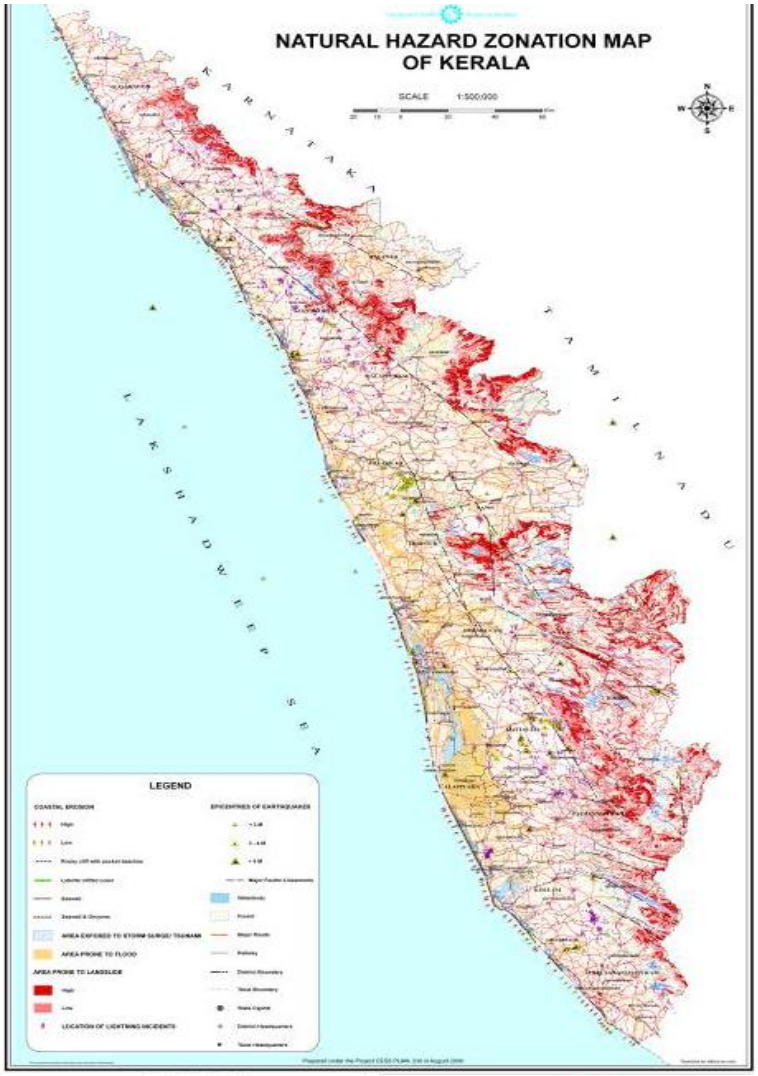
Government of Kerala

Kerala State Disaster Management Plan Profile



Kerala State Disaster Management Authority

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Foreword

Kerala State is vulnerable in varying degrees to a large number of natural and man-made disasters of recurrent nature that result in loss of life, livelihoods, infrastructure and property, and cause immense hardships to the affected population, besides resulting in disruption of economic activity. The increasing vulnerabilities due to a variety of factors such as rapid urbanisation, environmental degradation, growing population and climate change compounded the disaster risks in the State and this mandated a paradigm shift from a relief centric approach to a proactive and comprehensive mindset towards disaster management covering all aspects from prevention, mitigation, preparedness to response and recovery. The enactment of Kerala State Disaster Management Rules, 2007 and promulgation of Kerala State Disaster Management Policy, 2010 in line with National DM Act, 2005 marked defining steps towards holistic disaster management in the State.

The Disaster Management Act, 2005 provides that there shall be a plan for disaster management for every State to be called the 'State Disaster Management Plan' and enjoins upon the State Government to make provisions for financing the activities to be carried out under the State Plan. While the process of 'hazard, vulnerability and risk analysis' on which DM Plans should ideally be made has begun, it is highly felt that the preparation of plans should not await the outcome of risk analysis, rather it should be formulated on the basis of extant information and knowledge. Taking in to account past lessons and experiences and building on the good existing systems to further streamline them, a makeshift Disaster Management Plan for the State has been prepared by Department of Disaster Management. The State Disaster Management Plan Profile launched herewith establishes operational and management procedures for DM and include broad vulnerability of the State, strategies to be

adopted for the prevention and mitigation of disasters, capacity building measures to be taken and the roles and responsibilities of different Departments of the State in responding to threatening disaster situations.

Pending micro-level ‘hazard, vulnerability and risk analysis’ and short, medium and long term structural and non-structural prevention and mitigation plans based on the outcome of the risk analysis may be incorporated in the plan later on to develop an holistic State Disaster Management Action Plan with financial arrangements to address all the hazards the State is vulnerable to.

Dr. Nivedita P Haran IAS
Additional Chief Secretary
Revenue and Disaster Management
Kerala State

Chapter I

State Profile

Kerala, the '*Gods own country*' as it is popularly known, is a land blessed with natural resources. A narrow strip of land in the south-western margin of the Indian Peninsula, Kerala State is bounded by Western Ghats in the east and Arabian Sea in the west. On the longitudinal profile the land may be divided in to three zones, namely the high land, the mid land and the low land including the coastal plain. The state of Kerala consists of 14 Districts, 63 Taluks, 21 Revenue divisions, 152 Blocks, 999 Panchayaths and 1452 Villages.

Kerala is home to 3.44% of India's population. Kerala's rate of population growth is India's lowest, and Kerala's population as per Census 2001 was 318.41 lakh consisting of 154.69 lakh males and 163.72 lakh females. The sex ratio of Kerala has gradually increased from 1004:1000 in 1901 to 1028:1000 in 1951 and then to 1058:1000 in 2001. With 819 persons per km², it is nearly three times densely populated compared to the rest of India. In Kerala, 74% of the population lives in rural areas. It is a noteworthy feature of Kerala that the percentage of aged population (above 60 years) is rising fast.

Kerala's human development indices— primary level education, health care and elimination of poverty—are among the best in India. Kerala has one of the highest literacy rates (97.0%) among Indian states and life expectancy (73 years) was among the highest in India. Kerala's rural poverty rate fell from 69% (1970–1971) to 19% (1993–1994); the overall (urban and rural) rate fell 36% between the 1970s and 1980s. By 1999–2000, the rural and urban poverty rates dropped to substantially.

Since independence, Kerala has been primarily welfare economy. Per-capita GSDP of the State is Rs. 11,819 (US$ 243.47) which is above the Indian average. Kerala's economy largely depends on emigrants working in foreign countries (mainly in the Gulf countries) and the remittances annually contribute more than a fifth of GSDP. The service sector (including tourism, public administration, banking and finance, transportation, and communications) and the agricultural and fishing industries dominate the economy.

Kerala has a tropical 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 respect to the amount of rainfall

(80% of total rainfall). In Kerala, there are forty four (44) rivers, of which only three (3) are east flowing.

Disaster Scenario in Kerala State

The State's geographical location, weather pattern and high population density makes it prone to severe natural as well as human-induced disasters which can be countered only through organised mitigative actions. The State of Kerala is prone to a host of natural hazards such as coastal erosion, flood, drought, lightening, landslide and earthquake. All most all districts of Kerala are multi-hazard prone (Figure I). In Kerala lightning, landslides (debris flows) and floods are the most commonly occurring natural hazards. Droughts and minor earth tremors also occur occasionally. The recent Tsunami of 26 December 2004 added a new dimension to the disaster profile of the state.

Kerala is prone to high incidence of lightning, especially during the months of April, May, October and November. It is estimated that about 70 people die every year due to lightning. About 14.8% of the state is prone to flooding (CESS, 2010). 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 1871-2000, 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 (Kuriakose, 2009).

Kerala is also prone to several anthropogenic disasters such as road accidents, rail accidents, boat capsizing, industrial accidents, epidemics, pest infestation, stampedes, building collapses and fire accidents. As many of the dams in the state have exceeded their design life, they are potentially disastrous to people living in the downstream.

Population pressure and unsustainable land use practices prevailing in the state are the main reason for many of the hazards to turn into disaster events. Lack of proper infrastructure facilities and exceeding of carrying capacity are the cause of many of the anthropogenic hazards.

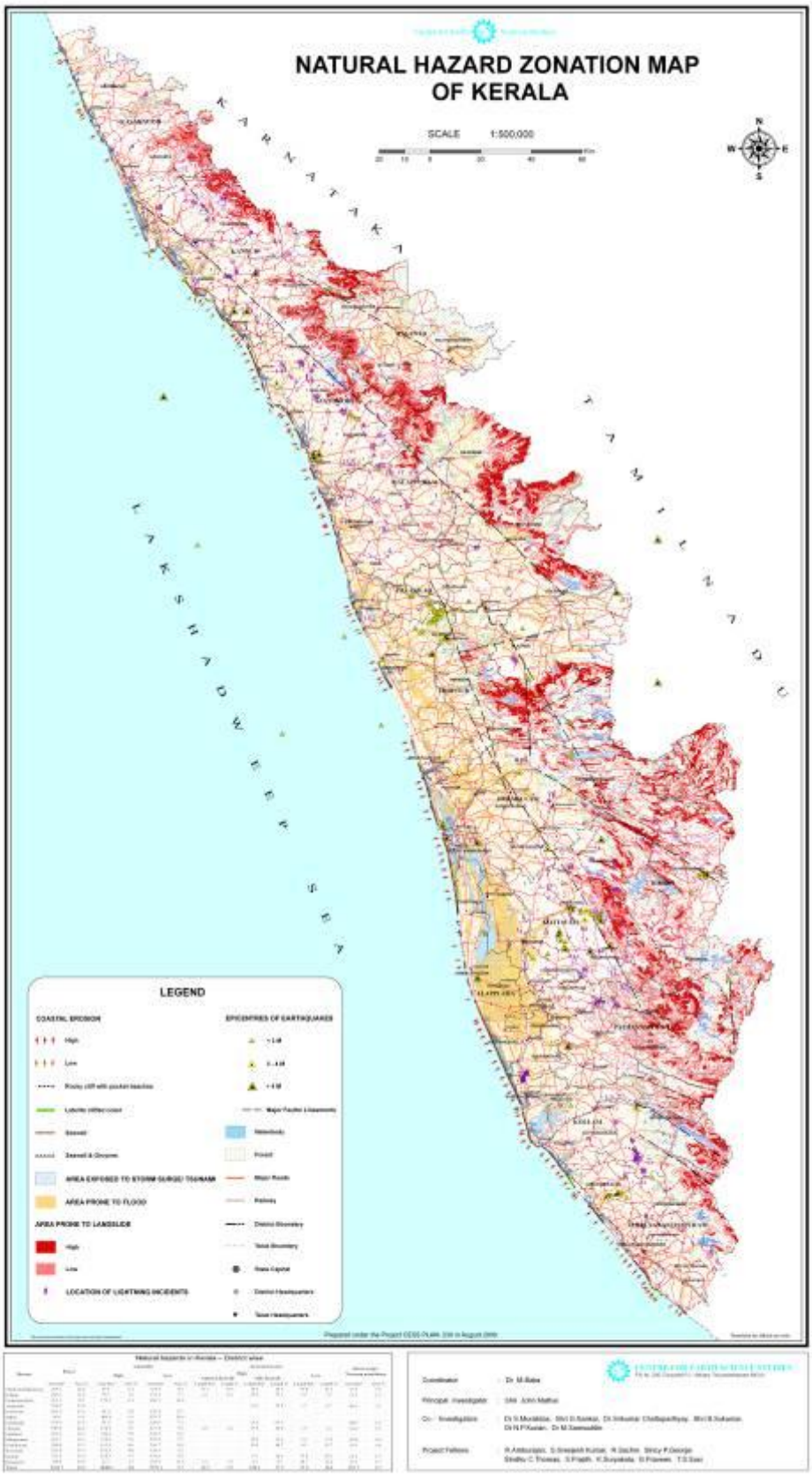

NATURAL HAZARD ZONATION MAP
OF KERALA
SCALE 1:500,000
LEGEND
COASTAL EROSION
EPICENTRES OF EARTHQUAKES
AREA EXPOSED TO STORM SURGE/ TSUNAMI
AREA PRONE TO FLOOD
AREA PRONE TO LANDSLIDE
LOCATION OF LIGHTNING INCIDENTS

Figure I : Multi-hazard zonation map of Kerala (CESS, 2010)

Kerala is a place of high incidence of lightning compared to most of the other parts in India. Weather patterns and placement of Western Ghats together cause formation of more lightning clouds. Relatively higher population of more lightening clouds.Relatively higher population density and vegetation density result in more causality. Accidents caused by ground conduction from trees, which is a special feature of Kerala.April, May, October, November have relatively much higher lightning incidence. It is estimated that approximately 70 people die and property worth millions of rupees are damaged in the state annually due to lightning.

Although the Kerala state does not experience floods as severe as in the Indo-Gangetic Plains, incidence of floods in the state is becoming more frequent and severe. High intensity of rainfall during the monsoons causes severe floods. Increasing flood plain occupancy and reclamation of water bodies and wetlands results in increasing flood damages.14.8% of the total area in the state is prone to flood. Kerala has been experiencing seasonal drought conditions every year during summer months. During the period 1871-2000 Kerala state experienced drought years out of which 12 each were moderate droughts. Increasing incidence of droughts is mainly due to weather anomalies change in land use, traditionl practices and life style of people.

With a length of 570 km and covering about 15% of state's total area the coastal zone of Kerala is an important physiographic unit. Hazards in the coastal zone are erosion, monsoon, storm surges, sea level rise etc. More than 300 km of sea shore is erosion prone. Extensive sea wall construction along with gabion-box and groins has failed to arrest the erosion in many cases. The tsunami of 2004 which was experienced along most of the coastal regions of the state has added a new dimension to the disaster scenario of the state.

The western flank of the Western Ghats covering the eastern part of Kerala is identified as one of the major land slide prone areas of the country. The Landslides in the state include rock falls, rock slips, debris flow and in a few cases rotational types of slides. But the most prevalent recurring and disastrous type of earth or tectonic movement noted in Kerala are the debris flow (urulpottal) characterized by the swift and sudden down slope movement of highly water saturated overburden ranging in size from soil particles to boulders destroying

and carrying with it everything that is lying in its path. About 1500 km^2 area in the Western Ghats is prone to landslides. Every year with the onset of monsoon, land slips and landslides are reported. Population growth and high rain fall are identified as the major driving forces behind the land sliding.

Chapter II

Hazard and Vulnerability Assessment

2.1. History of vulnerability of the state to the disasters of different types

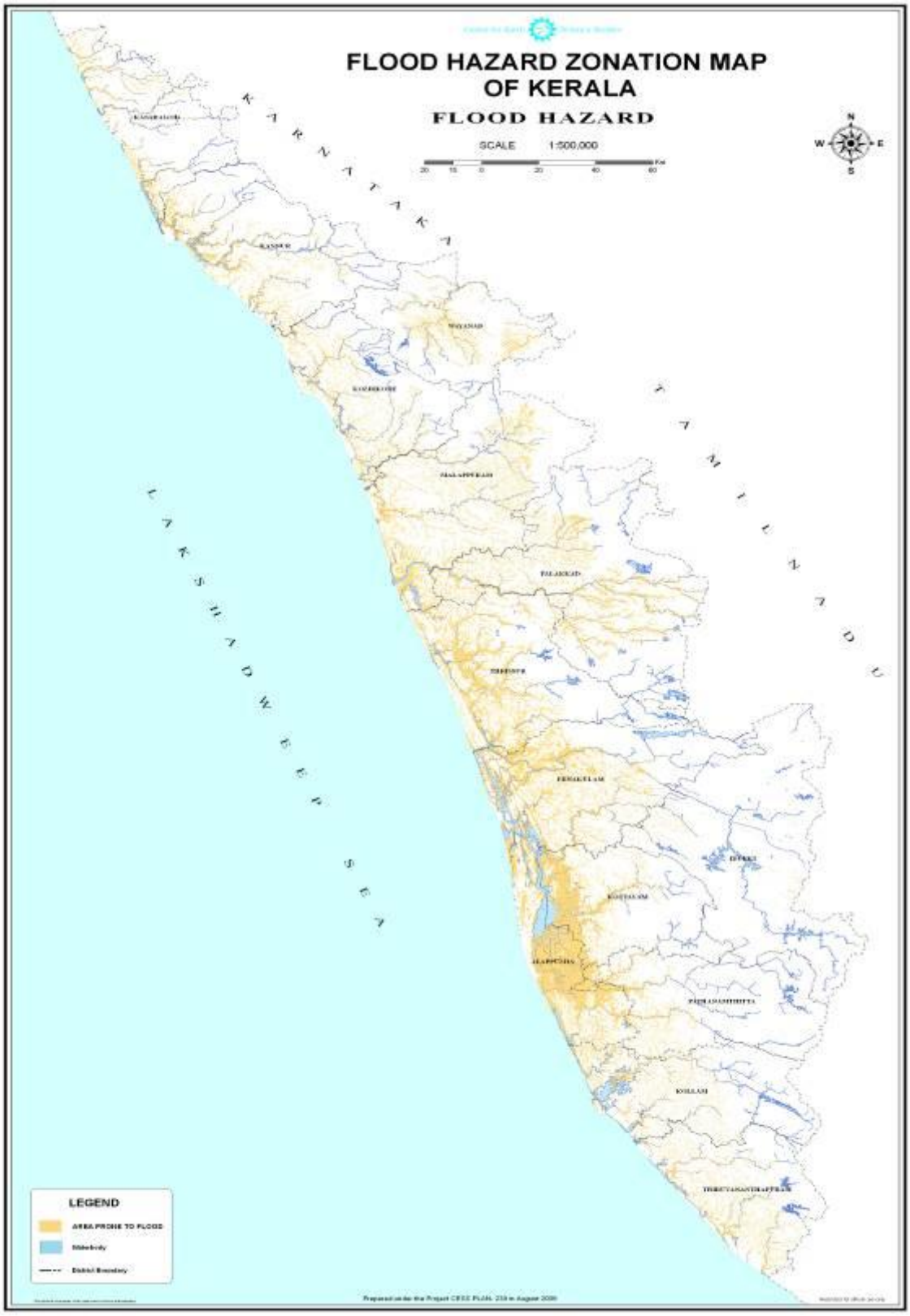
The state of Kerala is vulnerable to a multitude of hazards and is categorized as a multiple-hazard prone state. The state experiences various kinds of disasters of recurrent nature that results in loss of life, livelihood and property, and disruption of economic activity, besides causing immense hardship to the affected population.

2.2. Specific vulnerabilities of the state

- Kerala has a long coast line of 590kms out of which, 322 km is prone to severe sea erosion
- The density of population is 819 persons per sq.km which is the second highest density in the country.
- About 96.9% of the total area in the state lies in the 140.4km/h wind zone which is classified as Moderate Damage Risk Zone by the BMPTC Atlas while the remaining area lies in 118.8km/h wind zone.
- The mean maximum storm surge height in the state is 3.5m and minimum is 2.3m. If the storm surge is during high tide, the maximum surge height in the state will be 4.2m and minimum storm height will reach up to 3m, as observed by the Meteorological Department, Thiruvanthapuram.
- The coastal belt of Kerala is one of the most densely populated regions in the country, which adds to its vulnerability.
- The Western flank of the Western Ghats covering the eastern part of Kerala is identified as one of the major landslide prone areas of the country.

2.3. Floods

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. Reclamation and settlement in floodplain areas is a major cause of flood damage in Kerala. Defining the entire flood potential in a given area is a delicate task.


FLOOD HAZARD ZONATION MAP
OF KERALA
FLOOD HAZARD
SCALE 1:500,000
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KARNATAKA
TAMILNADU
LAKSHADWEEP SEA
WAYANAD
KOZHIKODE
MALAPPURAM
PALAKKAD
THRISSUR
ERNAKULAM
IDUKKI
KOTTAYAM
ALAPPUZHA
PATHANAMTHITTA
KOLLAM
THIRUVANANTHAPURAM
LEGEND
AREA PRONE TO FLOOD
Waterbody
District Boundary

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. The flood prone areas of the state are depicted in map given below. The district level maps depict the areas prone to flood in each district with greater precision. The following table gives the areas in sq.km and in percentage prone to flood at taluk, district and state level caused by high rainfall. The flood prone areas of the state are depicted in the above map. Table 1 gives the areas in sq.km and in percentage prone to flood at district level (CESS, 2010).

Table 1 Flood prone area in each district

District	Area km²	Area%		District	Area km²	Area%
Thiruvananthapuram	268.09	12.23		Idukki	38.78	0.89
Kollam	283.62	11.41		Thrissur	688.44	22.65
Alappuzha	762.57	53.77		Malappuram	601.67	16.93
Pathanamthitta	212.76	8.00		Palakkad	567.16	12.66
Kottayam	461.33	20.95		Kozhikkode	288.83	12.30
Ernakulam	718.94	23.50		Wayanad	215.39	10.11
Kannur	339.18	11.45		Kasargod	198.79	9.99

Consult CESS, 2010. Plan Project 249 for taluk wise area

The study (CESS, 2010) shows that 5642.68 sq.km of area which is 14.52% of the total area of the state is prone to floods. In Allepey 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.

2.4. Landslides

In Kerala, landslides commonly occur in localised areas of the Western Ghats region where the slope is steep and the soil is over saturated as a result of prolonged rainfall. These events vary from events affecting a parcel of land to those larger ones with much causality. Only the larger ones with losses of lives have been highlighted and studied in detail. The smaller events also indicate landslide potential of an area. Case studies by CESS show that most of the events are of debris flow type triggered by excess rainfall and are influenced by terrain factors like slope, overburden thickness, landuse, relative relief, disposition of streams, landform at micro level etc.

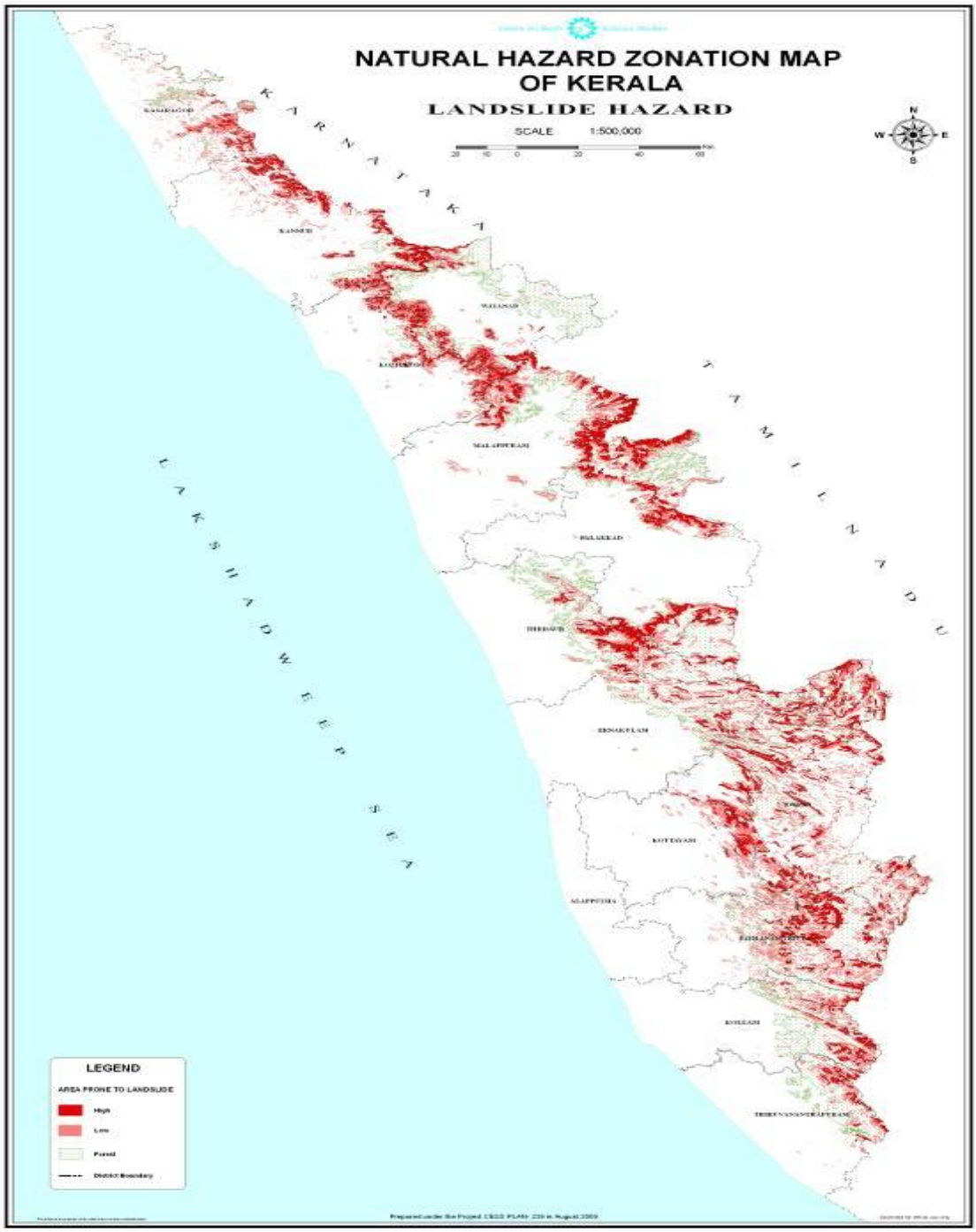
The area of the state is about 38863 sq.km of which 40% lies in the highland region forming the western slopes of Western Ghats. A considerable part of all districts of Kerala except the coastal district of Alleppey falls within this region. The western declivity of the Western Ghats is steep and usually terraced resembling ghat or landing stairs from which it derives the name. This region is characterized by rugged hills with steep slopes on which rests the soil and earth materials. The slope in the Western Ghats region is generally steep to very steep with plateau edges highly indented having > 25° slope.

The term landslide includes a broad range of different types of motion whereby earth material is dislodged by falling, sliding and flowing under the influence of gravity. In fact mass movements such as landslides are natural phenomenon that causes landscape changes, threat to life and destruction of property. The most common type of landslides in Kerala is debris flows.

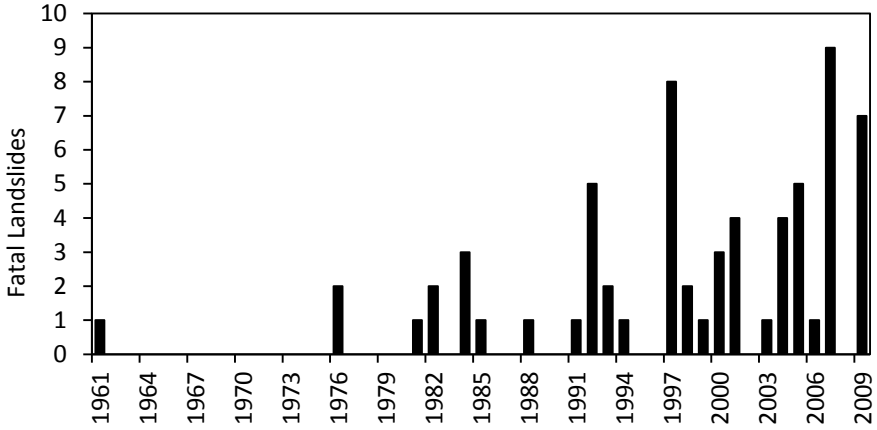
Table 2: Landslide prone area in each district

District	Area km²	Area %	Area km²	Area %
	High		Low	
Thiruvananthapuram	45.59	2.08	114.90	5.24
Kollam	75.61	3.04	191.07	7.69
Pathanamthitta	170.28	6.41	426.25	16.04
Alappuzha	0.00	0.00	0.00	0.00

Kottayam	61.78	2.81	190.50	8.65
Idukki	388.32	8.90	873.71	20.02
Ernakulam	61.42	2.01	229.05	7.49
Thrissur	108.15	3.56	217.40	7.15
Palakkad	324.62	7.25	366.88	8.19
Malappuram	198.34	5.58	267.56	7.53
Kozhikode	109.00	4.64	206.71	8.80
Wayanad	102.56	4.82	196.57	9.23
Kannur	168.64	5.69	272.55	9.20
Kasargod	33.67	1.69	205.90	10.35
Total for the state	1847.98	4.75	3759.07	9.67
Consult CESS, 2010. Plan Project 249 for taluk wise area				


NATURAL HAZARD ZONATION MAP
OF KERALA
LANDSLIDE HAZARD
SCALE 1:500,000
KARNATAKA
TAMILNADU
LAKSHADWEEP SEA
LEGEND
AREA PRONE TO LANDSLIDE
High
Low
Forest
District Boundary

The landslide prone area in each district is given in table 2. The study reveals that 1848 km2 or 4.71% of the state is under high and 3759 km2 or 9.77% under low hazard category. Devikulam, Vythiri, Nilambur, Mannarkad and Ranni are the most landslide prone taluks in the state. The landslide prone areas of the state are depicted in the above map. The graph below shows the increasing trend of fatal landslides (landslides that have killed at least one human being) in Kerala since 1961 (Kuriakose, 2010). A detailed description of the history and chorology of landslide prone areas of the state can be found in Kuriakose et al., 2009.



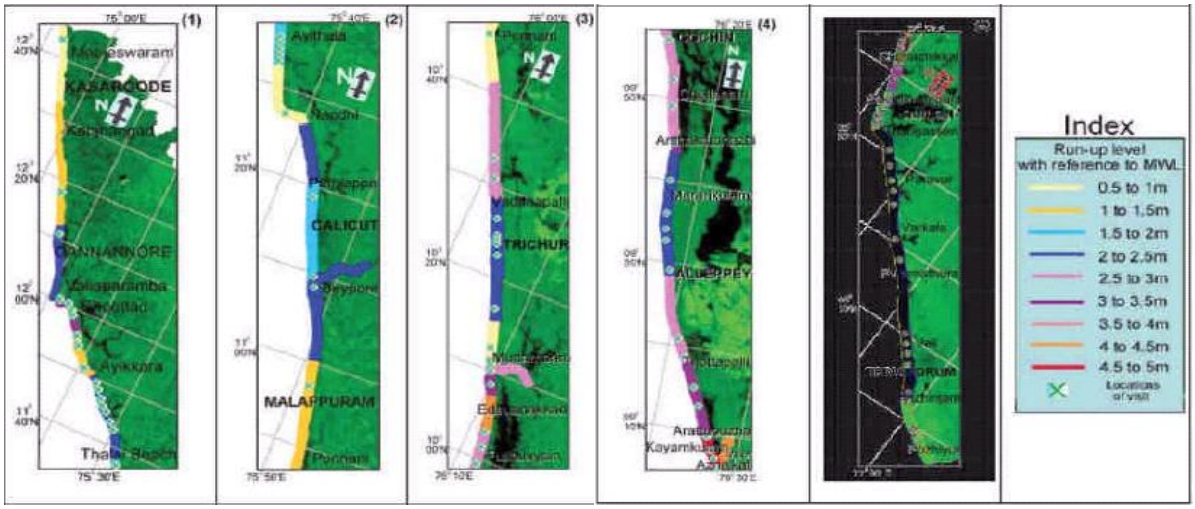
Graph 1: Number of fatal landslides in Kerala from 1961 to 2009 (Kuriakose, 2010)

2.5. Tsunami

The Kerala coast located in the shadow zone with respect to the direction of propagation of the tsunami, encountered unexpected devastation on 26 December 2004. Although tsunami affected parts of Kerala coast, maximum devastation was reported in the low coastal land of Kollam, Alleppey and Ernakulam districts, particularly a strip of 10 km in Azhikkal, Kollam district. The tsunami waves attained heights of 3 to 5 meters and inundated the coastal areas at different times. The figure below shows the time of maximum indundation at different locations, Kerala coast (Kurian et al., 2006).

This varying effect along the coast could be attributed to local amplification of tsunami waves in certain regions. About 176 people were killed and 1600 injured in the coastal belt8. Further, the tsunami pounded 187 villages affecting nearly 25 lakh persons in Kerala. As many as 6280 dwelling units were completely destroyed, 11175 were partially damaged and nearly 84773 persons were evacuated from the coastal areas and accommodated in 142 relief camps after tsunami.

Tsunami run-up level along the Kerala



It was concluded by Kurian et al. (2006) that the superimposition of tsunami waves with high tide was a factor that compounded the inundation resulted in higher intensity of damage. The worst affected part of the coast in terms of inundation, run-up and erosion was the 10 km segment of Azhikkal coast. Satellite imagery of this tract a day after the tsunami clearly shows highly turbid sediment-laden water. Many concrete houses, fishing boats canoes and automobiles of this area were uprooted and thrown to distances of 100 to 200 m. Even blocks of rocks (1m size) of the seawall were thrown ashore to 150m by the rushing tsunami waves.

2.6. Coastal hazards

In Kerala, out of 14 districts, 9 districts are bordering the sea coast vulnerable to various disasters such as floods, cyclones, coastal erosion, landslides etc.

Table 3: Eroding sectors along the coast in each District, Taluk and whole State

District	Length		Length		Length	
	km	%	km	%	km	%
	High (without sea wall)		High (with Sea wall)		Low	
Thiruvananthapuram	11.9	15.86	15.66	20.88	30.84	41.11
Kollam	1.14	2.34	37.77	77.58	0.91	1.86
Alappuzha			29.98	37.84	3.7	4.67
Ernakulam			33.39	69.02		
Thrissur	2.58	3.43	17.37	23.16	0.98	1.3
Malappuram			15.4	31.63	6.44	13.23
Kozhikode			35.4	44.68	8.47	10.69

Kannur			9.33	14.27	17.38	26.58
Kasargod	1.3	1.47	4.34	4.93	28.31	32.15
Total	16.91	3.02	198.63	35.47	97.02	17.33
Consult CESS, 2010. Plan Project 249 for taluk wise area						


NATURAL HAZARD ZONATION MAP
OF KERALA
COASTAL HAZARD
SCALE 1:500,000
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KASARAGOD
KANNUR
WAYANAD
KOZHIKODE
MALAPPURAM
PALAKKAD
THRISSUR
ERNAKULAM
IDUKKI
KOTTAYAM
ALAPPUZHA
PATHANAMTHITTA
KOLLAM
THIRUVANANTHAPURAM
ARABIAN SEA
LAKSHADWEEP SEA
LEGEND
COASTAL EROSION
High
Low
AREA EXPOSED TO STORM SURGE/ TSUNAMI
District Boundary

These nine districts are namely, Kasargode, Kannur, Kozhikode, Malappuram, Thrissur, Ernakulam, Alappuzha, Kollam and Thiruvananthapuram. The state has 223 coastal villages which has the probability of being affected by cyclone. Natural causes of coastal erosion are due to the action of waves, winds, tides, near shore currents, storm surges and sea-level rise. Human activities such as the construction of harbours, jetties and groynes, river training works, mining and dredging can also lead to erosion of certain regions. Some of the coastal stretches in Kerala have shown long-term erosion with net loss of land. It is reported that about 480 km length of the coast is under the threat of erosion. The rocky coasts with pocket beaches have minimum level of erosion. In areas with laterite cliffs, under cutting of the softer clay layers lead to slumping with a net landward migration of the shoreline. In the sandy areas some of the segments show long term erosion while others with either accretion or stable condition. Studies have also shown that in areas undergoing erosion a reversal can take place after a long period. The map below shows the areas prone to coastal hazards in the state while the table (Table 3) shows the length of coastline prone to erosion in each district.

2.7. Earthquakes

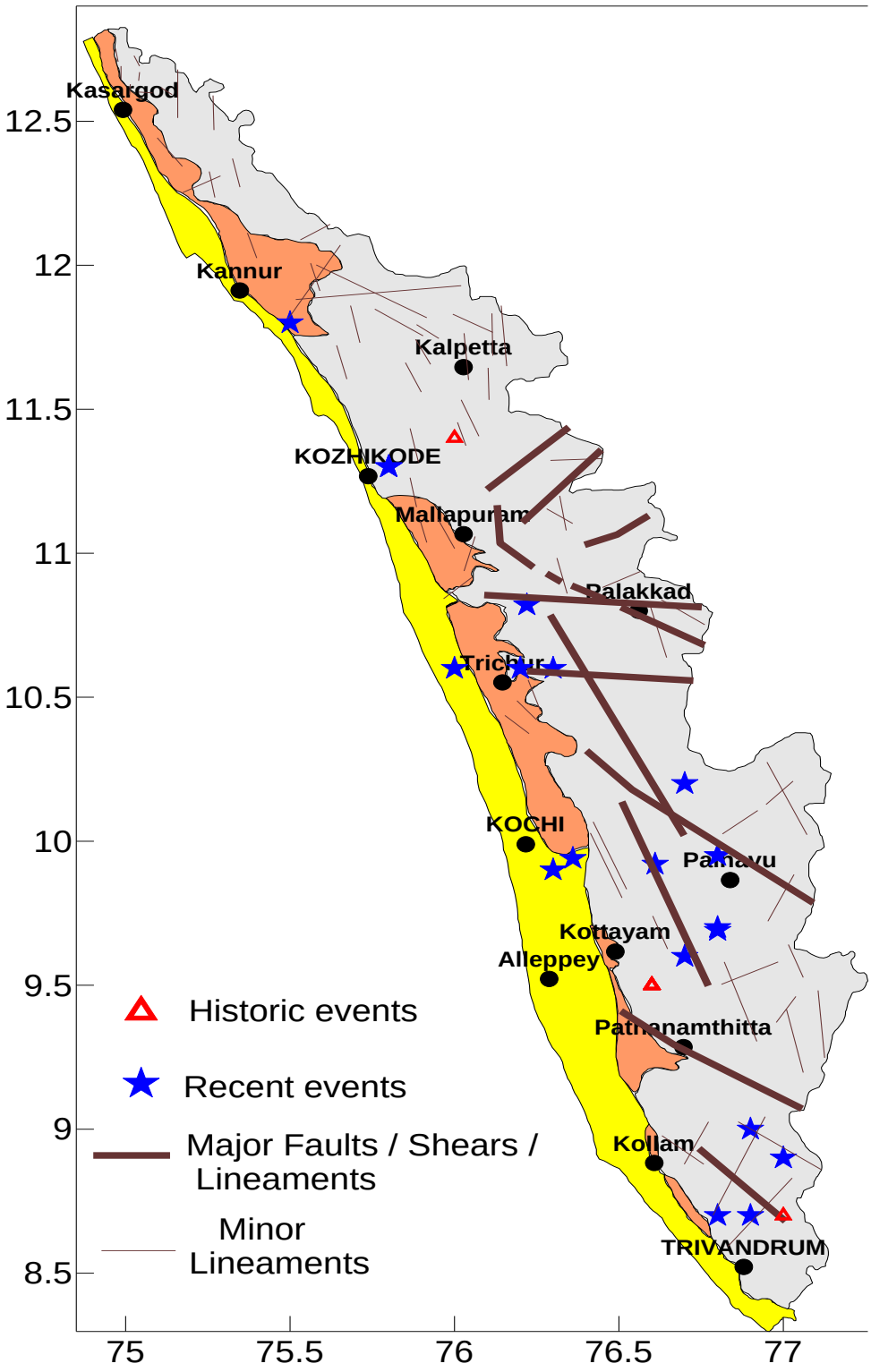
Kerala has experienced occasional mild tremors since historical times. None of them are reported to have caused casualties or major damages to built-up structures as in the case of Lathur earthquake. A seismic hazard map with 10% probability of exceedance in 50 years assigns low-level hazard to regions falling in Kerala. However pockets of higher ground acceleration have been identified in central Kerala. In this region higher levels of earthquake hazard are expected calling for the introduction of better building practices. Experience shows that sudden release of accumulated strain energy along planes of weakness in the earth's crust can generate large earthquakes and no region is safe from earthquakes (Latur earthquake). In Kerala, several deep seated faults exist, the notable among them are Periyar fault, Idamalayar fault, Muvattupuzha fault, Bhavali fault and Kuthuparamba fault. Besides there are many more minor faults and fractures that can generate minor tremors as a result of crustal readjustment. Minor tremors in Kerala are also explained by hydroseismicity model wherein pressure transients generated due to sudden increase in hydrostatic heads especially after rains results in increased pore pressure and movement along pre-existing faults (Radhakrishnan, 2007).

Past earthquake incidents in Kerala

Sl No	Data	Location	Remarks
1	8th February 1900	Coimbatore area of Tamilnadu	Felt over a large section of south India, the lagest event duing the historailcal period
2	27th April 1901	Off the Kerala Coast	Maximum observed intensity is 5
3	26th July 1953	Tekkumuri area, Kerala	Maximum observed intensity 5
4	Octber 1964	Kozhikode area, Kerala	Maximum observed intensity 5
5	7 June 1988	Kalar- Idukki area	Three events recorded, largest magnitude is 4.5 Ms
6	12th December	Idukki- Kottayam area, Kerakla	Local magnitude of 5.0 felt strongly in Kochi, Idukki, Kottayam, Alappuzha and Ernakulam
7	7th January 2001	Idduki –Kottayam area, Kerala	Felt thoughout the Tamil Nadu, local magnitude of 4.8
8	2nd September 2001	North Indian Ocean	Felt in the city of Thiruvanthapuram in Kerala
9	28 October 2001	Laccadive Sea	Magnitude 4.4

In the past fifty years, only four earthquakes have occurred in Kerala with more than 4 M. In the regional seismic zonation map of India, Kerala has been placed in Zone III where the maximum expected intensity is VIII in MM scale or 5.6 M in Richter scale. Though small and medium earthquakes have occurred in Kerala region, large earthquakes with casualty are yet to occur. The destruction due to earthquakes is limited to ground cracks and damages to buildings. The locations of the earthquakes that have occurred in the Kerala region for which records are available are plotted on to the district maps (map 3). Based on the magnitude they

have been categorised into three classes viz. <3, 3-4 and >4. Major faults and lineaments are also plotted. Higher levels of seismicity are seen in Kottayam-Idukki districts and Thrissur-Palakkad districts. Other districts like Thiruvananthapuram, Kannur and Kozhikode also show moderate levels of seismicity.



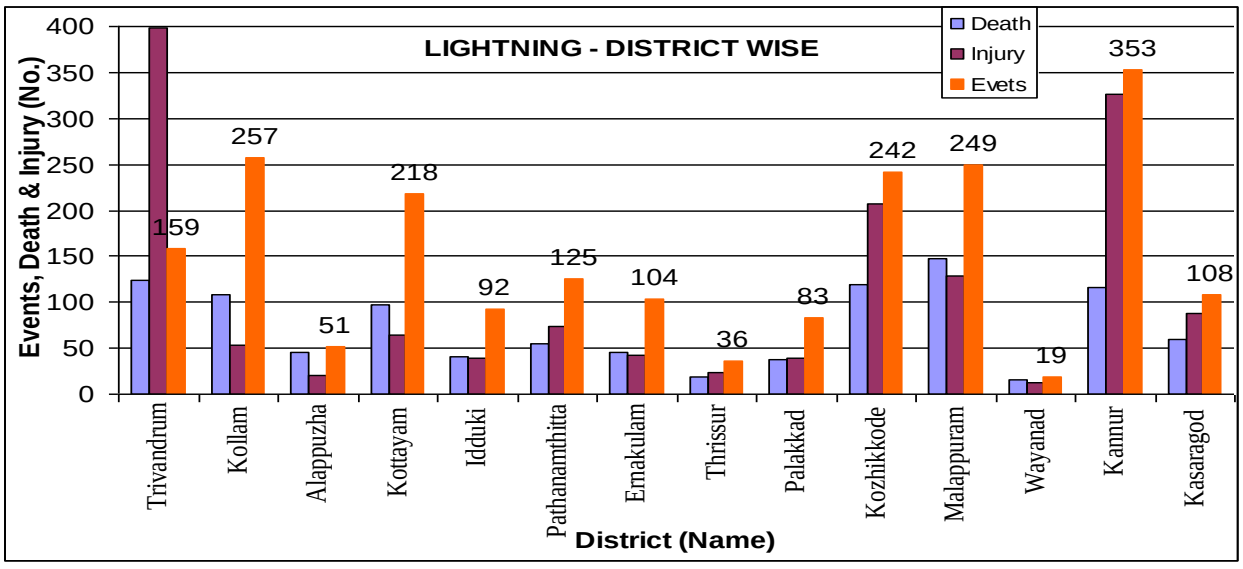
Location of historic and recent earthquakes in Kerala

2.8 Lightning

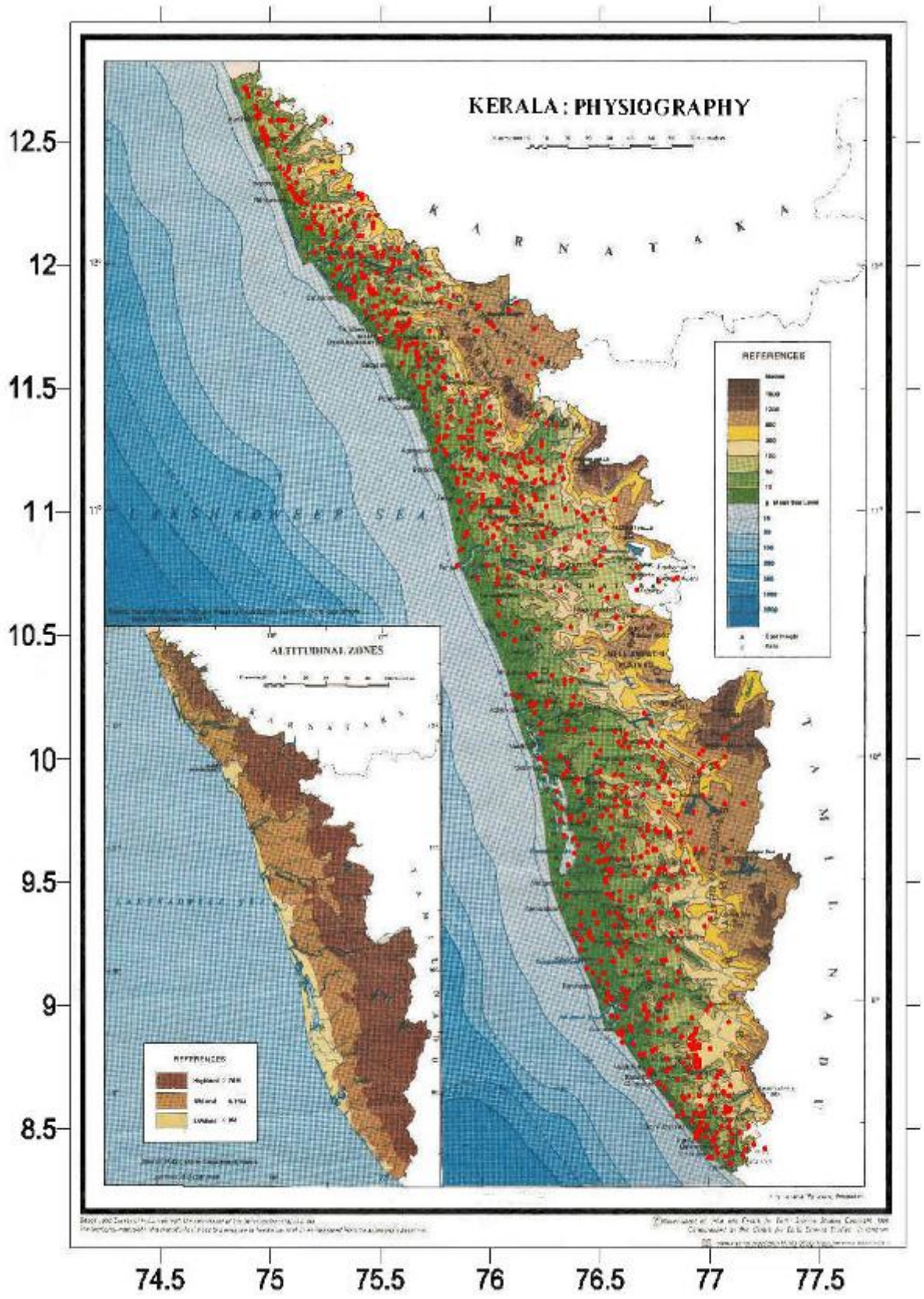
Lightning is a weather phenomenon. It is essentially an electrical discharge. This is not a phenomenon peculiar to Kerala. It is part of a global electrical system known as the 'Global Electric Circuit' involving the earth, ionosphere, and the atmosphere in between. On an average about 70 people in the state die due to lightning. This figure is based on felt reports available with village offices and old news papers for 17 years between 1986 and 2002. That is, when an event of injury or loss of property is reported it becomes one datum. The degree of destruction seen in the data is an under estimate because destruction of some property like house hold objects and trees goes unreported. The magnitude of the problem as seen from this felt report data is presented as dot map below. The dots indicate that lightning has occurred in that location. There are numerous overlaps of dots in the plot. It can be seen that there is a relative void in incidents in an area west of the Palakkad. More specifically the region west of Palakkad namely the region near Thrisur has less incidence. This is because the mountain range has a gap in Palakkad and so the absence of mountain results in less Cb formation and lightning incidence. The two figures indicate that the mid land of Kerala has more lightning. The high lands have the least of incidence and the frequency and distribution in the low lands falls between the other two.

District Wise Distribution of Accidents

District wise distribution of lightning taken from the same data is given in graph 2. The bar graph gives a picture of the relative distribution of incidence in different parts of the state. The proximity of a mountain in forming a Cb to cause lightning seems to be the reason for the difference in incidence in different districts.



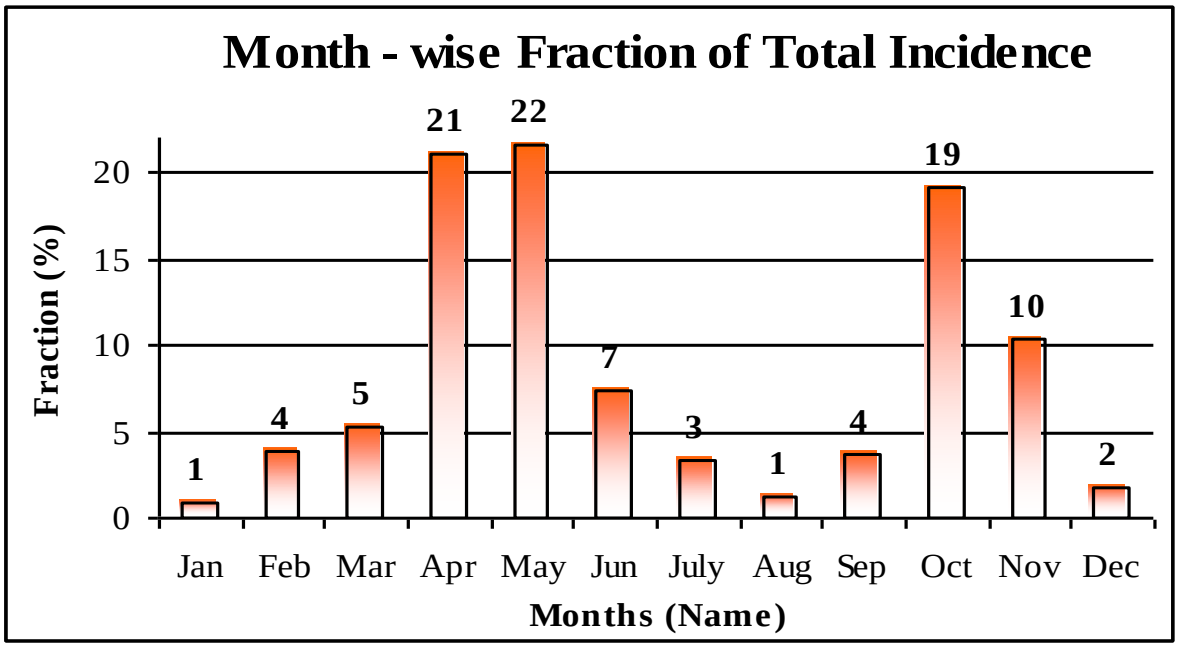
Graph 2: District wise distribution of lightning incidence in Kerala



Lightning hits plotted over the physiography map of Kerala

Month wise Distribution of Incidents

The Cb clouds usually form and produce lightning in, so to say, two seasons in an year. The first season comprises of months April and May and the second is for the two months of October and November. This is seen depicted in the bar graph of month wise fraction shown in graph 3.



Graph 3: Plot of month wise fraction of lightning incidents

Analysis of the 17 year's data yielded the most probable time for lightning to occur in a day also. Of the cases where time was available it was found that 83% of the events have happened between 1500 h and 1900 h.

2.9. Drought

Drought is a natural disaster and represents a period of 'drier-than-normal' conditions that results in water related problems. The table below shows the occurrence and intensity of drought (as per IMD criteria) in Kerala between 1871 and 2000. So far no studies have been attempted to map the drought prone areas of the state. Drought is not very well studied in Kerala from a risk reduction perspective.

Occurrence and intensity of droughts over Kerala during 1871-2000						
Decade	Intensity and occurrence of drought					
	Moderate	Large	Severe	Disastrous	Total	%
1871-80	0	0	1	5	6	60
1881-90	0	2	2	5	9	90

1891-00	0	1	1	2	4	40
1901-10	2	0	2	2	6	60
1911-20	1	1	1	2	5	50
1921-30	2	1	0	1	4	40
1931-40	0	1	1	1	3	30
1941-50	1	0	0	2	3	30
1951-60	0	1	0	1	2	20
1961-70	3	1	1	1	6	60
1971-80	3	2	1	1	7	70
1981-90	0	0	0	6	6	60
1991-00	0	1	2	2	5	50
Total	12	11	12	31	66	51
Drought intensity, %	18.2	16.7	18.2	46.9	-	-

2.10. Man Made Disasters

2.10.1 Road Safety In Kerala

India has one of the worst road crash rates in the world, 6 to 8 times more than most motorized countries. Within India, Kerala has one of the worst crash records in terms of deaths per vehicle registered. Since the beginning of the present century, Kerala has registered more than 2.38 lakh accidents in which about 2.50 lakh persons were injured, and more than 15,000 persons were killed. Though accidents have been declining in developed countries, Kerala registered a figure of 41,681 accidents in 2005, surpassing all the previous records. From 1960 to 2005, there is a steady increase in number of accidents, number of persons injured and number persons killed. Annual cost of these accidents to the exchequer is of the magnitude of Rs. 450 cores, which is equivalent to about 1.5 percent of the State Domestic Product. This is in part due to the high population density of the State. Awareness of this situation is, in large part due to work undertaken at NATPAC. The present state of the road network has much to do with the road safety problem. Little money is spent on maintenance and minor improvements, and investment in Kerala's excellent health and education systems has often been at the expense of road funding.

Growth of Accidents in Kerala

Year	Number of accidents	Persons Injured	Persons Killed	Number of Vehicles in lakhs	Accidents/1000 vehicles
1960	1528	1663	235	0.24	63.67
1965	2871	2982	368	0.55	56.34
1970	4214	4300	500	0.86	49
1975	5639	7107	842	1.31	44.69
1980	7064	9913	1184	1.75	40.37
1985	13756	18455	1489	3.78	37.78
1990	20447	26996	1793	5.81	35.19
1995	36086	49950	2519	10.06	35.87
2000	37072	49399	2710	19.1	19.41
2005	42363	51127	3203	31.22	13.57
2006	41647	49881	3589	35.59	11.7
2007	39917	48248	3778	40.25	7.28
2008	37263	43841	3897	44.42	8.39
2009	35434	41226	3742	48.8	7.26
Source: NATPAC					

2.10.2. History of Major Accidents in Kerala (Road / Rail/Boat)

- Perumon Tragedy, 8 July 1988. The Bangalore kanyakumari Island Express Train derailed on Perumon bridge over Ashtamudi lake, near Perinad, Kollam and fell into the lake, killing 107 people. Railway claims that the cause of the accident was a Tornado while the real cause still remains a mystery.
- Nine home-bound children of a primary school, eight of them girls, were killed and 11 injured when a van ran over them near Irikkur, about 22 km from Kannur, on 4th December 2008
- 18 dead as boat capsized at Thattekkad -Periyar River on 20 Feb 07.The accident happened at the Periyar river at the vicinity of the Bird Sanctuary, 55 km east of the port city of Kochi.
- Kumarakom Boat Accident: 29 persons who lost their lives in the boat accident on July 27, 2002 that a boat from Muhamma, carrying mostly youngsters who were coming to Kottayam to appear for a test conducted by the Kerala Public Service Commission,

capsized off Kumarakom coast in the Vembanad lake. Twenty-nine lives were lost on the spot, while another person who had received injuries succumbed to it a year later

- The Kadalundi River rail disaster was one of the biggest accidents on the Indian railway network in 2001. On 21 July, the Mangalore Mail commuter train heading for Chennai was crossing the Kadalundi River in the state of Kerala near Calicut on Bridge 924, when four carriages derailed and fell into the river. a figure of 57 people was eventually reported as killed or missing, including at least eight women and two children, whilst between 117 and 300 were injured and transported to nearby hospitals. These figures were still challenged by some, who said the toll was higher and that a number of people were still missing.

2.11. Industrial & Chemical Disasters

There is hardly any information regarding the hazard potential of industries in the state. However, it is reported that 55% of LPG that is required in the state is transported from Mangalore and 45 % of it is transported by road. Presently, road transportation of dangerous goods is a very weak area.

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Chapter III

Prevention and Mitigation Measures

Introduction

Preventing the occurrence of many of the natural hazards is impossible. However, life and property loss due to such extreme events can substantially be reduced by adopting mitigation measures (ADPC, 2005). Clear guidelines that address adoptable mitigation measures relating to individual natural and anthropogenic hazards is yet not complete for the state. Mitigation measures can be structural and non-structural; structural being construction of levees, check dams, control walls, etc. and non-structural being policies, awareness, methods and operating practices etc. It is known from the experiences of other States that that proper mitigation measures can result in huge economic benefit compared to a situation where no mitigation measures are adopted (Govt. of India, 1997).

It may be noted that although several studies addressing individual hazards have been conducted in the state ever since the colonial era, a focussed attempt to develop them into detailed mitigation plans suitable for various hazard prone regions of the state is still lacking. Further, a mitigation plan applicable to the entire state for a given type of hazard is nothing more than a myth. Based on available research from the State and elsewhere from the country, some general approaches for mitigating individual hazards are provided below which may be made use of by departments of the State for preparing their DM Plans and by District disaster Management Authority for preparing District DM Plans. Attempts are ongoing under the combined auspices of SDMA and CESS to compile and validate these approaches and eventually evolve detailed hazard mitigation plans.

Floods

A vast area in the state is prone to floods. It is required to introduce flood management system as a part of the integrated management plans of the river basins of the state. Drainage improvement shall be integrated into the master plan for water management in the urban areas with a specific focus on flood control.

Mapping of the flood prone areas is the primary step involved in planning mitigation measures. Historical records give the indication of the flood inundation areas, the period of occurrence and the extent of the coverage. It is better to reduce population density in flood prone areas. In flood prone areas where people already have built their settlements, measures

should be taken to relocate them. No major development should be permitted in the areas which are subjected to high flooding. Important facilities should be built in non-flood prone areas. In urban areas, water holding structures such as ponds, lakes or low-lying areas should be constructed which can reduce the amount of free flowing water. *Flood reduction* can be done by decreasing the amount of runoff by upstream interventions such as reforestation, protection of vegetation, clearing of obstructions from streams, regular de-silting of major reservoirs and water holding structures, conservation of ponds and lakes etc. *Flood diversion* includes construction of levees, embankments, dams and channel improvement which are also useful in some flood prone areas.

The mitigation of flood damage does not only depend upon the actions during floods but is a combination of pre-flood preparedness, operational flood management and post-flood review. It comprises of the following elements:

- *Pre-flood activities including flood risk management for all causes of flooding:* Disaster contingency planning, construction of flood defence infrastructure**,** land-use planning and management**,** discouraging of inappropriate development**,** public communication and education
- *Operational flood management which can be considered as a sequence of four activities:* Detection**,** forecasting**,** warning and response
- *The post-flood activities may include (depending upon the severity of the event):* Relief**,** reconstruction**,** recovery and review

An organization constituted for flood loss mitigation and management may have to coordinate all the above said activities and ensure sufficient financial means to carryout such activities. The nodal agency for flood hazard management in Kerala is the Department of Revenue.

It is necessary to ensure citizen participation in the operations. Sedimentation clearance, reforestation, construction of dykes etc. can be undertaken with community participation. In the eve of an extreme event, the community can assist the rapid response force in flood fighting for which a group of youngsters from the community must be trained and equipped.

Drought

Most of the water sources in Kerala are partially perennial and hence many parts of the state are prone to hydrological drought between the months of January and June (cf. Chapter 3). Many of the traditional sources of water in the state are neglected and the traditional practices are gradually dying out due to a variety of reasons. It should be highlighted that the practice of taking circular basins around coconut palms during monsoon season is largely declining in the recent past. The same is the case with the practice of ploughing. As a combined effect of several such factors the severity of drought is highly pronounced in the recent times when the northeast monsoon is below normal and/or the summer showers fail.

Drought, different from other natural disasters, do not cause any structural damages. The impacts of drought can be reduced through preparedness planning by identifying principal activities, groups, or regions most at risk and developing mitigation actions and programs that alter these vulnerabilities. Such a detailed drought mitigation plan is yet to be prepared for the state and hence only general directions for drought mitigation is provided herein.

Similar to the management of floods, a watershed based management approach is the most ideal for drought mitigation. From an evaluation study on the impact of soil and water conservation methods in three watersheds under the Western Ghats Development Programme, it is known that established watershed management techniques can improvement lean flow during summer months, reduction in recession of ground water table, improve the soil moisture and increase the productivity of cash crops. Locally increasing the water availability in each micro watershed would naturally lead to alleviation of drinking water scarcity in the treated areas and benefit all the crops, in both uplands and lowlands. The Hariyali project funded by the Department of Land Resources, Govt. of India that is being executed in Chadayamangalam block, Kollam district is an excellent example for revitalizing local water resources and thereby tackling hydrological drought conditions (Hariyali detailed project report, 2010).

The state Agriculture and Soil Conservation Departments have standardized structural/mechanical and agronomic measures for soil and water conservation strategies. An obvious structural method of meeting the water scarcity is to store the excess water during the monsoon period by creating large and small (check dams) reservoirs along the river course and utilize the stored water during the dry period. Agronomic measures include contour farming, off-season tillage, deep tillage, mulching and providing vegetative barriers on the contour. A number of such schemes have been already implemented in the state, while the actual results of such interventions are yet to be quantified in scientific terms.

An attempted to revitalize the traditional water sources may be of great leverage in tackling local drought conditions. In a survey carried out by the CWRDM, about 1000 ponds and tanks, each capable of irrigating a minimum of 2 ha of land were identified (CWRDM, 1989). Farm ponds extending up to 25 acres exist in Palakkad district. There are several interconnected/ networked ponds in Palakkad, Trivandrum and Ernakulam districts. Another survey conducted by CWRDM (1988) gave information on 250 springs in Kerala. Several springs were seen in the high range districts of Wayanad and Idukki and in the Attappady block of Palakkad district. It is very much important to rejuvenate these traditional sources of water. The construction of check darns across the streams and diversion of water to the adjacent plots for irrigation were age-old practices prevailed in Kerala. Restriction on Conversion of Paddy Fields and Wetlands will help in enhancing the excess rainwater retention in these natural bowls, which in turn reduce the flood discharge and increase the groundwater potential.

The existing drought management system has increased the dependence of people and communities on the State. As a result, people in drought-prone areas have abandoned traditional practices of drought management. There are government's initiatives in drought-proofing like the Drought Prone Areas Programme (DPAP), the Desert Development Programme (DDP), Integrated Wasteland Development Programme (IWDP) and Employment Assurance Scheme (Watershed). Unfortunately, most of these central schemes do not cover the State of Kerala.

Landslide

Unlike other hazards occurring in Kerala, landslides, particularly debris flows (Urul Pottal) are well studied by several researchers in several regions of the state (Kuriakose,

2010). A comprehensive landslide mitigation strategy has been detailed in Thampi et al., (1998). However, the findings of these studies have not yet been complied into detailed mitigation plans.

A landslide hazard zonation is the first step in the management of any prone area. The Geological Survey of India (GSI) is the nodal agency appointed by the Union Government to deal landslides in the country. GSI follows the zonation methods brought out by the Bureau of Indian Standards [IS Code 14496 (part-2):1998 and for cut slope evaluation. IS code 13365 (part 3) 1997]. This code was developed mostly based on the Himalayan landslides and hence was not completely suitable for Kerala. The Centre for Earth Science Studies (CESS) revised this methodology and made it suitable for the Western Ghats region falling within Kerala state. Based on this revised methodology, the CESS brought out a regional zonation of landslide prone areas in the Western Ghats of Kerala.

Since 1993 onwards CESS is conducting a number of awareness campaigns in associations with NGO's and print media throughout the state. CESS has also brought out a special news letter on Landslides, *Vasudha* in Malayalam for distribution in the prone areas. CESS has also made a documentary on landslides in Malayalam and English for creating awareness among locals. This documentary was telecasted in local as well as National networks of Doordarshan.

Some of the specific strategies adoptable in the state (depending on site conditions) to reduce the likelihood of a landslide or to repair damage done by an existing landslide are dewatering techniques, trench and interceptor drains, vertical wells and pumps, horizontal or directional drilling, bioengineering solutions, geotextile matting, slope grading. Details of individual mitigating techniques can be found in Sankar (2007).

Forecasting the probability of landslides is technically feasible in the state given the results of the detailed instrumented monitoring and modelling study conducted by CESS in collaboration with the United Nations University-ITC School for Disaster Geoinformation Management and University of Utrecht, The Netherlands (Kuriakose, 2010). The WINSOC system developed by Amrita University and deployed in Munnar is one of world's first functional state-of-the-art landslide early warning systems (Ramesh, 2009). However, forecasting can only be site-specific or with applicability to very small watersheds as it

largely dependents on the local rainfall characteristics, vegetation characteristics, soil depth, slope hydrological responses and the availability of historical landslide database (Kuriakose, et al., 2009).

At present, Indian Meteorological Department (IMD) is capable of issuing heavy rainfall warning only at district level which is insufficient for issuing landslide early warnings. In the state it is the Revenue Department that maintains data pertaining to disasters such as landslides. Apart from governmental departments and agencies, many newspapers keep archival data. It may be noted here that the reported occurrences of landslides are only a minor percentage of the actual happenings in the region. Normally the landslides with loss of life and property or considerable damage to public utilities like communication lines attract the attention of the authorities. Considerable part of the happenings in large scale plantations and forest land is not properly documented. These constrains limit the effective functioning of early warning systems.

Lightning

Some parts of Kerala are highly prone to lightning (cf. Chapter 3). Once lightning is initiated, it is impossible to escape from a lightning flash. This is because the whole phenomenon of one lightning flash, actually consisting of several flashes, will be over within about $1/10^{th}$ of a second and the minimum time of response of a human being is also of the same order. However, an understanding of lightning can go a long way in reducing the hazard due to lightning.

Kerala is a region with high density of vegetation. This results in most of the houses, RCC roof or otherwise, having a good number of trees nearby. In most of the cases the nearby trees are taller than the building which limits the lightning conductor installed atop them from protecting the trees. On lightning hitting one of the trees nearby, because of the electrical wiring and earthing of the house the lightning energy enters the house through the ground. The lightning rod does not prevent this. A ring conductor installed around the house can prevent such destruction to a large extent.

Electrical and electronic equipment, irrespective of whether they are inside a safe building or not, can go bad due to lightning energy entering their circuit directly or through telephone, internet and cable television networks. These equipments can be protected

to a considerable extent from lightning damage by installing a Lightning Arrestor. The CESS has issued best practices guidelines to reduce loss of life and property due to lightning (Muralidas, 2007).

Earthquakes

The seismicity pattern of Kerala exhibits crude spatial clustering around 1) Achankovil-Punalur 2) Idukki-Pala and 3) Thrissur-Palakkad areas, with minor activity near Trivandrum and Calicut. Although the mechanisms leading to earthquakes occurring in the state has been well documented, there have not been attempts to develop detailed mitigation plans. Available techniques and recommendations are all based on the Indian Standard Codes.

The present earthquake monitoring network and its state of affairs are detailed in Radhakrishnan (2007). Two sophisticated seismic observatories are function in the state since 1999, they being, the Peechi station of CESS and the Thiruvananthapuram station of IMD. After the 2000/2001 Irattupettah earthquakes, a major programme on time evolving-deformation based on GPS geodesy was initiated by CESS in and around Palghat gap and by Cochin University of Science and Technology (CUSAT) in and around Achankoil shear zone in collaboration with C-MMACS, Bangalore. Studies related to mapping geological structures to understand previous movements on selected faults have been initiated at CESS. Geophysical studies (Gravity and Magnetic) initiated at CESS and CUSAT along some of the major fault / shear zones such as Bavali shear, Palghat shear, Periyar and Idamalayar faults and Achankovil shear have shed light on the structural and tectonic aspects of these regions (Radhakrishnan, 2007). There is still need to strengthen instrumented monitoring, especially for monitoring micro tremors. Detailed seismic micro-zonation of the urban areas especially those situated on reclaimed wetlands such as parts of Kochi city are still lacking.

Buildings being the most severely affected structures need to be designed and built to withstand ground shaking. It is necessary to analyze soil type before construction and permission shall not be given to build structures on soft soil. Enforcement of construction byelaws, restriction on density and height of buildings and strengthening of important lifeline buildings are priority mitigatory steps to be adopted in Kerala.

Community based earthquake risk management strategies should be developed. Retrofitting of schools and important buildings, purchase of emergency response equipment and facilities, establishing proper insurance can be the programmes under Earthquake Risk Management Project. Local masons and engineers needs to be trained in disaster resistant construction techniques.

Cyclone

The coastal areas of the state are subjected to severe wind storms and cyclonic storms. Low pressure and the development of cyclones can be detected hours or days before its damage effects start. IMD uses satellites such as INSAT to track the movement and use geospatial technologies to project the likely path. Cyclone warning is disseminated by several means such as satellite based disaster warning systems: radio, television, telephone, fax, high priority telegram, public announcements and bulletins in press. Very few studies have been conducted pertaining to cyclone hazard, vulnerability and risk reduction in the state. Known techniques for cyclone risk reduction are based on experiences elsewhere and are briefly described blow.

Cyclone hazard mapping requires meteorological records of the wind speed and direction based on which the probability of extreme wind speeds is derived. Past records and paths can give the pattern of occurrence for particular wind speeds. A hazard map will illustrate the areas vulnerable to in any given year. Optimal construction practices should be adopted such as:

- It is advised to construct houses and other infrastructure on stilts or on earth mound. All elements holding the structures need to be properly anchored to resist the uplift or flying off of the objects
- A row of trees surrounding coastal settlements can act as a shield. Many coastal villages in Kerala have this vegetation belt
- Buildings storing food supplies must be protected against the winds and water
- Communication lines should be installed underground and satellite radio communication should be made available in all coastal villages
- Provide strong halls for community shelter in vulnerable locations

In conclusion, cyclone hazard requires to be studied in detail and location specific best practices for hazard mitigation needs to be developed along the coastal areas of the state.

Transportation Accidents

Kerala has one of the worst crash records in terms of deaths per vehicle registered. This is in part due to the high population density of the State, but there are many other contributing factors and road crashes are costing Kerala between 1 and 2% of its GDP, or conservatively, INR 450 crore per year. Transportation of hazardous materials by road has also caused several catastrophic accidents. However, detailed studies related to such accidents and mitigation strategies are yet to be conducted in the state. Strategies related to the mitigation of rail accidents are not currently available. The Indian Railway has standard procedures for ensuring the safety of rail traffic.

According to the yearly statistics published by the Govt. of Kerala, about 98% of all road accidents in the State are deemed to have been caused by the negligence of motor vehicle drivers. Inadequacies in the infrastructure, especially in the width of carriage-way, availability of pavements or shoulders, and their upkeep, obstructions caused by unscientific digging of roads and shoulders, raised or sunken man-holes, lack of basic discipline among pedestrians and cyclists, inadequacies in road markings and cautionary signs and want of strict enforcement of traffic rules by the police also play a role in leading to such large number of road accidents in the state.

Since the development of road infrastructure to cope with the increase in traffic is bound to be costly and time-consuming, our immediate priority ought to be for making the best possible use of the available road space and creating proper awareness of road safety matters among the people. In this context, a few aspects of special importance which are not sufficiently known and appreciated at present are observance of "Keep Right" by pedestrians, avoidance of dark clothes at night by pedestrians, cyclists and two-wheeler riders, avoidance of unplanned digging of roads and teaching road safety rules and best driving practices as part of the school curriculum.

Forest Fire

In Kerala there are no comprehensive data to indicate the loss to forests in terms of area burned, values, and volume and regeneration damaged by fire. The majority of the forest fires (in the state are human caused. It is widely acknowledged that most of these fires are

caused by the people deliberately and have a close relationship to their socio-economic conditions. Grazing, shifting cultivation, carelessness of the picnickers, travellers, and camper and collection of minor forest products by villagers are major causes of forest fires. The state forest and wildlife department has standard procedures such as fire line construction and vista clearance that are meant to reduce the probability of forest fires.

Chemical and Industrial Accidents, and Urban Fire outbreaks

At present, no information on chemical and industrial risk reduction is available for the state. Individual industrial complexes such as the Kochi Refineries Limited have their own off-Site and On-Site DM Plans. However, considering the fact that HAZCHEM are transported across the state by road, there is a need to address the transportation of hazardous substances under prevention and management of chemical accidents by respective ministries / State Departments in fine tuning the present legislative framework by introducing fresh rules, guidelines and facilities for the prevention and management of transportation emergencies.

Although reasons for urban fire outbreaks are known, there is hardly any hazard or vulnerability assessment carried out in this regards and hence specific risk reduction strategies are not available.

Epidemics

The state Health Department is responsible for the control and mitigation of epidemic outbursts. Structuring the health services is important to have clear understanding of roles and responsibilities of the public health system. Organizational preparedness and the coordination mechanism are required right from the State and District to the sub center level which is manned by the Village Health Nurses or the Health Workers.

An early warning system through a surveillance system is the primary requirement so as to have an effective response and prevent any outbreaks. For this, surveillance needs to be carried out at a regular basis through the routine surveillance system by involving the health tier system. Maps of all the health facilities in the region with an inventory of drugs and vaccines, laboratory set ups, list of number of doctors and supporting staff etc. need to be kept ready and updated at regular intervals. Training need to be given to so as to build the capacity at all levels. Training will help to cope better during the emergency response period for epidemics. Personnel protection through vaccination is an effective mitigation strategy and will protect the persons at risk.

Mainstreaming Disaster Mitigation in to Development Plans

The Disaster Management Act, 2005 (section 23.4.C) states that the State Disaster Management Plan shall include the manner in which the mitigation measures shall be integrated with the development plans and projects. The Eleventh Five Year Plan also emphasises the necessity of mainstreaming disaster management into development planning and requires that every development plan of a department should incorporate elements of impact assessment, risk reduction, and the 'do no harm' approach. The Second Administrative Reforms Commission (SARC) has recommended that disaster plans should be included in the development plans of the line departments of State Governments and local bodies.

Framework for Mainstreaming Disaster Management

Kerala State believes that disaster mitigation should be a part of the plan process and that the expenditure therein should be met out of the plan resources of the respective departments of the State. Although disaster mitigation is not generally associated with plan financing, there are in fact a number of plan schemes in operation, on sectors such as housing, health, infrastructure development and agriculture and on specific projects like drought proofing, afforestation, drinking water etc., which deal with the prevention and mitigation of the impact of disasters. It is advised that these schemes at the State level should be targeted towards mitigation, even though the current levels of funding of these schemes may not be adequate. The State Disaster Management Plan Profile calls for a framework for mainstreaming disaster management in the State and necessitates the departments of the State Government to give priority to hazard identification and risk assessment in their plans and schemes and allocation of a portion of plan funds for efforts that directly or indirectly help in disaster management.

The State Disaster Management Plan envisages formulation of a strategy for mainstreaming disaster management in the State which includes awareness generation, advocacy for political commitment, legislation, training and technical support, development of tools and monitoring and evaluation, and development of a set of indicators and assessment methodology.

a) Ways of mainstreaming Disaster Management

- **Structural Measures :**

  Ensuring all new critical infrastructure projects like power, water, communication etc compulsorily comply with the safety standards of disaster reduction.

  Implementation of techno-legal regime such as adoption of BIS codes.

  Ensuring all the existing infrastructure projects are retrofitted from future disasters, to the extent possible.

  Ongoing projects/programmes and already completed projects/programmes need to be audited to ensure that resilience to specific disasters to which the concerned locations are vulnerable.

- **Non – Structural Measures :**

  Amendment of Building by-laws, Land Use Regulations etc.

  Master plans for Earthquake Proofing /Flood Management etc.

  Flood Plane zoning

- **Specific Disaster Mitigation Programmes :**

  Implementation of Cyclone Risk Mitigation Programme

  Implementation of Earthquake Risk Mitigation Programme

  Implementation of State/District/local mitigation projects

b) Thematic / Sectoral linkages

- **Identify Key Sectors :** To mainstream disaster management, key sectors such as housing, infrastructure development, education, health and agriculture may be identified.

- **Develop appropriate guidelines for different sectors :**

  Housing – Promote increased use of hazard-resilient designs (flood proofing, seismic safety etc.,) in housing in hazard-prone areas, Utilization of national building codes and compliance and enforcement of codes and standards in hazard prone areas

Infrastructure: Public Works, Roads and Construction - Promote use of hazard risk information in land-use planning and zoning regulations, Conduct disaster risk impact assessments as part of the planning process before the construction of new roads or bridges.

Agriculture - Promote contingency crop planning to deal with year to year climate variations, Promote crop diversification including the use of hazard resistant crops to deal with shifts in climate patterns, Ensure sustainable livelihoods in areas of recurrent climate risks (i.e. arid and semi-arid zones, flood and cyclone prone areas) by promoting supplementary income generation from off-farm (e.g. animal husbandry) and non-farm activities (e.g. handicrafts), Promote effective insurance and credit schemes to compensate for agricultural related damage and losses to livelihoods due to natural hazards.

Education - Incorporate DRR modules into the school curriculum, Construct all new schools located in hazard-prone areas to higher standards of hazard resilience,

Health – Conduct vulnerability assessment of hospitals in hazard-prone areas, Promote hazard resilient construction of new hospitals, Implement disaster preparedness plans for hospitals.

- **Identify Key Programmes within each identified sector :** Specific programmes such as Indira Avas Yojana, Sarva Siksha Abhayan and JNNURM may be identified for mainstreaming.

- **Identify entry points and develop and employ mainstreaming tools in the project management cycle**

  Collecting and Using Information on Hazards, Environmental Assessment, Vulnerability Analysis, Social Impact Assessment, Risk Assessment, Economic Analysis, Safe Construction Design, Building Standards and Site Selection etc,.

- **Application of Checklists** - Setting a series of questions relating to disaster risk reduction, which must be answered during developing project planning documents.

Chapter IV

POLICY, INSTITUTIONAL, TECHNO – LEGAL & FINANCIAL FRAME WORK FOR DISASTER MANAGEMENT IN THE STATE

Kerala State has established a 'Policy, Institutional and Techno – Legal Frame Work' for disaster management' in the State which creates an enabling regulatory environment and compliance regime in the State and facilitates the activities of different phases of disasters.

Execution of Disaster Management Act, 2005 and enactment of Kerala State DM rules

The State Government, in line with National Disaster Management Act, 2005, has notified Kerala State Disaster Management Rules, 2007 (vide G.O (P) No. 71/2007/DMD dated 01/03/2007). The State has constituted State Disaster Management Authority (vide G.O (P) No. 154/2007/DMD dated 04/05/2007) and District Disaster Management Authorities (vide G.O (P) No. 303/08/DMD dated 09/09/2008) laying down clarity of roles and responsibilities for State and District authorities. The State Executive Committee of State Disaster Management Authority has also been constituted.

Kerala State Disaster Management Policy

The State Disaster Management Policy formulated by Department of Revenue and Disaster Management and promulgated by State Disaster Management Authority acts as the guiding principle for disaster management in the State. The goal of the Kerala Disaster Management Policy is to institute structures and systems and to establish directive principles for effective risk reduction and crisis management in order to minimise human, infrastructure, property, environment and livelihood losses and to contribute to the sustainability of development and better standards of living for poor and vulnerable sections.

Kerala State Disaster Management Authority and State Disaster Management Plan

Kerala State Disaster Management Authority shall function as the apex decision-making body and shall facilitate, co-ordinate, review and monitor all disaster management related activities in the State. The State Authority will lay down policies and plans for disaster management in the State. The State Authority will coordinate the implementation of State Disaster Management Plan and recommend provision of funds for various disaster management activities, particularly mitigation and capacity building.

The Government of Kerala has established State Disaster Management Authority with the following composition.

1. The Chief Minister of Kerala - Chairperson, ex-officio
2. The Minister for Revenue - Vice-Chairperson, ex-officio
3. The Minister for Home & Vigilance - Member, ex-officio
4. The Minister for Agriculture - Member, ex-officio
5. The Chief Secretary to Govt. of Kerala - Member, ex-officio
6. The Additional Chief Secretary, Home Dept. - Member, ex-officio
7. The Additional Chief Secretary, Revenue Dept. - Member ex-officio
8. Dr. K.G. Thara, Head, Disaster Management Faculty, ILDM - Member ex- officio
9. Dr. C.T.S. Nair, Executive Vice President, Kerala State Council for Science Technology and Environment & ex-officio Principal Secretary to Govt., - Member, ex-officio
10. Dr. G.S.L.H.V. Prasad Rao, Associate Director, Kerala Agricultural University, Thrissur - Member under clause (i) of rule 3

The State Authority will approve the disaster management plans prepared by departments of the Government of the State and will lay down guidelines to be followed by the departments for the purpose of integration of measures for prevention and mitigation of disasters in their development plans and projects. The State Authority shall also review the development plans of the departments to ensure that prevention and mitigation measures are integrated therein and review the measures being taken for prevention, mitigation, preparedness and capacity building in the State.

State Executive Committee and Crisis Management Group

The 'State Executive Committee' constituted by Government of Kerala vide G.O(P) No.339/2007/DMD dated 19.9.2007 with the following members will assist the State Authority in the performance of its functions.

1. The Chief Secretary to Government : Chairperson, ex-officio
2. The Principal Secretary, Revenue Department : Convener, ex-officio
3. The Secretary, Finance Department : Member, ex- officio
4. The Secretary, Home Department : Member, ex- officio
5. The Secretary, Health Department : Member, ex-officio

The State Executive Committee will coordinate actions in accordance with the guidelines lay down by the State Authority and will ensure compliance of the directions issued by the State Government. The State Executive Committee will implement the State Plan and will act as the coordinating and monitoring body for management of disasters in the State.

The State Executive Committee will also function as 'Crisis Management Group' under the chairmanship of Chief Secretary with Principal Secretary of Department of Revenue and Disaster Management as convenor at the State level in the event of a disaster as a nerve centre to support, coordinate and monitor crisis management activities related to various disasters.

The Department of Revenue and Disaster Management

The scope of Department of Revenue has been enhanced to include prevention, mitigation and preparedness aspects of Disaster Management apart from its traditional responsibility of relief and rehabilitation and renamed as Department of Revenue and Disaster Management. The department will be the nodal department for disaster management. The Principal Secretary to government will act as the State Relief Commissioner. The organizational structure of the Department dealing with disaster management will be so tailored as to reflect the change in focus from post-disaster relief and rehabilitation to prevention, mitigation and preparedness.

District Disaster Management Authorities and District Disaster Management Plans

The District Disaster Management Authorities notified and established by the State Government in all fourteen districts will act as the district planning, coordinating and implementing body for disaster management and take all measures for the purposes of disaster management in the district in accordance with the guidelines laid down by the State Authority. The District Disaster Management Authorities will prepare District specific District Disaster Management Plans and coordinate and monitor the implementation of State and District Plans. The District Authority will issue such instructions to different

Departments of the Government in the District on implementation District Disaster Management Plan and Departmental Disaster Management Plans.

State Nodal Departments and Departmental Disaster Management Plans

The Department of Revenue and Disaster Management will be the nodal department for management of all types of natural disasters that include geological and hydro-meteorological disasters. The Department of Home shall be the nodal department for management of manmade (and human induced) disasters including air and rail accidents. The Department of Public Health shall be the nodal department for biological (health related), radiological and nuclear disasters. The Factories and Boilers Department shall be the nodal department for industrial accidents and the department shall work in tandem with Industries Department in the event of a disaster. While Agricultural Department deals with drought, pest attacks and hailstorm; cattle epidemics shall be handled by Animal Husbandry Department. Irrigation Department shall be the lead agency for disasters related to dam bursts. Public Works Department and Local Self Government Departments are the nodal agencies for major building collapses. Forest Department shall be the nodal department for disasters like forest fire.

Every nodal department of the State Government will prepare a Disaster Management Plan in conformity with the guidelines issued by State Authority and furnish implementation status report to the State Executive Committee of State Authority.

State Disaster Response Force

Kerala State has constituted State Disaster Response Force with headquarters at Peerumedu Taluk in Idukki District for the purpose of specialised response to threatening disaster situations. A Regional Response Centre of National Disaster Response Force is also set up in Kozhikode, in addition to the Seasonal Response Centre in Idukki.

Emergency Operation Centres

A State Emergency Operation Centre (EOC) is set up under the nodal department of Revenue and Disaster Management linked with the office of State Disaster Management Authority. Its system and procedures are designed in such a way that information can be promptly assessed and relayed to concerned parties as rapid dissemination contributes to

quick response and effective decision making during the emergency. EOC will function round the clock and will maintain direct linkage with district control rooms through phone, fax, wireless and internet. The State Disaster Management Authority will ensure that a comprehensive information network is available for timely collection of hazard-related information and rapid dissemination of relevant information and alerts/warnings.

Emergency Operation Centres are set up in each district headquarters under the control of District Collectors for day to day monitoring of preparedness measures and to coordinate rescue and relief operations.

State Nodal Departments will also establish Emergency Operation Centres and will assign Nodal Officers for disaster management.

Institute of Land and Disaster Management

The Institute of Land and Disaster Management set up under the Department of Revenue and Disaster Management will function as the nodal planning and analysis, and training arm of the State Disaster Management Authority and will be responsible for training and research, documentation and development of state level information base, generation of technical data banks, generating short and long-term rehabilitation measures and for imparting appropriate training to State and District level officials on disaster management. This institute will promote sharing and dissemination of specialised knowledge on disaster management among various implementation agencies, NGOs, private sector and the community in the state.

Techno – Legal Frameworks

The state government will follow national building codes and other codes as laid down by Bureau of Indian Standards. Relevant departments / District administrations / local authorities shall ensure that existing building bylaws, land use zoning regulations and development control regulations correspond to the requirements for safe construction as laid down by various agencies such as Bureau of Indian Standards (BIS) for seismic zone III. Transfer of disaster resistant construction technology (Disaster resistant designs and construction practices and retrofitting techniques) by capacity building of construction fraternity (town planners, engineers, architects, builders and developers and masons) shall be promoted by the state government.

State Disaster Response Fund

The Calamity Relief Funds which was in operation till March, 2010 to meet the expenditure for providing immediate relief was merged in to State Disaster Response Fund vide notification G.O (P) No. 498/2010/DMD dated 03-12-2010 on the recommendation of 13'th Finance Commission. The fund is maintained in the public account of the state for providing immediate relief. The State Government will also claim on the National Disaster Response Fund (previously NCCF) through memorandums for central assistance for relief and rehabilitation in the event of any calamity of a larger proportion.

Chapter V

Preparedness and Capacity Building Measures

Preparedness involves measures that enable the government, communities and individuals to respond rapidly and effectively to disaster situations and ensure that communities and services are capable of coping with the effect of disasters.

Roles and responsibilities of important stakeholders

State Disaster Management Authority

The Kerala State Disaster Management Authority will act as the nodal agency for preparedness and capacity building measures and would monitor the preparedness of the State to various disasters.

State Disaster Management Authority will develop and constantly update, a Master Disaster Management Plan for the State in furtherance of the State DM Plan Profile to enable the State and District administrations, departments and the community to prepare for and to respond systematically and effectively to disasters. Analyses of different types of hazards and assessment of vulnerabilities and risks of the State for developing detailed prevention, mitigation and preparedness measures would be part of State DM Plan. A comprehensive repository of man power, machinery and other resources would be created, maintained and easily accessible to the relevant authorities at all times to facilitate quick contact with people and availability of resources on the onset of a disaster.

Departments of State Government

The departments of the State Government will prepare 'Departmental Disaster Management Plans' that involve programmes within the routine departmental works for disaster prevention, mitigation and preparedness and strategies for its successful implementation. The Departmental Plans will also describe the departmental responsibilities during various disaster situations and department-level capacity building policy. The nodal departments will prepare disaster specific DM plans for different types of hazards that keep

integration with the functioning of Crisis Management Groups and State EOC. The State departments shall also formulate 'Disaster Management Cells' within the departments and shall deploy a senior officer as 'Nodal Officer for Disaster Management'. Details of the main departmental officials (name, designation, and contact details), inventory of departmental resources (resource, capacity, location etc.) and departmental standard operating procedures shall also be prepared as part of departmental plans. Standard Operating Procedures that precisely define how operations are to be carried out, explain what is expected and required of the department personnel and procedures for evacuation, procurement of essentials, deployment of resources and such other activities shall be prepared by relevant departments to ensure effective functioning in the event of disasters.

District Collector / District Disaster Management Authority :

The State Disaster Management Plan imposes that there is a plan for disaster management for the district. The District Collector shall facilitate and coordinate with local bodies to ensure that pre-disaster activities in the district are carried out successfully and ensure appropriate linkage between disaster management activities and regular development activities. The District Collector shall facilitate training and awareness programmes for communities and ensure that relevant officials in the district are properly trained in handling possible disasters in the district.

Local Authorities

Local Authorities are responsible for ensuring compliance to various disaster management specifications and codes stipulated by relevant agencies based on hazard zonation and risk and vulnerability assessments. The local authorities shall coordinate community based disaster preparedness activities of the district.

Non-Governmental Organisations and Private Sector

Civil society organisations, voluntary agencies and local community groups shall actively participate in preparedness activities of the district and assist the district administration and local bodies in providing trainings in the pre-disaster stage. The private

sector shall ensure compliance to disaster management codes and specifications stipulated by relevant authorities and shall ensure that the staffs are adequately trained in disaster management. Corporate sector shall actively involve in awareness generation, training and research in the field of disaster management. The Industrial Sector would develop and implement on-site and off-site disaster management plans as part of preparedness and capacity building.

Preparedness & Capacity Building Programmes

a) Early Warning / Emergency Communication System :

In order to strengthen the emergency response communication capabilities and early warning facilities of State and District administrations and to enhance coordination between State, District administrations and villages, VHF based Early Warning System is installed in 295 vulnerable villages in the state with the support of Asian Development Bank and United Nations Development Programme. This wireless radios system offers a free flow of communication between District Head Quarters and Village Offices / Taluk Offices. The wireless radio installed in the villages which is connected to a PA system through an amplifier, facilitates the communication from District Headquarters to the general public, if necessary. The PA system installed at the top of the Village Office building can disseminate warnings or messages from District Administration to a distance of 1.5 KM (radius), enabling District Collector to directly communicate to the community living in these villages. Other than disseminating warnings, the system also provides communication facilities between District Headquarters and Village Offices / Taluk Offices facilitating coordinated response and relief in the event of a disaster.

b) Community Level Preparedness

The Government of Kerala has implemented a Community Based Disaster Risk Management Programme in 197 vulnerable villages covering nine coastal villages with the support of United Nations Development Programme that aimed at building local capacities at various levels and promoted preparedness. Formation of Community based hazard prevention, mitigation and preparedness plans and constitution of disaster management committees and task forces were the main components of the project

c) Training & Capacity Building

Institute of Land and Disaster Management under the Department of Revenue and Disaster Management functions as the nodal training arm of the State Disaster Management Authority. The institute undertakes training for various governmental agencies, NGOs, public/private sector and the community in the State with the help of National Institute of Disaster Management.

d) School Suraksha Programme

To generate awareness on disasters at school level, to promote a culture of disaster preparedness in the school community in the state and to promote disaster management clubs/teams in schools, Department of Revenue and Disaster Management has initiated a 'School Suraksha Programme' in association with Department of Education. The programme launched in 2010 will cover all the Government Schools in the State. Rs. 1.75 Crores is allocated by Department of Revenue and Disaster Management for the implementation of the programme.

e) Strengthening / Capacity Building of Search & Rescue Services

The Department of Revenue and Disaster Management has effectively utilised the provisions in the Calamity Relief Fund to procure equipments necessary for search and rescue for Fire and Rescue Services in the State. Rs. 20 Crores have been allocated during the last two years for the same.

f) National Cyclone Risk Mitigation Programme

The Department of Revenue and Disaster Management will undertake construction of Cyclone Shelters cum- multipurpose community centres in nine coastal districts, shelter belt plantation & regeneration of mangroves, shelter connectivity and related activities in vulnerable villages with due provisions for accommodating displaced families with the support of National Disaster Management Authority and World Bank. The key objectives of the Project is to create suitable infrastructure to mitigate the effects of cyclones in the coastal Districts of the State and to reduce the vulnerability of coastal communities to cyclone and climate hazards through improved access to emergency shelter, evacuation, and protection against wind storms, flooding and storm surge in high risk areas. An investment proposal

worth more than Rs. 200 Crores has been submitted to National Disaster Management Authority and the project is expected to be launched in 2011.

g) Government of India – United Nations Development Programme Disaster Risk Reduction Programme

Based on the Disaster Risk Management actions stipulated in the National DM Act (2005) to be undertaken by DM Institutions at various levels, risk reduction priorities identified in the Eleventh Five Year Plan, actions highlighted in the Hyogo Framework of Action (HFA) and lessons learnt from the implementation of GoI-UNDP Disaster Risk Management Programme (DRM 2002-2009), a Disaster Risk Reduction Programme (DRR 2010-2012) is chalked out by Ministry of Home Affairs with the support of United Nations Development Programme. The DRR programme is envisaged to support State Government Programmes and initiatives by providing critical inputs that would enhance the efficiency and effectiveness of these efforts.

GOI-UNDP DRR Programme will have two outputs. I) Institutional strengthening & capacity building for Disaster Risk Reduction to be implemented by NDMA. II) Urban Risk Management to be implemented by Ministry of Home Affairs. The programme would have four sub-outputs as follows: Institutional strengthening, Capacity-building for recovery, Disaster risk reduction and Urban risk management. Rs. 1.3 Crores have been earmarked for the implementation of the project in three Districts (Idukki, Wayanad & Palackad) and five Municipal Corporations in year 2010.

h) Capacity Building Programmes under Capacity Building Funds recommended by Finance Commission

Effective disaster response requires trained manpower to deal with complex situations where effective and speedy handling can reduce the impact of a disaster on human life and property. It is necessary to continuously undertake measures to build capacity amongst those handling response and creating awareness amongst people. The Kerala State has been allotted Rs. 20 Crores by Central Government on the recommendation of 13'th Finance Commission and this amount shall be utilised for taking up activities for building capacity in the

administrative machinery for better handling of disasters. The broad Capacity Building Plan for next four years include strengthening of EOCs that function in 14 District Head quarters, Setting up GIS Lab facilities for DM, Strengthening of State Disaster Response Force, installation of Digital Rain Gauge systems in Taluks, preparation of IEC materials, setting up knowledge Centre, Developing GIS based Critical Facility Information System for districts, procurement of Search and Rescue equipments, Training and Capacity building of various stakeholders and preparation/updation of district and state level disaster management plans as envisaged in the DM Act

Chapter V

State Response Plan

The Disaster Response involves emergency search, rescue and relief measures taken in anticipation of, during and immediately in the aftermath of a disaster to ensure that the effects of the disaster are minimized. The overall response strategy will vary from level to level of the disaster (L0, L1, L2, and L3) based on the ability of various authorities to deal with them.

The State will remain in readiness to provide assistance if needed in an L1 specified disaster that can be managed at the district level. The State will actively participate, mobilise resources at the state level and will provide assistance to the respective District Disaster Management Authorities in disasters in the category of L2. Even though there cannot be water tight compartmentalisation of responsibilities between districts and the State, the participation of the State will normally be at the L2 level disaster.

Roles and Responsibilities of Stakeholders

State Administration

As and when a crisis situation is developed, the District Collector will flash the 'first information' to the State Administration / Crisis Management Group and stimulate crisis management activities under the guidance of State Crisis Management Group. The Principal Secretary, Department of Revenue and Disaster Management as convenor of State Crisis Management Group would recommend to the State Government or State Disaster Management Authority if the event needs to be declared as a state disaster (L2 Disaster)

The Kerala State Disaster Management Authority will facilitate, co-ordinate and monitor the activities in the response phase. The Kerala State Disaster Management Authority would, if required, co-ordinate with agencies of other states and other national and international agencies to supplement the relief being provided.

The Crisis Management Group and Incident Response System at the state level will be activated in this phase as Chief Secretary / Principal Secretary of respective nodal department as the Responsible Officer. Each department would perform their respective responsibilities as per the Emergency Support Function under the Incident Response System.

Departments of State Government

The relevant government nodal departments shall carry out search, rescue and immediate relief operations as per the Departmental Disaster Management Plans and District Disaster Management Plans under the overall supervision of State Disaster Management Authority.

District Disaster Management Authority

The District Disaster Management Authority headed by the District Collector will activate all the institutional arrangements for disaster response in this phase as per the District Disaster Management Plan.

Local Authorities

The Local Authorities including Municipal Corporations, Municipalities and District, Block and Grama Panchayaths would work in close coordination with State Disaster Management Authority and relevant government departments in performing the key activities of this phase catering to the immediate requirements of affected population.

Non-Governmental Organisations and Private Sector

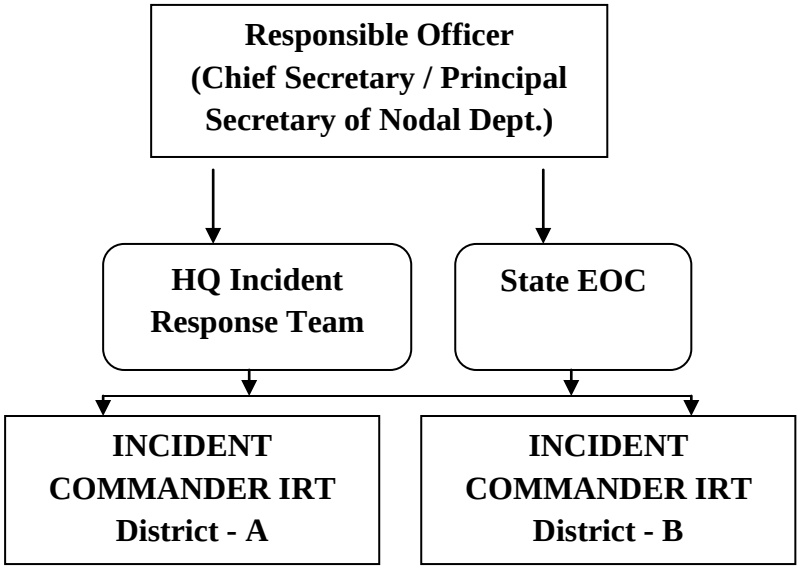
The human, material, technical and financial resources of Non-Governmental Organisations and the private sector shall be mobilized to provide immediate relief to the affected people. They shall also support the relief efforts of the State Government through supply of emergency search and rescue items, hardware items like generators, pumps, industrial equipments etc. along with deployment of skilled technicians and volunteers.

State Incident Response System for Response

The Incident Response System is an organized system of government departments and other agencies that are to be worked under a structured pattern for response and immediate recovery. The Incident Response System provides a structure under which all the line departments will function in tandem with the District and State Administration and lays down various tasks that may need to be performed by the existing administrative machinery at

various levels. Departments and external agencies are grouped into various 'Emergency Support Functions' under the system.

The State Administration will provide necessary support to the District Administrations, if Districts are overwhelmed in any situation, as the initial efforts would always be taken by the District Administration in any disaster response. In order to clearly demarcate proper coordination of the various response efforts at the State level with that of the District, the structure of the Incident Response System in the context of State response is formed and given below.



The Organisational structure, particularly the HQ Incident Response Team of Incident Response System at the State level will be activated only in a State level disaster and Responsible Officer will involve all required Emergency Support Functionaries (ESF) and Headquarters Incident Response Team (IRT) to support the on-scene Incident Commander who will work in close coordination with State EOC and report to Responsible Officer.

Emergency Support Functions (ESF)

A crisis situation demands the intervention and assistance of experts from different departments / fields in order to ensure a quick and effective recovery. Keeping this aspect of disaster management in view, Emergency Support Functions have been conceptualised to take care of various response actions. Each Emergency Support Function is headed by a lead

department and the designated primary agency will be assisted by one or more support agencies (secondary agencies) and will be responsible for managing the activities of the Emergency Support Function. Nodal officers of all the ESFs would constitute and employ Incident Response Team who will accomplish the response actions at the field level. Similarly supporting agencies would also assign their nodal officers and IRT members will assist the primary officers during response.

The relevant departments/ agencies shall draw up Emergency Support Function Plans and constitute Incident Response Teams and designate resources in advance. Pre contract/ agreement can be made for all disaster relief items so as to avoid delays in procuring relief items after disaster situation.

ESF – 1 Coordination (warning, evacuation, relief, shelter, damage assessment, NGO/volunteers Coordination)

Primary Functions:

- Establishment of evacuation plans / Identification of fastest evacuation routes and all alternative routes.
- Coordinate search and rescue logistics during field operation
- Immediate arrangement of food and relief materials during the crisis.
- Ensure coordination of activities involved with the emergency provisions of temporary shelters, emergency mass feeding and bulk distribution of relief supplies to the disaster victims
- Control quality and quantity of food for relief/ Ensure timely distribution
- Provide adequate and appropriate shelter to all population / Locate relief camps close to open traffic and transport links.
- Develop alternate arrangements for population living in structures that might be affected even after the disaster.
- Encourage various voluntary agencies and organizations to depute the volunteers / Gather general youth mass to volunteer / Operation wise categorize the volunteers / Identify any specialized skills and area of interest among volunteers.

- Arrange of mass donations of monetary resource, food, clothes, medicines, essential items, cattle feed, and cattle medicines.
- Maintain a record of donations and its supply to the needy area.
- In coordination with relevant depts. assess the Number of lives lost, Number of People Affected, Number of Houses damaged (category wise), Damage of Infrastructures like School, Hospitals, Govt. Buildings, Road, Electricity, Water Supply etc.

ESF	Primary Agency / Team Leader	Supporting Agencies/ Nodal Officer
Coordination	Revenue & DM / Commissioner of Land Revenue or Head of SDMA Secretariat	Police – DGP Fire & Rescue – Commandant

ESF – 2 Communication

Primary Functions:

- Restore Communication facilities after disaster
- Provide emergency communication for response to government: link affected site with DEOC/DEOC with other Departments etc.
- Provide communication facility to affected communities
- Coordinate the requirements of temporary telecommunication in affected areas.

ESF	Primary Agency / Team Leader	Supporting Agencies/ Nodal Officer
Communication	Police / DGP BSNL / State Head	Pvt. Tele/mobile operators, HAM Radio Operators

ESF – 3 Search & rescue

Primary Functions:

- Establish, maintain and manage search and rescue operations.
- Coordinate search and rescue logistics during a field operation

ESF	Primary Agency / Team Leader	Supporting Agencies/ Nodal Officer
Search & Rescue	Fire & Rescue Services / Commandant	Police – DGP, Revenue – CLR, Health – DHS, Fisheries – Director Air Force/Army/Coast Guard

ESF – 4 Law & Order

Primary Functions:

- Maintaining law and order (crowd control, riot/looting control, preventive arrests).
- Assisting the authorities in un-interrupted relief operations.
- Coordinate the requirements of temporary telecommunication in affected areas.

ESF	Primary Agency / Team Leader	Supporting Agencies/ Nodal Officer
Law & Order	Police / DGP	CISF /CRPF/Military Forces

ESF - 5 Medical Response

Primary Functions:

- Direct activation of medical personnel, supplies and equipments.
- Activation of Mobile Medical teams with first aid & Mobilize emergency treatment for the injured people .

- Appropriate mass vaccination to check the waterborne epidemics.
- Set up Trauma Counseling Desks.
- Perform medical evaluation and treatment as needed.
- Maintain patient tracking system to keep record of all patients treated.

ESF	Primary Agency / Team Leader	Supporting Agencies/ Nodal Officer
Medical Response	Department of Health / DHS	Pvt. Hospitals, Ambulance Services, Blood Banks, Indian Red Cross, NGOs

ESF – 6 Public Works (debris/road clearance, equipment support)

Primary Functions:

- Restore the road communication system / Assess the damage for reconstruction of road ways
- Restore the infrastructure like health centers, school, important buildings,
- Initiate the reconstructions unrecoverable important infrastructures
- Emergency clearance of Debris
- Coordinate and provide manpower and equipments for debris and road clearance
- Provide alternative routes, if main routes are affected
- Demolish unsafe buildings

ESF	Primary Agency / Team Leader	Supporting Agencies/ Nodal Officer
Public Works	PWD / Chief Engineer	Fire & Rescue , LSGD, Revenue, Forest, MILITERY SERVICES

ESF – 7 Public Information/Help lines/NGO coordination

Primary Functions:

- Provide and collect reliable information on the status of the disaster / disaster victims for effective coordination of relief work
- Setting up of toll free numbers for emergency information assistance / Establish help lines for providing, directing and coordinating logistical operations.
- Process and disseminate information / Manage flow of information and warning dissemination.
- Provide a platform for NGO coordination

ESF	Primary Agency / Team Leader	Supporting Agencies/ Nodal Officer
Public Information	Public Relations / PRD	Doordarsan, AIR, BSNL, Media, NGOs

ESF – 8 Logistics (Water, Electricity & Transportation)

Primary Functions:

- Ensure smooth transportation links
- Restoration of power supply or temporary power supply to critical areas.
- Facilitate restoration of electricity distribution systems at most affected sites on priority to help in Search and Rescue operations.
- Provide electricity in lifeline buildings.
- Delivery of clean drinking water
- Transportation of relief/relief parties/affected community.
- Ensure quick restoration of drainage system.

ESF	Primary Agency / Team Leader	Supporting Agencies/ Nodal Officer
Logistics	Water – KWA / MD	Revenue
	Electricity – KSEB / CE	PWD
	Transport- Transport Dept./Commissioner	KSRTC, Private Bus Owners

Annexure I

Emergency Telephone Directory

I. Kerala State Executive Committee / Crisis Management Group

6. **The Chief Secretary to Government** : Chairperson, ex-officio,
Contact no: 0471-2333147,2327376, Fax no:0471-2327176, Mobile no: 09447773303

7. **The Principal Secretary, Revenue Department** : Convener, ex-officio,
Contact No: 0471-2325239, Fax no: 0471-2335467, Mobile no: 09447132755

8. **The Secretary, Finance Department** : Member, ex- officio
Contact no: 0471-2327586, Fax no: 0471-2326990,

9. **The Secretary, Home Department** : Member, ex- officio
Contact no: 0471-2327451, Fax no: 0471-2327451, Mobile no: 09446440085

10. **The Secretary, Health Department** : Member, ex-officio
Contact no: 0471-2336602, Fax no: 0471-2336602, Mobile no: 09895033377

II. SDMA Secretariat / Technical Wing,

Address : Revenue Complex, Commissionarate of Land Revenue, Public Office Building, Opp. to Museum, Thiruvanthapuram-33. ☏: 0471-2324 120, Fax: 2333 198

Designation	Emergency Contact Nmber
Secretary	09446313133
Technical Expert	09526454705
Section Officer	09447901994
Clerk	09496204334

State level Emergency Operation Centre (EOC):
2nd Floor, Revenue Complex, Commissionarate of Land Revenue, Public Office Building, Opps., to Museum, Thiruvanthapuram, Contact Nos: 0471 - 2331639, 0471 - 2333198.

GOI – UNDP Disaster Risk Reduction Programme
State Project Officer : 09744797371
Programme Coordinator, URR : 09995824251
Documentation & Communication Officer – 09447573494
IT/GIS Specialist - 09746396112

III. DM Nodal Officers of Major departments

Sl.No.	Department	Nodal Officer	Phone & Fax no.
1.	Police Department	Addl. Director General of Police(South Zone)	0471- 2323775, Fax: 0471-2323573, Mobile: 09497999993
1.1	Police Department	Addl. Director General of Police (North Zone)	0495-2368500, Fax: 0495-2369190, Mobile: 09497999998
2.	Fire & Rescue Services	Commandant General	0471-2320868, Fax: 0471-2320868
3.	Health Department	Director	0471-2303025, Fax: 0471-2303025, Mobile: 9946105491
4.	Agriculture Department	Additional Director & Head Soil Survey	0471-2466145, Fax:0471-2468190, Mobile09847138143
5.	Irrigation Department	Chief Engineer (Irrigation & Administration)	0471-2322927, Fax: 0471-2322927

6.	Mining & Geology department	Director	0471-2447429, Fax: 0471-2447429
7.	Director of Ports	Director	0471-2324842, Fax: 0471-2324533
8.	Animal Husbandry Department	Director	0471-2302283, Fax: 0471-2302283
9.	Motor Vehicles Department	Dy. Transport Commissioner (South Zone)	0471-2333336, Fax: 0471-2333336, Mobile: 09539010261
10.	Industries & Commerce Department	Joint Director	0471-2308721, Fax:0471-23054493, Mobile: 09895146826
11.	Factories & Boilers Department	Director	0471-2463597, Fax: 0471-2477141
12.	Panchayat Department	Director	0471-2323286, Fax:0471-2323286, Mobile:09447183286
13.	Fisheries Department	Asst. Director of Fisheries	0471-2304348, Mobile:09496410944
14.	Civil Supplies Department	Commissioner	0471-2321152, Fax:0471-2321152, Mobile: 09447744200
15.	Social Welfare Department	Asst. Director	0471-2300672, Fax : 0471-2300672

EMERGENCY CONTACT NUMBERS

KSDM

State Level

Office	Telephone	Mobile	Fax
inister	04712333812	9447711500	04712333489
linister	04712327876	9447711600	04712327016
e Minister	04712333176	9447788200	04712332021
ecretary	04712333147	9447165022	04712327176
ecretary	04712327451	9446440085	04712327550
e Secretary	04712326239	9447132755	04712333017
es Sentary	04712327582	9847495954	04712327582
g Secretary	04712333028	9447028410	04712333028
	04712721601	9447733311	04712726560
(Tech), Fire Force	04712320872	9847088006	04712337422
, Civil Supplies	04712320578	9446327878	04712321152
, Health	04712303025	9946105491	04712303025
(I&PRD)	04712327782	9446356334	04712327782

The Kerala State Disaster Management Authority was formed as stipulated in the National Disaster Management Authority Act of 2005 with the Chief Minister as Chairman and the Revenue Minister as Vice-Chairman. KSDMA has a State Executive Committee headed by the Chief Secretary to Government. KSDMA is bringing out this emergency contact numbers ready reckoner directory with contact numbers of State Control Room, State Level Offices, Centralized Services and District Level Key Departments which will be helpful in emergency situations for the Officers involved in Disaster Management.

State Level

Office	Telephone	Mobile	
Director of Public Instructions	04712325108	9746333100	047
MD, KWA	04712322767	9447798383	047
Chairman, KSEB	04712442125	9446008002	047
Director, Agriculture	0471230480	9446304480	047
Director, Animal Husbandry	04712302283	9446562283	047
Director, Fisheries	04712303160	9447120661	047
CE, PWD(B&R)	04712322346	9447094676	047
CE, PWD(Bldgs)	04712322946	9447122946	047
Director, Urban Affairs	04712322886	9446533341	047
MD, KSRTC	04712462829	9447576859	047
MD, KTDC	04712727108	9447730470	047
Director, Panchayath	04712323286	9447183286	047
Director, State Water Transport Dept.	0477225015	9446385722	047

Centralised Services

partment	Telephone	Mobile	Fax
rmy	04712352373		04712353030
lavy	04842872466 04842872268	9496062028	04842668257
ir Force	04712551361 04712551362	9446551361	04712554908
NG Control Room)	04712750981	9447972100	04712756638
Centre Control	04712752617		
Coast Guard	04842218121	9447972212	04842217164
	04712505364	9446422242	04712505364
ction Force	04832783397	9447743398	04832783396
s	04712325828	9746789000	04712325469

Control Room	0471-2333198
Relief Commissioner	04712325239, 9447132755
epartment	04712336987, 9447700116
A	04712335185, 0471 2324120

District Collectors

District	Telephone	Mobile	Fax	Control Room
Thiruvananthapuram	04712731177	9447700222	04712731166	04712731188
Kollam	0474279400	9447795500	0474279270	0474279400
Pathanamthitta	04682222505	9447029008	04682222505	04682222515
Alappuzha	0477225172O	9447129011	0477225172O	0477226831
Kottayam	04812562001	9447029007	04812303303	04812562201
Idukki	04862233103	9447032252	04862233101	04862232242
Ernakulam	04842423001	9447729012	04842422282	04842422282
Thrissur	04872361020	9447129013	04872362290	04872362424
Palakkad	04912533266	9387288266	04912505556	04912505309
Malappuram	04832734355	9847029017	04832734355	04832734922
Kozhikode	04952371400	9447171400	04952370552	04952371002
Wayanad	04936202230	9447204666	04936203450	04936202251
Kannur	04972700243	9447029015	04972704243	04972713266
Kasargode	04994256400	9447496600	04994255833	04994257700

Helplines

Childline	109
Crimestopper Cell	109
Kerala Government Call Centre	155
Railway Call Centre	139
Traffic Helpline	109
Accident Helpline	994
Railway police Helpline	994
Police Helpline	047
Women Helpline	109

District Level

rtment/ nation		TVM	KLM	PTA	ALPA	KTYM	IDK	EKM	TSR	PKD	MPM	KKD	WYD	KNR	KSGD
P	Tele	04712315803	04742764422	04682222636	04773339326	04812564700	04862233006	04842623550	04872361000	04912534011	04832734377	04962523100	04936202525	04972783330	049
	Mob	9497996985	9497996984	9497998983	9497996982	9497998980	9497996989	9497996979	9497998978	9497996977	9497998976	9497996975	9497996974	9497998973	949
	Fax	04712315803	04742744165	04682222636	04772263600	04812564700	04862233006	04842623550	04872361000	04912534011	04832734377	04962523100	04936202525	04972783360	049
scue	Tele	04712331101	04742746200	04682222001	04772230303	04812567444	04862272300	04842220613	04872423650	04912505701	04832734800	04952323191	04936202333	04972706900	049
al Officer	Mob	9447905207	9446540101	9496330418	9447956270	9447125848	9946558014	9447557277	9633782848	9847815208	9447808581	9446777535	9497076505	9895639594	949
MO	Tele	04712473257	04742795017	04682222642	04772252329	04812562778	04862233030	04842360802	04872333050	04912505189	04832766857	04952370540	04935240390	04972700194	046
	Mob	9946105472	9946105473	9946105475	9447725764	9446064060	9946105481	9995340207	9946105485	9946105487	9946105489	9447313639	9946105493	9946105495	944
e RDO	Tele	04712731600	04742793461	Thiruvalla 04692601202 Adoor 04734224827	Chengannoor 04792452225 Alappuzha 04772243441	04812562315 Pala 04822122212	04862232231 Devikulam 04865264222	Muvattupuzha 04852863 19 Fortcochin 04842215340	04872360100	04912535585 Ottappalam 04662244303	Perinthalmanna 04933227214 Thirocr 04942421200	04952375458	Manantthawady 04936240222	Thalassery 04902343500	0467