta	-	77
Kollam	1	686.2
Thiruvananthapuram	4	342.7
Total	**42**	**9777.2**

Figure 19: Major industrial accident hazard susceptibility map

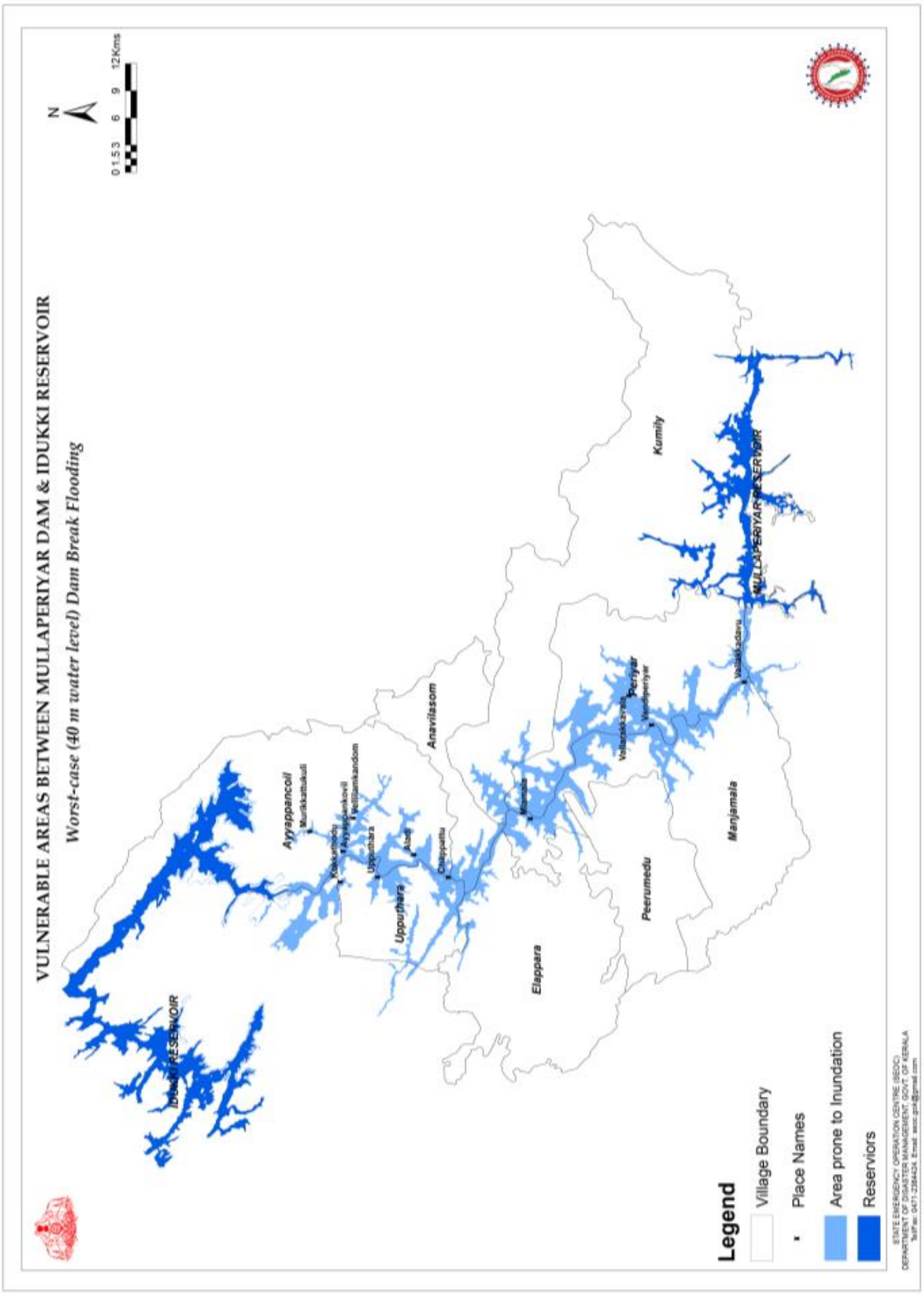


Figure 20: Dam break flood prone area between Mullaperiyar dam and Idukki reservoir

2.4.14 Terrorism, riots and Naxalite attacks

In the recent times, reports of individuals with suspected linkages to international terrorist groups have been reported from the State. Till date no terror attacks have been reported in Kerala. Communal riots occurred in many parts of the state, sporadically. Vizhinjam (Thiruvananthapuram - 1980, 1982, and 1994), Valiathura (Thiruvananthapuram - 1982), Poonthura (Thiruvananthapuram - 1970, 1978, 1980 and 1992), Marad (Kozhikode, 2002 and 2003), Thaikkal (Alappuzha - 2002), Korman Beach (Malappuram - 2002), Perumathurai (Thiruvananthapuram - 2003) were some important spots of riots. Recent events were, on 16th May 2009, 5 people were killed in police firing during the clash between the representatives of two regions and more than 30 people were injured at Poonthura, Thiruvananthapuram. Riots triggered by political outfits have also been reported from many parts of the state and have resulted in substantial number of deaths in the state.

The Naxalite movement in Kerala was inspired from the events that happened in Naxalbari village of West Bengal in 1967. Naxalite attacks in Kerala were concentrated in the northern districts of Waynad and Kannur and Calicut.

2.4.15 Building collapse

Kerala has many buildings that have exceeded their design life and which requires retrofitting. Several buildings under construction have also collapsed in the state and have caused loss of life and property. Public buildings, particularly critical facilities such as schools and hospitals are the ones to be especially cared for. Lack of proper maintenance and not following the prescribed safety procedures are the major reasons for building collapse in the state. Instances of collapse of life line buildings have not so far been reported from the state.

2.4.16 Biological accidents

Hazards from hospital wastes (tissues and body parts that are removed during surgery or autopsy) can lead to the transmission of the following diseases like, AIDS, Hepatitis B, most common bacterial infections including cholera, dysentery and typhoid, plague, tuberculosis and many parasitic infections. The presence of hazardous chemical fertilizers was detected in 15 kinds of vegetables used in day-to-day chores in the State. Poisoning due to consumption of decayed and fungal affected food is also common in the State.

During 1976-2000, the Plantation Corporation of Kerala flew some 65 sorties and aerially sprayed endosulfan, a persistent organic pollutant (POP) over an area of about 12000 acres in nine villages in Kasargod district. This was to eradicate tea mosquitoes in the cashew plantations. The people living inside the plantations and downwind and downstream of the experiment were exposed to this hazardous chemical for 25 years. Studies conducted after the ban of the pesticide show significantly higher concentration of endosulfan products in

environmental media like water, soil and lake sediments and human blood, even in a village 25 km away from the sprayed area. The government of Kerala banned the use of Endosulfan in Kerala in 2001. The Central government has banned its aerial spray. This POP is still being applied widely India and is also available in Kerala. It is strongly believed by many doctors and researchers that endosulfan enter human body from:

- mother's body to foetus via placenta– 36 weeks – Placental Exposure
- mother's milk to baby – 36 months – Maternal Milk-borne exposure
- locally grown plant and animal foods – egg, milk and meat – chronic, perennial – Food borne exposure
- water – Chronic and perennial – Water borne Exposure
- air through breathing and through skin – Few hours till the vapour remains suspended in air – short duration – Aerial Exposure

The National Human Rights Commission (NHRC) mandated the National Institute of Occupational Health (NIOH) to investigate the issue in 2001. NIOH observed that "aerial exposure" to endosulfan was responsible for delay in sexual maturity among the adolescents. In the final report submitted to NHRC and the Ministry of Agriculture, Government of India, NHRC categorically stated that they did not see any serious diseases like cancer or mental retardation in the villages they went. They recommended a detailed epidemiological study and long term monitoring for cancers of the endocrine system in the affected villages.

2.4.17 Air accidents

The presence of Thiruvananthapuram International Airport; Naval Technical Area Airport Kochi; CIAL International Airport, Kochi; Calicut Airport, Kozhikode and Kannur Airport, Kannur increases the probability of air traffic related accidents in Kerala.

The nearest to an air accident that Kerala experienced was the accident of Air India Express Flight 812 at Mangalore. Air India Express Flight 812 was a scheduled passenger service from Dubai to Mangalore, which, at around 01:00 UTC on 22nd May 2010, overshot the runway on landing, fell over a cliff, and caught fire, spreading wreckage across the surrounding hillside. Of the 160 passengers and six crew members on board, only eight passengers survived. A large number of victims were from Kerala.

2.4.18 Rail accidents

There is 1148 km railway line across Kerala. Four major accidents have occurred involving railways in the State. Twelve coaches of Thiruvananthapuram-Mangalore express derailed around 2.30 am on 28th August 2016 near Karukutty station, around 45 kms from Kochi. No casualties were reported in the incident. On 22nd June 2001, the Mangalore-Chennai mail passenger train heading for Chennai was crossing Bridge 924 over the Kadalundi river near

Kozhikode when four carriages derailed and fell into the river killing 57 individuals. On 14th May 1996, thirty-five of a marriage party was killed as bus carrying them collided with the Ernakulam–Kayamkulam train at an unmanned railway crossing near Alappuzha in Kerala. On 8th July 1998, in the Peruman railway accident, the (Train No 26) Bangalore-Trivandrum Island Express train derailed on the Peruman bridge over Ashtamudi Lake, near Perinadu, Kollam, Kerala, India and fell into the lake, killing 105 people.

2.4.19 Boat capsizing

Capsizing is when a boat or ship is turned on its side or it is upside down. One of the most remembered boat tragedy in Kerala was the one which occurred on 16th January 1924 at Pallana near Alappuzha in which the famous poet Shri. Kumaranashan died. In total 24 passengers died in the incident. Kerala has witnessed the following accidents in the recent past.

- 19-03-1980 - 30 Persons were killed in Kannamaly boat mishap in Ernakulam
- 25-09-1983 - 18 persons died when tragedy occurred while they were returning after Vallarpadam church feast in Ernakulam
- 1991 - Seven persons drowned when a boat capsized at Peppara Dam, Thiruvananthapuram
- 1992- Periyar Boat mishap in Kochi in 1992 resulted in the death of 4 passengers
- 27-07-2012 - Kumarakom boat tragedy caused death of 29 persons in Kottayam
- 30-08-2004 - 7 boat workers drowned off Kollam coast
- 02-01-2005 - 4 persons including an Arab were drowned in Vembanad lake
- 20-2-2007 - 14 students and 3 teachers were killed in Thattekkad boat accident, Ernakulam
- 30-09-2009 - 45 tourists downed when 'Jalakanyaka', a double decker boat of Kerala Tourism Development Corporation capsized in Thekkady lake at Manakkavala, Idukki district
- 26-01-2013 - 4 persons were killed when a passenger boat capsized in Punnakad in Alappuzha
- 11-06-2013 - 2 persons died when a Shikkara capsized in Punnakad in Alappuzh
- 26-08-2015 - 24 persons died in a boat accident near Fort Kochi

2.4.20 Space debris impacts

It is still not conclusive whether the fireballs seen in the sky on 27th February 2015 are human-made space debris or mid-air explosion of meteorite/asteroid. However, the possibility of such debris falling in the land area of Kerala cannot be ruled out in light of this incident.

2.4.21 Occupational hazards and recreational-area related hazards

Occupational accidents are common in the state. Separate statistics of these incidents are not readily available. Major types of events reported are, deaths due to:

- inhalation of toxic fumes from sewerage systems while entering for cleaning
- inhalation of toxic fumes from open wells while entering for cleaning
- construction site accidents

- inhalation of carbon dioxide due to burning of plastics
- accidents in mining sites
- accidents by falling into abandoned open wells
- accidents in recreational area related hazards such as those occurring in theme parks and play grounds

As recently as on 23-07-2016, in Ikkarachira, Aymanam, Kottayam an individual died due to inhalation of toxic fumes while cleaning a rainwater harvesting tank. This being a rare instance, the event is noted in this plan.

2.4.22 Accidents involving Armed Forces premises and assets

Kerala is home to the Southern Air Command, Southern Naval Command, Military Camps and arms depot of police and paramilitary forces. Although no major accidents have occurred in these premises, experience in other parts of the country indicates that such accidents may also involve civilian population living close to or commuting through such premises. Unlike events in civilian premises the nature of accidents involving the premises of armed forces are regulated by the rules and regulations of the armed forces.

2.4.23 Disasters outside State's administrative boundaries affecting Keralites

In the last 5 years, four major disasters have occurred outside State's administrative boundaries affecting Keralites, they being:

- In June 2013, a multi-day cloudburst in Uttarakhand caused devastating floods and landslides becoming the country's worst natural disaster since the 2004 tsunami. About 75 Keralites were directly affected and stranded due to the incident.
- In September 2014, the Kashmir region suffered disastrous floods across many of its districts caused by torrential rainfall. By September 24, 2014, nearly 277 people in India had died in this floods. About 576 Keralites and 75 services personal hailing from Kerala were directly affected by the floods.
- On 12th February 2015, at 7.35 am the Bengaluru-Erankulam Inter-City Express derailed near Bengaluru when the engine and eight coaches of the express train jumped the track and derailed after it left Anekal station (near Bengaluru) towards Hosur (in Tamil Nadu) on the inter-state border. The train mainly had passengers towards Kerala. The event resulted in the death of 2 Keralites.
- On 25th April 2015 Nepal earthquake (also known as the Gorkha earthquake) killed more than 8,000 people and injured more than 21,000. It occurred at 11:56 Nepal Standard Time with a magnitude of 7.8Mw and a maximum Mercalli Intensity of IX (Violent). Its epicenter was east of Gorkha District at Barpak, Gorkha, and its hypocenter was at a depth of approximately 8.2 km. Two medical doctors who went as tourists to Nepal died in the incident and one doctor was severely injured requiring evacuation via air.
- On 5th September 2016, in the latest development in Cauvery river water controversy, Supreme Court directed the Karnataka government to release 15,000 cusecs of water per day to Tamil Nadu for the

next ten days. On 12th September, the Supreme Court modified its order, and instead asked the state administration in Karnataka to release 12,000 cusecs of water on a daily basis till September 20. Widespread disorder was present in Karnataka with bandhs, road, rail, metro and air travel impacted, buses burnt, and anti-tamil violence resulting in curfew being imposed in parts of Bengaluru. Numerous Keralites who were waiting to travel to Kerala for Onam vacation got affected and stranded in the event.

2.5 Multi-hazard vulnerability of Kerala

Vulnerability is the degree of loss to a given element or set of elements-at-risk resulting from the occurrence of natural phenomenon of a given magnitude. Taluk-wise population vulnerability has been calculated from the population density of the taluks overlaid upon the hazard prone area. Based on the hazard susceptibility, multi-hazard vulnerability map of the state has been prepared using a heuristic approach and weightage approach. The method has resulted in obtaining ranks for taluks and based on the ranks, the taluks have been categorised highly vulnerable, moderately vulnerable and least vulnerable. Tables below shows the heuristic criteria used for preparing the multi-hazard vulnerability map. The multi-hazard vulnerability map is given as Figure 22.

Sl. No.	Hazard type	Susceptible area (km^2)	Vulnerable population	Weightage
1	Flood	6789.5	> 1,00,000	4
			10,000-1,00,000	2
			<10,000	1
2	Landslide	5619.7	> 1,00,000	4
			10,000-1,00,000	2
			<10,000	1
3	Coastal Hazards	289.7	> 1,00,000	Nil
			10,000-1,00,000	2
			<10,000	1
4	Drought	31877	>1,00,000	4
			10,000-1,00,000	2
			<10,000	Nil
5	Industrial Accident	7070.02	> 1,00,000	4
			10,000-1,00,000	2
			<10,000	1
	Based on the frequency of occurrence of the event			
6	Lightning & Earthquake		<1	1
			1-2	2
			2-3	3
7			3-4	4

Multi-hazard vulnerability rate	Multi-hazard population vulnerability
<10	Least
10 to12	Moderate
>12	High

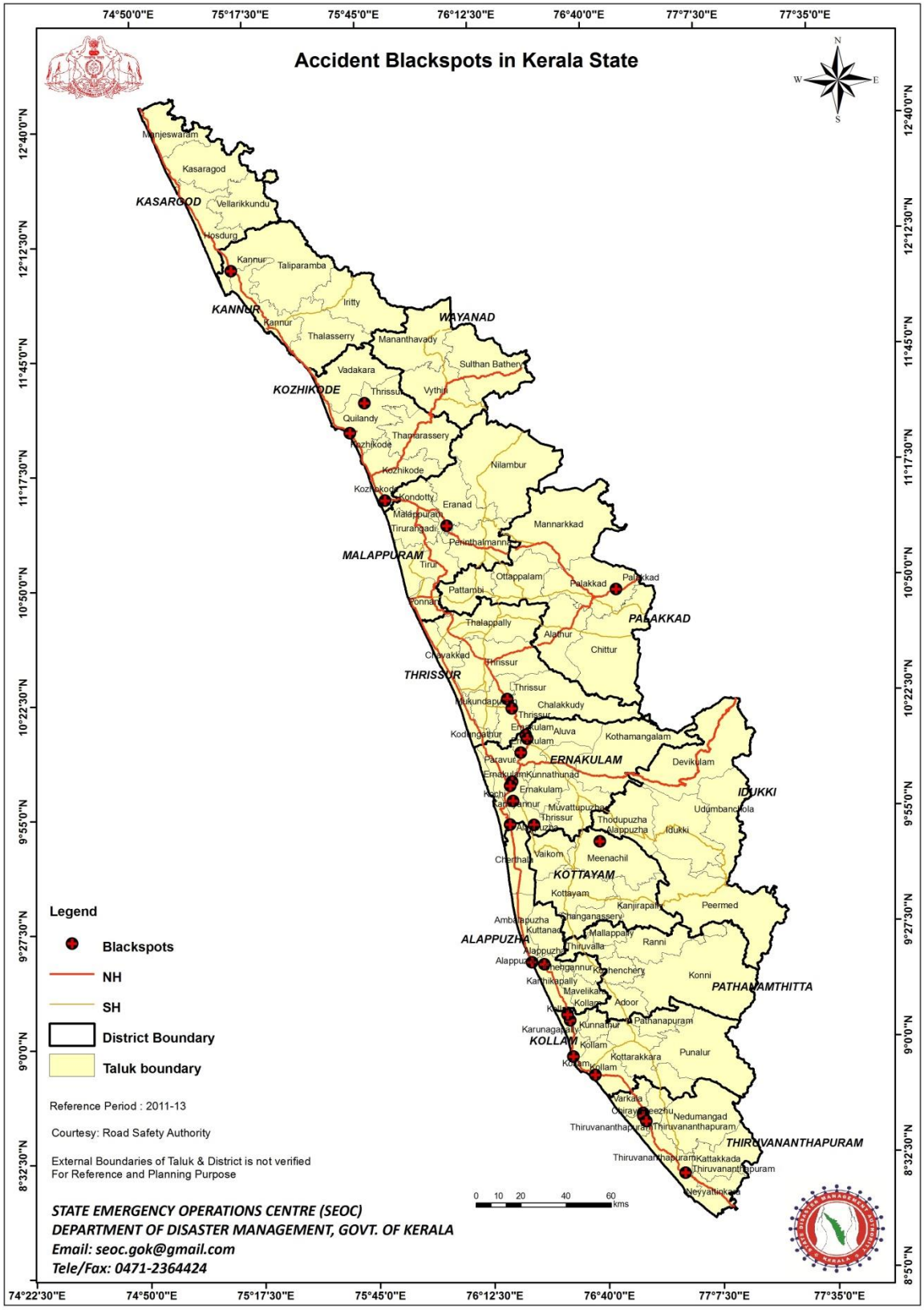


Figure 21: Black spots in the roads of Kerala

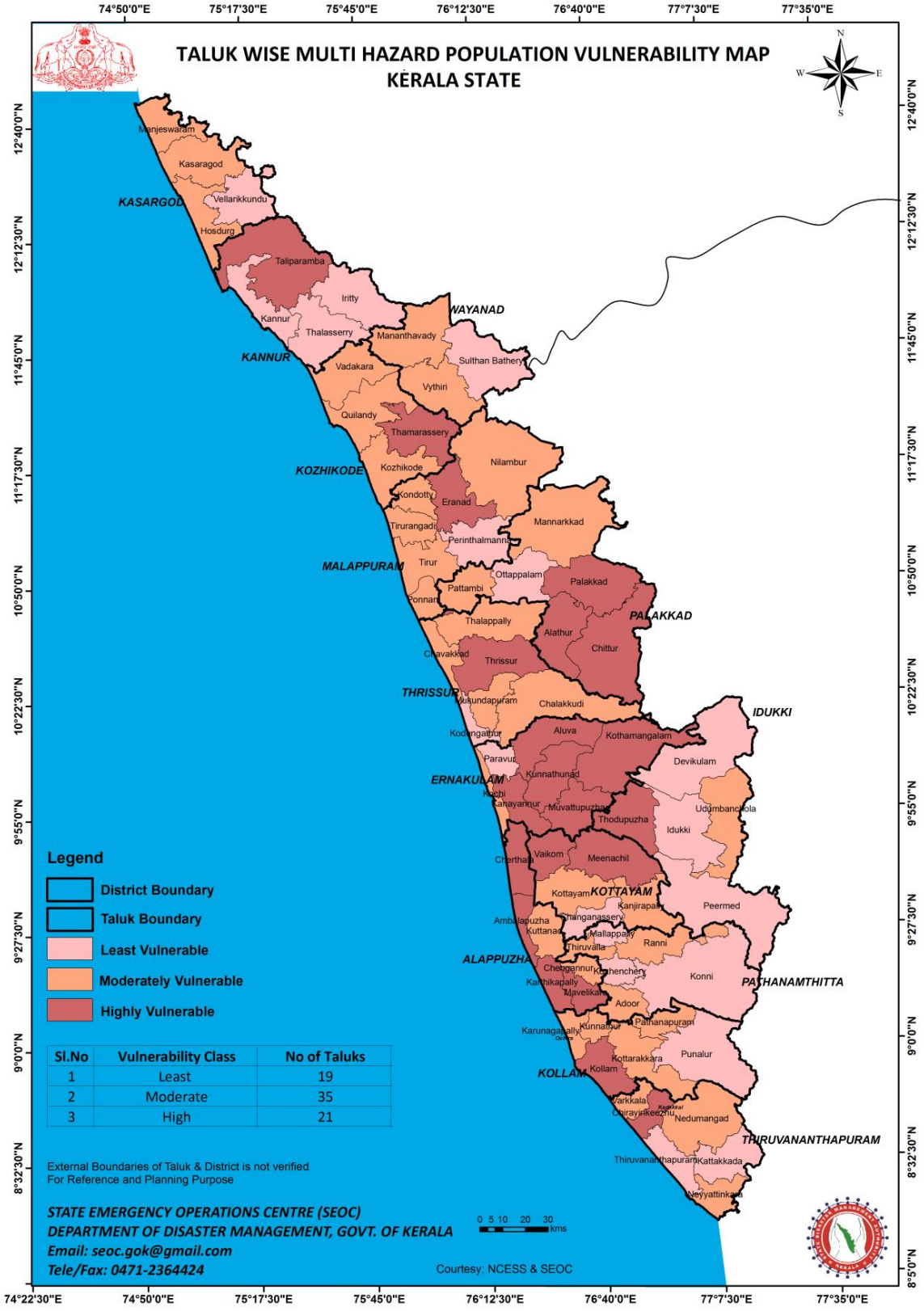


Figure 22: Multi-hazard vulnerability of Kerala

Table below shows the susceptible area and population exposure to major hazardous phenomena in the State:

Phenomena	Taluk prone	Area susceptible (km^2)	Population exposed
Landslide	50	5619.7	2799482
Flood	75	6789.5	7795816
Coastal hazards	24	289.7	313205
Major industrial accidents	40	7070	6934605

Table below shows the exposure of hospitals to various hazards.

District	Total Number of Hospitals	Flood	Landslide	Storm Surge	MAH	
					Severe	Moderate
Alappuzha	86	33	Nil	4	23	22
Ernakulam	114	33		4	68	44
Idukki	60	1				5
Kannur	103	14		1		
Kasargod	55	7		2		
Kollam	85	11		5	29	7
Kottayam	80	17			17	5
Kozhikode	91	16		2	1	34
Malappuram	119	21		3		6
Palakkad	109	13			1	1
Pathanamthitta	64	18				
Thrissur	117	13				64
Trivandrum	111	14		2	5	15
Wayanad	34	2				
Total	1228	213		23	144	203

Details of the hospitals exposed to each hazard type are given in the Annexures dealing with the vulnerability to respective hazards.

Table below shows the exposure of railway line to various hazards.

District	Total Railway Line Length (km)	Flood	Landslide	Storm surge	Tsunami	MAH	
						Moderate	Severe
Alappuzha	125	46	No Data	0.9	Nil	52	50
Ernakulam	91.3	39.5		Nil	Nil	10.57	79.6
Kannur	64	13.5		3.1	1.9	Nil	Nil
Kasargode	84.5	24.6		3.3	5.7	Nil	Nil
Pathanamthitta	8.92	5.2		Nil	Nil	Nil	Nil
Kottayam	55	19.2		Nil	Nil	4.7	14.5
Malappuram	99.7			0.61	0.57	6.1	Nil
Palakkad	160	82		Nil	Nil	11.2	26.7
Thrissur	91.1	33.98		Nil	Nil	40.4	Nil

Trivandrum	80.3	10.9		0.09	0.39	7.5	15.5
Kollam	136.8	17.7		0.2	3.7	8.4	51.5
Kozhikode	74.8	16.1		0.29	1.09	39.3	1.96
Total	1071.42	308.68		8.49	13.35	180.17	239.7

Table below shows the exposure of educational institutions to various hazards. Details of the educational institutions exposed to each hazard type are given in the Annexures dealing with the vulnerability to respective hazards.

Sl. No	District	Total Number	Landslide	Flood	MAH		Storm Surge	Tsunami
					Moderate	Severe		
1	Wayanad	472	14	55	Nil	Nil	Nil	Nil
2	Trivandrum	979	1	142	102	31	6	8
3	Thrissur	373	Nil	59	274	Nil	Nil	Nil
4	Palakkad	262	Nil	35	Nil	Nil	Nil	Nil
5	Kozhikode	495	4	119	158	Nil	2	5
6	Kasargod	553	16	77	Nil	Nil	12	13
7	Kannur	1198	19	197	1	Nil	7	10
8	Alappuzha	571	Nil	206	176	140	6	18
	Total	4903	54	890	711	171	33	54
Location data of educational institutions pertaining to remaining districts is being collected and will added subsequently to the Annexures								

Table below shows the exposure of roads to various hazards. Details of roads exposed to each hazard type are given in the Annexures dealing with the vulnerability to respective hazards.

District	Exposure of Major District Roads (km)								
	Total	Flood	Landslide			Storm Surge	Tsunami	MAH	
			Me	L	H			S	Mo
Alp	1071.1	513	0			16.5	49.75	219	335.1
Ekm	7.76	1.05						7.3	0.39
Idu	9.01	0.12	0.43						2.3
Kan	1792.65	340	74.4		25.4	7.8	3.19	3.5	10.56
Kas	1040.9	210.1	0.34	36.2	2.4	17.26	17.44		
Kol	1409.4	212.1	6.8	0.6	0.75			397	100
Kty	2144.5	368	50.5	23.5	21.2			216	200.4
Koz	1640.7	486	50.7		12.0	4.9	8.2	0.72	519.4
Mal	1656.6	221.9	16.6		2.6	2.13	13.7	12.1	64.4
Pkd	1425.5	270	10.7		11.6			9.7	13.7
Ptn	1464.1	435.5	18.7	21.8	0.96				8.4
Tvm	1679.9	226	9.7	4.7	0.14	10.7	16.65	94.1	175.2
Tsr	1.52	0.513							
Way	641.9	123.8	3.8						

Total	15985.5	3408.1	242.7	86.8	77.0	59.3	108.9	959.4	1429.8

District	Exposure of National Highways (km)								
	Total	Flood	Landslide			Storm Surge	Tsunami	MAH	
			Me	L	H			S	Mo
Alp	92.06	12.25				0.43	1.96	35	25.6
Ekm	0.86	0.86						0.86	
Idu									
Kan	76.8	9.15				1.66	1.28		
Kas	85.3	15.3				1.12	1.46		
Kol	137.9	6.69						45	13.3
Kty	51.06	6.42							
Koz	133.2	36.4	5.2		2.4	0.23	0.49	0.85	66.08
Mal	164.9	24.8					0.5	5.9	8.2
Pkd	119.45	31.5						4.6	5.3
Ptn		91.6							
Tvm	97.4	6.6						15.7	25.83
Tsr	1.93	0.04							
Way	60.67	13.2			0.001				
Total	1021.5	254.8	5.2	0	2.4	3.4	5.7	107.9	144.3

District	Exposure of State Highways (km)								
	Total	Flood	Landslide			Storm Surge	Tsunami	MAH	
			Me	L	H			S	Mo
Alp	170.8	75.6	0	0	0	1.73	7.04	11.4	46.4
Ekm	1.03	0.523	0	0	0	0	0.03	1.03	0
Idu	0.66	0	0	0	0	0	0	0	0
Kan	237.13	49.9	3.6	0	0	0	0	0	0
Kas	147.9	26.4	0	0	0.6	0.23	0.1	0	0
Kol	154.7	40.9	0.2	0	0	0	0	5.7	4.8
Kty	389.1	80.8	17	5.6	4.3	0	0	70	41.4
Koz	201.7	56.3	2.8	0	0.5	0.77	0	0	78.8
Mal	325.4	45.36	6	0	0.68	0	1	0	0
Pkd	215.8	41.3	0	0	0	0	0	3.5	5.24
Ptn	244.8	0	3.2	2.3	3.36	0	0	0	0.02
Tvm	195.6	69.9	1.9	1.53	6.12	0	0.18	4.3	6.18
Tsr	0.05	386.6	0	0	0	0	0	0	0
Way	123.2	21.8	3.9	0	0	0	0	0	0
Total	2407.8	895.4	39	0	0	2.73	8.4	95.9	182.8

District	Exposure of other roads (km)								
	Total	Flood	Landslide			Storm Surge	Tsunami	MAH	
			Me	L	H			S	Mo
Alp									
Ekm	2439.0		8.7	0.9		25.4	40.5	1244.0	1133.9
Idu	2086.2	66.4	221.3		92.9				116.3
Kan									
Kas									
Kol									
Kty	3.9	0.2	0.0					0.9	2.0
Koz									
Mal	0.1	0.0							
Pkd	3.1	1.2							
Ptn	0.0		0.0						
Tvm									
Tsr	1796.6		6.3					0.1	1028.0
Way	0.2	0.2							
Total	6329.1	68.1	236.3	0.9	92.9	25.4	40.5	1244.9	2280.2
Me: Medium; L: Low; H: High; S: Severe; Mo: Moderate									

2.6 Hazard seasonality matrix

Based on long period data of recurrence, the seasonality matrix of hazardous phenomena in Kerala is given below.

Hazard Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Flood												
Landslide												
Drought												
Heatwave/sunstroke/sunburn												
Coastal Erosion												
Wind damages												
Lightning												
Epidemics												
Earthquake												
Tsunami												
Anthropogenic hazards												

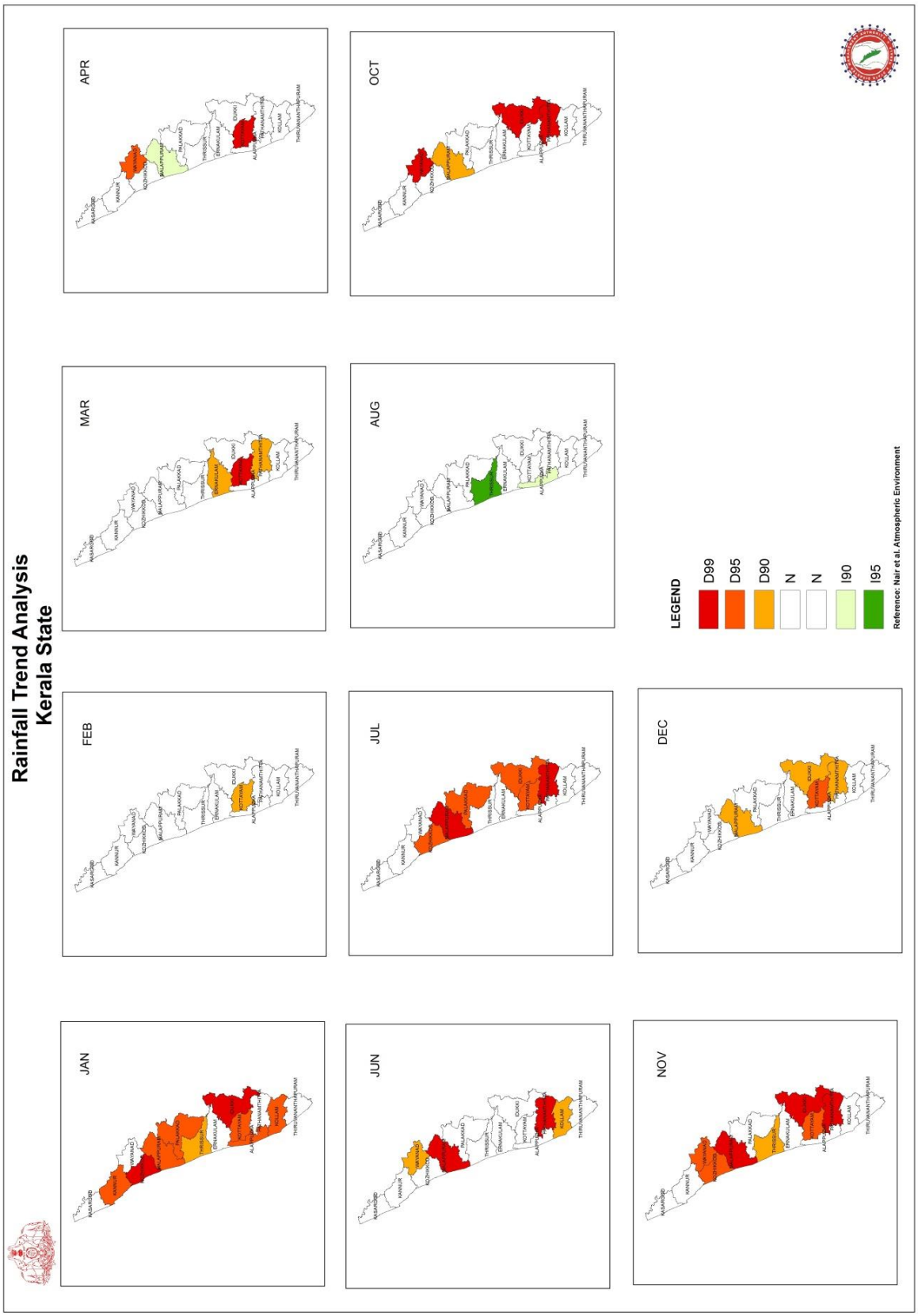


Figure 23: Rainfall trend analysis of Kerala – Climate Change Effects

2.7 Climate Change vulnerability of Kerala

It is impossible to be absolutely certain about all the disaster-related effects of climate change, owing to the intrinsic uncertainty in the climate projections, the diverse and rapidly changing nature of community vulnerability, and the random nature of individual extreme events. However, there is plenty of information on the serious impacts of events that have occurred in past decades, and on this basis alone there is much to be concerned about. The likely consequences were assessed from review of research works and are tabulated below:

Parameter	Effects
Temperature	Annual mean surface temperature increase of 0.5 to 4.5°C in 100 years expected
Precipitation	Observed decreasing trend based on rainfall data for the last 100 years; extreme events expected to increase in frequency
Wind	No reference to be found
Sea level	Estimate of sea level rise of 1.30 mm/year based on past tide gauge data. Future global projections indicate an average increase of about 4 mm/year. Sea level may rise by 15 to 38 cm by mid-21st century

Based on this inputs, the anticipated effects of global climate change in the state are as follows:

- Increase in autumn and winter season's extreme rainfall will increase the probability of urban flooding during the north-east monsoon period
- Decrease in spring rainfall would imply that the drinking water shortage faced during the peak summer (April-May) months will intensify
- Spring rainfall also has a cooling effect on the general urban temperature. The reduction in extreme rainfall during the period may increase the urban temperature and lead to intensification of urban heat-island effect. An increase in mean surface temperature by 0.5 to 4.5C may significantly increase the probability of epidemics.
- Increase in sea-level may increase the intensity and extent of coastal erosion along the thickly populated coastline of the State

Although the intensity of drought, floods and coastal erosion may increase, it is assumed that the hazard footprint may not increase beyond the worst case scenarios mapped and hence separate hazard foot print assessment in light of climate change scenarios was not conducted. Figure 23 shows the trend analysis of rainfall over the last 100 years which reveals that there is significant (99%) decreasing trend in most of the regions of Kerala especially in the month of January, July and November.

3 DISASTER PREPAREDNESS AND MITIGATION

Disaster preparedness includes all aspects covered under prevention, capacity building and mitigation which are aimed at minimizing loss of life, disruption of critical services, and damage when the disaster occurs. All preparedness measures are supported with allocation of responsibilities, budgetary provisions and guidelines. The schemes directly implemented or supported by KSDMA are detailed in this chapter. Prevention and mitigation measures are of structural and non-structural nature. KSDMA has undertaken projects covering both structural and non-structural measures for risk reduction in the State.

- Structural measures generally refer to capital investment on physical constructions or other development works. These include engineering measures and construction of hazard resistant and protective structures.
- Non-structural measures refer to awareness and education, policies, techno-legal systems and practices, training, capacity development etc.

3.1 Plans and Guidelines supporting disaster preparedness in the State

The documents that guide disaster prevention and mitigation in Kerala are:

1. National Disaster Management Plan, 2016 (NDMP, 2016)
2. 12th Five Year Plan - Disaster Management (2012-17) – Report of the Working Group - Ltr. No. 5660/2011/PPSD/SPB dated 26-11-2012
3. Kerala State Action Plan on Climate Change, 2014
4. Norms for relief assistance under National/State Disaster Response Fund approved vide GO (Ms) No. 194/2015/DMD dated 20-05-2015 (SDRF Norms, 2015)
5. Norms for relief assistance under State Disaster Response Fund for State Specific Disaster approved vide GO (Ms) No. 343/2015/DMD dated 23-07-2015 (SSDRF Norms, 2015)
6. Handbook on Disaster Management – Volume 1 – Hazard Susceptible Areas of Kerala, 2014 (HSAK, 2014)
7. Handbook on Disaster Management – Volume 2 – Emergency Operations Centres & Emergency Support Functions Plan, Kerala, 2015 (ESFP, 2015)
8. Standard Operating Procedure for Festival Disasters – Safety in Religious Mass Gatherings, 2015 (FSOP, 2015)
9. Chemical Disaster Risk Reduction Guidelines, 2012 (CDRRG, 2012)
10. Railway Disaster Management Plan, 2016 (RDMP, 2016)
11. Standard Operating Procedure for the deployment of National Disaster Response Force (NDRFSOP, 2015)
12. Crisis Management Plan 2016 (Part 1), Ministry of Home Affairs (MHACMP, 2016)
13. Manual for Drought Management, 2009, Ministry of Agriculture (MDM, 2009)

14. Compendium of laws on disaster management, NDMA, 2015
15. District Disaster Management Plans of Thiruvananthapuram, Kollam, Pathanamthitta, Alappuzha, Kottayam, Idukki, Ernakulam, Thrissur, Palakkad, Malappuram, Kozhikode, Wayanad, Kannur and Kasargode of 2015
16. Thiruvananthapuram City Disaster Management Plan, 2015 (TCDMP, 2015)
17. National Disaster Management Guidelines
    a) Prevention and Management of Heat-Wave, 2016
    b) School Safety, 2016
    c) Hospital Safety, 2016
    d) Minimum Standards for Shelter, Food, Water, Sanitation, Medical Cover in Relief Camps, 2016
    e) Management of Earthquakes, 2007
    f) Management of Tsunamis, 2007
    g) Management of Cyclones, 2010
    h) Management of Flood, 2008
    i) Management of Urban Flooding, 2010
    j) Drought Management, 2010
    k) Landslide and snow avalanches, 2009
    l) Nuclear and Radiological Emergencies, 2009
    m) Chemical Disaster (Industrial), 2007
    n) Chemical (Terrorism) Disaster, 2009
    o) Medical Preparedness and Mass Casualty Management, 2007
    p) Biological Disaster, 2008
    q) Psycho-Social Support, 2009
    r) Formulation of State DM Plans, 2007
    s) Incident Response System, 2010
    t) National Disaster Management Information and Communication System, 2012
    u) Scaling, Type of Equipment and Training of Fire Services, 2012
    v) Seismic Retrofitting of Deficient Buildings and Structures, 2014
18. Kerala Inland Vessels Rules, 2010 (amendment 2015)
19. Manual on Administration of State Disaster Response Fund and National Disaster Response Fund published by Ministry of Home Affairs, Government of India, 2013 (SDRF Manual, 2013)

These guidelines and plans form an integral part of this plan. Specific modifications and customization needed to these guidelines for pragmatic implementation in the State are decided on a case-by-case basis by the State Executive Committee of KSDMA from time to time and necessary executive orders are passed by the Department of Disaster Management (Revenue K), Government of Kerala, Government Secretariat.

3.2 Surakshaayanam 2012

Surkashaayanam was the first of its kind of event on disaster risk reduction in the State. Recognizing the fact that disasters do not limit to political boundaries and that there are numerous replicable best practices for disaster risk reduction across the country and the world, the Government of Kerala was keen to foster sharing of experience of key global and national actors through an international workshop. It was the first event wherein disaster risk reduction was dealt comprehensively from all angles. Surakshaayanam as an event had eight days exhibition of disaster risk reduction initiatives from across the world and a two day international workshop on the topic 'Disaster Risk Reduction and Contingency Planning' with the slogan 'Towards a Safer State' from March 9th to 10th, 2012, at Kanakakunnu palace grounds in Thiruvananthapuram. The National Center for Earth Science Studies was the technical advisors of the programme. The workshop was intended to make a better platform to interact and establish relationships with scientists and experts in hazards and disaster risk management from all over the world and to receive global inputs for the formulation of world standard scientific frameworks and policies to manage and reduce future disaster risks and threats. The workshop had fourty invited speakers including from countries such as Cuba, United Kingdom, The Netherlands, United States of America and Philippines. In this workshop, for the first time in the country, a state adopted a set of goals to work towards for achieving comprehensive disaster risk reduction in the State. These goals were adopted by the State as '*Statement on Disaster Risk Reduction*' adopted by the International Workshop on Disaster Risk Reduction and Contingency Planning. This statement may be found as Annexure 6. It is eight specific goals in the Statement that there after lead Disaster Risk Reduction planning in the State. The workshop paved way for the streamlining of disaster risk reduction in the State and was very crucial in ensuring that the State allocated a separate plan budget head for disaster preparedness.

With inputs from *Surakshaayanam*, the State formulated a five year plan for Disaster Preparedness. Based on the 5 year plan, specific annual plans are formulated and implemented. The major ongoing initiatives as part of disaster prevention and mitigation in the State are:

3.3 Headquarters building of Kerala State Disaster Management Authority

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 is being 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.

3.4 Information Technology and Communication Systems of SEOC

In the past emergency operation centers worked on the basis of contingency planning. Later the situation imporved to be on a fusion centre based approach wherein face to face (f – 2 – f) inputs are required for multi-domain response. In the modern day, operations are management through intelligent systems that can permit remote operators to interact and operate based on existing standard operating procedures. Table below shows the operational evolution of EOCs in that last three decades. In Kerala, the Taluk Control Rooms are operated in a contingency theory based approach while DEOCs are in a Fusion Center Based approach. The SEOC is in a transition stage between Fusion Centers and Intelligent Response. With the financial support of 13th Finance Commission Grant-in-Aid, the State Emergency Operations Centre was operationalized. The ESPF, 2015 provides the functions of SEOC in detail.

Contingency theory based	Fusion Center Based	Intelligent Response Based
No real technology needed, map, pins, paper and a phone	Representatives from different domains are located in the same place	Information from different domains solutions are integrated by an international standard
Solution is based on the skill of the operators on hand at the time on the incident	AVI and communication technology can be shared	Responses to an event can be cross referenced with additional information and resources to ensure most optimal response

Has no ability to share information unless you are in the room	Main method of communication is performed face to face (f-2-f)	Information can be readily shared with all (1st responders, DEOCs and public)
Tracking of activities steps is impossible as actions are performed without logs	Each domain has a their own closed loop system with little or no integration	Response tracking is possible in real time and for continual improvement
Overload of information can overwhelm response effort	Cross domain management must happen at f-2-f communications, which can generate misses	Predetermined standard operations procedures (SOP) can operate across domain information
Up-scaling can only be achieved by addition more physical resources but can also add to clutter	Operational response can be problematic as the responses from each domain must be synchronised via f-2-f	Intelligent response can evolve and protect against organizational memory loss
No specific method of conducting if and but analysis and support disaster risk reduction planning	With inputs from domain experts, the fusion centre based EOCs could support disaster risk reduction planning	Intelligently conduct if-but analysis and scenario analysis concurrently, in short term and long term incorporating advanced numerical models

SEOC being the nerve centre of disaster risk reduction initiatives in the state is to have a full-fledged operational decision support system (DSS) and communication system. The decision support system should integrate multi-source and multi-type inputs into a Geographic Information Systems platform for achieving the functional objectives of SEOC as laid in the ESFP, 2015. The DSS is expected to be a predictive system for climate change inclusive long term disaster risk reduction planning. It also will have an advanced call receive and computer aided dispatch facility. It offers integrated data visualization, near real-time collaboration and deep analytics that will help agencies prepare for problems, coordinate and manage response efforts and enhance efficiency of services. A similar system is implemented in the Rashtrapathi Bhavan, New Delhi and this was inaugurated by the Hon'ble President of India on 19-05-2016. However, the system in Rashtrapathi Bhavan does not incorporate the predictive models required for an SEOC.

The project was approved by the Government vide GO (Ms) No. 65/2015/DMD dated 9-02-2015 and is implemented by M/S Keltron, the State Government run Total Solution Provider with technological inputs from M/S IBM and M/S ESRI India Ltd. It is implemented in a phased manner with an

implementation time of 36 months and a continued maintenance support of 36 months for each phase.

Once fully operational, this intelligent response based system will provide scientific and integrated decision support to the State Relief Commissioner and the District Collectors in preparing and responding to various calamities in the State. The project costs ₹6.0467376 crores which is funded under the 13th Finance Commission grant-in-aid and State Disaster Response Fund.

3.5 Seismic monitoring instrumentation

Although Kerala is seismically less vulnerable to earthquakes as compared to North Indian States the presence of numerous dams makes it vulnerable to tremors that may affect the structural integrity of dams. Hence, in collaboration with Kerala State Electricity Board Ltd. the Kerala State Disaster Management Authority has implemented a digital seismic monitoring network. The instrumentation includes seismographs at Meencut, Aladi, Kulamavu, Vallakadavu, Chottupara and Idukki Arch Dam and accelerometers at Idukki Arch Dam and Vallakadavu. The data from these instruments are transmitted in near real time to the central receiving station at SEOC. Figure 14 shows the distribution of these instruments in the State. It may be noted that the network is clustered in Idukki district considering the density of lineaments and dams in the district.

This network was established for a cost of ₹3.9 crores from the State Disaster Response Fund and is managed by a three member sub-committee of SEC constituted vide GO (Rt) No. 1627/2015/DMD dated 27th March 2015.

In addition, a single non-networked digital seismograph is operated by National Centre for Earth Science Studies in the premises of Kerala Forest Research Institute which provide coverage of tremors in the northern Kerala. The Indian Meteorological Department has a broadband seismograph operational at Thiruvananthapuram. The SEC has sanctioned the purchase of an additional seismograph for deployment in Thiruvananthapuram for extending the coverage of networked seismic instrumentation to the southern districts too.

3.6 Coastal hazard monitoring system

The KSDMA has funded National Centre for Earth Science Studies for establishing a coastal hazard monitoring system vide GO (Rt) No. 4791/2015/DMD dated 14-09-2015. The instrumentation has onshore video camera and electronic display board for ocean state display. The camera telecasts information on a 24 x 7 manner to NCESS. The data is used to validate the ocean state predictions issued by INCOIS. Eventually, the system is expected to be scaled up to SEOC for continued monitoring of wave activity along the coastal areas of the State. The project costs ₹23,22,800/- and is in the final stage of commissioning.

3.7 GoI-UNDP Project on Enhancing Institutional and Community Resilience to Disasters and Climate Change (2013 –2017)

The Department of Revenue and Disaster Management, Government of Kerala had implemented Government of India (GoI) – United Nations Development Programme (UNDP) 'Disaster Risk Management Programme and the Urban Risk Reduction Programme' from January 2010 to December 2012. The UNDP DRR project was instrumental in laying the foundation stones of disaster risk reduction in the State. The project lead to the framing of KSDMPo, 2010, creation of State Emergency Operations Centre, popularizing the concept of disaster risk reduction in the state through awareness programmes, conduct of Surakshaayanam 2012 which resulted in the 'Trivandrum Statement on Disaster Risk Reduction' etc.

As a continuation of DRR & URR programmes UNDP awarded the project on enhancing institutional and community resilience to disasters and climate change. This programme provides technical support to strengthen capacities of government, communities and institutions to fast-track implementation of the planning frameworks on Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA). At national level, the project is implemented by the Ministry of Home Affairs, Government of India with technical and managerial support from UNDP. At the state level, the State Emergency Operations Centre of KSDMA is entrusted with the implementation. The project supported the development of the TCDMP 2015, the ESFP 2015, village disaster management plans in 2015. The project also supported in framing a climate change and disaster risk reduction inclusive plan for mainstreaming mitigation measures in the development plans and projects of various departments. The following programmes were conducted under this project:

2013

- Early Warning System Assessment Workshop on 19th March 2013 for various scientific, research and administrative staff. As a result of which, an Early Warning Action Plan has been prepared and published by Hon'ble Mayor, Thiruvananthapuram in the year 2016.

- Awareness workshop on landslide & climate change, jointly organized by Geological Survey of India and GoI-UNDP project.
- Programme on development of sectoral plans to mainstream DRR & Climate change adaptation in development programmes in Thiruvananthapuram city.

2014

- Community Based Disaster Risk Management Programme was organized in 56 wards of Thiruvananthapuram Corporation under this project. All these wards have Emergency Response Teams (ERT) in four various tasks i.e. First Aid, Search & Rescue, Shelter Management, Evacuation. Each ward has a Disaster Management Committee with Ward Councilor as the chairperson. Ward disaster management plans are also prepared.
- Urban community volunteers were trained on epidemic control in 40 wards of Thiruvananthapuram. ASHA workers, JPHN, Anganwadi workers were the trainees for the programme.
- Training Needs Assessment (TNA) was conducted for the health sector representing the entire medical/health practitioners of the state and a comprehensive report was prepared and handed over to the Directorate of Health Services

2015

- State level consultation on Mainstreaming disaster risk reduction & climate change adaptation was held at Thiruvananthapuram on 7th July 2015. Representatives from nodal departments of the government attended the same
- Module development and Training of Casualty Medical Officers was done for the State through Kerala State Institute of Health & Family Welfare. CMOs from 12 districts participated for this training
- Village Disaster Management Plans were prepared for Munroethuruthu & Peringara villages of Kollam and Pathanamthitta villages respectively. Communities were mobilised towards disaster preparedness along with formation of disaster management committees chaired by Panchayat President

2016

- Support of a State Project Officer and administrative expenses were provided to the State
- The SPO actively support the state in implementing the programmes of State and District Disaster Management Authorities

Table below shows the number of volunteers trained under the project in Thiruvananthapuram City Corporation:

Sl. No	Particulars	Men	Women	Total
1	Total Members attended for Awareness Programmes in all the Wards (40)	583	1325	1908
2	Total Members attended for Participatory Learning and Action	170	254	424
3	Total Members trained for all the 4 task forces	136	862	998
4	Total Members trained in First Aid	50	192	242

5	Total Members trained in Shelter Management	23	260	283
6	Total Members trained in Search & Rescue	39	187	226
7	Total Members trained in Evacuation	24	223	247

3.8 Safety in religious mass gatherings

The FSOP, 2015 is the regulating document for disaster risk reduction in festivals as approved vide Government Letter No. 25548/K2/2016/DMD dated 19-04-2016. The State Authority directly involves in the emergency preparedness of Sabarimala and Thrissur Pooram considering the number of people who congregate in these locations. These activities are funded under the 'Anthropogenic Hazard Mitigation and Management'.

At Sabarimala, the EOC is made operational during the pilgrim season at Pamba with control rooms at Sannidhanam and Nilakkal. The control rooms are interlinked with VHF radio network and hotlines to Pathanamthitta DEOC and the SEOC. Hourly accounting of incoming and outgoing pilgrims are carried out and at a given point of time if the number of pilgrims at Sannidhanam exceeds 1 lakh, the traffic to Nilakkal from neighboring districts are restricted by SEOC through the respective DEOCs. Support of NDRF is provided to Sabarimala for the conduct of Mandalapooja (approximately 15th November to 26th December) and Makaravilakku or "Makar Sankranti" (14th January).

At Thrissur, on the day of Thrissur Pooram in April, HAM Radio Operators are deployed in high-rise buildings around the region where the Firecracker Display is conducted and they are linked to the onsite EOC, the DEOC Thrissur and SEOC vide GO (Rt) No. 2296/2016/DMD dated 16-04-2016. Instances of rushing crowd or possible traffic congestion zones are monitored closely by these teams and incase of possible crisis the onsite EOC is informed by this team for crisis prevention and management. Support of NDRF is also provided for the smooth conduct of Thrissur Pooram.

The operations of EOCs at Sabarimala and Thrissur Pooram are supported by the KSDMA through its plan funds.

Support of NDRF is also availed for the conduct of 'Karkidavavubali' at Tirunavaya Navamukunda Temple, Malappuram usually in August considering the possibility of drowning.

3.9 Drought preparedness

Kerala experienced a severe drought during the period from August 2012 to May 2013. This forced Kerala to meticulously plan for drought risk reduction. Detailed drought risk reduction measures were formulated and circulated to districts and necessary funds were also released for the purpose. Even since then circulars are issued in the month of February of March for District Authorities to follow for drought risk reduction. The Government Circular No. 16789/K3/2016/DMD dated 04-03-2016 for drought risk reduction in the State clearly highlights

various replicable methods for drought risk reduction. The KSDMA as a principal does not prefer large structural interventions for drought risk reduction. Four successful schemes supported by KSDMA are highlighted for replication state wide, they being:

3.9.1 Mazhapolima – Thrissur Model

Mazhapolima is a community based roof-rainwater harvesting and open well recharge project being implemented in Thrissur district. The project works with a simple logic: harvest rainwater, channel the harvested rainwater either directly to the open well (after passing through a sand and gravel filter) or put it into recharge pits constructed next to an open well. In total 24,989 well recharge units have been implemented by Mazhapolima in the entire state. The project was funded by Kerala State Disaster Management Authority through State Disaster Response Fund and through the plan funds of KSDMA at various instances vide the following Government Orders.

Government Order	Amount
GO (Rt) No. 3298/2008/DMD dated 21-10-2008	₹1 crore
GO (Rt) No. 5708/2013/DMD dated 25-10-2013	₹2 crores
GO (Rt) No. 5634/2015/DMD dated 8-05-2015	₹1 crore
GO (Rt) No. 970/2016/DMD dated 8-02-2016	₹16 lakhs

Mazhapolima was recognized as a project for drought risk reduction vide GO (Rt) No. 5634/2015/DMD dated 8-05-2015 in all the districts through the District Authorities. Center for Water Resources Development and Management (CWRDM), an autonomous research and development institution under the Kerala State Council for Science, Technology and Environment located at Kozhikode conducted an impact assessment in the year 2011. This report makes substantial evidence for promoting this activity across the state. The analysis of the hydro-geological data generated from the study area indicates that direct well recharge by rainfall harvested from rooftops is augmenting the groundwater reservoir. The increase in utilizable groundwater potential with Mazhapolima is estimated for the sample area representing highland, midland and lowland is about 7.22, 14.08, and 43.35 Million liters respectively. The

study also indicates that the impact of direct well recharge on groundwater regime in coastal and midland region is very significant, whereas in highland region it is marginal.

3.9.2 Jalavarshini

Funded under the Natural Hazard Mitigation and Management sub-scheme of the KSDMA plan funds, the project intents to identify and provide financial support to model water conservation projects. The project funds are exclusively for structural mitigation of selected ponds in the State. State Disaster Response Fund and KSDMA Plan funds are used for this project with scientific and long manner planning. Some landmark outputs under the concept of this scheme are:

- Ente Kulam Ernakulam, 2016: Cleaned 51 ponds in various panchayaths of Ernakulam district with the help of 'Anbodu Kochi', a social media group of likeminded individuals. This may be the first scheme in the country which would have leveraged a social media group for disaster risk reduction
- Kulma Koru Biriyani Tharam scheme of Kozhikode district, 2016: Cleaned 26 ponds under this scheme

Ongoing schemes under this project vide GO (Rt) No. 5788/2015/DMD dated 4-11-2015 are:

- Rs. 25 lakhs as onetime grant from plan funds sanctioned for implementing a model drought mitigation project in Vadakarapathy panchayath, Palakkad by National Centre for Earth Science Studies, Akkulam, Thiruvananthapuram as a model project to develop a perennial fresh water source in Kerala's most drought prone area, the Vadakarapathy Panchayath
- Rs. 8.7 lakhs as onetime grant to District Disaster Management Authority, Ernakulam for the renovation of Thumbasssery chira, Mazhuvanoor Grama Panchayath, with a timeline of 1 year for implementation as per the estimates submitted by Assistant Engineer, Minor Irrigation, Pattimattom. The DDMA Ernakulam has to ensure that the continued maintenance of the pond is undertaken by the concerned Local Self Government for a minimum of 5 years with the own funds of the LSG and the pond should be used only for drinking water purposes (Priority 1) and agricultural purposes (Priority 2).

3.9.3 Minor check dams with local materials – Malappuram model

In the year 2012, the DDMA Malappuram applied a convergence of funds approach from various sources such as MGNREGA, KRWSA, own sources of panchayaths and the drought response fund from State Disaster Response Fund to create 516 minor check dams in the streams of the district. This innovative convergence resulted in ensuring that the amount of water supply through tankers in the district was bare minimum in that year which was a 100 year return interval drought year in the State. The check dams built using local materials such as sand filled gunny bags, twigs, boulders, wooden barks etc. ensure an ecofriendly approach to the entire process. These minor check dams ensured retention of water and recharge of surrounding open wells. Each check dam costed not more than ₹50,000/- including labour. Most of the check dams became permanent impediments in the river bed over a period of 1 monsoon season by siltation and thereby ensuring continued water retention. In the year 2015, with reference to GO (Rt) No. 5634/2015/DMD dated 8-05-2015, the DDMA Wayanad created 135 logwood check dams and Thrissur created 18 check dams, following the Malappuram Model

Sl. No	District	Number
1	Malappuram	516
2	Wayanad	135
3	Thrissur	18

In line with the general principle of promoting non-structural minor water conservation projects, the Authority intents to promote this successful model to other districts as well on a need basis as requested by the respective DDMAs.

3.9.4 Water Kiosks – Kannur model

In the 'urgent workshop on drought preventive measures' held on 26th December 2012 at Institute of Management in Government (IMG) organized by SEOC, considering the serious drought conditions that the state was facing in the year 2012, the concept of Water Kiosks was evolved. The idea of a water kiosk is simple – a large 5000 to 10,000 liters of PVC water tank located on a pedestal in a public area with a tap attached to it. Water to the kiosk shall be filled in them by district administration from approved water sources and a log book shall be maintained by the local ward member countersigned by the Village Officer concerned.

The concept was for the first time effectively implemented in Kannur district and hence it was projected as Kannur model vide GO (Rt) No. 5634/2015/DMD dated 8-05-2015 for wide implementation. Table below shows the number of water kiosks established in each district. All except Kannur established it in the year 2015.

Sl. No	District	Number
1	Kannur	355
2	Kasargode	1
3	Thriuvananthapuram	27
4	Kozhikode	6
5	Alappuzha	264
6	Malappuram	34
7	Ernakulam	77

This model offers the following advantages:

a) Reduce pilferage by making the water delivery locations fixed, thereby making the transportation cost fixed

b) Ensure transparency of water usage – being in public locations, the possibility of misuse of water collected from the kiosks becomes less

This method ensures that potable water is available in selected locations free of cost for the public. This model is promoted by the Authority for statewide implementation.

3.10 Mullaperiyar Crisis Management Plan

In response to the anxiety and crisis prevailing in the minds of public living between Mullaperiyar Dam and Idukki reservoir, the KSDMA initiated a project titled Mullaperiyar Crisis Management Plan. The project was approved by the Government vide GO (Rt) No. 5884/2011/DMD dated 12-12-2011 and was sanctioned ₹2 crores under the State Disaster Mitigation Fund. This project is considered a perennial one until a new dam is built. The project has three components, they being:

1. Technical Component: Under this component, following activities were done:
    a. The perimeter of the worst-case scenario d am break flood prone area as in Figure 40 were marked on the ground

b. All infrastructure, houses and people within this worst-case scenario as in Figure 20 were mapped into a Geographic Information Systems database. All evacuation routes and possible safe shelters in inundation free area were mapped into this geodatabase. The database was shared in print and in digital form with major responding forces and the district administration

2. Incidence Response System: The district, taluk and village administration were trained in IRS. Training was imparted to Revenue staff for use of VHF Radio network and repair of the VHF facilities in Idukki
3. Community based disaster risk reduction plan. Under this component, following activities were done:
   a. Grama Panchayath Disaster Management Committees were formed in 6 Grama Panchayaths that are prone to the dam break flood, they being Vandiperiyar, Upputhara, Elappara, Kumali, Kanchiyar and Ayyappankovil
   b. Four emergency response teams were formed in each panchayath and training was imparted to the volunteers with the help of National Disaster Response Force. The Emergency Response Teams formed were Alert/Warning & Coordination (468 volunteers), Search & Rescue (490 volunteers), Evacuation (430 volunteers) and First Aid (716 volunteers).
   c. Training was imparted on safe constructions for 40 engineers and masons
   d. Set of five books in Malayalam for educating students on disaster management were distributed to all schools in the region
   e. Psycho-social training was imparted in all schools of the region for ensuring that trauma related to the anxiety does not reflect in children
   f. Substantial funding was provided for purchase of emergency lighting and other emergency response facilities every year since 2011

The project also aims at developing a surveillance system for the dam structure and interlinks it with the decision support system of the SEOC and to the DEOC.

3.11 Support to Fire and Rescue Services

An amount of ₹25 crores have been allotted to modernize State Fire and Rescue services in the period from 2010-2015. Around 150 ASKA lights have been purchased for use of Police and Fire & Rescue Services. Modernization of Fire and Rescue Service is a major support item under the 10% emergency response equipment purchase fund under the State Disaster Response Fund.

3.12 Strengthening emergency response capabilities of differently abled

According to the Disability Census, 2015 conducted by the Social Justice Department 9.87 lakh households in Kerala has disabled people, which constitute 11.01% of the total number of dwellings in the state. There are 7,91,998 disabled persons in Kerala which constitutes 2.23% of the state's total population. Considering the emerging needs of people with disabilities towards disaster preparedness and response, Kerala State Disaster Management Authority (KSDMA) has approved the project titled 'Strengthening of emergency response capabilities with emphasis on differently abled people in Kerala'. The project seeks to address the issues of the people with disabilities towards disasters at the district level by training the stakeholders in First Aid, Survival Skills, Search & Rescue, Evacuation, Early Warning etc. To discuss on the approach towards the project, a consultation meeting was held on 11th May 2016 and a follow-up meeting was held on 30th June 2016 at Thiruvananthapuram. The project is funded under the Plan Budget 2015 of KSDMA and is implemented by SEOC. In the consultation held on 11th May 2016, audio brochures and brochures in Braille text have been released by the State Authority.

3.13 Soil piping research

The project intents to develop low-cost techniques for long term mitigation of soil pipping affected locations and to continuously monitor and map soil piping affected areas. The project is funded by National Disaster Management Authority. The research work is undertaken by the National Centre for Earth Science Studies and the SEOC, jointly vide GO (Rt) No. 1158/2012/DMD dated 27/02/2012. The financial support of NDMA to the project was ₹49,73,100/-. The report of the project was submitted to NDMA and to KSDMA. Considering the fact that several districts of the state are affected by soil piping and this may in long term be a cause of land degradation and desertification, it is appropriate to consider soil piping as a state specific disaster, which may be considered in the SEC.

3.14 Flood Mitigation - Operation Anantha

Operation Anantha is a flood mitigation project initiated by the District Disaster Management Authority of Thiruvananthapuram with financial support from the State Disaster Mitigation Fund. The project was triggered by Proceedings of Chairman, DDMA, Thiruvananthapuram No. H1-33275/15 (2) dated 2-05-2015 (Annexure 7). Under the first phase of the mission, 30 km of canals and storm water drains in the city had been desilted and widened

up to 3.5 meters. The project was approved by the Government vide GO (Rt) No. 178/15/DMD dated 12-05-2015. The flood mitigation measures under Operation Anantha were put to test as Thiruvananthapuram city received 66.8 mm rainfall on 17-05-2016. No water-logging was experienced at flood-prone Thampanoor and the central bus stand. Amayizhanjan canal that passes beneath the Thiruvananthapuram Central railway station sucked in maximum water due to the recent cleaning works undertaken. Numerous encroachments were evicted to implement the first phase of the project.

The project was extended to Kannur District for supporting the eviction and cleaning up of a major pond in Kannur City which is expected to substantially reduce the flooding and drought conditions in the city limits. The first phase of the project culminated on 19-05-2016 with a national workshop for sharing the lessons learned attended by dignitaries from across the country.

The Government in its budget speech in February 2016 indicated that the project will be extended to other districts with budgetary allocation as a plan scheme. Major Government orders sanctioning funds for the implementation of the project are:

Government Order	Amount
GO (Rt) No. 2687/2015/DMD dated 25-05-2015	₹5 lakhs
GO (Ms) No. 207/2015/DMD dated 25-05-2015	₹10 crores
GO (Rt) No. 6010/2015/DMD dated 18-11-2015	₹12.45 crores
GO (Rt) No. 892/2016/DMD dated 5-02-2016	₹10 crores

3.15 National Cyclone Risk Mitigation Project

National Cyclone Risk Mitigation Project is implemented in Kerala by a State Project Implementation Unit headed by the Additional Chief Secretary, Revenue and Disaster Management and the day-to-day operations are managed by a State Project Manager. The Project has three components, each funded in a separate pattern:

- Component A: Early warning dissemination systems – ₹15 crores (100% World Bank grant)
- Component B: Cyclone Risk Mitigation Infrastructure (27 multi-purpose cyclone shelters & allied roads) – ₹133.8 crores [₹100.2 crores World Bank (75%) & ₹33.6 crores State Government (25%)]
- Component C: Capacity building [Allocation not yet ascertained]
- Component D: Project Management & Implementation Support – ₹7.8 crores (100% World Bank grant)

The sites for the construction of the multi-purpose cyclone shelters have been finalized vide GO (Rt) No. 641/2016/DMD dated 28-01-2016 and the drawings of three model designs are being finalized. The project started in August 2015 and will be completed in 2020.

3.16 Disaster Management Training & Information Materials

Training to stakeholders in disaster management is imparted through the Disaster Management Centre at Institute of Land and Disaster Management and the Civil Defense Institute. The Disaster Management Centre trained over 5683 stakeholder representatives in 2015-16. Training was being conducted in the Centre since 2010. The State Disaster Management Authority through the Centre has already provided training on precautionary and preventive measures to be taken in the case of petro-chemical transportation accidents to 426 Police, Fire and Rescue Services and Revenue officials in the state. The above training yielded high results in as much as it can be seen that there is a steep declination of inferno and fatality due to BLEVE (Boiled Liquid Evaporation Vapour Explosion) in such accidents.

The Civil Defense Institute which began functioning in June 2016 has already imparted training to 60 Excise Officers in the month of July with the assistance of National Disaster Response Fund.

The Authority has published information brochures of Landslides, Lightning, Coastal Erosion, Fire Safety, Floods, Drought, Sun Burn, Cyclones, Earthquake, Chemical Accidents, Drowning and Family Disaster Management Preparedness and has circulated widely. As recently as in 2016, audio brochures and brochures in brail text have also been released by the State Authority under its scheme for ‘strengthening emergency response capabilities with emphasis on differently abled’. The Authority also regularly conducts FM Radio campaigns to educate public regarding disaster risk reduction measures. KSDMA has also published a video documentation of Operation Anantha for training young executives.

KSDMA publishes an annual calendar which provides specific precautionary measures against potential disasters based on occurrence probability in each month.

3.17 Techno-legal regime

A committee was constituted vide GO (Rt) No. 2204/2011/DMD dated 08-04-2011 (and amendments thereof) for recommending necessary amendments to Kerala Municipal Building Rules (KMBR) in tune with the Arya Committee Report of the National Disaster Management Authority. The Committee has submitted a report after detailed deliberations. The SEC, under Section 64 of the Disaster Management Act, 2005, direct the Local Self Government Department to consider amending KMBR and Kerala Panchayath Building Rules based on the findings of the

Committee, in line with the recommendations of the Arya Committee Report of the National Disaster Management Authority after further necessary consultations.

3.18 Strengthening SDMA and DDMA

Kerala is implementing the project Strengthening SDMA and DDMA GO (Rt) No. 1857/2016/DMD dated 2-03-2016. The project funded by NDMA is for a period from 2015-2017 and is worth ₹94 lakhs and provides human resource support to the States for strengthening its SDMA and DDMA. Under this project, three Hazard Analysts have been posted in the SEOC and one each in Ernakulam, Kozhikode and Thrissur District Emergency Operations Centres of DDMA's. Recruitment to the post of Hazard Analysts in Kollam, Idukki and Wayand are underway. The project is ongoing and the State has requested Government of India to permit to extend the scope of the project to all districts and for a further period of one year without any additional cost.

Funds have been allotted vide the following orders to DDMAs for various activities.

- Order No. 76/SDMA/2011 dated 22-11-2011: Rs. 16 lakhs/DDMA (to non-coastal districts – Pathanamthitta, Idukki, Kottayam, Wayanad, Palakkad)
- Order No. 195/SDMA/2012 dated 31-03-2012: Rs. 1,00,00 to DDMA Ernakulam
- Order No. 269/SDMA/2012 dated 31-03-2012: Rs. 25,000 to all DDMAs excluding Ernakulam
- Order No. 282/SDMA/2013 dated 30-03-2013: Rs. 28 lakhs/DDMA
- Order No. 326/SDMA/2013 dated 19-12-2013: Rs. 7 lakhs/DDMA
- Order No. 955/SDMA/2013 dated 24-01-2014: Rs. 50,000/DDMA
- Order No. 153/SDMA/2014 dated 31-03-2014: Rs. 10 lakhs to DDMA Thrissur for imparting swimming training

3.19 Strengthening DEOCs

The DDMAs of Pathanamthitta, Kottayam, Idukki, Wayanad and Palakkad were given ₹16 lakhs each for setting up the District Emergency Operations Centers vide Order No. 76/SDMA/2011 dated 22/11/2011 of Secretary, KSDMA. Further, funds were given vide Order No. 282/SDMA/2013 dated 30/03/2013 (₹28 lakhs/DDMA) and Order No. 326/SDMA/2013 dated 19/12/2013 (₹7 lakhs/DDMA) of Secretary, KSDMA to all DDMAs for operationalizing DEOCs as per Government Letter No. 24121/K1/2014/DMD dated 22-05-2014.

3.20 Communication systems

Under Section 22 (p) of the DM Act, 2005, it is the responsibility of the State Executive Committee to ensure fail-proof communication systems. The State Disaster Management Authority has undertaken the following projects to ensure that alternate communication systems are in place in the State to ensure critical redundancy.

3.20.1 National Disaster Management Services

NDMS is a project implemented by NDMA. It is a grant-in-aid in kind project that intents to pilot the establishment of satellite based communication network in all states. In Kerala, the project is implemented in creating satellite based communication linkages between SEOC and DEOCs of Idukki, Ernakulam and Wayanad. The instrumentation includes VSAT Connectivity, Satellite Phones, HF Radio sets and support of one technician in each location. The satellite based network is expected to provide additional redundancy in communication. The project is implemented by SEOC vide GO (Rt) No. 2203/2016/DMD dated 30-03-2016. An MoU has been entered between the NDMA and Government of Kerala on 5th May 2016 for the implementation of the project and it has a duration of 24 months.

3.20.2 VHF Radio network for Disaster Management

With the financial assistance of the UNDP and the Tsunami Rehabilitation Programme, the Dept. of Revenue and Disaster Management established a VHF radio network in the state as given in the table below. Owing to various reasons including lack of trained technical human resources in the Land Revenue Department for continued maintenance and operations, some of this equipment is presently under repair and steps have been initiated to operationalize them. Lack of proper training to the Revenue officers managing the VHF network is also a major concern.

Sl. No	Office	Number
1	State Level	4
2	District headquarters (one each)	14
3	Taluk headquarters (one each)	63
4	Vulnerable villages (VHF and public address system)	295

The Government vide GO (Rt) No. 2497/2014/DMD dated 6-06-2014 has appointed a State Nodal Officer for maintaining the VHF network of the Disaster Management Department. The State Nodal Officer is responsible for the upkeep of this network, on behalf of the SEC and to advice the Government in appropriately maintaining this communication system.

Vide Ltr. No. 24121/K1/2014/DMD dated 22/05/2014, the DDMAs have been directed by the Government to ensure the functioning of this VH network within the respective department through the Police Telecommunications wing.

- On an everyday basis, starting 8 am to 10 am, the DEOC shall contact the Taluk Control Rooms and the respective Taluks to the Villages so as to ensure that the network is functional and a report of the same shall be made available to the State Nodal Officer from the DEOC via the VHF network.
- At the district, taluk and village level, the respective responsible officers (Deputy Collector (DM)/ADM at the district level, Tahasildar at the taluk level and Village Officer at the

village level) shall check the functioning status of the VHF system in their respective office on a daily basis.

- If any instrument is not functioning, the matter shall be brought to the notice of the Police Telecommunications wing of the respective district.
- Payments for the repair shall be met from the funds allotted to the respective DDMA for strengthening emergency response capability/strengthening DEOCs.
- At the state level and at DEOCs, if the instruments are not functioning, the matter shall be informed to State Nodal Officer.
- The State Nodal Officer shall ensure that the connectivity between the state offices and the district EOCs are functional at all times for which the services of the Police Telecommunications wing shall be sought

3.21 Disaster Prevention

Based on the inputs from experts annually, monsoon and drought risk reduction circulars are issued by the State Relief Commissioner. The ESFP, 2015 and the specific circulars form integral part of this plan. The latest drought circular was issued as Government Letter No. 16789/K3/2016/DMD dated 4-03-2016 and monsoon circular was issued vide Government Letter No. 26378/K1/2016/DMD dated 05-05-2016. Specific guidelines are issued to District Disaster Management Authorities and given below for disaster risk reduction. These instructions shall be treated as a direction under Section 22 (2) (b) and strict directions for compliance shall be issued to concerned departments and local self-governments under Section 30 (2) (v) failing which actions under Section 51 (b) shall be initiated against those who are unwilling to comply.

3.21.1 Landslide risk reduction

- Developmental activities in the high-hazard zones as marked in the district wise landslide hazard susceptibility map shall strictly be regulated and restricted
- An example of restrictions that could be imposed for construction in such high-hazard zones can be found in the Proceedings of the Chairman, DDMA, Wayanad No. 2014/21178/12/H3 dated 30-06-2015 (Annexure 8). Hon'ble High Court of Kerala upheld this proceedings excluding the 'retrospective effect' part of the proceedings in order WP (C) No. 24873 of 2015 (H) dated 3rd November 2015
- Landslide SOP as given in ESFP, 2015 shall be complied with
- Creation of rain pits in slopes greater than 20° will increase the probability of landslides and hence shall be banned
- In the high-hazard zones, quarry blasting is known to increase the probability of triggering landslides. DDMAs of Kerala shall ensure that permission is not granted for quarry blasting in the landslide high-hazard zones as given in HSAK, 2014. In moderate hazard zones as given in

HSAK, 2014, quarrying shall be permitted only after getting the approval of the district level crisis management committee for mining constituted vide G.O (Rt) No. 542/14/ID dated 26-05-2014

- Quarry blasting shall temporarily be banned if there are two consecutive days of rainfall in the respective village until a completely rain free day occurs. Village Officers are specifically delegated for ensuring the implementation of this. This shall be in effect throughout the monsoon season

3.21.2 Flood risk reduction

- The Kerala Conservation of Paddy Land and Wetland Act 2008 shall strictly be implemented
- Paddy lands and wetlands are flood buffers and their protection will ensure reduction of flood magnitude
- Conservation of ponds & open wells and rainwater harvesting in slopes less than 20° will ensure reduced magnitude of floods
- SOP for various levels of rainfall as given in ESFP, 2015 shall be strictly complied with when such warnings are issued by the Indian Meteorology Department and/or other competent organizations as delegated vide ESFP, 2015
- An example of flood mitigation can be found in the Proceedings of Chairman, DDMA, Thiruvananthapuram No. H1-33275/15 (2) dated 2-05-2015 (Annexure 7). Hon'ble High Court of Kerala upheld this proceedings vide WA No. 2745 of 2015 in WP (C) 26377/2015 dated 5th April 2016

3.21.3 Drought risk reduction

- The Kerala Conservation of Paddy Land and Wetland Act 2008 shall strictly be implemented
- Paddy lands and wetlands offer sponge effects for conserving ground water and surface water
- Implementation of Jalavarshini and Mazhapolima schemes will further reduce drought risk
- Latest drought circular was issued as Government Letter No. 16789/K3/2016/DMD dated 4.03.2016 and shall be strictly complied with
- GO (Rt) No. 5634/2015/DMD dated 8-05-2015 provides specific guidelines for medium term drought risk reduction which shall be complied with
- DDMAs shall ensure that prior to issuing license for land and coastal excavation/mineral excavation/mining a No Objection Certificate of Ground Water Department is obtained so as to ensure that vadose zone [is the part of Earth between the land surface and the top of the phreatic zone, the position at which the groundwater (the water in the soil's pores) is at atmospheric pressure ("vadose" is from the Latin for "shallow")] is preserved and water table is lowered by excavations
- No Objection Certificate of Ground Water Department should be obtained for landfilling, waste treatment plants and cemetery so as to ensure that ground water is not contaminated by such activities

- Local Self-governments shall ensure that prior to sanctioning license for all ground water based industry (soda, ice, mineral water plants, flats, hollow bricks manufacturing and hotels) a no-objection certificate from the Ground Water Department is produced for tapping ground water

3.22 Towards a Safer State series of Workshops

The KSDMA conducts workshops of experts on various disaster management topics under the title 'Towards a Safer State' series of workshops. Under the scheme, KSDMA also partially supports conferences, workshops and seminars with relevance to disaster management in kind or cash. The important workshops organized are:

1. Conference on disaster preparedness organized by Kerala Institute of Medical Sciences, 18th June 2016
2. Strengthening Emergency Response Capabilities of Differently Abled, 11th May 2016
3. Tsunami Mock Drill - Stakeholders Workshop, 11th March 2016
4. Urban Flood Management – Lessons and Learnings from Operation Anantha, 19th February 2016
5. Regional training programme for NDEM South Indian Nodal Officers, 30th July 2015
6. INDIS training for southern States, 23rd to 24th July 2015
7. International Day for Disaster Risk Reduction, 13th October 2014
8. Climate Risk Management in Urban Areas through Preparedness and Mitigation, 3rd September 2014
9. Landslides & climate change, 25th August 2014
10. Incident Response System, 26th to 30th May 2014
11. National Conference for media on disaster reporting, 6th to 7th January 2014
12. Lessons learned from Uttarakand Floods, 12th September 2013
13. National Consultation Workshop on Lightning and Coastal Erosion, 14th October 2011

3.23 Training Needs

Emergency Operations Centres are unlike Police Control Rooms wherein trained human resource with a single hierarchical command and control is present. Being a facility were civil and uniformed staff work in tandem, staff of the EOC needs to be specially trained in emergency operations management. The following syllabus is identified for training the Human Resource deployed to EOCs under the ESFP, 2015.

Sl. No	Topic	Detailed Syllabus	Time
1	Disasters - General Introduction	Introduction to Disasters – L0, L1, L2, L3 – What is a disaster and what is not a disaster? Types of Disasters, Basic concepts and terminologies, Hazard, Vulnerability, Risk, disasters in Kerala, National DM Act 2005, administrative setup of disaster management in the central and state	2 hrs
2	Disaster Communication	Types of communication – VHF, SMS, Email, Telephone, FAX, Satellite Phone – clarity in messaging, message	2 hrs

		recording, message transfer to nodal departments; early warnings and competent agencies for issuing warnings; sources of warning	
3	Emergency Operations from EOC	Organizational setup of EOCs, functions of EOCs, desk operations and facilities required, rapid assessment of emergency, formats for damage reporting, rapid damage assessment, norms of SDRF/NDRF, daily reporting via email, preparation and archival of daily reports, using maps for effective disaster management, using state and district hazard maps, use of Google Earth in the event of crisis, Standard Operating Procedures, assessing hazard probability with limited data, scaling emergency levels – L1 to L3, judging the deployment of resources	4 hrs
4	Central Forces and Emergencies	Assessing the need for requisition of NDRF, Army, Navy, Air Force and other central paramilitary forces; hierarchy and command structures of central forces; interfacing district incident commander and the central forces; requisition and derequisition of central forces	2 hrs

A three day, structured training on the above is provided at SEOC and the Civil Defense Institute for DEOC staff as recommended by the respective DDMAs.

Funds were allotted vide DM2/748/2012/SDMA dated 23-01-2013 to ILDM for imparting training to engineers and masons in all districts on safe construction practices and training was imparted.

Following specialized trainings were also conducted by KSDMA:

- A detailed training need assessment (TNA) was carried out for the Medical Professionals in the State with the help of Indian Institute for Emergency Medical Services, Kottayam. Based on this TNA report, a training programme on emergency management was conducted in the Kerala State Institute of Health & Family Welfare on 21st and 22nd December 2015 for enhancing the role of medical/health professionals towards disaster related emergencies
- Basic & intermediate course on Incident Response System (IRS) for Thiruvananthapuram City Corporation was conducted from 26th to 30th May 2014 so as to equip the staff of the Corporation on emergency response
- Formation of School Safety Clubs, 10th and 11th January 2012
- Training for school bus drivers, 10th and 11th December 2011
- Safe driving – training and health camp for Government Drivers, 20th November 2011

3.24 India Disaster Resource Network

The IDRN Network of Ministry of Home Affairs, Government of India provides a platform for creating and updating district wise database of emergency response equipment. Kerala has till date uploaded information regarding 1905 equipment covering all 14 districts. The database is accessible for public at www.idrn.gov.in. SEOC has dedicated human resource with expertise in managing the IDRN platform.

3.25 National Database on Emergency Management

NDEM is a platform for organizing disaster information created and hosted by National Remote Sensing Centre at www.ndmcc.nrsc.gov.in. SEOC has dedicated human resource with expertise in managing the NDEM platform. NDEM offers a platform for updating geo-location based disaster information and cross analyzing the information against multiple layers.

3.26 Support to local bodies

Chapter VI, Section 41 (a) of makes it mandatory for all local authorities to be prepared for disaster management as per directions of the District Authorities. In order to initiate the district panchayaths and urban-local bodies of the state in disaster risk reduction initiatives, an amount of ₹57,99,000/- has been released to DDMAs vide Proceedings No. DM3/69/2016/SDMA dated 11-02-2016 of Secretary, KSDMA. The funding is to be utilized for specific purposes and illustrated in the proceedings. Necessary technical support for implementation of the scheme is provided by SEOC. Funds of upto ₹50,000/- was released to DDMA's vide Order No. 955/SDMA/2013 dated 24-01-2014 for capacity building of Panchayaths.

3.27 Mock Drills

Kerala, for the first time ever conducted a state wide Tsunami Mock Drill exercise on 11th March 2013. Staff of Revenue, Police, Fire and Rescue Services, Health, Army, Navy, Air Force, Coast Guard, Indo-Tibetan Boarder Police and Coastal Police participated in the programme that covered 9 coastal districts of the State. The scenario simulated was a 9M earthquake with origin off the coast of Pakistan causing a maximum wave run-up of 3 m along the coast of Kerala. A second Tsunami Mock Drill is planned in the month of September.

Funds of upto ₹25,000/- were released to each DDMA excluding Ernakulam vide Order No. 269/SDMA/2012 dated 31-03-2012 and ₹1,00,000/- was released to DDMA Ernakulam vide Order No. 195/SDMA/2012 dated 31-03-2012.

On 14th October 2012 a fire mock drill was conducted in the South and South-sandwich blocks of Government Secretariat as part of the International Day for Disaster Risk Reduction.

Kerala has prepared and submitted a Mock Drill Calendar to NDMA for financial support in the year 2016-17 which is given below:

Sl. No	Type of Disaster	District	Date & Month
1	Forest Fire	Wayanad	April 22nd
		Kozhikode	April 25th
		Palakkad	April 27th
		Thrissur	April 29th
2	Rough sea/Rescue mission connected	Kasaragod	June 1st

	with drowning	Thrissur	June 10th
		Alappuzha	June 15th
		Thiruvanathapuram	June 26th
3	Landslide	Kannur	June 3rd
		Wayanad	June 6th
		Kozhikode	June 8th
		Kottayam	June 17th
		Pathanamthitta	June 21st
		Idukki	June 23rd
4	Flood/Rescue mission connected with drowning	Thrissur	June 10th
		Ernakulam	June 13th
		Alappuzha	June 15th
		Pathanamthitta	June 20th
		Thiruvananthapuram	June 25th
5	Tsunami	Kannur	June 4th
		Ernakulam	June 13th
		Kollam	June 27th
6	Earthquake	Thrissur	December 15th
		Idukki	December 28th
7	Tanker Lorry Accidents	Kasaragod	December 1st
		Kannur	December 3rd
		Kozhikode	December 6th
		Malappuram	December 9th
		Thrissur	December 15th
		Ernakulam	December 17th
8	Fire Accidents (F)/Road Accidents (R)/Stampede (S)	Kasaragod (F & R)	December 1st
		Kannur (F & R)	December 2nd
		Wayanad (F & R)	December 5th
		Kozhikode (F & R)	December 6th
		Malappuram (F & R)	December 8th
		Palakkad (F & R)	December 13th
		Thrissur(F & R)	December 16th
		Ernakulam (F & R)	December 19th
		Alappauzha (F & R)	December 21st
		Kottayam (F & R)	December 22nd
		Idukki (F & R)	December 27th
		Pathanamthitta (F & R)	December 29th
		Kollam (F & R)	December 31st
		Thiruvananthapuram (F & R)	January 3rd, 2017

3.28 Strengthening State Disaster Relief Force

In the meeting held on 26th December 2013, the State Executive Committee had decided that Home Department shall:

- Issue orders for renaming the State Disaster Relief Force [constituted as per GO (Ms). No. 262/2012/Home dated 17-10-2012] as State Disaster Response Force in line with the national nomenclature [Orders for renaming was issued vide GO (Rt) No. 2421/2013/Home dated 31-08-2013]. SDRF shall be stationed in 3 locations in Kerala and each team shall have specific districts assigned to them to respond in the event of disasters. The team stationed in each zone shall respond to the call of the district collectors of the respective zones
- At the state level, the Additional Chief Secretary, Home shall directly supervise the SDRF in his/her capacity as Member, State Disaster Management Authority
- The SDRF shall be a dedicated force for Disaster Response and the personal of SDRF shall not be utilized for routine activities of the State Police
- Vide GO (Rt) 5240/2014/DMD dated 30-10-2014 an amount of ₹1.83 crores was released to SDRF for training and training equipment purchase

3.29 Observance of International Day for Disaster Risk Reduction

Kerala observes International Day for Disaster Risk Reduction (IDRR) every year on 13th October. KSDMA had instituted awards for media personnel for disaster preparedness reports in the years 2011 and 2012. State wide quiz, photo exhibitions, painting competitions for school students are conducted as part of the observance programme. Magic shows and specialized workshops for stakeholders are conducted as part of IDRR celebrations based on the theme of the IDRR of the respective year under the ***Step Up*** initiative. The themes based on which programmes were conducted are:

- 2011: Making Children and Young People Partners for Disaster Risk Reduction
- 2012: Women and girls, the (in)visible force of resilience
- 2013: Living with Disability and Disasters
- 2014: Resilience is for life
- 2015: Knowledge for life
- 2016: Live to tell

4 MAINSTREAMING DISASTER MANAGEMENT

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.

Another source of funding for mainstreaming disaster management is the 10% flexi funds of Centrally Sponsored Schemes for Disaster Preparedness in the respective sector approved vide Ltr. No. 47-38/2011-DM-III dated 11th March 2016 from Ministry of Home Affairs, Govt. of India (Annexure 10). In the present scenario of the State, funding as stipulated under Section 30 (c) does not feature in the development plans of the respective departments.

Hence, it is directed under Section 22 (2) (h) of the DM Act, 2005 that:

1 No structural development plans in the State shall be approved without consideration of the hazard prone area maps published by SEOC

2 All departments shall allocate 10% of their annual plan budget for disaster preparedness, response, recovery and mitigation in their respective sectors

3 It is often noticed that there is inadequate funds for retrofitting and maintenance of lifeline buildings. It shall the responsibility of the respective department to apply science and technology and engineering inputs to improve infrastructures including dams and reservoirs, hospitals, schools and bridges in the State. Funds allocated under clause (2) may be utilized for this purpose

4 It shall be the responsibility of the local self-governments to ensure that all private buildings in their jurisdiction are disaster resilient and have been constructed following all required safety considerations under Kerala Municipal Building Rules and Kerala Panchayath Building Rules.

In order to achieve this goal, the Government of India has revised the formats for pre-approval from Expenditure Finance Committee (EFC) and preparing the Detailed Project Reports (DPR) for financial assistance from Government of India.

A similar approach is being adopted for Kerala. The following checklist shall be filled and enclosed along with new scheme for plan funding under the State budget.

Activity	Responsibility	Yes/No
Have the multi-hazard susceptibility of the location/area of project implementation been ascertained	Concerned department in consultation with SEOC	Yes/No
Have the vulnerability assessment of the project (damage that can be caused to the project by natural disasters, design of the project that could accentuate the vulnerability of the area to disasters and/or lead to rise in damage/loss of lives, property, livelihood and surrounding environment) been undertaken		Yes/No
Whether the design and engineering of the structure has taken into consideration the National Building Code 2005, the appropriate BIS Codes, other applicable sources as per the type of the project and the NDMA guidelines (Refer Section 3.1 (16) for NDMA guidelines)	Local Self Government, Fire and Rescue Services and Line Department	Yes/No
Ascertain whether the department has allocated funds under Section 39 (c) of DM Act, 2005 and as given in Chapter 4 (4) of this document	Planning Board and Finance Department	Yes/No

A separate checklist for detailed natural disaster impact assessment is given in Annexure 11.

5 RESPONSIBILITIES OF STAKEHOLDERS

Section 38 and 39 of the DM Act, 2005 enlists the responsibilities of the State Government and the Departments of the State Government. All departments shall ensure that their departmental disaster management plans are submitted to KSDMA for approval within 3 months of approval of this plan.

5.1 Nodal departments and their disaster specific roles

Table below shows the nodal departments that will be responsible for each hazardous phenomena/event. These nodal departments shall prepare the Departmental Disaster Management plans. The departmental disaster management plans should address the preparedness, response, recovery and mitigation strategies of phenomena that may turn disastrous as identified under Section 2.2.

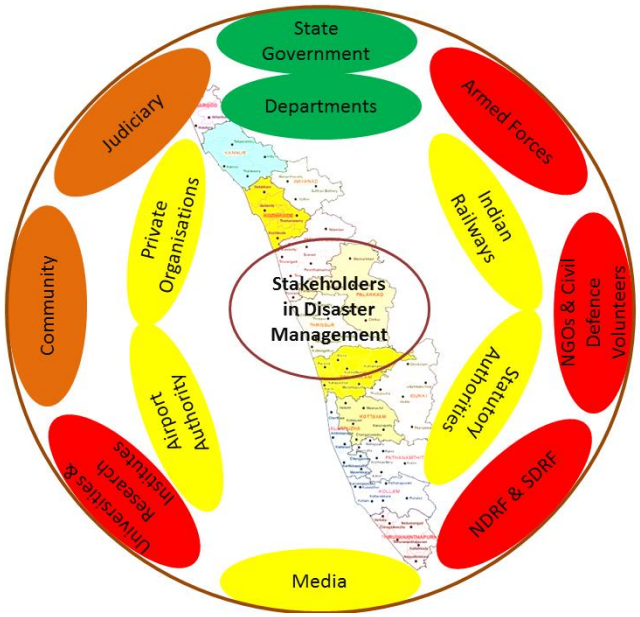
Sl. No	Category	Type	Preparedness	Response	Recovery	Mitigation
1	Natural Hazards	Flood	WR	LR	LR	WR
2		Landslides	LSG	LR	LR	LSG
3		Drought	WR	LR	LR	LSG & Agri
4		Coastal hazards	WR & Fi	LR & Fi	LR & Fi	WR & Fi
5		Wind	LSG	LR	LR	LSG
6		Lightning	LSG	LR	LR	LSG
7		Earthquakes	LSG	LR	LR	LSG
8		Human epidemics	HS	HS	HS	HS
9		Plant disease epidemics and pest attack on crops	AGD	AGD	AGD	AGD
10		Avian epidemics	AH	AH	AH	AH
11		Animal epidemics	AH	AH	AH	AH
12		Pest attack of human habitations	AGD	AGD	AGD	AGD
13		Forest Fire	FD	FD	FD	FD
14		Meteorite/asteroid impacts	LR	LR	LR	LR
15		Soil Piping	LSG	LR	LR	LSG
16		Heat wave/sunburn/sunstroke	LR & LD	HS	HS	LR & LD
17		Natural background radiation	HS	HS	HS	HS
1	Anthropogenic Hazards	Stampedes	P	P	P	P
2		Fire cracker accidents	LR & P	P & FS	P & FS	LR
3		Petro-chemical transportation	P & OC	P & OC	P & OC	P & OC

		accidents				
3		Industrial accidents	PB & FB	PB & FB	PB & FB	PB & FB
4		Dam break	KSEB & WR	KSEB & WR	KSEB & WR	KSEB & WR
5		Dam spillway operation related floods & accidents	KSEB/WR	KSEB/WR	KSEB/WR	KSEB/WR
6		Oil spill	PCB, OC, OHA	PCB, OC, OHA	PCB, OC, OHA	PCB, OC, OHA
7		Road accidents involving civilian transport vehicles	P	P	P	P
8		Human induced forest fire	FD	FD	FD	FD
9		Human-animal conflicts	FD & LSG	FD & LSG	FD & LSG	FD & LSG
10		Fire accidents in buildings and market places	LSG & FS	LSG & FS	LSG & FS	LSG & FS
11		Boat capsizing	TD, IND & KWTC	TD, IND & KWTC	TD, IND & KWTC	TD, IND & KWTC
12		Accidental drowning	SYW & TD	FS	FS	SYW & TD
13		Building collapse	LSG & PWD	FS	FS	LSG & PWD
14		Hooch accident	E	E	E	E
15		Air accidents	AAI	AAI	AAI	AAI
16		Rail accidents	IR	IR	IR	IR
17		Terrorism, riots and Naxalite attacks	P	P	P	P
18		Nuclear and radiological accidents	RS & BARC	RS & BARC	RS & BARC	RS & BARC
19		Space debris impacts	P	P	P	P
20		Biological accidents	HS, FSa	HS, FSa	HS, FSa	HS, FSa
21		Occupational hazards and recreational-area related hazards	LSGD, LD & TD	LSGD, LD & TD	LSGD, LD & TD	LSGD, LD & TD
22		Accidents in Armed Forces premises and assets	AF	AF	AF	AF
Disaster occurring outside the state's administrative boundaries in which tourists from Kerala of non-residential Keralaites are affected			SDMA of the Respective State and NORKA		As decided by SEC or KSDMA	
AAI: Airport Authority of India; AF: Armed Forces (Indian Army, Navy, Air Force, Coast Guard, Indo-						

Tibetan Board Police, Central Reserve Police Force; Defence Security Corps); AG: Agriculture Department; AH: Animal Husbandry; BARC: Baba Atomic Research Centre; E: Excise Department; FB: Factories and Boilers Department; FD: Forest Department; Fi: Fisheries; FS: Fire and Rescue Services; FSa: Food Safety; HS: Health Services; IND: Inland Navigation Department; IR: Indian Railway; KSEB: Kerala State Electricity Board Ltd.; KWTC: Kerala Water Transport Corporation; LD: Labour Department; LR: Land Revenue Department; LSG: Local Self-Government; P: Police; WR: Water Resources Department; OC: Oil Companies; OHA: Oil Handling Companies; PCB: Pollution Control Board; PWD: Public Works Department; RS: Radiation Safety Department; SYW: Sports & Youth Welfare Department; TD: Tourism Department

KSDMA will ensure that all concerned departments in the State prepare and publish their departmental disaster management plans in line with the State plan in the financial year 2016-17.

5.2 State Government



- The State Government shall ensure that Chapter 4 of this plan is scrupulously implemented
- Specific budgetary heads of accounts are made available to all departments for allocating funds for disaster management as per Section 39 (c) of DM Act, 2005 which amounts to at-least 10% of the department's annual plan budget
- According to KSDMR 2007, the term of the non-*ex-officio* members in the Authority are for a period of 3 years
- State Government shall ensure that vacancy in the Authority is for not more than 2 months from the date of expiry of the term of an *ex-officio* member
- Ensure that all relief assistance under State/National Disaster Response Fund is directly credited to beneficiary account
- The State Government shall ensure that there is a professionally trained virtual cadre of officers in all the departments of the State for disaster management

5.3 Virtual cadre for Disaster Management

- The State shall have a virtual cadre for Disaster Management. The virtual cadre will principally be 15 selected individuals (one each in each district and one in the State

level) with at least 20 years more of service left. The members of this virtual cadre shall be the departmental nodal officers for disaster management who shall be as individuals responsible for supporting the district and state disaster management authorities in disaster management

- The KSDMA will ensure that these individuals are adequately trained in matters related to disaster management
- The concerned department shall ensure that no two officers of this virtual cadre are posted in the same district (except in the case of Thiruvananthapuram where there can be the State Nodal Officer and the District Nodal Officer). These officers shall be trained in rapid damage assessment and certification in the respective sector
- The disaster-specific nodal departments through this virtual cadre will ensure liaison and coordination with KSDMA and DDMAs in the smooth implementation of the departmental disaster management plan and with SEOC and DEOCs for ensuring coordinated response to events
- All departments are hereby directed under Section 22 (2) (h) of the DM Act, 2005 to select and intimate the members nominated to the virtual cadre
- State Government shall issue an executive order under Section 16 of the DM Act, 2005 formalizing the virtual cadre once the selection list is approved by the SEC
- Being in the virtual cadre do not entitle the members for any additional remuneration or allowance
- The appointment shall be purely on voluntary basis
- The Head of the Department of the respective department or the KSDMA or the Government will have full freedom to delist any individual from the virtual cadre

5.4 Land Revenue

- Land Revenue Department is specifically the nodal department for handling natural disasters. Hence the departmental disaster management plan of Land Revenue Department should have natural disaster preparedness, response, recovery and mitigation plans
- It is the nodal department for controlling, monitoring and directing measures for organizing rescue, relief and rehabilitation
- It is the lead department in running the District Emergency Operations Centres and hence the department has to ensure that the DEOCs are manned 24 x 7 by a personnel of the department
- Ensure that the disaster management VHF network of the districts are functional

- At the district level the District Incident Commander is the District Collector, at the Taluk Level the Responsible Officer will be a Deputy Collector assigned by the District Collector and at the Village Level the Responsible Officer will be the Village Officer
- Land Revenue Department handles relief assistance to calamity victims since time immemorial. Hence it is the Land Revenue Department which has to develop the minimum relief code of the State. Technical Assistance of SDMA will be made available to Land Revenue Department for undertaking and constantly updating the minimum relief code
- Ensure updating of IDRN platform at least once in 3 months with information regarding the status of resources of the department
- Identify and map locations of mass burial of dead bodies in each Taluk

5.5 Home – Police, Fire & Rescue Services and State Disaster Relief Force

- Ensure that all DEOCs in the State are manned 24 x 7 by Police and Fire and Rescue Services personnel with access to Police VHF network
- Ensure proper functioning of all equipment and vehicles under Police, Fire & Rescue Services and State Disaster Relief Force
- Ensure that 100 trained men of SDRF with adequate resources are available exclusively for disaster response at all times. In peace times, the SDRF shall be utilized for training of Home Guards, Volunteers and Student Police Cadets in Disaster Response
- Ensure that Fire and Rescue Services is fully manned and that they are not short of any emergency response equipment. In peace times, the Fire and Rescue Services personal shall provide training of Home Guards, Volunteers and Student Police Cadets in Disaster Response
- Prepare for quick deployment of Home Guards and volunteers for providing safety to affected population and evacuated structures/houses
- Train uniformed personnel, staff, Home Guards and Student Police Cadets in first aid and basic life support systems
- Prepare communication plan for uninterrupted communication to all DEOCs, police posts and various control rooms across the state
- Ensure proper maintenance and functioning of all fire-fighting equipment and personal protection equipment
- Ensure updating of IDRN platform at least once in 3 months with information regarding the status of resources of the department
- Prepare a database of private fire-fighting agencies and their resources

- Keep vigil regarding MAH units and other hazardous installations in the state and prepare for possible emergency situation

5.6 Agriculture

- Monitor the drought, floods and pest attack prone areas and monitor them during vulnerable season
- Map plant disease prone areas
- Ensure a proper mechanism for communicating early warning to farmers regarding rainfall, flood, droughts, cyclone, etc.
- Ensure popularity of various crop insurance schemes of Government of India amongst farmers
- Ensure speedy damage assessment through the members of the virtual cadre and fast release of funds

5.7 Water Resources Department

- Ensure proper early warning mechanism for flood by monitoring water level of surface water bodies
- Ensure proper and timely inspection of conditions of sea walls, bunds, embankments, inlet and outlets of lakes, drains, channels and pump houses and ensure adequate repair
- Ensure proper functioning of all equipment including dewatering pumps
- Prepare for arrangement of safe drinking water supply for community in the affected areas, relief camps and shelters
- Prepare for prompt repair of pipelines supplying potable water
- Ensure availability of adequate number of water tankers, drums, jerry cans or identify their private suppliers to prepare for supply of water, in scarcity period and in emergency
- Ensure availability of water supply/filling points for fire tenders, water cannons, hospitals and other necessary lifesaving infrastructure
- Ensure adequate sand filled gunny bags for immediate and temporary repair of sea walls, bunds and polder walls
- Ensure that ground water extracting industries reduce the extraction by at least 50% during the peak summer months of March, April and May
- Ensure that No Objection Certificate of Ground Water Department is obtained for landfilling, waste treatment plants and cemetery so as to ensure that ground water is not contaminated by such activities

5.8 Animal Husbandry

- Map animal and avian disease prone areas
- Identify sources for emergency procurement of fodder, feed, water and medicines prior to monsoon season and disease prone seasons
- Ensure rate contracts for fodder, feed, water and medicines prior to monsoon season and disease prone seasons
- Identify and map safe locations for cattle and poultry camps in flood prone areas
- Ensure proper administration of deworming and vaccinations for cattle, sheep and goats, pigs and other relevant measures for disease management in cattle camps
- Identify and map locations for burial of carcases

5.9 Information and Public Relations Department

- Conduct regular training programmes for media on disaster management
- Ensure coverage of disaster risk reduction measures in Government publications
- Ensure accurate and controlled information dissemination in the event of major disasters as determined by the State/District Incident Commanders
- Ensure accurate communication of the reconstruction and rehabilitation measures being taken by various stakeholders
- Communicate with the affected communities with a view to appraising them of efforts being made for their relocation/rehabilitation/ reconstruction
- Using the communication network to get feedback on reconstruction and rehabilitation measures

5.10 Pollution Control Board

- Develop an oil spill contingency plan involving Coastal Police, Ports, Fisheries, Coastal Shipping & Inland Navigation Departments and Tourism Department and submit to KSDMA for approval

5.11 State Environment Impact Assessment Authority

- Ensure that disaster management plans and hazard susceptibility maps are consulted and adequate risk reduction measures are incorporated into project proposals, prior to issuing environmental clearance

5.12 Coastal Zone Management Authority

- Strictly implement the Coastal Regulation Zone Act, 1991
- Ensure implementation of coastal protection measures by concerned departments
- Promote bio-engineering and soft solutions for coastal protection

5.13 Environment and Climate Change Department

- Ensure that Environment Relief Fund under Section 7A of the Public Liability Insurance Act, 1991 (amendment 1992) is created and Section 11 of the Act is complied with
- Increase and protect mangrove cover
- Increase and protect green cover along the coastline and river banks
- Promote climate risk insurance
- Provide localised projections of the implications of climate change in rainfall, temperature, humidity, wind speed and wind direction
- Ensure the implementation of the Kerala State Action Plan on Climate Change, 2014

5.14 Education Department (Collegiate, Vocational, Higher Secondary, General, SCERT, Universities, Medical, Engineering)

- Attempt to incorporate subject wise and general concepts of disaster risk reduction in the curriculum and syllabus from lower primary to professional education
- Organise camps in school and colleges for awareness of dos and don'ts of possible hazards in the state
- Ensure preparation of school disaster management plans and first aid kits in all schools and colleges
- Facilitate and conduct mock drills in collaboration with Fire and Rescue Services and DDMAs
- Facilitate basic life support and first aid training in collaboration with Sports and Youth Affairs Department
- Identify safe schools and colleges which can be used as relief shelters for short duration of time in the aftermath of any disaster and communicate it to DEOCs and SEOC
- Ensure that vulnerable schools and educational institutions as identified in the vulnerability assessment annexures are made disaster resilient

5.15 Food and Civil Supplies, Supply Co, Consumer Fed and Horti Corp

- Department of Civil Supplies, Supply Co and Consumer Fed shall arrange calamity reserve stocking of rice (100 kg), cereals (two kinds; 50 kg each), cooking oil (10 lts) and kerosene (75 ltrs) per taluk and the provisions shall be made available to any location within the district as per the direction of the District Collector
- Horti Corp shall ensure necessary vegetable supply to the camps
- Additional supplies shall also be arranged in short notice

- Civil Supplies Department shall ensure that LPG and Kerosene required for operating the relief camps are provided as per need without any hindrance to the DDMA as per demand
- Food Safety Commissionerate shall ensure preparedness, response, recovery and mitigation plans for addressing mass food poisoning

5.16 Factories and Boilers Department

- Ensure than CHEMREC has necessary facilities for industrial and chemical emergency response
- Ensure that CHEMREC has a modern emergency response vehicle for handling industrial accidents
- Ensure that CHEMREC has necessary trained human resource to handle industrial and chemical emergency response
- Ensure that onsite and offsite emergency response plans for MAH units are prepared, updated every year and submitted to the respective DDMA for approval
- Prepare a database of suppliers/manufactures of antidotes for hazardous chemical and enter into annual rate contracts for ensuring emergency supplies

5.17 Fisheries Department

- Prepare a contingency plan for in sea accidents of fishermen in consultation with Land Revenue, Coastal Police, Coast Guard, Navy and Police
- Create a mass messaging facility for dissemination of warnings issued by KSDMA, INCOIS, IMD etc. to all sea faring fishermen
- Develop early warning in all harbours based on colour flags and display boards for informing sea state to fishermen, in collaboration with INCOIS

5.18 Chemical Emergencies Response Centre (CHEMREC)

The Chemical Emergencies Response Centre (CHEMREC), Kochi under the Department of Factories and Boilers Department is the organization responsible for management of emergency response of petro-chemical and industrial disasters in the State. The organization shall ensure preparation of necessary contingency plans and emergency response plans in collaboration with various stakeholder departments and submit to KSDMA for approval.

- Address: Chemical Emergency Response Centre, Kakkanad, Ernakulam – 682030
- Email: jdekm@fabkerala.gov.in
- Tel/Fax: +91 (0) 484 - 242 2258

5.19 Health and Family Welfare Department

- Develop plan for hospital preparedness and mass casualty management
- Prepare a database of registered private hospitals, clinics, diagnostic labs, blood banks, etc. along with their capacities and facilities provide
- Establish state wide medical emergency access number
- Ensure authentic medical database enlisting public and private facilities available in the state. This includes details of manpower, logistics, medical equipment, medicines, antidotes, personal protective equipment, disinfectant, vaccines, etc.
- Standardize and license ambulance services
- Ensure availability of adequate supply of life saving equipment and drugs, portable supplies like portable oxygen cylinders, portable x-ray machines, triage tags, etc. and update IDRN with these details
- Formulate trained medical first responder, quick response medical team, stationary and mobile decontamination facilities, identification of poison centres, mobile hospital, antidotes plan and crisis management plan at hospitals chemical disaster preparedness
- Prepare trained psychological and psychosocial care teams
- Impart training to manpower for emergency services
- Ensure proper and safe management of medical waste
- Ensure that antidotes are available for all the chemicals used in the MAH units and small scale chemical industrial units in the respective district and taluk hospitals
- Ensure that anti-venom and anti-rabies vaccines are adequately available upto Taluk Hospitals of the State
- Ensure a quick response medical team in every district for handling Chemical, Biological, Radiological and Nuclear Disasters
- Ensure that vulnerable hospitals and clinics as identified in the vulnerability assessment annexures are made disaster resilient

5.20 Forest Department

- Ensure that public safety achieves primary attention in the border areas of the Forests of the State
- Ensure that human-wild animal conflicts are reduced by facilitating food and water within forest areas during the summer season
- Ensure relief assistance to victims of human-wild animal conflicts, including snake bites anywhere within the State

5.21 Fisheries Department

- Ensure at least one high speed search and rescue boat in all fishing landing sites for fishermen rescue through rate contract, particularly during the fishing seasons (in addition to the search and rescue boats of the department and that of Coastal Police)
- Ensure distress signal beacons in all ocean going mechanised vessels
- Ensure that wind, cyclone and heavy rainfall early warnings reach all the fishermen through SMS and popularise the use of Ocean State Forecast from INCOIS by setting-up display boards in all fishing hamlets in the state
- Ensure adequate emergency response equipment such as floating buoys with 100 m ropes attached, scuba diving gear, oxygen cylinders and first aid kits at all fish landing sites
- Develop trained civil defence volunteers from amongst the fishermen community to assist in deep diving and search and rescue with equipment provided by the department
- Ensure insurance for all sea faring fishermen, boats, catamarans and nets
- Ensure safe harbour and facilities for anchoring boats and catamarans and storing nets in all fishing harbours

5.22 Ports Department

- Ensure at least one high speed search and rescue boat in all harbours and ports for civilian rescue through rate contract, particularly during the fishing seasons (in addition to the search and rescue boats of the department and that of Coastal Police)
- Ensure that wind, cyclone and heavy rainfall early warnings reach all the fishermen who venture into the sea from the respective ports
- Ensure speedy response to crisis situation similar to that involving Trailer Suction Hopper Dredger, 'Hansita V' in 2016 such that they are not repeated
- Ensure adequate emergency response equipment such as floating buoys with 100 m ropes attached, scuba diving gear, oxygen cylinders and first aid kits at all ports
- Develop trained civil defence volunteers from amongst the Fishermen community to assist in deep diving and search and rescue with equipment provided by the department

5.23 Coastal Shipping and Inland Navigation Department

- Ensure that all boats, country boats and tourist boats (including house boats) registered or operating in the State comply to the safety criteria of the Kerala Inland Vessels Rules, 2010 (amendment 2015)
- Ensure atleast one oil-spill response equipment and trained human resource in one harbour per district through rate contract or tender (such equipment is rare, highly

specialised and trained human resource is in short supply. Hence professional private agencies may be engaged)

- Ensure adequate emergency response equipment such as floating buoys with 100 m ropes attached, scuba diving gear, 100 m underwater camera (water proof tube camera), oxygen cylinders and first aid kits at all ports

5.24 Coastal Police

- Ensure the development of an oil spill contingency plan for the State and operationalize the plan in collaboration with Pollution Control Board, Ports Department, Coastal Shipping and Inland Navigation Department, Fisheries Department and Tourism Department and ensure the approval of the plan by KSDMA
- Develop a coastal terrorism contingency plan and operationalize it with the approval of the Crisis Management Group for Anthropogenic Hazards

5.25 Public Works Department

- Conduct structural audit of all public buildings in the State
- Conduct structural audit of all bridges in the PWD roads
- Identify and enlist life line buildings and priority buildings in the state and prepare a retrofitting plan for the buildings based on the structural audit report as required
- Provide technical support and expertise for repair, restoration and reconstruction of public infrastructure
- Prepare building and bridge collapse contingency plan
- Prepare an inventory of heavy earth movers, cranes, concreate cutters, jack hammers, JCBs and Hitachi in the State and update the data in IDRN database from the respective DEOCs
- Create a quick response team for responding to building collapse and bridge collapse
- Prepare for prompt clearance of debris post disaster
- Ensure prompt construction of new temporary roads and bridges for diverting traffic from the affected area
- Prepare for construction of temporary facilities like that of medical post, temporary shelters, etc. at short notice
- Prepare for restoration of government buildings damaged during disaster
- Ensure that vulnerable PWD roads as identified in the vulnerability assessment annexures are made disaster resilient

5.26 Local Self-Government Department Engineering Wing

- Conduct structural audit of all bridges in the LSGD roads and recreational structures such as giant wheels, roller coasters and tourist destinations
- Identify and enlist life line buildings and priority buildings in LSGD control and prepare a retrofitting plan for the buildings based on the structural audit report as required
- Provide technical support and expertise for repair, restoration and reconstruction of public infrastructure in LSGD areas
- Prepare building and bridge collapse contingency plan and occupational hazard management plan for construction sites along with Labour Department
- Prepare safety audits of all tourist destinations along with Tourism Department
- Implement road/bridge repair works as approved from State Disaster Response Fund as per norms
- Create a quick response team for responding to building collapse and bridge collapse
- Ensure that prior to sanctioning license for all ground water based industry (soda, ice, mineral water plants, flats, hollow bricks manufacturing and hotels) a no-objection certificate from the Ground Water Department is produced for tapping ground water
- Ensure that vulnerable LSGD roads as identified in the vulnerability assessment annexures are made disaster resilient

5.27 Soil Conservation Department

- Technically support and implement drought risk reduction measures in collaboration with DDMAs
- Ensure that farmers are not creating rainwater pits in slopes >20°
- Technically support and implement landslide risk reduction measures in collaboration with DDMAs

5.28 Road Safety Authority

- Identify and map all black spots in the roads of the state
- Ensure the implementation of Outdoor Advertisement Policy of the state
- Conduct safe driving lessons in schools
- Ensure that free refreshment is offered to heavy vehicle drivers, particularly petro-chemical tanker lorry drivers, along the National and State Highways at the entrance of every district between 8 pm and 6 am during the monsoon seasons

- Ensure that the GPS tracking system of tankers established by Public Sector Oil Companies are working and if not notices shall be issued to them to ensure continuous monitoring of all tankers carrying petro-chemical goods
- Ensure that all private sector oil companies operating the state have necessary emergency response vehicle within the State devoid of which they shall not be permitted to operate within the state
- Prepare a contingency plan for road accidents in the state involving Police, Motor Vehicles Department and Health Services

5.29 Dam Safety Authority

- Prepare and publish the operations manual of all spill ways in the state
- Ensure that a copy of the spill way operations manual of the dams in a district are available in the DEOC of the district
- Ensure that worst case scenario dam break modelling in light of seismically induced dam break and exceedance of Peak Maximum Flood are prepared and vulnerability assessment based on the model output is prepared and published
- Ensure that spill way operations are intimated atleast 12 hrs in advance to the concerned DEOC
- Attempt to ensure that spills ways are not opened after 6 pm and before 6 am
- Ensure that digital gauging of rainfall and water level is established in all dams

5.30 NORKA

- Prepare a contingency plan and allocate necessary funds for evacuating victims of disasters/terrorism in other states and country, hailing from Kerala
- Establish a permanent EOC in Kerala, interlinked with the SEOC for addressing situations such as those which emerged in Nepal, Uttarakand, Jammu and Kashmir and Chennai
- Ensure that NORKA representatives posted outside the State has contacts of the Disaster Management Authorities of the respective states
- Prepare a database of officers in the embassies of other countries who are handling foreigners affairs
- Establish a protocol and allocate necessary funds for transporting domestic and foreign tourists who are affected by disasters in Kerala
- Ensure close liaison with private tour operators such that passenger lists of domestic tourists from Kerala to other destinations are immediately available

5.31 Public Sector Oil Companies & Oil Handling Agencies

- Ensure that emergency response vehicles (ERVs) are in operational condition in the state
- Support Pollution Control Board to prepare and publish the oil spill contingency plan of the state
- Ensure adequate financial support for the operation of CHEMREC
- Provide support to Coastal and Inland Navigation Department and Coastal Police for procuring necessary oil spill response equipment
- Prepare and publish onsite contingency plans and business continuity plans for all establishments under the public sector oil companies

5.32 Airport Authority of India

- Conduct mock drills for air accidents within and outside the premises of airports
- Prepare and publish airport contingency plan for onsite and off-site air accidents with the approval of the respective DDMA
- Ensure support of emergency fire-fighting equipment of the airport to DDMAs during extreme emergency conditions
- Ensure that all airlines operating from the airport has contingency plans prepared and published

5.33 Railways

- Conduct mock drills for railway accidents
- Ensure that safety cells of the Divisional Manager's Office are fully functional and manned 24 X 7
- Share the railways crisis management plan with all DEOCs
- Ensure that vulnerable railway line stretches as identified in the vulnerability assessment annexures are made disaster resilient

5.34 Social Justice Department

- Prepare and regularly update database of scheduled castes, developing castes, social and economically backward classes, minorities communities, differently abled persons, orphans, destitute, beggars, old aged persons and ensure that they are able to avail benefits under respective welfare schemes so as to reduce their vulnerability to disasters
- Ensure that women and children receives special nutrition and supplements when housed in relief camps during disasters

5.35 Tourism Department

- Prepare a departmental disaster management plan for inbound tourists and outbound tourists
- Prepare and publish safety guidelines for tourists in all recognized tourist destinations
- Prepare a departmental SOP for handling inbound foreign tourists in the times of disasters

5.36 Telecommunications Service Providers

- Ensure location information of callers to the telephone numbers of SEOC for integrating with the Decision Support System
- Ensure that early warnings issued by SEOC are transmitted to all subscribers in a selected area or entire state as determined by the SEOC
- Ensure that access to 1077, 1070 and 1079 are available from all service providers
- Ensure that one Nodal Officer for disaster management is posted by all service providers in the State
- Ensure that the Nodal Officer is also the controlling authority of the mobile/portable transmission towers for fast deployment to disaster affected areas
- Ensure that information of mobile tower locations (latitude and longitude), tower ids and critical infrastructure related to ensuring uninterrupted mobile communication in the state are provided to SEOC and sufficient precautionary measures are taken to ensure disaster resilience as recommended by SEOC

5.37 Sports and Youth Welfare Department

- Conduct regular disaster management training programmes for Nehru Yuva Kendra, National Service Scheme, Scouts, Guides and National Cadet Corps
- Conduct swimming training programmes in all schools in the State
- Conduct first aid and basic live support training programmes for secondary higher secondary school students and college/university students

5.38 Local Self Governments

Chapter VI of the DM Act, 2005 details the statutory responsibilities of local self-governments in Disaster Risk Reduction. Kerala has a strong three tire local self-governance system. Under Section 30 (2) (vi) of the DM Act, 2005 all local self-governments are to formulate disaster management plans for their respective jurisdictions as directed by the DDMAs. The various local self-governments of the State are:

Sl. No	Type of local government	Numbers

1	Grama Panchayat	941
2	Block Panchayat	152
3	District Panchayat	14
4	Municipality	86
5	Corporation	6
	Total	**1199**

- Thiruvananthapuram City Corporation prepared a City Disaster Management Plan in 2015 and received due approval from DDMA Thiruvananthapuram. Thus Thiruvananthapuram City Corporation became the first ever urban area in the State to have a formalized Disaster Management Plan
- Villages namely Munreothuruthu of Kollam District and Peringara of Pathanamthitta District became the first of the two villages in the State to have prepared Village Disaster Management Plans in 2016 with a Community Based Disaster Risk Management approach and have received due approval from the respective DDMAs
- As part of Mullaperiyar Crisis Management Plan, Grama Panchayath Disaster Management Committees have been formed in Vandiperiyar, Upputhara, Elappara, Kumali, Kanchiyar and Ayyappancoil Grama Panchayaths and four emergency response teams (ERTs) namely, Alert/Warning & Coordination (468 volunteers), Search & Rescue (490 volunteers), Evacuation (430 volunteers) and First Aid (716 volunteers) have been formed

Detailed enlisting of dangerous and accident prone tourist sites in the respective panchayaths should be identified and local community and tourists should be warned of probable accidents in such sites.

Necessity to prepare the Disaster Management Plans, form local self-government level disaster management committees and create ERTs has been given as instructions to DDMAs. Initial focus is given to urban areas of the state and creating district level awareness for stakeholder institutions and accordingly funds have been released to respective DDMAs for capacity building of urban local self-governments and district panchayaths.

5.39 Media

- Give priority and highlight early warning messages issued by authentic sources
- Popularize the concept of disaster risk reduction
- Ensure one fixed mobile number and email per media for receiving early warning messages
- Ensure training on disaster reporting to all frontline reports in collaboration with KSDMA
- Leverage the use of corporate social responsibility funds for projects promoting water conservation, energy conservation etc. Few examples being Palathulli (Malayala Manorama), SEED (Mathrubhumi), Ente Puzha (Asianet) etc.

5.40 Non-Governmental Organizations

- NGOs, local community groups and voluntary agencies including NGOs normally have active role in prevention and mitigation activities under the supervision of DDMAs and the guidance of KSDMA
- The KSDMA and DDMA encourage NGOs, local community groups and voluntary agencies to participate in all training activities and should familiarize themselves with their role in State disaster management
- NGOs that are actively involved in disaster risk reduction efforts in the state are Habitat Technology Group (Thiruvananthapuram), CARITAS (Ernakulam), Foundation for Development Action (Pathanamthitta), Malankara Social Service Society (Thiruvananthapuram), Trivandrum Social Service Society (Thiruvananthapuram), Indian Institute of Emergency Medical Services (Kottayam), Angels India (Kozhikode), Amritanandamayi Math (Kollam), Malappuram District Trauma Care (Malappuram) etc.

5.41 Private Sector

- Provide Corporate Social Responsibility Support to State Disaster Mitigation Fund
- Assist DDMAs for conducting training programmes and popularizing information on disaster risk reduction via audio, video and print advertisements

5.42 Families of Kerala

It may be appropriate for every family in Kerala to have a disaster preparedness plan. Guidelines for the same are attached as Annexure 12.

5.43 Individuals in Kerala

It is the duty of every Indian citizen and foreign nationals within the jurisdictional limit of Kerala to assist KSDMA and DDMA engaged in disaster management whenever demanded for the purpose of disaster management under Section 65 of the DM Act, 2005. It is obligatory upon India citizens and foreign national to comply with warning and alert messages issued by competent authorities, failing which they are punishable under Section 51 of the DM Act, 2005. Whoever circulates false alarms or warnings about impending disasters without the authentication of the nodal agencies as approved vide ESPF, 2015 will be punishable under Section 54 of the DM Act, 2005.

6 DISASTER RESPONSE AND RELIEF

6.1 Handbook on Disaster Management – Volume 2 – Emergency Operations Centres & Emergency Support Functions Plan, 2015

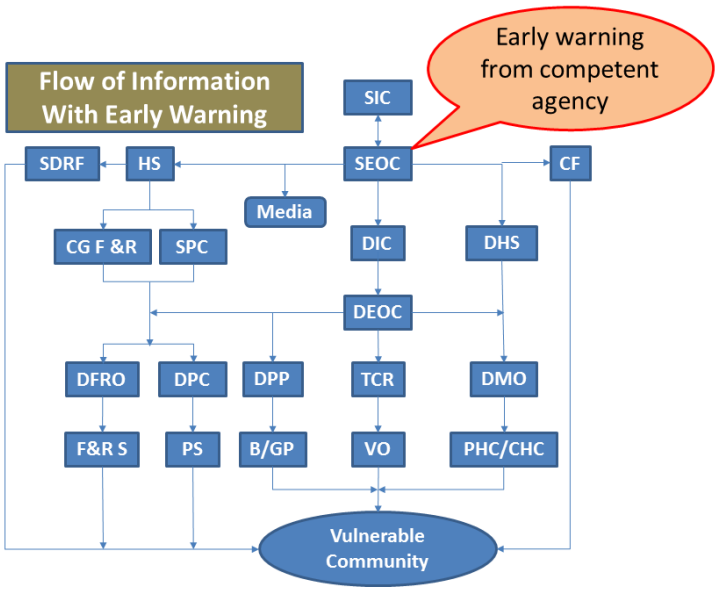
Response to emergencies in the State will be as per the Handbook on Disaster Management – Volume 2 – Emergency Operations Centres & Emergency Support Functions Plan, Kerala, 2015 (ESFP, 2015) and the National Disaster Management Guidelines - Incident Response System, 2010. These two documents thus forms and integral part of this chapter.

In case of significant emergencies or disasters, the Chairman of KSDMA or the Chief Executive Officer of KSDMA or the State Relief Commissioner shall invoke Section 24 of the DM Act, 2005 and emergency operations will be undertaken through SEOC under the command and supervision of the State Incident Commanders (SICs) (Chief Secretary and Additional Chief Secretary, Revenue and Disaster Management) as provided in the Emergency Supports Functions Plan, 2015 and the National Disaster Management Guidelines - Incident Response System, 2010.

Response process begins as soon as it becomes apparent that a disastrous event is imminent and lasts until the disaster is declared to be over.

1. Response is triggered when an authenticated early warning or information on occurrence of disaster is received at the DEOC or SEOC as the case may be
2. On receipt of alert/early warning or information about onset of disaster, District Collector or State Relief Commissioner assumes the role of District Incident Commander (IC) for L1 or L2 level disaster respectively, as the case may be
3. Immediate access to the disaster site through various means of communications such as mobiles, VSAT, wireless communication and hotline shall be attempted
4. The EOCs will continue to operate in Emergency Time Mode as long as the need for emergency relief and operations continue
5. Flow of information will be regulated as given in figures below for events with and without early warning
6. Early warnings issued by competent agencies will be verified and cross checked against past history of occurrence by SEOC before issuing it to media for public dissemination. SEOC will issue the following warnings to media:
   - INCOIS Ocean High Wave Alerts: All high wave alerts of >3 m will be issued to media
   - INCOIS Tsunami alerts will be issued as is to media if applicable for Kerala
   - ISGN/SEOC Seismic Event reports of >3 M will be provided to media
   - IMD Rainfall warnings: All warnings starting from Heavy Rainfall Warning onwards will be issued to media
   - IMD Wind warnings: All wind warnings of >40 km/hr will be issued to media

7. The levels of disasters have been categorized as L0, L1, L2 and L3 in the ESFP 2015 for organizing the responsibility of preparedness, enforcement of safety regulations and response, based on the ability of various authorities to deal with them.
   a. L0 denotes normal times which are expected to be utilized for close monitoring, documentation, prevention, mitigation and preparatory activities. Nodal departments as identified in Section 5.1 of this document will be responsible for monitoring, documentation, prevention, mitigation and preparatory activities including disaster response planning as per the departmental disaster management plans and the ESFP, 2015
   b. L1 specifies disasters that can be managed at the district level, however, the state and centre will remain in readiness to provide assistance if needed. All events that results in the loss of life of at-least one (1) individual or which injures at-least two (2) individuals or which affects 50% of the area of a ward of a Grama Panchayath/Municipal Corporation/City Corporation will be considered as L1 events and the district nodal officers for disaster management of the respective nodal department shall ensure adequate response through the District Emergency Operations Centers. Services of Central Forces shall not be availed for managing such events unless otherwise deemed absolutely necessary
   c. L2 specifies disaster situations that may require assistance and active participation of the state, and the mobilization of resources at the state level. All disastrous events that results in the loss of life of at-least five (5) individuals or which injures at-least ten (10) individuals or which affects 50% of the area of a Grama Panchayath/Municipal Corporation/City Corporation will be considered as L2 events and the State Authority will facilitate necessary support for emergency response by availing the services of central forces such as Army, Navy, Airforce, Coast Guard, Indo-Tibetan Boarder Police, Defence Security Corps, Central Industrial Security Force, Central Reserved Police Force and National Disaster Response Force. The state nodal officers for disaster management of the respective nodal department shall ensure adequate response through the State Emergency Operations Center. The Chairman of DDMA may decide whether to raise the response to a particular event to the State and treat it as an L2 event. However, the decision of the State Incident Commanders (Chief Secretary and Additional Chief Secretary, Revenue and Disaster Management) and the Chairman of KSDMA will be final in whether to accept the request or not to raise an event as

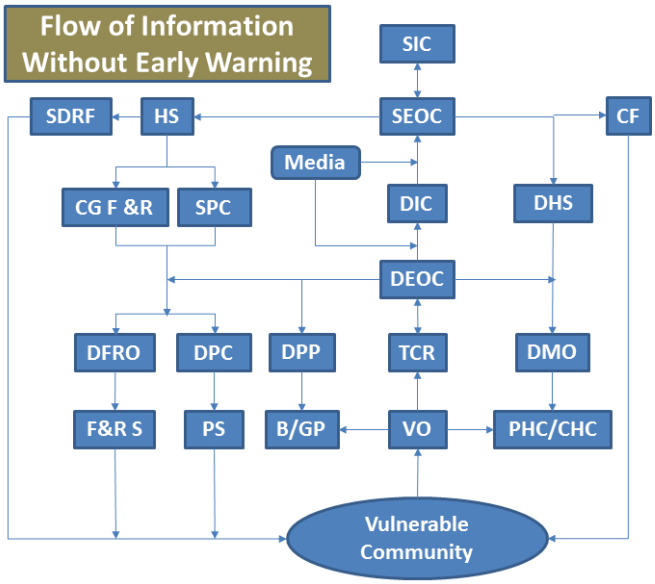


L2 and extend the support of central forces to the district

d. L3 disaster situations arise from large-scale disasters where districts and the state may not have the capacity to respond adequately and require assistance from the central government for reinstating the state and district machinery. Management of L3 disaster response will be regulated by the Crisis Management Plan 2016 (Part 1), Ministry of Home Affairs (MHACMP, 2016)

8. ESFP 2015 will be applicable to all disaster events with the loss of life of at-least two (2) individuals or injures to at-least five (5) individuals or which affects 50% of the area of a Grama Panchayath/Municipal Corporation/City Corporation or threatening disaster situations that require relocation to temporary camps
9. The SEOC will be staffed and operated as the situation dictates. When emergency situation is declared, operations of SEOC will be supported by senior officers (in addition to the inherent staff of SEOC) from line departments and central government agencies; private sector and volunteer organizations may be used to provide information, data and resources to cope with the situation. Once SEOC is activated and information is passed on to concerned departments, the state nodal officer of the departments shall reach SEOC within 30 minutes
10. At the district level, all operations will be commanded and controlled by the District Incident Commander (DIC) (*inter alia* District Collector) though the DEOC. All members of DDMA are to be present in the DEOC once an emergency situation is declared by the DIC. Services of the nodal department shall be extended through the district departmental nodal officer to DEOC within 30 minutes once the services of the district departmental nodal officer is requested by the DEOC
11. At the site of the disaster, the senior most uniformed officer of the responding forces will be the Onsite Incident Commander (OIC). The Onsite Incident Commander will report to the District Incident Commander directly
12. OIC will make all emergency decisions
13. OIC shall have the delegated powers under Section 34 of the DM Act, 2005 in the respective area of operation
14. The OIC shall report to the DEOC every 30 minutes and take orders from the DIC
15. The DEOC shall, every 1 hour, update the SEOC regarding the status of activities and take order from the SEOC
16. Services of National Disaster Response Force will be requested as per NDRFSOP, 2015
17. The DIC will coordinate and control resources of the District and those provided by the State when L2, or by the Nation when L3, events occur
18. All Central Forces shall report directly to the SEOC every 30 minutes regarding the status of activities

19. It will be the responsibility of the DEOCs to communicate emergency and disaster information via telephone, FAX, SMS or email to SEOC so as to trigger interdepartmental coordination and inform and avail the services of departmental nodal officers. The contact details are: Email (seoc.gok@gmail.com), Fax (0471-2364424), Telephone (0471-2364424), Mobile: 9446579222.



20. Information regarding warnings and emergencies will be disseminated by all possible media through SEOC and DEOC as deemed appropriate
21. Coordination with surrounding States is essential when an event having impacts beyond State boundaries occur. The Chief Executive Office of the SDMA or the Convener of the SDMA will have the powers for official interactions and discussions with neighboring states and decision making in matters relating to disaster management involving neighboring States
22. All nodal departments have to prepare Departmental DM Plans in accordance with the guidelines provided as Annexure 9
23. Departments, agencies and organizations assigned either primary or supporting responsibilities in the ESFP, 2015 must develop departmental plans in order to undertake the emergency supports function assigned to them
24. When local resources prove to be inadequate during emergency operations, request for assistance will be made to the State and the State shall seek the assistance of Departments, Institutions or Organizations under Government of India in accordance with the MHACMP, 2016
25. The State EOC will coordinate with other State's EOCs, National ERC, agencies of the Govt. of India like Indian Meteorological Department, Central Water Commission, Indian National Centre for Ocean Information Services to maintain up-

SIC: State Incident Commander; HS: Home Secretary; SDRF: State Disaster Response Force; SPC: State Police Chief; CG F & R: Commandant General Fire & Rescue Services; DIC: District Incident Commander; DHS: Director of Health Services; DPP: District Panchayat President; DMO: District Medical Officer; TCR: Taluk Control Room; VO: Village Officer; B/GPP: Block/Gram Panchayat President; DPC: District Police Chief; DFRO: District Fire & Rescue Officer; PS: Police Station; F & RS: Fire & Rescue Station

to-date information concerning potential heavy/very heavy rainfall, cloud bursts, cyclones, flooding, tsunami etc. As appropriate, such information will be provided to the citizens of the preparing areas in the State that may be affected by the event

26. Disaster occurrence could result in disruption of government functions and, therefore, all levels of local government and their departments should develop and maintain procedures to ensure continuity of Government functions

6.2 Nationally approved Disasters for NDRF/SDRF assistance

The State Disaster Response Fund is a fund for immediate relief assistance as recommended by 14th Finance Commission in a proportion of 75:25, respectively wherein 75% is contributed by the Government of India and 25% is contributed by the Government of Kerala. As per the Operational Guidelines for constitution and administration of the National Disaster Response Fund approved by the Ministry of Home Affairs, Government of India vide Letter No. 33-5/2015-NDM-I dated 30-07-2015 following are the disasters recognized for relief assistance under National Disaster Response Fund (NDRF) and State Disaster Response Fund (SDRF): Drought, Flood, Cyclones, Earthquake, Hailstorm, Landslides, Cloud burst, Fire, Tsunami, Avalanche, Pest attack and Cold wave/frost. Relief assistance is regulated as per the norms approved vide GO (Ms) No. 194/2015/DMD dated 20-05-2015.

6.3 State Specific Disasters

The 14th Finance Commission recommended that states can utilize upto 10% of the annual allocation under SDRF for State Specific Calamities as determined and notified by the State Executive Committee. Accordingly, vide GO (Ms) No. 343/2015/DMD dated 23-07-2015 the State Executive Committee of KSDMA decided to declare lightning, coastal erosion and 'strong wind that causes damage to life and property' as state specific calamity. Further, in light of the Puttingal Firecracker Accident, the SEC decided to declare the incident as State Specific Calamity considering the significant loss to life and property due to the event, vide GO (Ms) No. 318/2016/DMD dated 25th May 2016.

6.4 Disaster Reporting

Disaster reports are of five types. Each assessment report has different format for collection of data and reporting of information. These reports are rapid damage assessment report, preliminary report, annual calamity report and calamity memoranda report.

6.4.1 Rapid damage assessment report

Rapid damage assessment report is to be furnished within 24 hours by all DEOCs to SEOC. The prescribed format for Rapid Damaged Assessment is given as Annexure 13. These

reports are to be emailed to seoc.gok@gmail.com and sdmcontrolroom@gmail.com every day at 10 am and 4 pm from the respective DEOCs. It may be noted that the DEOCs shall send available information regarding occurrence of disasters in the format to SEOC at these time limits without waiting for complete details. The rapid damage assessment reports are of indicative nature and the details therein may be verified and approved in the detailed damage assessment report to be furnished every week. Efforts have been initiated to create an online form for the purpose and will be completed in the financial year 2016-17.

6.4.2 District Level Statistics on Disasters

This report is more detailed and is based on the format approved by Ministry of Home Affairs, Government of India vide Ltr. No. 32-4/2011-NDM-I dated 28th March 2013. This format is given in Annexure 14. This document shall be sent once in 7 days to SEOC and the Commissionerate of Land Revenue in the following email ids: seoc.gok@gmail.com and sdmcontrolroom@gmail.com. It may be noted that this format is of great importance for the country as the data from this format is uploaded to the National Database for Emergency Management (NDEM).

6.4.3 SEOC investigation series reports

The SEOC in collaboration with science and technology institutions or district administration shall investigate specific anomalous phenomena with potential to cause damage or as per the direction of the State Relief Commissioner. Further, in the times of major calamities, as determined by the State Relief Commissioner, the SEOC shall commission a post disaster need assessment study. Such a study shall be completed within 3 months from the event. These reports shall form the basis of long term recovery and rehabilitation plans.

6.4.4 Annual calamity report

The Commissionerate of Land Revenue is the authority for the preparation of this report. This report is the official document detailing the annual calamity losses and the response, relief and rehabilitation measures undertaken by the district administrations. This report is crucial for the release of funds by Ministry of Home Affairs to the State Disaster Response Fund. This report shall be furnished to the Government in the month of May every year for the preceding financial year. Specific format for the preparation of the annual report is issued by the Ministry of Home Affairs, Govt. of India.

6.4.5 Calamity Memoranda

The Tenth Finance Commission held the view that ‘if a calamity of rare severity occurs, it should be dealt with as a national calamity, requiring additional assistance and support from

the Centre, beyond what is envisaged under the CRF scheme'. For receiving additional assistance from the National Disaster Response Fund to the State Disaster Response Fund, the State Relief Commissioner has to submit detailed calamity memoranda to the respective nodal department of Government of India, as prescribed in the SDRF Manual, 2013. The manual also has prescribed data formats for furnishing sector wise damage assessment. SEOC is the authorized agency of the state for the preparation of calamity memoranda.

6.5 Relief and compensation

Based on various damage and needs assessments, relief packages shall be planned for affected population. The relief packages from external aid agencies should be culturally sensitive and appropriate to the needs of affected population. In case, external relief and aid is required, KSDMA shall ensure that need is flashed and published well through various mode of media, so that only required relief material is sent by external agencies. This prevents unnecessary stock of unsolicited relief material at critical facilities like airport, ports, railway stations, State Headquarters, etc. Relief packages would include details relating to collection, allocation and disbursal of funds to the affected people. Relief would be provided to all the affected families without any discrimination of caste, creed, religion, community or sex whatsoever. The relief norms will be as per the SDRF Norms 2015 and SSDRF Norms 2015. All efforts are being made to publish the minimum relief code of the State in 2016, until which the Minimum Standards for Shelter, Food, Water, Sanitation, Medical Cover in Relief Camps, 2016 issue by NDMA for the country will be in force, in the State. Once the State's Minimum Relief Code is accepted by KSDMA and published by the Government, that document will form an integral part of this section of KSDMP, 2016.

6.6 Lesson's learned workshops

After every major emergency, once normalcy is achieved, the KSDMA shall organize a 'lessons learned' workshop involving all stakeholders and document the lessons learned for long term institutional memory and revisiting the relevant plans. These workshops shall be commonly called the 'Towards the Safer State Series of Workshop'.

7 REHABILITATION AND RECONSTRUCTION

This forms part of the long term recovery component of the disaster management cycle. Rehabilitation and reconstruction are primarily carried out by the local bodies (Gram Panchayats, District, Taluk, Municipal Corporations, Municipalities, etc.) and various Government departments and boards. The reconstruction and rehabilitation plan is designed specifically for worst case scenario. This stage is triggered based on the SEOC investigation series reports. The Tsunami Rehabilitation Project (TRP) is the largest post-disaster rehabilitation and reconstruction project implemented in Kerala. Experiences of implementing TRP shall be documented and lessons shall be learned for betterment of such project implementation.

7.1 Recovery strategy

Depending on the type of damage and population affected, following measures can be initiated as comprehensive recovery strategy. While the short term reconstruction strategy includes repair, restoration and strengthening of affected structures, long term strategy includes reconstruction and relocation.

7.1.1 Repair and restoration

The Government, through Housing Department or any other department as it deems appropriate may formulate a repair and restoration policy. This should neither be treated as compensation for damage nor as an automatic entitlement and is only relief assistance within the limits of the SDRF Norms, 2015 and SSDRF Norms, 2015. Alternatively, the assistance as prescribed vide SDRF Norms, 2015 and SSDRF Norms, 2015 shall be paid directly to the beneficiary.

If donor agencies or Government of India extends support, the policy as formulated for repair and restoration of houses by the State Government will be the one applicable. Till such a policy is formulated and approved, the Land Revenue Department will formulate a case by case approach for repair and restoration in case of external aid.

7.1.2 Reconstruction

GO (Rt) No. 369/2016/DMD dated 24-06-2016 was a land mark with regards to reconstruction works in the State. For the first time Government sanctioned 5 rapid houses (prefabricated houses) to victims of *Gustnado* that affected 49 families on 10-06-2016. The only previous instance for such a disaster reconstruction was after the Tsunami 2004. Local Self Governments and Land Revenue Department shall oversee reconstruction and rehabilitation work and ensure that it takes into account the overall development plans for the state.

Reconstruction should be done on the principle of Owner Driven and with a vision of ‘build back better’. The new constructions post disaster should comply with all safety norms,

guidelines and building codes. The design of these buildings should be disaster resilient as per the hazard profile of the state.

7.1.3 Relocation

Relocation is the last resort in the time of disasters. Availability of livable land in the custody of Government is a major constrain in the state. Land acquisition for rehabilitation may also not be a viable solution without external aid considering the exorbitant cost of livable land in the state. Further, communities may have specific occupational and traditional attachment to the land in which they live. Relocation efforts will include activities like:

- Gaining consent of the affected population
- Land acquisition
- Urban/ rural land use planning
- Customizing relocation packages
- Obtaining due legal clearances for relocation
- Getting the necessary authorization for rehabilitation
- Livelihood rehabilitation measures for relocated communities, wherever necessary

While planning on site reconstruction or relocation, care should be taken to provide the community with all basic amenities in close vicinity of the reconstruction site. This leads to holistic reconstruction process. Some of the basic amenities are as follows:

1. Health
2. Education
3. Proper drainage system
4. Provision to drinking water
5. Provision for proper sanitation
6. Provision for waste collection and management
7. Market place
8. Connectivity to road and railway

7.2 Rehabilitation

Rehabilitation is a broad term involving social, cultural, economic, psychological, medical and environmental rehabilitation. Depending on the post disaster need assessment report, rehabilitation projects may focus on one or more of these aspects. Aim of all rehabilitation efforts should not be confined to reinstating the pre-disaster situation, but shall be to achieve the highest standards prevailing in the country, as all disasters are opportunities for betterment.

Rehabilitation projects shall be managed based on the damage assessment and need assessment report, by the department handling the sector that is the most affected. Focus of

rehabilitation projects should be based on the post-disaster need assessment report. As rehabilitation project have to be completed in a time bound manner and most of the activities involve non-conventional procedures of procurement, such projects shall be managed by separate project management units as deemed appropriate by the Government.

7.2.1 Socio-cultural rehabilitation

It is often that socio-cultural fabric of a community is affected beyond repair in major events. It was noted that many affected communities lost their socio-cultural fabric, post Indian Ocean Tsunami 2004. In such situations, it shall be cared that families/individuals with similar social and cultural background are identified, grouped and given attention required to rehabilitate their specific socio-cultural fabric. Care should also be taken to address the needs of various socially vulnerable groups like that of women, adolescent girls, old age persons, differently abled persons, children, destitute, scheduled castes, scheduled tribes etc. Traditions and believes, attachment to traditional land, land linked rituals and rites of passages etc. shall be address for each socio-cultural group.

7.2.2 Psychological rehabilitation

Disasters often lead to long time stress and trauma due to loss of near and dear ones, injuries, loss of limbs, loss of housing and related property, trauma generated by facing the disaster and fearful sites, fear of repetition of the disaster, etc. If not addressed appropriately, it may lead to lifelong psychological fear and disorders, thus it is necessary to provide psycho-social first and psychological care to the affected population.

A very recent instance of psychological rehabilitation was the post-disaster psychological attention provided to the victims of Puttingal firecracker explosion tragedy in Kollam district, by the Department of Health.

7.2.3 Economic rehabilitation

Disruption of livelihood means is one of the most important effects of a disaster. It is often that the lead bread earner of the family will be the one affected by a calamity. In such conditions, identification of suitable livelihoods keeping in account of the socio-cultural fabric of the society is an important task. In so far possible, seed funds for reinstating the community's economic background should be part of the rehabilitation scheme. If traditional livelihood means are affected beyond repair and the socio-economic aftermath of the situation warrants, it shall be part of the rehabilitation package to identify alternate livelihoods and ensure necessary training and capacity building of victims to assimilate the newly chosen alternate livelihood.

7.2.4 Environmental rehabilitation

Environmental damage may occur due to natural and anthropogenic hazards or cascading hazards. Environmental emergencies like uncontrolled, unplanned or accidental release of a substance into the environment not only impact human life in many ways but also damage environment to great extent which may be impossible or may take years to restore to original. Without proper consideration of the environment, pre-existing vulnerabilities may be re-created or exacerbated. Based on the need assessment report, environmental rehabilitation shall be a major concern in the rehabilitation project.

7.3 Dispute resolution

Institutionalizing dispute resolution is an important step for relief, reconstruction and rehabilitation. In case of disputes in relief reconstruction and rehabilitation, the Disaster Management Act, 2005 will be applicable. DDMA shall make all efforts to not delay resolution of individual cases of disputes beyond 15 days. SDMA shall make all efforts to not delay resolution of individual cases of disputes beyond 30 days. Parties shall not submit the same complaints to both DDMA and SDMA. A matter under consideration of the DDMA shall be dealt in DDMA. It shall be noted that SDMA is not an appeal authority of DDMA. Any decisions taken by DDMA or SDMA can only be challenged in the High Court or Supreme Court as per Section 71 of the DM Act, 2005.

8 FINANCIAL ARRANGEMENTS

Financial mechanism for disaster management is already in place at national, state and district level. Additionally there are various projects, programmes and initiatives catering to different phases of disaster management at nation, state and district level. The table below provides a concise picture of funds that are available for disaster risk reduction in the State.

Preparedness
▪ State Plan - Disaster Management, Mitigation and Rehabilitation (2012-17) Head of Account 2053-00-094-50: ₹500 lakhs/year
▪ 13th Finance Commission Grant-in-Aid for Capacity Building in Disaster Response (2010-15): ₹1600 lakhs
▪ GoI-UNDP Project on Enhancing Institutional and Community Resilience to Disasters and Climate Change" (2013 –2017): ₹38.44495 lakhs
▪ Strengthening SDMA and DDMA funded by NDMA (2015-17) Head of Account 2053-00-094-47: ₹94 lakhs
▪ National Disaster Management Services (NDMS) funded by NDMA (2016-17) – GO (Rt) No. 2203/2016/DMD dated 30-03-2016: ₹28 lakhs (Grant-in-Aid in kind)
▪ Government of India – United Nations Development Programme Project on Enhancing Institutional and Community Resilience to disasters and climate change (2013-17): ~₹100 lakhs
▪ 10% Flexi funds of Centrally Sponsored Schemes for Disaster Preparedness in the respective sector – allotment approved from non-legislative funds – Letter No. 47-38/2011-DM-III dated 11th March 2016 from Ministry of Home Affairs, Govt. of India (Annexure 10)
Capacity building
▪ 5% of State Disaster Response Fund (SDRF) – GO (Ms) No. 194/2015/DMD dated 20-5-2015 (Annexure 15)
Procurement of response and communication equipment
▪ 10% of State Disaster Response Fund – GO (Ms) No. 194/2015/DMD dated 20-5-2015
Response
▪ State Disaster Response Fund – GO (Ms) No. 194/2015/DMD dated 20-05-2015 ▪ State Specific Disaster Response Fund (SSDRF) – GO (Ms) No. 343/2015/DMD dated 23-07-2015 (Annexure 16)
Relief
▪ State Disaster Response Fund – GO (Ms) No. 194/2015/DMD dated 20-05-2015 ▪ State Specific Disaster Response Fund (SSDRF) – GO (Ms) No. 343/2015/DMD dated 23-07-2015
Mitigation
▪ National Cyclone Risk Mitigation Project (2015-20) – Head of Account 2245-80-102-98 - ~₹18400 lakhs ▪ State Disaster Mitigation Fund – S.R.O No. 5/2012 dated 2nd January 2012 (Annexure 17)

8.1 State Plan Fund

Based on the inputs from *Surakshaayanam* 2012, a detailed 5 year plan was prepared and approved vide Ltr. No. 5660/2011/PPSD/SPB dated 26-11-2012 by the Planning Board. This plan, prepared by leading experts for 12th Five Year Plan Period and approved by the Government contains 7 sub-heads with detailed plans for disaster risk reduction and response. The chief controlling officer of this fund is the Additional Chief Secretary vide GO (Rt) 2181/2016/DMD dated 23rd March 2016 and GO (Rt) No. 2167/2016/DMD dated 19th March

2016. Annual allotment is roughly ₹5 crores. Expenditure against each sub-head in the last 4 years is as given below:

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

8.1.1 Annual Plan 2016-17

Based on the 5 year plan, an annual plan was prepared for the year for utilizing the budget allocation. Detailed write-up of the annual plan is provided as Annexure 18. The plan allocation is given in the table below:

Sl. No	Name of Project	Amount (₹ in lakhs)
1	Construction of building for State Disaster Management Authority	210
2	Strengthening emergency response capabilities	85
3	Strengthening of institutional arrangements for Disaster Management	132.5
4	Implementing State and District Disaster Management Plans	0
5	Science and technology for Disaster Risk Reduction	0
6	Natural hazard mitigation and management	72.5
7	Anthropogenic hazard mitigation	0
	Total	**500**

8.2 National/State Disaster Response Fund

This fund is allocated for disaster response as approved vide GO (Ms) No. 194/2015/DMD dated 20-05-2015 and is allotted under 22 sub-heads. Allotment to this fund is as recommended by the 14th Finance Commission for a period from 2015-20. The fund is non-lapsable and any saving from a particular year is carried forward to the next year. The allotment is as determined by the State Executive Committee of KSDMA.

10% of this fund is apportioned every year from 2015-20 for State Specific Calamities as determined by the State Executive Committee. Table below shows the allocation under this fund for the period 2015-20.

Year	Central Share (75%)	State Share (25%)	Total (₹ in crores)
2015-16	166	18	184
2016-17	175	19	194
2017-18	183	20	203
2018-19	193	21	214
2019-20	202	22	224

Table below shows the allotment to districts in the last 5 years.

District	2010-11	2011-12	2012-13	2013-14	2014-15	TOTAL (₹)
Trivandrum	195364000	169643395	339961390	230911966	320114526	1255995277
Kollam	98062323	135184490	213928608	231394196	131055450	809625067
Pathanamthitta	65230170	114894359	164232598	122499541	176960000	643816668
Alappuzha	197389865	149932000	145069988	420395153	185450000	1098237006
Kottayam	78442000	109366096	168961977	252487770	146970000	756227843
Idukki	72102970	61093957	114781999	291084458	163600000	702663384
Ernakulam	116682455	117484742	149639890	254569948	177751597	816128632
Thrissur	76236000	114264687	141904671	197835767	170880141	701121266
Palakkad	131143000	102400000	196213645	210737217	130785000	771278862
Malappuram	130905000	119450000	203032546	246386261	238460000	938233807
Kozhikkod	120467000	82360604	124906457	160112728	162190000	650036789
Wayanad	53774537	63475600	62000000	266048529	112700000	557998666
Kannur	76375000	100926770	139412122	163755157	171250000	651719049
Kasargod	68286800	50310000	84746725	106439289	70300000	380082814
TOTAL (₹)	1480461120	1490786700	2248792616	3154657980	2358466714	**1073,31,65,130**

Table below shows the allocation of funds under the 22 sub-heads of SDRF in 2010-15 period.

Sub-head	Amount (₹)
2245-01-101-98 - Drought – Food and Clothing	2,50,000
2245-01-101-99 - Drought – Agriculture crop loss	27,17,84,794
2245-01-102-99 - Drought – Drinking Water supply	264,54,91,312
2245-02-101-94 - Flood – Other Items	41,36,96,025
2245-02-101-95 - Flood – Agriculture crop loss	126,31,03,008
2245-02-101-96 - Flood – Supply of Medicines	75,08,323
2245-02-101-98 - Flood – Food and Clothing	27,76,10,537
2245-02-105-99 - Flood – Veterinary Care	1,47,22,350
2245-02-106-99 - Flood – Repairs & Restoration of roads and bridges	447,09,93,724
2245-02-107-99 - Flood – Repairs to Government office building	33,96,242
2245-02-110-99 - Flood – Repairs of Damaged water supply	1,15,73,268
2245-02-111-99 - Flood – Exgratia to bereaved families	15,19,60,000
2245-02-112-99 - Flood – Evacuation of population	73,99,977
2245-02-113-99 - Flood – Repairs to Houses	89,25,01,459
2245-02-114-99 - Flood – Assistance to farmers to purchase Agriculture inputs	0
2245-02-115-99 - Flood – Assistance to farmers to clear sand and slit	1,31,040
2245-02-122-99 - Flood – Repairs & Restoration of damaged irrigation & flood control work	0
2245-02-800-96 - Flood – Exgratia to injured persons	1,66,83,139
2245-02-118-99 - Flood – Assistance for repair of fishing boats	71,56,300
2245-02-119-99 - Flood – Assistance to artisans for repair/replacement of tools	3,18,000
2245-02-800-80 - Flood – Other Miscellaneous Relief Expenditure	27,58,11,088
2245-02-102-99 - Flood – Drinking water supply	10,76,464
Total	1073,31,65,130

The chief controlling officer of this fund is Additional Chief Secretary, Revenue and Disaster Management and the District Collectors are the drawing and disbursing officers. The SDRF Manual, 2013 is the document that governs the administration of the utilization of this

fund. The infrastructure damages have to be assessed and certified by a Technical Competent Officer. Vide GO (Ms) No. 24/2015/LSG dated 30-01-2014 the Overseers and Engineers of Local Self Government Engineering Wing are authorized to value losses to individual infrastructural losses (Annexure 19).

From the analysis of allotments in the last 5 year period, it is evident that majority of funds are utilized under four sub-heads, they being 2245-02-106-99 - Flood – Repairs & Restoration of roads and bridges, 2245-01-102-99 - Drought – Drinking Water supply, 2245-02-101-95 - Flood – Agriculture crop loss and 2245-02-113-99 - Flood – Repairs to Houses. Few sub-heads have no allotments due to lack of demand. It may be noted that in Kerala all the booking are made under Drought or Flood Sub-heads only. Because of this fund allotment pattern, it is not possible to identify the actual expenditure incurred against various calamities recognized for relief assistance under National/State Disaster Response Fund norms and the State Specific Calamity norms. Further, the sub-heads also do not represent the sections of the norms of disaster response fund. This implies that a thorough rework is needed in the sub-heads/minor heads.

As per the Guidelines on constitution and administration of the State Disaster Response Fund and National Disaster Response Fund based on the recommendations of the 14th Finance Commission 2015-20 issued vide Letter No. 33-5/2015-NDM-I dated 30-07-2015 from Ministry of Home Affairs, Government of India, Section 8, booking of the expenditure on immediate relief from this fund has to be as follows:

‘The actual expenditure on relief works will be booked only under respective sub/minor head within major head 2245 (i.e. 01 for drought, 02 for flood, 03 for cyclones, 04 for earthquake, 05 for hailstorm, 06 for landslides, 07 for cloud burst, 08 for fire, 09 for tsunami, 10 for avalanche, 11 for pest attack and 12 for cold wave/frost and 13 for other state specific disasters, 13.1 for 1st state specific disaster, 13.2 for 2nd state specific disaster, 13.3 for 3rd state specific disaster, 13.4 or 4th state specific disaster, 13.4 for 5th state specific disaster...etc; 16 for "State Disaster Response Fund" and 80 for General). As proper accounting brings in transparency for booking of expenditure, office of the Controller General of Accounts/Accountant Generals of the respective states may be create sub-head/minor head in respect of each of the notified calamites/items under Major Head 2245’.

Hence it is appropriate to restructure the sub-heads/minor heads under NDRF/SDRF according to the recommendations of the Ministry of Home Affairs, Government of India such that exact burden on the exchequer against each calamity may be clearly understood. An illustrative example for reworking the sub-heads of NDRF/SDRF is given as Annexure 20. From amongst the nationally recognized disasters, avalanche is not relevant to Kerala. Not all items

under the norms are eligible for assistance under the State Specific Disaster category. Attempt will be made to restructure the sub-heads, in 2016.

8.3 State Disaster Response Fund for State Specific Disasters

Vide GO (Ms) No. 343/2015/DMD dated 23-07-2015, the Government of Kerala has recognized lighting, coastal erosion, 'strong wind less than cyclones that causes damage to life and property' as state specific disasters. Further, the Puttingal Firecracker Explosion 2016 was also declared as state specific disaster vide GO (Ms) No. 318/2016/DMD dated 25th May 2016.

It is the 10% of SDRF every year which can be utilized for State Specific Disaster Response. Hence the following is the annual maximum allotment possible under the state specific disasters:

Year	CS (75%)	SS (25%)	Total	Maximum allotment
2015-16	166	18	184	18.4
2016-17	175	19	194	19.4
2017-18	183	20	203	20.3
2018-19	193	21	214	21.4
2019-20	202	22	224	22.4
CS: Central Share; SS: State Share (All figures as ₹ in crores)				

8.4 State Disaster Mitigation Fund

Mitigation fund is regulated by the guidelines given in Annexure 17. Two programmes have been funded under the scheme, they being the Mullaperiyar Crisis Management Plan and Operation Anantha. Mullaperiyar Crisis Management Plan was approved vide GO (Rt) No. 5884/2011/DMD dated 12-12-2011 and was sanctioned ₹2 crores. This is a perennial project and may continue as long as a new dam is constructed. Operation Anantha was a flood mitigation project initiated in Thiruvananthapuram but extended to Kannur too. The project was approved vide GO (Rt) No. 178/15/DMD dated 12-05-2015 and till date an amount of ₹32.5 crores have been released for the project to DDMAs of Thiruvananthapuram, Kannur and Habour Engineering Department. Table below shows the expenditure from SDMF since 2012.

1) Mullaperiyar Crisis Management Plan	
Flood Field Mapping	3,58,500
School Safety programme	6,46,159
Community Based Disaster Risk Reduction Programme (CBDRM)	41,45,461
Technical Component	60,00,000
Audit	45,000
Early Warning System – VHF Network	35,823
Support To DDMA	17,00,000
Total	129,30,943
2) Operation Anantha (please refer for details in Section 3.10)	32,50,00,000
Grand total	33,79,30,943

8.5 13th Finance Commission Grant-in-Aid for Capacity Building in Disaster Response (2010-15)

The 13th Finance Commission had provided ₹5 crores/year to Kerala from 2010-11 to 2014-15 for capacity building in Disaster Response. The State Executive Committee of KSDMA prepared a perspective plan for its utilization in 2011. Further in 2013, NDMA vide Ltr. No. F. No. 05-03/2013/NDMA/CBT(Pt) dated 7th October 2013 informed that sufficient relaxation will be given for the utilization of the 13th Finance Commission grant-in-aid provided, the state is able to make the State Emergency Operations Centre fully functional and provided the Disaster Management Plans of the State and the District are prepared. Accordingly necessary modifications were made to the perspective plan. Amongst the committed funds is the fund allotted for setting up the SEOC which is a 3 year long project with a 3 year handholding commitment from M/S Keltron and hence is of special nature. The allotments and utilizations under 13th Finance Commission Grant-in-Aid under approved sub-heads are as follows:

Sl. No.	Item		2010-11	2011-12	2012-13	2013-14	2014-15	Total
I	Setting up of State Emergency Operations Centre	Plan	-	370	272	-	140	782
		Utilized						267.2120
		Committed						449.6360
		Balance						0
II	Training/Capacity building of stakeholder functionaries	Plan	190.4	30	3	60	10	313.4
		Utilized						327.44876
		Committed						91.27504
		Balance						0
III	Capacity building of State ATI (Disaster Management Centre of Institute of Land and Disaster Management)	Plan	8.53	-	55	90	160	263.5
		Utilized						148.06281
		Committed						0
		Balance						0
IV	Disaster Management plans with Hazard, Vulnerability and Risk Assessment (Executed by SEOC)	Plan	118.17	-	70	80	90	358.2
		Utilized						100.85
		Committed						0
		Balance						0
V	Strengthening of District Disaster Management Authorities (DDMAs)	Plan	82.9	-	-	200	-	282.9
		Utilized						98.25
		Committed						15
		Balance						0
							Total plan	**2000**
							Total grant received from Government of India	1600
							Total utilized	941.82357
							Total committed	555.91104
							All values in ₹lakhs	

8.6 Audit

The funds of KSDMA are audited by the Controller and Auditor General of India on an annual basis excluding specific projects in which the donor agencies have decided on separate audit to be carried out. The accounts of KSDMA and SEOC are maintained in Tally Software. Books are also maintained as required by the audit teams.

8.7 Perspective 5 year Plan 2017-22

The 13th five year plan of the State is to be prepared in the financial year 2016-17. In line with the Sendai Framework 2015-30, following broad themes will be addressed for effective disaster risk reduction in the State in the next five year period:

1. Community based disaster risk reduction – formation, training and capacity building of civil defence force in districts
2. Strengthen State Disaster Response Force
3. Strengthen Fire and Rescue Services
4. Strengthen the network of Emergency Operations Centres
5. Strengthen instrumented monitoring and science and technology for disaster risk reduction
6. Mainstreaming disaster risk reduction into development planning
7. Updating Hazard, Vulnerability and Risk Assessment of the state and the District and State Disaster Management Plans

9 PLAN MAINTENANCE

- **Training** – On receipt of this plan, the Department Heads and the Chairpersons of DDMAs shall initiate programmes for training the Government Officers of every department/district personnel in disaster management such that they have the knowledge, skills and abilities needed to perform the tasks identified in the plan and the reference documents. Personnel should also be trained on the department-specific procedures necessary to support the plan tasks. Office of KSDMA will facilitate such customized trainings through the Disaster Management Centre of ILDM and the Civil Defense Institute.
- **Exercise the plan** – Evaluating the effectiveness of plan involves a combination of training events and mock drills to determine whether the goals, objectives, decisions, actions and timing outlined in the plan lead to a successful response. The purpose of a mock drill is to promote preparedness by testing policies, plans and the training requirements of the stakeholders.
- **Revise and Maintain** – Reviews should be a recurring activity. Review on an annual basis is considered minimum. It is mandatory to review and update the plan after the following events:
  - A major disaster
  - A change in operational resources (e.g., policy, personnel, organizational structures, management processes, facilities, equipment)
  - A formal update of planning guidance or standards
  - Each activation of ESFP, 2015
  - Major exercises
  - A change in the State's demographics or hazard or threat profile
  - The enactment of new or amended laws or ordinances

Responsibility of the periodic revision of the KSDMP will be that of the State Emergency Operations Centre. The SEOC shall internally review the plan on a yearly basis and either update or reaffirm its validity. The updated or reaffirmed document shall be used to summarize the accomplishments of the past year and help the administration to prioritize mitigation goals for the next year.

One copy of the plan shall be sent to all Government Secretaries, all local self-governments, all Heads of Departments, members of NDMA and SDMA, members of DDMAs and two copies to Ministry of Home Affairs, Government of India. A PDF copy of the plan shall be uploaded to the websites of KSDMA and SEOC.

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Villages Affected by SW Monsoon Related Calamity
(June 1st - June 30th 2013)
Legend
District Boundary
Landslide
Flood Affected Area
Coastal Villages
Non Coastal Villages
External boundaries of the state are not verified
For reference purpose only
HAZARD, VULNERABILITY AND RISK ASSESSMENT (HVRA) CELL
DEPARTMENT OF DISASTER MANAGEMENT, GOVT. OF KERALA
Rainfall Departure from Normal
June 1st - June 29th, 2013
Ref period: June 1st - June 29th, 2013 (Districtwise Normal)
Source: IMD
Legend
Rain Gauges
District Boundary
Departure from Normal (%)
High : 100
Low : -50
External boundaries of the state are not verified
For reference purpose only
HAZARD, VULNERABILITY AND RISK ASSESSMENT (HVRA) CELL
DEPARTMENT OF DISASTER MANAGEMENT, GOVT. OF KERALA