Child Centred

Risk Assessment

Kerala

2019

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Dr K B Valsalakumari

DRR Consultant - UNICEF

Chapter 1

Child Centric Risk Assessment (CRIA) and Programming

1.0 The Rationale

Across the world, crises are becoming more frequent and complex, and are lasting longer and affecting more children than ever before (Global Humanitarian Overview, 2019)

It is a well known fact that globally the number and the types of hazards are on the increase. The world has been witnessing hazards that were unheard of several decades ago. As human society is evolving and emerging with new scientific and technological developments altering the living patterns, new threats, hazards and disasters are emerging. In the past, disasters were predominantly of natural origin which has now diversified as chemical, nuclear and other human induced disasters. Apart from that, the intensity and frequency of several hazards have increased. One of the biggest challenges that humanity faces is climate change and its disastrous consequences. For instance, last summer the whole of Western Europe was reeling under temperatures as high as 42°C which is the highest recorded temperature in Europe in the last two decades. Kerala floods of August 2018 had devastating consequences to the economy, environment and society of the state. A flood of such intensity had happened way back, only about one century back, in 1924. Climate change related risks are emerging as a security threat to nations across the world triggering civil unrests and affecting welfare of the people. It has been observed that in the past 35 years, the number of disasters especially weather related disaster events have tripled (Hoeppe, 2015).

The global humanitarian appeal for 2018 is set at a record US$22.5 billion, to cover 91 million persons. The total economic losses worldwide associated with natural disasters average between

US$250 million and US$300 million per year. In future, annual losses are expected to reach US$314 billion in the built environment alone. Between 1980 and 2012, more than 42 million human life years (Global Assessment Report on Disaster Risk Reduction,2015) were lost annually to internationally reported disasters, representing an enormous setback to economic development and social progress. More than 80% of this loss was experienced in low- and middle-income countries (ibid.).

Disasters have serious negative consequences for lives of people, assets, properties, livelihood and services. Although disasters don't discriminate among different categories of people, the way disaster is experienced by people, varies from people to people. In a situation of disaster, the worst impacted are the most vulnerable sections of the society like children, the disabled, pregnant women, lactating mothers, and the aged. Class, caste and gender are further exacerbating factors of a disaster. Of these categories of the vulnerable population, the worst affected are children because their voices are not heard and they are not fully capable of expressing their views, opinions, experiences and needs. In situations of disasters children are sometimes separated from their parents, they are severed from their main source of sustenance and very often from the channels of services that keep them alive. Children bear the brunt of disasters especially in situations of violence and war. They cannot move out of their houses, cannot play or engage in normal daily activities. They lose their childhood. They are cut off from their parents and essential services resulting in illness, malnutrition, limited or lack of access to education, exploitation etc. Children especially girls are forced into child labour. Sometimes both girls and boys have to undergo the trauma of migration along with their parents, severing all relationships with their friends and communities. Nearly a quarter of the worlds' children ie 535 million children were to live in countries affected by armed conflict, violence, disaster and/or chronic crisis in 2017(Guidance on Risk Informed Programming UNICEF, 2018). Currently, throughout the world, there are nearly 40 million children displaced by natural or man-man disasters (Bothe *et al.* 2018). 50 million children

were deemed “uprooted” in 2016, having either migrated across borders or been forcibly displaced by conflict, climate change or poverty. 800 million people were living in low-income, informal settlements in 2014, residing on land exposed to hazards and without adequate protective infrastructure, decent housing or access to basic services (Global report on internal displacement, 2019). 385 million children were living in extremely poor households in 2013, meaning that they had limited capacity to cope with the impacts of shocks and stresses. 136 million people across the world are in need of humanitarian aid and protection. As the first assessment of the cost of internal displacement on education was published in February 2019 by the Internal Displacement Monitoring Centre (IDMC), it is estimated that USD 850 million per year is required at the global level for basic educational needs of all internally displaced children(Global report on internal displacement, 2019). Very often the needs and aspirations of children are not articulated properly or heard by planners and policy makers at the national or sub-national levels. UNICEF being an organisation that stands for every child, hopes to bridge this gap of inadequacy and inaudibility by highlighting and analysing the risks faced by children, and assessing the impact of those risks on children, thus paving the way for advocacy.

All major international documents like Transforming Our World: The 2030 Agenda For Sustainable Development, Global Humanitarian overview 2019, Sendai Framework for Disaster Risk Reduction 2015-2030, Paris Agreement on Climate Change 2015 speak about the need for addressing and reducing risks globally. India being a signatory to all these major international agreements is duty bound to implement the relevant provisions of the documents. The National Disaster Management Act 2005, National Policy on Disaster Management 2009, National Disaster Management Plan 2016, all point towards the need for addressing disaster risk reduction at the national and sub-national levels.

When a disaster strikes a community, the loss of the community is very huge. Instead of responding to a disaster and subsequently taking recovery measures, as the saying goes, prevention is always better than

cure. Investing money in preventive actions and long term mitigation measures is much more economical than allowing a disaster to occur and then subsequently trying to recover from it. So it makes good economic sense to invest in preventive measures like disaster risk reduction activities, including long term mitigation measures. Analysing the risks faced by a community and adjusting programmes accordingly will go a long way in minimising or preventing the loss of hard earned development gains. It minimises the loss of human beings and animals apart from preventing destruction of the rich biodiversity of an area, arresting environmental degradation and losing of livelihood.

Transforming Our World- 2030 Agenda for Sustainable Development recognises the impacts of various hazards and reiterates the need for reaching those who are left behind , girls and boys, women and individuals with disabilities and the most impoverished who are disproportionately vulnerable and who bear the brunt of the negative impacts of stress/shocks (Sustainable development Goals, 2015). The Sendai framework for DRR draws our attention towards preventing new crises and the need to reduce disaster risks related to various stresses and shocks (Sendai framework, UNISDR, 2015). It focuses on human vulnerability and urges us to integrate gender, age, disability and cultural perspective in all policies and practices. The World Humanitarian Summit 2016 which transformed the agenda for humanity into one that favours the most vulnerable segment of society states that the success of any international intervention is to be measured by a year on year reduction of human vulnerability on risk and not by the proportion of acute and urgent risks. All these international documents are a pointer to the need for designing policies at the national and sub national levels with a view to reducing vulnerability rather than responding to shocks and stresses after it occurs.

According to the preamble of the Convention on the Rights of the Child(1989) ‘ the child should be fully prepared to live an individual life in society, and brought up in the spirit of the ideals proclaimed in the Charter of the United Nations, and in particular in the spirit of peace, dignity,

tolerance, freedom, equality and solidarity'(Convention on the rights of Child, 1989). Article 6 of the same document recognises the inherent right of every child to live. Article 37 says that every child deprived of liberty shall be treated with humanity and respect for the inherent dignity of the human person, and in a manner which takes into account the needs of persons of his or her age.

Adopting a right based approach will be the first step towards ensuring that children are insulated from violations of these rights. Any violation can be redressed by approaching the appropriate authority or body. Children are the future citizens of a country and they are the rich resources for nation building. Hence it is imperative that we provide a milieu of safety and security to them from all forms of disasters. Child Centric Risk analysis is a major step forward to accomplishing this environment of safety, security, and resilience of children.

At the national level various initiatives have been taken to make the lives of children safe and secure. Co-terminus with the economic aspirations of the country is the desire to make the most vulnerable segments of society insulated from the negative impacts of disasters. The Government of India took a major step by enacting the Disaster Management Act of 2005 which is a fairly comprehensive piece of legislation aimed at the effective management of disasters in the country. It provides for the creation of a National Disaster Management Authority that is mandated to lay down national policies on disaster management, approve national plan for DM and sectoral plans for disaster management, lay down guidelines to be followed by states and various ministries and departments and for coordinated enforcement and implementation of policies and plans, recommending provision of funds for mitigation purposes and capacity building. Following this many states and union territories framed their own state disaster management plans that are specific to their unique climatic, geographic, and meteorological conditions. The Disaster Management Policy of 2009 and the National Disaster

Management Plan of 2016 along with the Disaster Management Act provide the policy framework for states and union territories to chart their roadmaps towards disaster risk reduction for the population. Closely aligned to these national policy structures, the state government has also taken meaningful measures to combat disasters, to reduce risks to its populations especially to the most vulnerable sections. Following the 73 rd and 74th amendments to the Constitution of India, passed by Parliament in 1992, greater functions, funds and functionaries were devolved to the local self governments of Kerala. In Kerala there are a total of 1200 local governments, including 941 gram panchayats, 152 block panchayats, 87 municipalities, 6 municipal corporations and 14 district panchayats. The people's planning movement was a great thrust to participatory planning and also helped in deepening of democracy. Understanding how, climate change compounds the consequences of disasters in Kerala, and bearing in mind the need for preserving he biodiversity of the state and at local levels, a working group(namely the 13th working group) has been additionally constituted for biodiversity management, climate change, environment protection, and disaster management by the state government (GO (RT) No 2462/2018/LSGD dated 19/09/2018). This is in addition to the already existing 12 working groups that deal with agriculture, health, women and children, social security, energy etc. in the planning process at the level of the local self government. The 13th working group will play a major role in the preparation of the DM plan at the panchayats level. The panchayats will be the focal point in ensuring convergence of all service at the local level for effective risk reduction and for rebuilding a resilient and green Kerala.

This Child risk impact assessment report of Kerala is unique in the sense that based on historical evidence, the vulnerability of children to various risk is assessed at the Gram Panchayat level. This document will give the various risks that children are vulnerable to at the local level so that gram panchayats can use this document as a planning tool and take preventive and long term and short term

mitigative actions. This in turn will minimise fatalities of children, will ensure continuity of essential services to children, thus minimising malnutrition, illness etc.

1.2 Methodology

The history of multiple hazards, vulnerability and capacities are taken from the data available with KSDMA, IMD and Women and Child Development department. Based on the data, the risks were projected visually in GIS platform using ARC GIS by overlaying various layers in the map (vulnerability, stress/shock, vulnerability, exposure) and a risk index is calculated for each administrative unit. If one panchayat falls in high risk index zone, then the panchayat is highly prone to multiple hazards with respect to child population in that panchayat and one with the low risk index indicates that the gram panchayat is least prone to multi hazards.

This document is a tool for advocacy for children. It is also a planning tool that will strengthen school safety program in Kerala and help students and their parents and teachers in emergency preparedness, and fast recovery. It will also build resilience at the grass roots level apart from reducing vulnerability and exposure of children to multi hazards. This can also be used as a tool for strengthening the capacity of service delivery systems.

Chapter 2
Kerala

2.1 Kerala – State Profile

Kerala known as God's Own Country is blessed by nature profusely, situated as a narrow strip of land sandwiched between the Arabian Sea to the west and the Western Ghats to the east, located between latitudes 8º 18' and 12º 48' North and longitudes 74º 52' and 77º 22' East. Physiographically the State comprises of highland which is higher than 75m above msl (48%), midland with foothills and plains which is between 7.5 and 75m above msl (42%), lowland and coastal belt which is below 7.5m from msl (10%). The state has a long coastline extending to 590 km. Kerala has 10 soil types, and 13 distinct agro climatic zones

Kerala receives an average annual rainfall of 3107 mm which is one of the highest rainfall averages in the country. Parts of Kerala's lowlands may average only 1250 mm annually while the cool mountainous eastern highlands of Idukki district comprising Kerala's wettest region – receive excess precipitation. Kerala's rains are mostly the result of seasonal monsoons. Kerala averages some 120–140 rainy days per year. Kerala's average maximum daily temperature is around 36.7 °C and the minimum temperature is 19.8 °C. the rivers that originate in the western ghats bring along with them fertile topsoil, enriching the natural fertility of the soil. The density of dug wells per square kilometer in different physiographic regions of Kerala is 100 in highland, 280 in midland and 500 in coastal/lowland and has the highest well density in the world.

As per the Census of India 2011, the population of Kerala was 3,34,06,061 or 2.76 per cent of India's population. Out of the State's total population, 52 per cent are women and 48 per cent are men. The decadal growth rate of Kerala's population was 4.9 per cent, the lowest among the Indian States.

Literacy – As per 2011 census, Kerala has a very highly literate population and literacy rate being 94%, male literacy 96.1% and female literacy 92.1%. This is the highest female literacy in the entire country. The high female literacy has significant implication for development because literate mothers are the best conduits for the intergenerational transmission of information and knowledge and healthy practices. The decadal growth rate of Kerala's population was 4.9 per cent, the lowest among the Indian States.
The Census data shows an absolute decline in the number of children aged o to 6 years in the State. Kerala's total child population in 2011 was 34,72,955 (10 per cent of total population) as against 37,93,146 (12 per cent of the total population) as per the 2001 Census data. At the all India level child population as per 2011 census was 13.1 per cent while it was 15.9 per cent as per Census 2001.The Census 2011 data also reveals that the child population as a proportion of the total population is below the national average for Tamil Nadu (9.56 per cent), Karnataka (11.21 per cent) and Andhra Pradesh (10.21 per cent). The highest proportion of child population was in Malappuram District and the lowest proportion was in Pathanamthitta District. A decreasing trend in the proportion of child population is seen in all Districts of the State. The southern Districts of Kerala witnessed 2 per cent decline except for Kollam, in which there was a decline of 1 per cent in the proportion of child population, while the northern Districts in Kerala showed 1 per cent decline in the proportion of child population. But Wayanad District had a decline of 2 per cent.

The drainage of the region is in conformity with the physiographic division, with the summit of the Western Ghats forming the natural divide between the drainage systems of the west coast and Tamil Nadu plains. Majority of the streams in Kerala flows in westerly direction, in their course through highland and midland following the trends of rocks. In the coastal plains covered by a thick mantle of alluvium and laterite, the streams flow with a low gradient towards sea preferring no particular direction.

Kerala is blessed with 44 major rivers, out of which 41 west flowing rivers, most of them having their sources in the Western Ghats and drain into the Arabian Sea. Some of these rivers have a portion of their catchments in the adjoining states of Karnataka and Tamilnadu. In addition there are three rivers which also originate from the Western Ghats, but they flow eastwards into the states of Karnataka and Tamilnadu. All the rivers are entirely monsoon-fed and many of them shrink into rivulets or dry up completely during summer.

Kerala has diverse land use and cropping pattern. Population growth, migration, urbanisation, industrialisation and globalisation had led to significant land use changes in the state. The land reform introduced in the state brought in radical and comprehensive institutional changes leading to drastic transformation in the land holding pattern. This has resulted in shift in the land uses pattern. The data on land use pattern of Kerala for the year 2014 – 2015 reveals that out of a total geographical area of 38.86 lakh, net sown area is about 53%. Forest occupies around 28%. Agriculture and forest sector together account for over 84% of the land area. The net sown area has increased by 3% from 5.65 Lakh Ha in 2013 – 14 to 5.81 lakh ha in 2014 – 15. As a result, the gross cropped area registered a minor increase of 0.3 percent. Another notable feature is the decline in the area of barren and uncultivated land (-5 %), Permanent pasture and grazing land (-38%) and the area under current fallow (-8%).

Kerala being situated in the humid tropical zone with heavy precipitation and high temperature has given rise to widely varying soil group from similar parent materials. They are forest soil, laterite soil, red soil, alluvial soil, peat soil, sandy soil, and black soil. Though the main geological formation of the state belongs to the Archean period consisting of crystalline and metamorphic rocks, climate and topography seem to be the dominant soil forming factors.

An important geomorphic feature of the coastal plain of Kerala is the existence of a string of estuaries and lagoons along the coastline. There are 27 estuaries and 9 lagoons. Of these, the largest is

the Vembanad estuary. Occurrence of mud bank is another peculiar phenomenon of Kerala coast. The Backwaters are well-recognized feature of Kerala, it is an interconnected system of brackish water lakes and river estuaries that lies inland from the coast and runs virtually the length of the state. These 34 backwaters facilitate inland travel throughout the region.

The State consists of 14 districts, 75 Taluks, 21 Revenue divisions, 152 blocks, 999 panchayats and 1664 villages. Compared to all-India level, Kerala's gram panchayats are large, with about 20,000 people in each, and spreading over arbitrarily delineated territory. About 40% of the State development funds are utilised through the local self government institutions. The sea coast is bordered by 222 gram panchayats, 19 municipalities and 4 corporations. The density of population in the coastal area is 2250 as against 860 of the state.

The population spread across the State indicates that there are no big urban agglomerations. The human settlement pattern of the State is characterized by dwellings occupied in small individual plots, scattered all over the habitable area. As per 2011 census data, Kerala is positioned in the 9thranking for the level of urbanisation among the States of India, while as per the 2001 census the State was positioned in the 19thrank.

2.2 Climate and its variability

The State of Kerala is specifically vulnerable to the changing climatic dynamics owing to its location along the sea coast and steep gradient along the western slopes of the Western Ghats. Though high potential growth rate of forests and perennial agriculture in Western Ghats provide high resilience against mild climatic variations, high population density, especially in the coastal areas, adds to the vulnerability to the climate related problems. Kerala experiences two rainy seasons, viz., the South-West (i.e. June to September) and the North-East (i.e., October to December) seasons, locally known as

'Edavappathy' and 'Thulavarsham' respectively. The South-West Monsoon brings heavy rainfall (~60%). The annual rainfall varies from < 1000mm to more than 5000 mm with an annual average of 3000 mm. Kerala, which lies in the tropic region, is experiencing humid tropical wet climate. Meanwhile, its extreme eastern fringes experience a drier tropical wet and dry climate. Annual rainfall distribution is better in the southern districts of Thiruvananthapuram, Kollam, Pathanamthitta, Kottayam, Alappuzha and Ernakulam, than its northern counterpart..

Both day and night temperatures are lower over the plateau and at higher elevations than over the plain. The mean annual temperature is 27°C. The average minimum temperature ranges from 19°C - 20°C, whereas average maximum temperature from 27°C - 37°C. March is the hottest month with a mean maximum temperature of about 33°C. Mean minimum temperature (28.5ºC) is in the month of July.

Unprecedented events of Heat wave conditions were reported in many parts of Kerala State during the summer months of April-May, during 2015 and 2016. As per media reports, casualties were reported more from the northern districts of Kerala close on the heels of Palakkad registering maximum temperature of 41.9 °C during 2016, the highest temperature ever recorded in the State. Heat waves are anomalous episodes with extremely high surface air temperatures exceeding the long-term average by about 4.5 °C, and lasting for several days with serious consequences. The maximum temperatures recorded in many parts of the State either crossed or reached near the critical level of 40 °C, leading to unpleasant living condition. For example, mercury levels in Kannur town rose to 39.2 °C surpassing the earlier all-time highest temperature record of 38.3 °C observed on 16 April 1998 (Fig. 1).

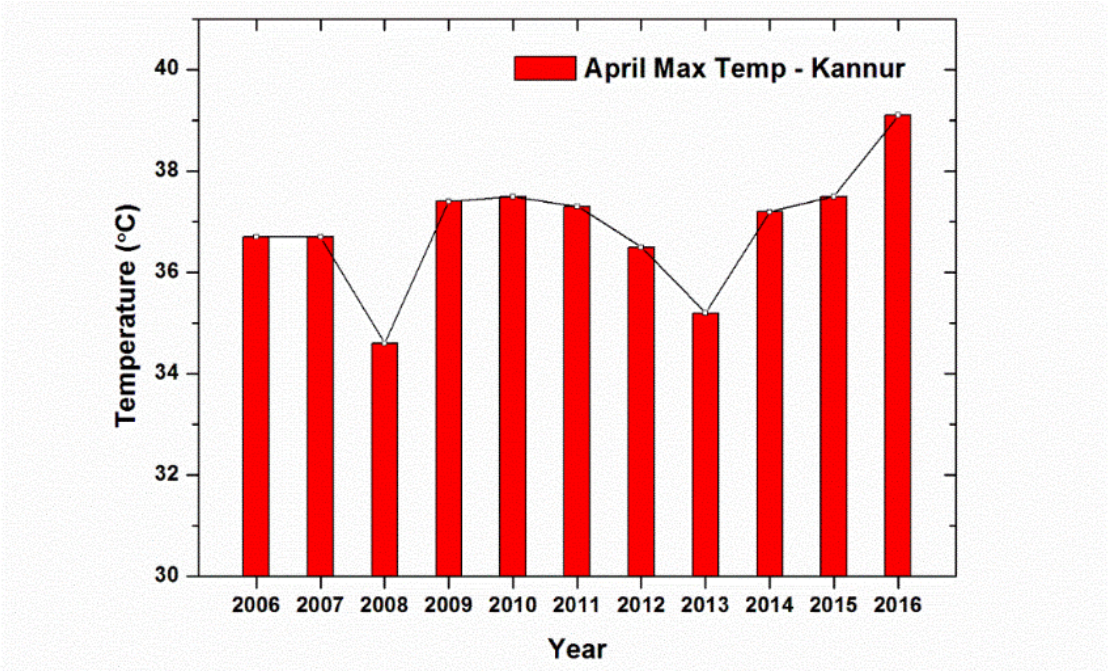


Fig.1 Maximum temperature recorded in the month of April from 2006-2016

Similar conditions existed over other districts too. Generally, the weather during the pre-monsoon months April-May is hot with ample humidity. This peculiar characteristics lead to the formation of widespread thundershowers with occasional severe thunder and lightning, and bring about a temperature drop by about 2-3 °C. However, the summer rainfall during 2016 was very sparse (Fig. 2) over the State with exception of a few showers. Yet, this spell of rain was not good enough to bring significant respite from the intense heat. As a result, most of the drinking water sources dried up, which is a strange phenomenon for the last 3-4 decades. The excess amount of humidity in the atmosphere intensifies the adverse effect of heat on human and animal body by slowing the natural evaporative cooling mechanism, a special concern for Kerala in the context of heat burn and sun-stroke related health risks and deaths.

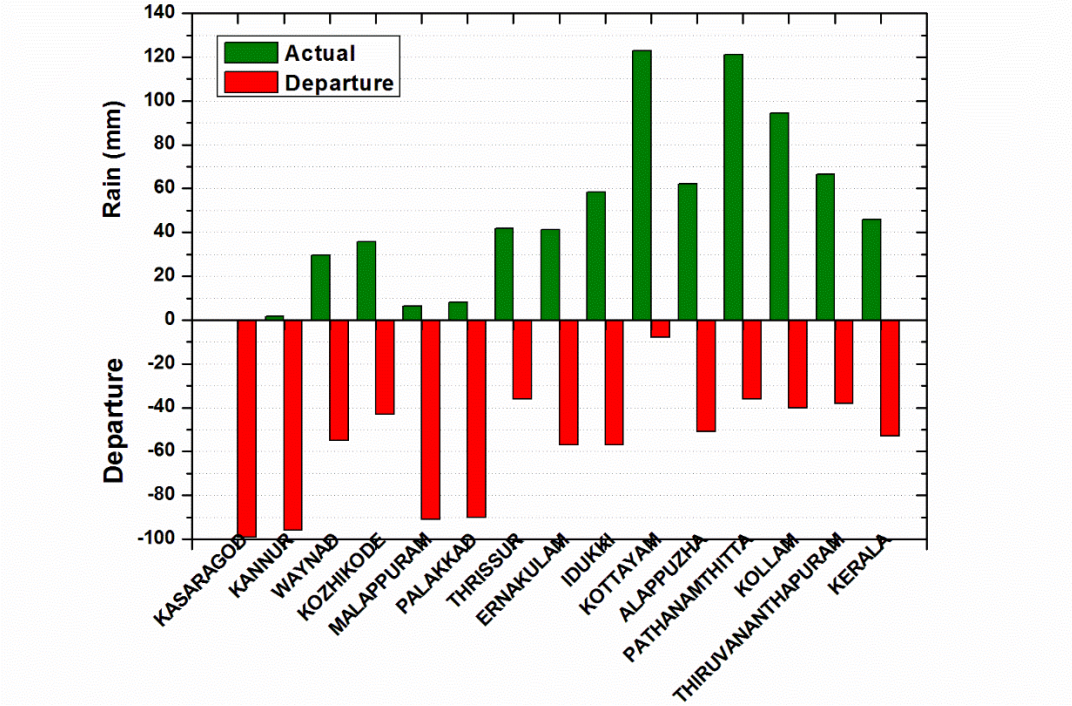


Fig 2 Departure of pre-monsoon rainfall (from 01 March to 22 April, 2016) for different stations in Kerala

Climatological analysis of rainfall data for the last 140 years shows cyclic pattern with a significant declining trend in the south-west monsoon season for the last six decades. IMD in its 'State level climate change trends in India' documents that Kerala is witnessing an average decline in south-west monsoon rainfall by about 2.42 mm per year. There is a long-term decreasing trend in the annual mean rainfall over Kerala during the last 146-year period. Whereas, a significant declining trend in annual rainfall is noticed from 1965 onwards. A decrease of 27 mm was noticed during the study period of 146 years as against the normal rainfall of 2837 mm whereas a decline of 338 mm was noticed during the period of last 100 years as against the normal rainfall of 3025 mm.

It is confirmed from the analysis of 146 years of rainfall data that there is a significant decrease (10.9 mm in 10 years)in southwest monsoon rainfall while increase (7.5 mm in 10 years)in post monsoon season. Rainfall decline is more significant in June and July but not so in August and

September within the monsoon season. The percentage rainfall contribution during the southwest monsoon was declining while increasing during pre and post-monsoon seasons. The above phenomenon was more significant in recent decades. There is a significant increasing trend in monthly rainfall during February, March, October and November. Of the total annual rainfall the contribution of the June rainfall decreased from 28% to 22.4% and that of July decreased from 23% to 18.4% over a period of 146 years.

2.3 Hydrology

The net annual groundwater recharge (utilizable) and utilization for the state have been assessed as about 6029 MCM and 2809 MCM respectively by the CGWB (2009). This means only about 47% of the groundwater potential is utilized in the State, comprising of 152 revenue blocks. Considering this State level estimate (macro level), it appears that more than 50% of the groundwater potential is still available for further development. However, a micro level examination at block level, reveals problems only in few blocks. One block (Chittur) has been classified as over exploited (>100% utilization) and 3 blocks (Kasaragod, Malampuzha, Kodungallur) have been classified as critical (> 90% to 100% utilization). More than 80% of rural and 50 % of the urban population use groundwater for their domestic needs. Almost every rural household has its own well. The density of dug wells per square kilometer in different physiographic regions of Kerala is 100 in highland, 280 in midland and 500 in coastal/lowland and is the highest well density in the world. The domestic water requirement, especially in urban areas is mainly met through public water supply schemes dependent mostly on rivers. However, most of the piped water supply schemes depend on wells or infiltration galleries constructed in the river beds tapping the base flow in the rivers or groundwater accumulated in the river bed. Groundwater also meets partial requirement of irrigation and industrial needs of the State.

The annual replaceable groundwater resources and the net groundwater availability in Kerala are estimated at 6841 Mm^3 and 6231 Mm^3 respectively. As per the monitoring report of Central Ground Water Board, Kerala Region, the depth to ground water level in the state as monitored from the observation stations varies widely in the range of 0.20 to 20 mbgl except in isolated areas. The present gross groundwater draft for all uses in the state is computed as 2920 Mm^3. Of this, the domestic and industrial draft accounts for 37.6 % (1099 Mm^3) and irrigation accounts for 62.4% (1821 Mm^3).

The major water use sector in the State is agriculture, accounting for about 60 to 70% of the water resources currently being utilised. The State has 18 completed irrigation projects, with a total storage capacity of about 1200 MCM. Four irrigation projects are at different stages of implementation. Minor irrigation structures including Vented Cross Bars, Check Dams and Lift Schemes irrigate almost 80% of the net irrigated area of 3.96 lakh ha in the State. The combined utilization of both major and minor irrigation projects is about 5000 MCM. The major source of irrigation in Kerala is wells (both private and government open wells and tube wells) which irrigate 37 % of the net irrigated area, followed by private and government canals (25%), private and government tanks/ponds (11%), minor lift irrigation (2%) and other water based-irrigated area in the state has been fluctuating around one lakh ha for the past several years. As per the assessment of the Directorate of Economics and Statistics the net irrigated area in the state as on 2003-04 is 3.81 lakh ha and the gross area irrigated is 4.27 lakh ha. Only 17.36% of the net cropped area is under irrigation. The net irrigated area that was 4.13 lakh ha in 2015-16, declined to 3.77 lakh ha in 2016-17 and showed an increase of 4 per cent to 3.92 lakh ha in 2017-18. Wells contributed as the major source of irrigation benefiting 1.23 lakh ha followed by irrigation canals which served an area of 0.76 lakh ha.

The estimated groundwater balance is about 5590 Mm^3. Dug wells are the major extraction structures with a density of 200 wells per square km and with a total number of 6.5 million in the State. Apart from the above, Kerala has 995 tanks and ponds having more than15000 Mm^3 summer storage.

Chapter 3

Hazards and Risks

3.1 The total number of phenomena that have the potential to cause disasters in Kerala as identified by KSDMA is 39. Out of these, those listed below are categorized as natural. The likelihood of them morphing into disasters will depend upon the coping capacities of the communities:

1	**Flood (Riverine, Urban and Flash Floods)**
2	**Landslides (includes debris flows, rock fall, rock avalanche, rock slide, landslips and mud slips)**
3	**Drought**
4	**Coastal hazards (High waves, Storm surges, *Kallakadal,* Tsunami, Salt Water Intrusion, Coastal erosion*)***
5	**Wind (Cyclone, Gustnados, Gusty winds)**
6	**Lightning**
7	**Earthquakes**
8	**Human epidemics**
9	**Plant disease epidemics and pest attack on crops**
10	**Avian epidemics**
11	**Animal epidemics**
12	**Pest attack of human habitations**
13	**Forest Fire**
14	**Meteorite/asteroid impacts**
15	**Soil Piping**
16	**Heat wave/sunburn/sunstroke**

17	**Natural background radiation**

Source: Kerala State Disaster Management Plan 2016

Apart from these natural hazards, the following anthropogenic hazards are likely to occur in the state.

Sl No	Type
1	**Stampedes**
2	**Fire cracker accidents**
3	**Petro-chemical transportation accidents**
4	**Industrial accidents**
5	**Dam break**
6	**Dam spillway operation related floods& accidents**
7	**Oil spill**
8	**Road accidents involving civilian transport vehicles**
9	**Human induced forest fire**
10	**Human-animal conflicts**
11	**Fire accidents in buildings and market places**
12	**Boat capsizing**
13	**Accidental drowning**
14	**Building collapse**
15	**Hooch accident**
16	**Air accidents**

17	**Rail accidents**
18	**Terrorism, riots and Naxalite attacks**
19	**Nuclear and radiological accidents**
20	**Space debris impacts**
21	**Biological accidents**
22	**Occupational and recreational area relatedhazards**
23	**Accidents in Armed Forces premises**
24	**Disasters outside State's administrative boundaries, affecting Keralites**

Source: Kerala State Disaster Management Plan 2016

3.2 Nature of Key Hazards and Risks

Floods, landslides, drought, lightening and coastal / beach erosion are the five shocks and stresses that have been taken for detailed analysis since these are the five major disasters that are likely to impact the people, especially children.

Likelihood: This expresses the probability of a shock or stress occurring and is rated from 'very likely' to 'very unlikely' on a range of 1 to 5. Whereas 5 represents 'very likely', 1 represents 'very unlikely'.

Exposure: This expresses the presence of people, properties, environment, service delivery systems that are likely to be impacted by the stress or shock. A hazard becomes a disaster only if there is the presence of people, properties, service delivery systems in the area. Instances of 'exposure' include the number of people impacted, critical infrastructures like hospitals, schools, and roads, epidemics, unplanned urban settlements etc.

Geographic locations: Shocks and stresses are marked at the Panchayat level. Following five hazards have been chosen for the risk analysis as they are the ones most extensive and likely to affect the community with negative impacts on children. We have taken the data of the previous 20 years and based on that the likelihood has been described.

3.2.1 Floods

Riverine flooding is a frequent phenomenon in Kerala which has almost 6 months of rainfall from the South West Monsoon, North East Monsoon and pre-monsoon showers. Continuous and intense rainfall cause rivers to overflow its banks on to the flood plains. These flood plains get inundated based on several factors like reclamation and settlement, cultivation, terraces, slope of land, changes in ground water level, deforestation in upper catchment area etc. In order to design flood mitigation measures flood prone areas and flood plains are mapped using remote sensing and by using data from field level observation and flood damage reports.

Based on these scientific evidences it is found that 14.52% of the total area of the state is prone to floods. In one district alone namely, Alapuzha, 50% of the area is flood prone especially the rice bowl of Kerala i.e. Kuttanad that lies below mean sea level and connected to the Vembanad lake. The Kole lands of Trichur district and the coastal tract of Ernakulam and Malappuram districts and western parts of Kottayam that are close to Vembanad lake are the other flood prone areas of the state. Wayanad is a hilly district. But its flat bottom valleys and flood plains close to Manathavadi are areas prone to flood. The district that is least affected by floods is Idukki. After the catastrophic floods of river Periyar in 1341 A.D, and 1924, the next cataclysmic flood happened in August 2018 that affected 14 million people with 433 fatalities including 67 children. The frequency and magnitude of the floods in Kerala has been steadily increasing. Urban flooding too is on the increase since there is no proper storm water drainage system that is maintained well. Flash floods have also increased of late. The population, land

and environment of 27 taluks are highly vulnerable to floods. Floods in the remaining 45 taluks are moderate. Urban flooding happens irrespective of seasons. Trivandrum, Kochi and Kozhikode are the urban areas that suffer the worst urban flooding.

Likelihood

5=Very Likely

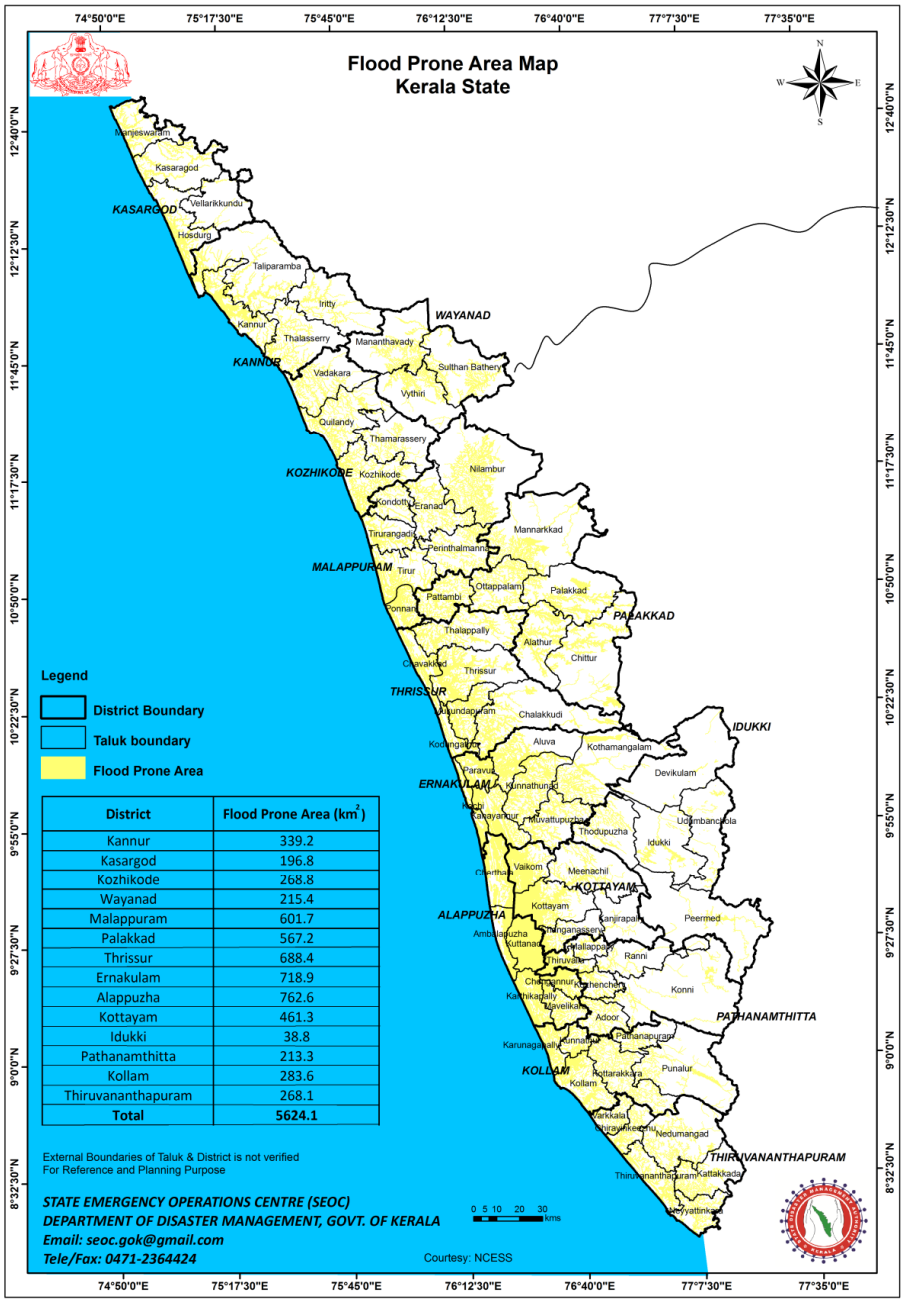
Data available with the KSDMA shows that of the 77 taluks in Kerala, 27 taluks are highly vulnerable to flood and 45 taluks are moderately vulnerable to floods. 14.52% of the area of the state are impacted by floods. Urban flooding and flash flooding are very common during the monsoons in Kerala.

Exposure of children and services for them

5=Very heavy damage

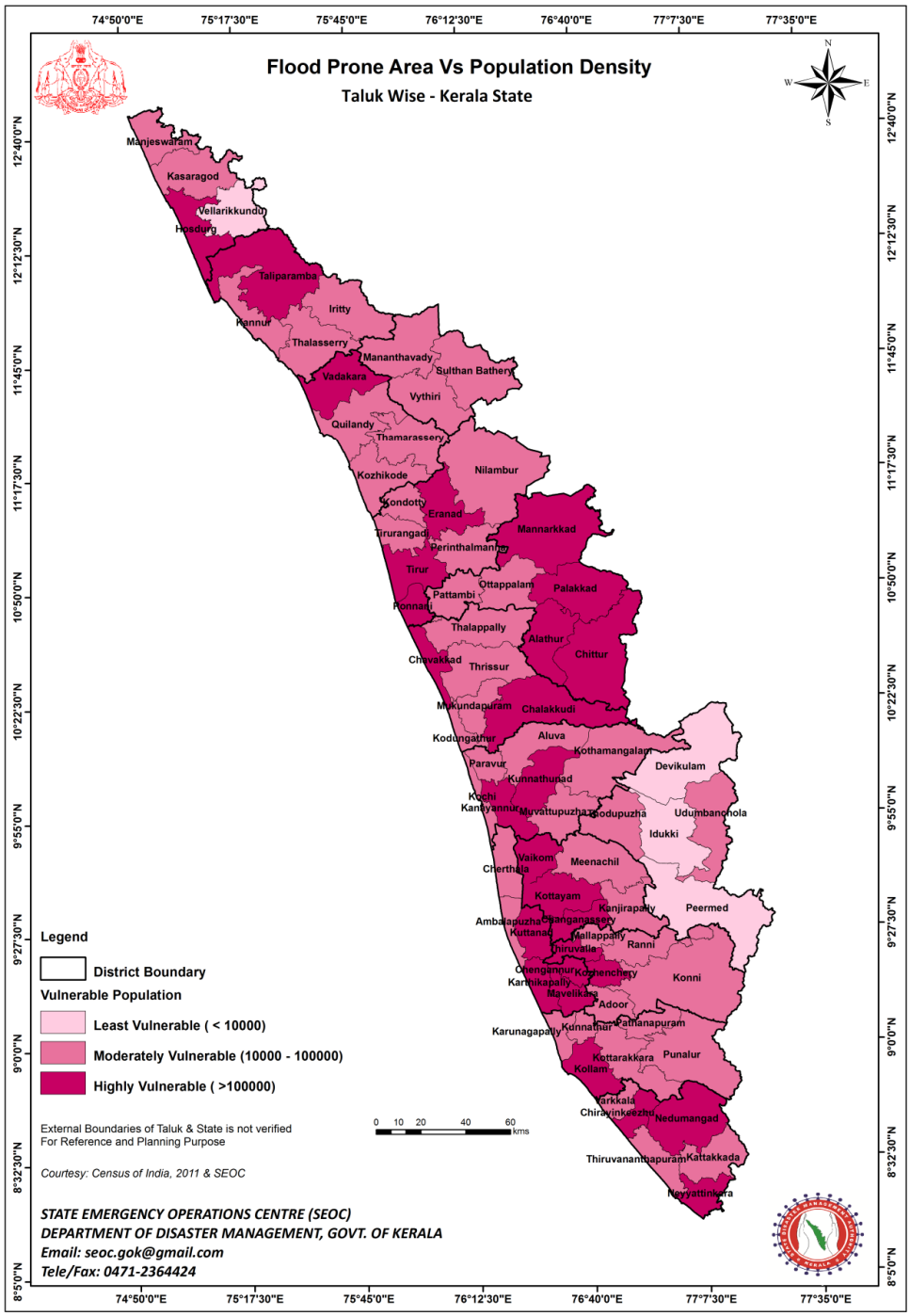
According to the National Remote Sensing Agency 55007 hectares of land was inundated as on 16th of July 2018. According to the Memorandum submitted to Government of India for flood assistance, 363 villages were affected due to monsoon related disasters. Of the total 33114 Anganwadis in the state 9122 anganwadis are at risk of being inundated. Children will not be able to go to Anganwadis till the flooding has subsided, anganwadis cleaned and disinfected. The working of these anganwadis will be disrupted and the services like supplementary feeding will be temporarily stopped for one or two weeks. This will compromise their nutrition till the anganwadi becomes functional. Pre school education will stop temporarily. Immunisation and growth monitoring will be deferred. 1350 subcentres will be affected by the floods. So will 277 primary health centres and 95 community health centres. These health facilities are the closest geographically to the anganwadis and where the children are taken to initially on falling sick. Sanitation and hygiene in the low lying areas, especially in places like Kuttanad which lie below the sea level will be compromised leading to an increase in water borne diseases like diarrhea.

Over 20000ha of cropped area will be exposed to risk of inundation and damage leading to loss of livelihood for the farmers and will negatively impact the nutritional security of children and pregnant women. For children in the age group 6 to 18 educational services will be disrupted not just because of inundation of schools but also because schools will be used as shelters for the affected communities.



District	Flood Prone Area (km²)
Kannur	339.2
Kasargod	196.8
Kozhikode	268.8
Wayanad	215.4
Malappuram	601.7
Palakkad	567.2
Thrissur	688.4
Ernakulam	718.9
Alappuzha	762.6
Kottayam	461.3
Idukki	38.8
Pathanamthitta	213.3
Kollam	283.6
Thiruvananthapuram	268.1
Total	**5624.1**

The following map gives the flood vulnerability mapping of the state based on the density of populationofthetaluks.



3.2.2. Landslides

Landslides are common phenomena in the highlands and midlands of Kerala. The physiographic unit that is most susceptible to landslides in Kerala is the west facing scarps of Western Ghats that run along the entire length of the state. Landslides are found to occur basically in slopes exceeding 20degrees. Landslides are characterized by swift and sudden down slope movement of water saturated heterogeneous elements ranging from soil particles to huge boulders. In their destructive rage, they carry down the slope, with them, everything that is in their pathway from land and houses to human beings and cattle and trees. Landslides are caused by variations in pore pressure engendered by prolonged and intense rainfall lasting for about 4 hours and water table being raised and maintained to critical levels for about 10 hours. Human activities like terracing, agricultural operations, constructing structures further exacerbate the hazard. Deforestation, especially in the forests up hills, is one of the major human interventions that trigger landslides because when trees are cut, the roots of trees that act as a soil binding agent are destroyed.

The entire state except the district of Alapuzha is prone to landslides. Deep seated landslides are experienced in Wayanad and Kozhikode while Kottayam and Idukki districts experience shallow landslides. Between 1961 and 2016 a total of 85 major landslides have occurred in Kerala claiming 295 precious lives. The severest landslide was in Amboori in Trivandrum that resulted in 38 deaths in November 2001.

10 taluks are highly vulnerable to landslides in view of the density of population. 25 taluks come under moderate landslides category and the remaining 14 taluks are least vulnerable to landslides. The map below shows the susceptibility to landslides and the following map shows the vulnerability to landslides based on population.

LANDSLIDES

Likelihood

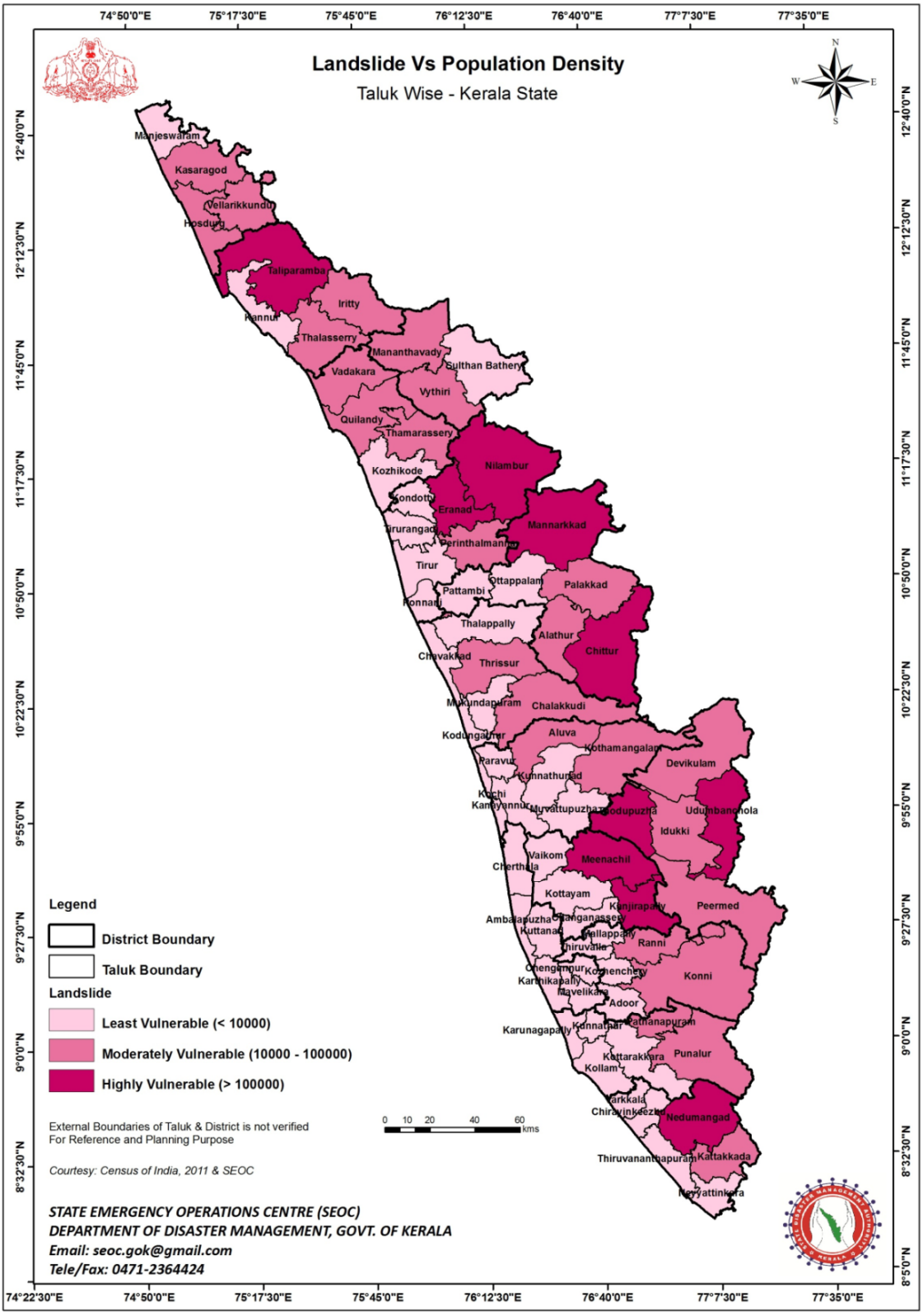
4= likely

10 taluks are highly vulnerable and 25 taluks are moderately vulnerable to landslides. Every year several landslides have been reported during the monsoon seasons.

Exposure of children

3= high damage

Around 45 % of taluks are prone to landslide. The severely affected population will be around 46,71,177. Further, 536410 children in the age group 0-6 will be at high risk of being exposed to landslides. When landslides wash away dwelling units, not only are they likely to be damaged but lives of the inhabitants are also at high risk. The death or injury to a family member will be highly traumatic to the children and they need psycho- social support to tide over the situation. When landslides wash away land completely erasing pre existing structures, land and vegetation, people become homeless and extremely vulnerable. Locating alternative land for rebuilding homes is a long drawn out procedure and can lead to drop outs in cases of school going children.


Landslide Vs Population Density
Taluk Wise - Kerala State
74°50'0"E
75°17'30"E
75°45'0"E
76°12'30"E
76°40'0"E
77°7'30"E
77°35'0"E
12°40'0"N
12°12'30"N
11°45'0"N
11°17'30"N
10°50'0"N
10°22'30"N
9°55'0"N
9°27'30"N
9°0'0"N
8°32'30"N
8°5'0"N
74°22'30"E
Manjeswaram
Kasaragod
Vellarikkundu
Hosdurg
Taliparamba
Iritty
Kannur
Thalasserry
Manandavady
Vadakara
Sulthan Bathery
Vythiri
Quilandy
Thamarassery
Kozhikode
Nilambur
Kondotty
Eranad
Mannarkkad
Perinthalmanna
Tirur
Ottappalam
Palakkad
Pattambi
Ponnani
Thalappally
Alathur
Chittur
Chavakkad
Thrissur
Mukundapuram
Chalakkudi
Kodungallur
Aluva
Kothamangalam
Paravur
Devikulam
Kunnathunad
Kochi
Kanayannur
Muvattupuzha
Thodupuzha
Udumbanchola
Idukki
Vaikom
Meenachil
Cherthala
Kottayam
Kanjirapally
Peermed
Ambalapuzha
Changanassery
Kuttanad
Mallappally
Ranni
Thiruvalla
Chengannur
Kozhenchery
Konni
Karthikapally
Mavelikara
Adoor
Karunagapally
Pathanapuram
Punalur
Kottarakkara
Kollam
Varkkala
Chirayinkeezhu
Nedumangad
Kattakkada
Thiruvananthapuram
Neyyattinkara
Legend
District Boundary
Taluk Boundary
Landslide
Least Vulnerable (< 10000)
Moderately Vulnerable (10000 - 100000)
Highly Vulnerable (> 100000)
External Boundaries of Taluk & District is not verified
For Reference and Planning Purpose
0 10 20 40 60
kms
Courtesy: Census of India, 2011 & SEOC
STATE EMERGENCY OPERATIONS CENTRE (SEOC)
DEPARTMENT OF DISASTER MANAGEMENT, GOVT. OF KERALA
Email: seoc.gok@gmail.com
Tele/Fax: 0471-2364424

3.2.3. Drought

Drought is defined as a condition of insufficient moisture caused by a deficit in precipitation over some time period (McKee, Doesken, Kleist, 1993). It is a complex natural hazard that affects agricultural production that in turn entails food and health insecurity and habitat loss through land degradation and desertification (Smakhtin and Schipper, 2008).Drought is a very serious condition that has gripped not just Kerala but the whole of India. It is estimated that by 2030, 40 % of Indian population will have no access to drinking water (The Guardian, 12th June 2019; CNN News, 4th July 2019) Drought is not something new to the state. Kerala experienced 66 drought years between 1881 to 2000. Receding of the water table and hence scarcity of drinking water for humans and animals is a characteristic feature of this phenomenon. The aridity index (that shows the frequency of drought) of many parts of the state has increased. Although the deviation in annual rainfall from the long term average is not significant, there is considerable variation in the availability of rainfall during the different seasons (KSDMP, 2016).

An analysis of the trend in rainfall data over the last 100 years (Nair *et al.,* 2014) reveals that there is a significant (99%) decreasing trend in most of the regions of Kerala especially in the month of January, July and November. The annual and seasonal trends of rainfall in most regions of Kerala are also found to be decreasing significantly. According to the authors the possible reasons for this could be due to human induced green house gas emissions, increased fossil fuel use, changes in land use caused by urbanisation and deforestation, increased atmospheric pollution caused by transportation.

There are evidences from studies across the world to the effect that anthropogenic activities increase drought. For instance Chen and Sun (2017) have established based on their studies regarding SPEI (Standardized Precipitation Evapotranspiration Index) that drought occurrences across China has increased during 1951-2014, especially during the last two decades. Interestingly, most of the drought

events happened under warm dry conditions that coincided with relatively high temperature anomalies although there was no huge variability in annual precipitation. Their studies suggest that warming induced by anthropogenic activities has increased hot drought occurrences, the risks associated with them and their impacts across China. Although the annual precipitation is projected to increase, the probability of occurrence of drought events will increase to 100% by the year 2050, according to the study.

Seydou Traore and Tom Owiyo (2013) in their study in Northern Burkino Faso have found that extreme droughts tend to have a cascading impact; they first cause water scarcity that affects seedling and crop yields, which in turn affects the availability of food for people and feed for livestock . This, in turn, restricts their coping capacity to deal with future droughts. The following table shows the number of villages with water bodies (and without water bodies)that experience moderate or severe drought.

Table 1

	Villages with Water bodies			**Villages without Water bodies**		
DISTRICTS	Severe	Moderate	Drought	Severe	Moderate	Drought
Kasargod						
Kannur	**0**	32	0	0	97	0
Kozhikode	**0**	24	3	0	86	4
Wayanad	**19**	1	0	13	16	0
Malappuram	**0**	49	0	4	82	0
Palakkad	**0**	42	0	14	101	0
Trichur	**0**	77	7	1	161	8
Ernakulam	**0**	32	0	16	77	0
Alapuzha	**11**	3	0	64	13	0

Kottayam	**10**	22	0	25	37	0
Idukki	**10**	5	0	38	11	0
Pathanamthitta	**19**	1	0	47	1	0
Kollam	**34**	0	0	69	0	0
Thiruvananthapuram	**39**	4	0	59	11	0
Total	**142**	**313**	**10**	**350**	**757**	**12**

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

Source : Kerala State Disaster Management Plan, 2016

In 2012 Kerala faced severe drought conditions. The departure of South West monsoon rainfall from normal was -24.1%. Similarly in 2015 the deviation from normal rainfall of South West monsoon was -25.7%. But the north east monsoon had compensated for this deficit.

Water level in reservoirs is a good indication of the availability of water for drinking purposes, household activities, electricity generation and irrigation. The tables cited above indicate that water levels were far below the FRL.

Citing CWDRM study Mathrubhumi daily (8th July, 2019) reports that the situation of water availability is critical in 33 out of 152 development blocks of Kerala.

DROUGHT

Likelihood

4= likely

Kerala experiences seasonal drought conditions in summer months. Even during normal rainfall years, the midlands and highlands experience drought in summer. Drinking water becomes a problem and district administrations try to tide over the situation by supplying drinking water in tanker lorries. Streams and rivers dry up during the summer months and several wells too in the vicinity of such areas dry up making women and children travel long distances to gather drinking water. From 1881 to 2000, Kerala experienced 66 drought years (KSDMP, 2016). Although the variation in rainfall from the long term average is,(not clear) there is great variation in the availability of rainfall in different seasons(KSDMP, 2016). On a scale of 1 to 5 the likelihood of drought in Kerala is 4.

Exposure:

3.5=Heavy loss

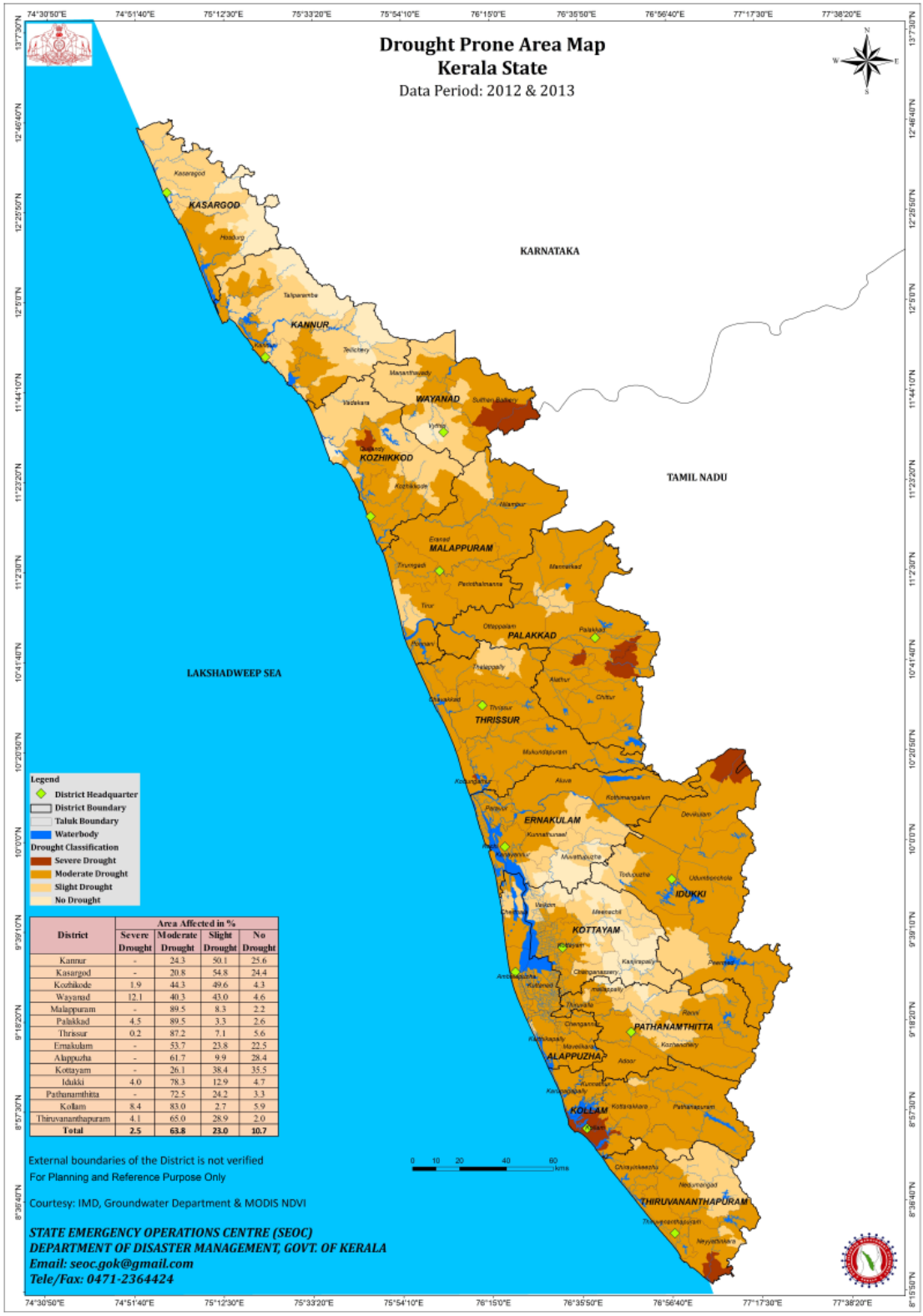
More than 50 % of the area of the state will be exposed to the risk of drought. Surface water will dry up. Ground water will also be depleted. This will impact the children of the state badly. Around 19431sq.km of land mass will be under the grip of moderate to severe drought conditions. Around 15000000(15 milion) people will be affected by the drought in different intensities. Around 15, 45, 000 (1.5 m)children in the age group of 0-6 years in around 15000 anganwadis will be exposed to the risk of

drought. Open wells and ponds form an important source of water for rural anganwadis. Small children play in the sand or on the floor soiling their hands. Many children will need to use the toilets more than once in a day. They may soil their clothes due to incontinence or just by playing in the soil. Once the water bodies dry up, not only the quantity but also the quality of water will be compromised leading to diseases like diarrhea.

School going children in the age group of 6-18 years in around 8500 schools will also be negatively impacted by water scarcity. Although schools will have drinking water of their own or sourced from open market, shortage of water in toilets will be a matter of serious concern especially to adolescent girls. Menstrual hygiene will be compromised leading to diseases. Girls during menstrual period are likely to absent themselves from schools where there will be shortage of water in toilets. Many adolescent girls help their mothers in domestic chores like fetching water from afar and in cooking. When drought situation arises girls will have to spend more time waiting for their turn in the queues thus losing out on precious time they could use for their daily lessons and for completing assignment to be done at home. Thus temporary drop out rates of adolescent girls due to water scarcity are likely to go up.

Water shortage exposes handicapped children to worse conditions. They will take longer time to get ready to go to school since they have to wait for longer periods for the water to arrive.

Map showing drought prone areas in Kerala



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

3.2.4 Lightning

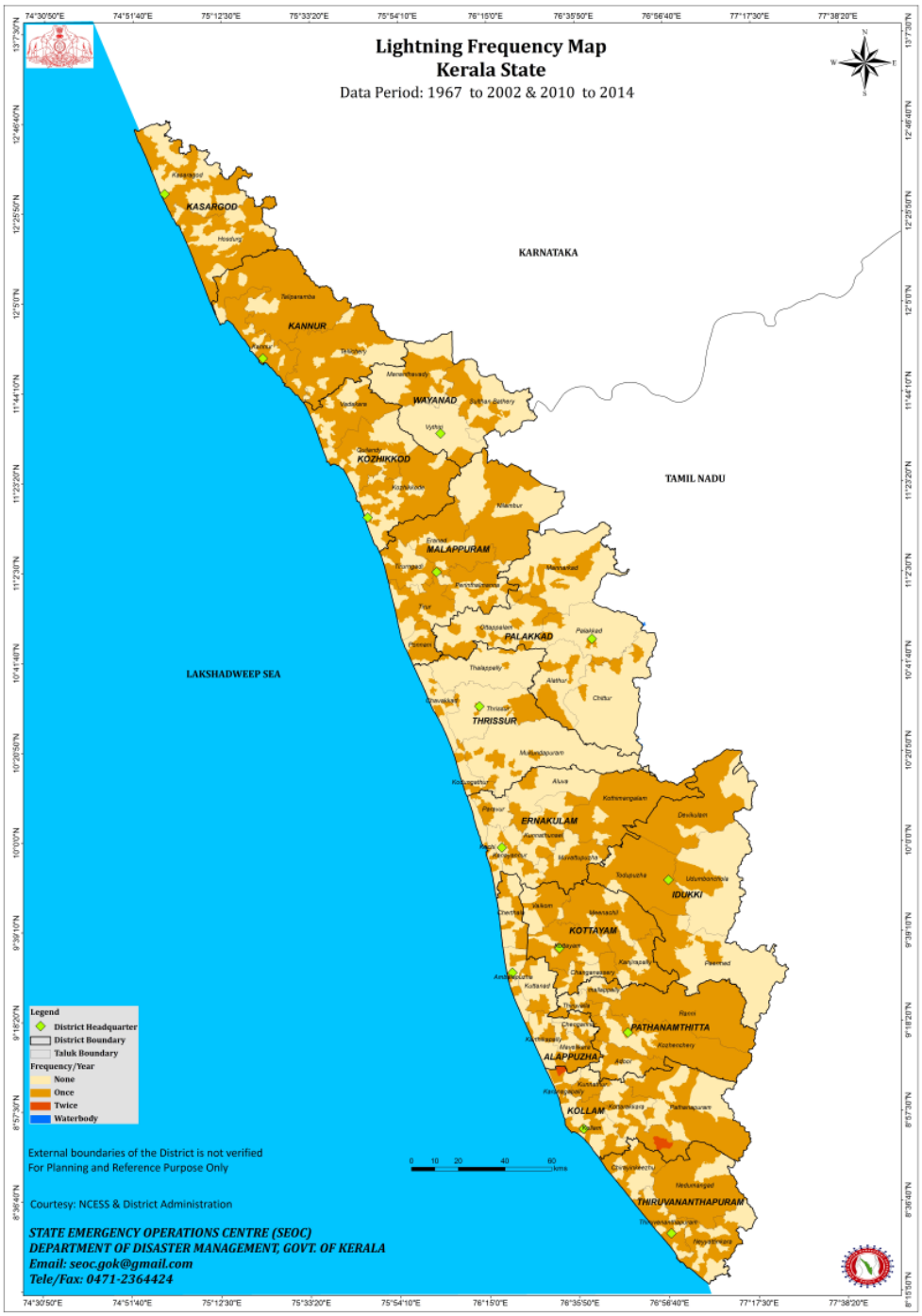
Lightning is a high-energy luminous electrical discharge from a thundercloud to the ground accompanied by thunder. Of the three types of lightning namely intracloud lightning, inter cloud lightning and cloud to ground, the third is what concerns children and their communities because it causes fatalities and damages to properties. Lightning is very fast and takes only 1710^{th} of a second to reach the ground from the cloud and the discharge creates a temperature of about 30000 degree Celsius. Lightning discharge occurs with a current of few tens of kilo amperes. It is very difficult to predict the exact time and location of lightning but normally lightning happens in the afternoons and maximum occurrence after 7 pm.

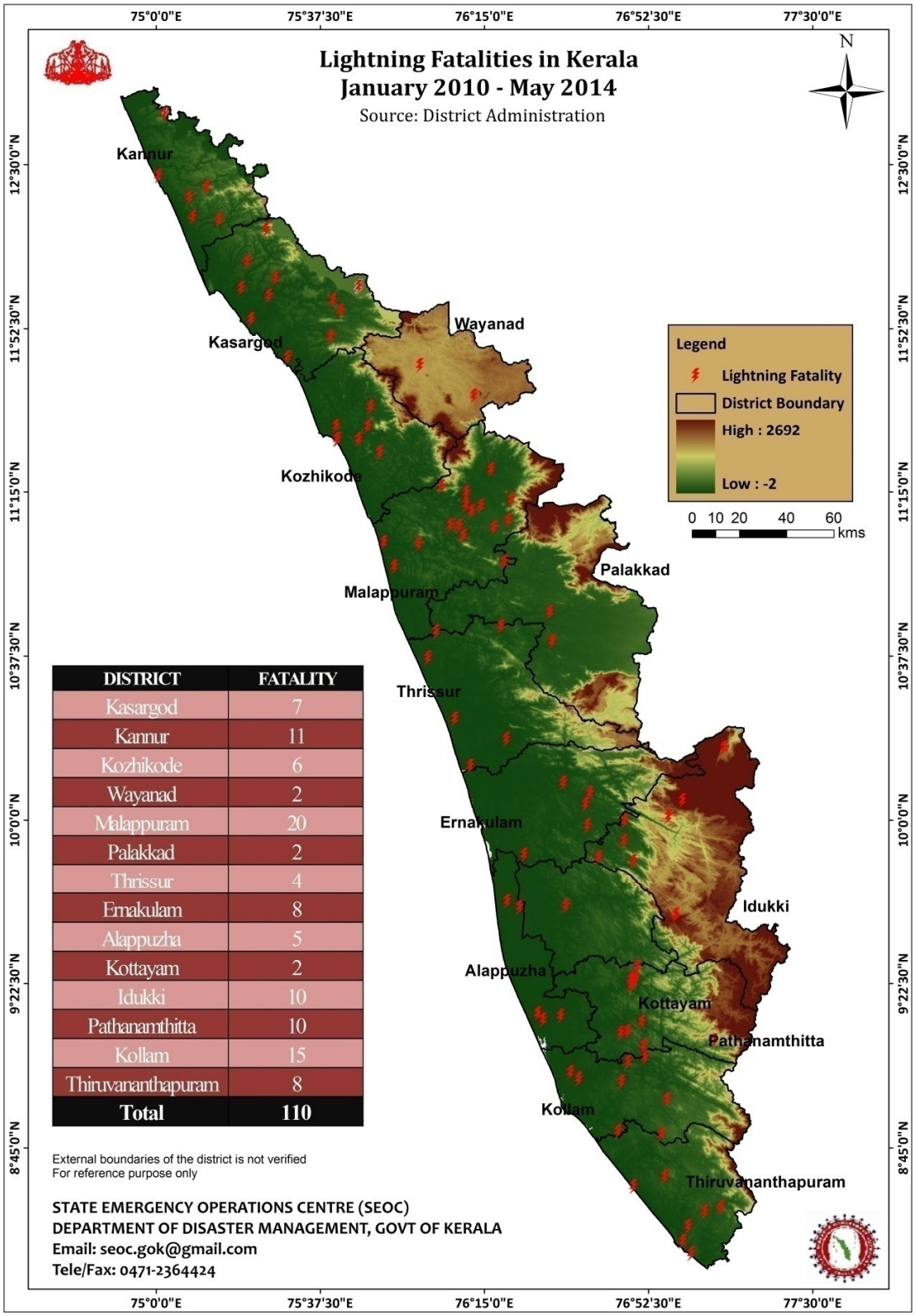
Majority of the lightning strikes from convective cumulonimbus clouds (Cb).and they occur in the afternoon hours. In Kerala, most of the thunderclouds are of the convective type and are formed mostly during the northeast monsoon (October to December) and during the pre monsoon (March to May).

Between 1986 and 2002, around 159 people died in Thiruvananthapuram district alone due to lightning. The district has over 400 living victims of lightning, which is the highest in the state (Deccan Chronicle March 17, 2017). Areas such as Gandhipuram at Sreekariyam, Mangalapuram, Kilimanoor Kattakada have places prone to lightning. Kumbil at Kadakkal on the Thiruvananthapuram-Kollam border is a place synonymous for lightning strikes.

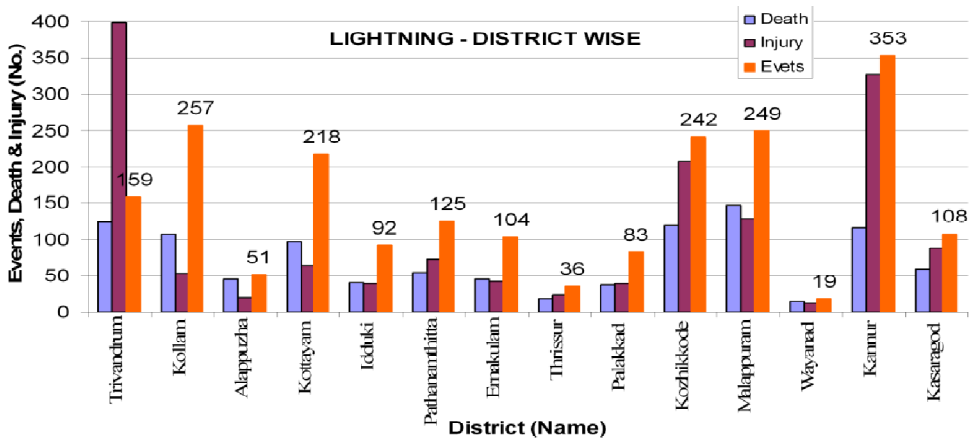
Children are more likely to be affected by lightning since they usually prefer outdoor activities. School going children like to play once they come back from school. Lightning occurs normally in the evenings and this is the time when children are outdoors. Another activity that causes death due to lightning is when clothes left for drying after washing are removed from lines (usually this iron wires).

Due to gender roles it is usually girls who are entrusted the job of collecting dry clothes when it starts to thunder and rain. So girl children are more likely to be impacted by lightning than boys.





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



Source: District wise distribution of lightning events in Kerala (Murali Das, 2007)

Among Indian states Kerala ranks no2 in lightning fatalities rate, no 2 in fatalities density rate and no 4 in total number of fatalities. 396 people have died between 1979 and 2011 due to lightning in Kerala (Singh and Singh, 2015).

Murli Das *et al.* (2007, 2009) state that about 51% of the accidents occur as a consequence of exposed rocky terrain of the State. According to the authors, exposed rocky terrains normally have low soil conductivity and aid in ground conductance to relatively longer distance, and therefore such terrains are comparatively more susceptible to lightning strikes (Murli Das *et al.*, 2007, 2009).

Temporally speaking the largest number of lightning events occur during the monsoon season from July to September (Singh and Singh, 2015) 57% and in the summer months or pre-monsoon period (31%). Post monsoon season accounts for relatively lower number of incidents. About 72% of lightning deaths in Kerala occurred in April (21%), May (22%), October (19%) and November (10%). This is in contrast to Northern states where the fatalities were more during winter.

Reports from district administrations reveal that from Jan 2010 to May 2014, a total of 110 fatalities have occurred in Kerala, which is quite high. Studies show that there is a gender variation of fatalities in that of men which is 18 times higher than that of women. This is due to the differential rate

of work participation of men and women and also because of the nature of work men and women are employed in. Men are more likely to participate in outdoor works like construction and regular farming operations than women. Children are also likely to be vulnerable especially since children are fond of playing outside. Kerala being a densely populated state fatalities will be more in Kerala as compared to many other state that are not so thickly populated. The more vulnerable population live in districts like Idukki, Wayanad, Kottayam, Pathanamthitta, eastern parts of Trichur and Malappuram. A total of 3023847 people are more exposed to lightning of whom more than 3 lakhs will be children in the age group of 0-6years. Over 3000 anganwadis will be exposed to risk of lightning. Some anganwadis function in fairly strong buildings whereas others function in not so sturdy buildings and they are more vulnerable to the risk of lightning. Since lightning events happen more in the month of June which also happens to be the school re opening month, around 30 lakh school children in the age group of 6-18 years are more likely to be exposed to the risk of lightning in the month of June.

3.2.5 Coastal Erosion

The Kerala coast is one of the most densely populated coasts in India. It has a shore line of 570 kms. Studies (T.K. Mallik et al, 1987)were conducted along the entire coast by setting up stations at regular intervals of 5 kms. Beach profiling done at regular intervals during the post and pre monsoons in 1984 revealed that the erosion along 55 stations was 1276m3/m. Another study (Sreekala, et al, 1998) using satellite imageries and aerial photographs showed that while 148 kms of coast was eroding 304kms of coast was accreting.

Although beaches may accrete in some locations, at others beaches are lost. Every monsoon season with the surging waves and strong winds that lash the coast, there is huge destruction of houses in the coastal area and the worst sufferers are the fisherfolk, who like the tribes, are a marginalized

group. Efforts to control sea erosion had started 100 years back (Noujas and Thomas, 2015). These included construction of groins and later on sea walls and now sea wall –groin combination. Erosion hotspots normally occur at the downdrift side of harbor breakwaters, groins, end of sea wall, mining sites, fishing gaps, downdrift side of mud banks, tidal inlets and adjoining areas, places where protective measures are wrongly designed or implemented. Seasonal erosion is found along the entire coast of Kerala during South West monsoons.

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

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

COASTAL EROSION

Likelihood

4= likely

Source: IIT Indore and Guwahati

Kerala has a beach line of 570 kms adjoining the Arabian sea. The coastal Kerala is a highly densely populated area. .Beach erosion is a repetitive natural phenomenon during the monsoon seasons. Not a single monsoon season has gone by without newspapers reporting on the vast damage done to the beach and the ensuing misery to the coastal folks. Beach is eroded in both the south west and north east monsoons.

Exposure

5=severe damage

The lashing fury of the wind and the waves act jointly to destroy the beaches of Kerala. According to Rao *et al.* (1985), the differential movements along coastal segments along with slope morphometry of the foreshore causes variations in accretion and erosion of beaches in different parts of the coast of Kerala with varying intensity.

Kerala is a highly densely populated state (860 persons/sq km as per the census of 2011). It is much higher than the all India figure that stands at 382 persons/sq.km. The density of coastal Kerala is even higher. In Trivandrum it is 1340 and in Ernakulam it is 1290 per sq.km. Nine out of the 14 districts of Kerala are coastal districts. Out of the total area of 38863sq.kmof Kerala, 3355 sq.kms account for coastal area. It supports a population of 72.72 lakh population. As against an urban density of 2097 people/sq. Km in Kerala, the urban coastal density is 4228 persons /sq,km. As against a rural density of 603 in Kerala, the coastal rural density is 1700.

The coastal waters support the livelihood of a large number of people especially the fisher folks. Coastal erosion affects the lives of over 70 lakh people mainly fisher folks who depend on the sea for their livelihoods. The south western monsoon brings in its wake storm and tides which result in coastal flooding. The fishermen keep their boats and allied equipment for fishing on beach landing centres or close to their houses in the beach. When the tides are high and the waves very turbulent, they are

exposed to the risk of losing their fishing implements that affect their livelihood. Lashing wind and tides expose them to the risk of total or partial damage to their houses. Although many have constructed brick and mortar buildings with government assistance there are many houses that are structurally not stable. Many of them do not have adequate toilet facilities. This exposes children to the outbreak of diarrhoeal diseases and other water borne diseases. Anganwadis located in coastal areas will be shut down temporarily till water recedes. The services rendered through anganwadis will also be stopped temporarily. This affects the supplementary nutrition, and pre school activities of children 0-6years.

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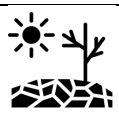
Likelihood- Exposure of hazards in Kerala

5.0										
4.5										
4.0										
3.5										
3.0										
2.5										
2.0										
1.5										

1.0										
0.5										
	0.5	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**	**5.0**

EXPOSURE TO HAZARDS

In short all the five hazards analysed here affects the lives of people of Kerala but affects children disproportionately. Their vulnerability to the hazards are exacerbated by the fact that they are children with less skills and resources to cope with the situation

Chapter 4

Risk Analysis

4.1 In this chapter hazard analysis is done at the grassroots level of the local self governments, both the panchayats and urban local bodies. This will be an important planning tool for those in the local governance structure to make their development plans risk informed thus making their plans more sustainable and hence facilitate rebuild Kerala better in a more resilient and greener manner.

In this chapter maps of 10 districts illustrating risks down to the anganwadi level has been prepared and incorporated. Apart from this a map of the state showing the child centric district wise risks has also been included. We have added a unique interactive map in KML format showing panchayat level risks with the location of Anganwadis overlaid on it.

4.2 Methodology:

Mapping at the local self government has been done for the entire state. As a starting point the hazard maps in the KSDMP, 2016 has been taken. Five major disasters affecting the state namely flood, drought, landslide, lightening, and storm surge in coastal areas have been chosen. Analysis of the potential areas of these hazards was conducted using GIS platform. This area was subjected to normalization process from which a vulnerability index for each of the geophysical hazards was derived. From this vulnerability index of individual hazards a composite vulnerability index was derived for all physical hazards in a local body.

From the annual survey done by the department of women and children in 2017-2018, the data relating to vulnerabale households was taken. From that data the following 5 indicators were taken:

1. Women headed families
2. Families with differently abled children

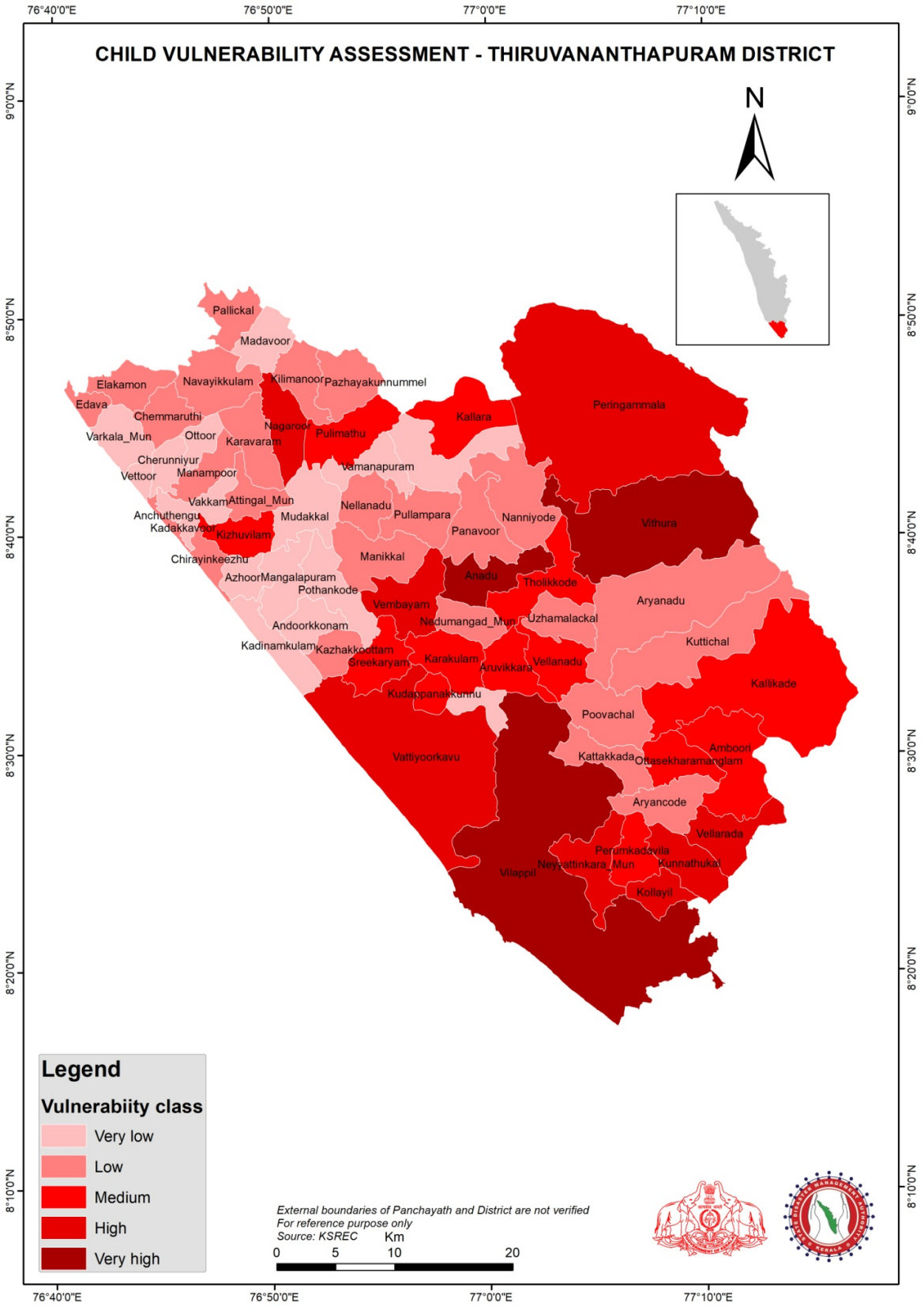
3. Families with mentally challenged children
4. Families where parents are alcoholic
5. Families with history of domestic violence

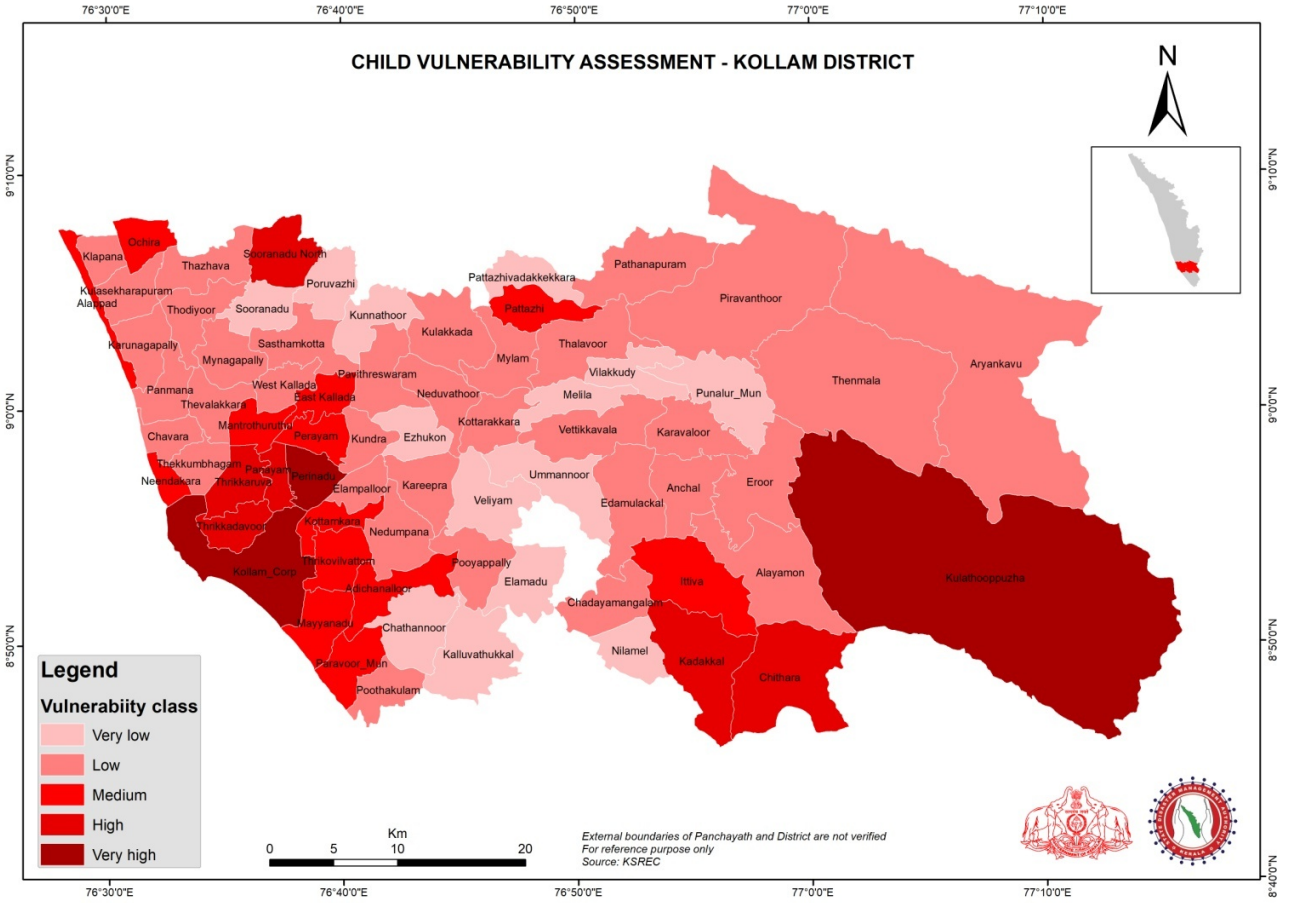
To these 5 indicators was added another indicator namely "Asraya families" (poorest of the poor families) obtained from Kudumbashree. Together these 6 indicators constitute the social vulnerability.

The value of each of the above 6 indicators was normalized using the formula "particular observation minus maximum of the observation divided by maximum of the observation minus minimum of the observation". Then a composite indicator for each local self government was derived from the 6 indicators.

The physical vulnerability index and the social vulnerability index were aggregated and averaged to obtain a composite physico-social vulnerability index of each local body. This index was then categorized into five classes based on their value.

Then 10 maps have been prepared for the 10 districts of Kerala and based on the composite geo-physical vulnerability index color coding was given to the jurisdictional area of each local self government. There are 5 classes and each one has been assigned a different color ranging from pink to Brown. Brown indicates very high vulnerability whereas pink indicates very low vulnerability. Based on these maps the local self government can prepare risk informed development plans. Each of the local self government will find this to be a very useful planning tool. They can use this for advocacy for children, for fund raising and earmarking more funds for children and women of vulnerable sections of society.


CHILD VULNERABILITY ASSESSMENT - THIRUVANANTHAPURAM DISTRICT
N
76°40'0"E
76°50'0"E
77°0'0"E
77°10'0"E
9°0'0"N
8°50'0"N
8°40'0"N
8°30'0"N
8°20'0"N
8°10'0"N
Pallickal
Madavoor
Elakamon
Navayikkulam
Kilimanoor
Pazhayakunnummel
Edava
Chemmaruthi
Varkala_Mun
Ottoor
Karavaram
Nagaroor
Pulimathu
Kallara
Peringammala
Cherunniyur
Vettoor
Manampoor
Vamanapuram
Vakkam
Attingal_Mun
Anchuthengu
Kadakkavoor
Kizhuvilam
Mudakkal
Nellanadu
Pullampara
Nanniyode
Panavoor
Vithura
Chirayinkeezhu
Manikkal
Azhoor
Mangalapuram
Pothankode
Anadu
Tholikkode
Aryanadu
Vembayam
Nedumangad_Mun
Uzhamalackal
Andoorkkonam
Kuttichal
Kadinamkulam
Kazhakkoottam
Sreekaryam
Karakulam
Aruvikkara
Vellanadu
Kallikade
Kudappanakkunnu
Poovachal
Amboori
Vattiyoorkavu
Kattakkada
Ottasekharamangalam
Aryancode
Vellarada
Perumkadavila
Neyyattinkara_Mun
Kunnathukal
Vilappil
Kollayil
Legend
Vulnerabiity class
Very low
Low
Medium
High
Very high
External boundaries of Panchayath and District are not verified
For reference purpose only
Source: KSREC
Km
0
5
10
20

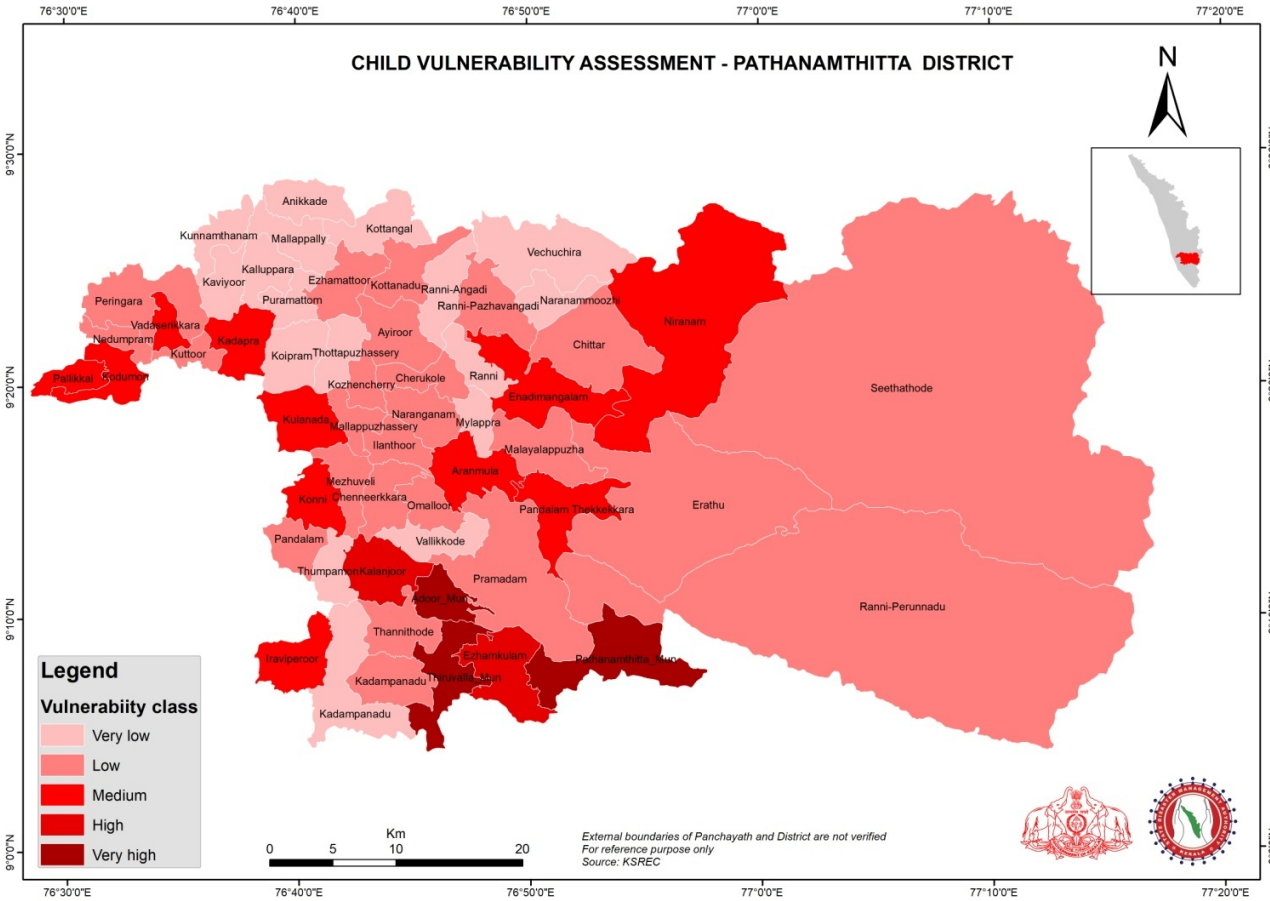


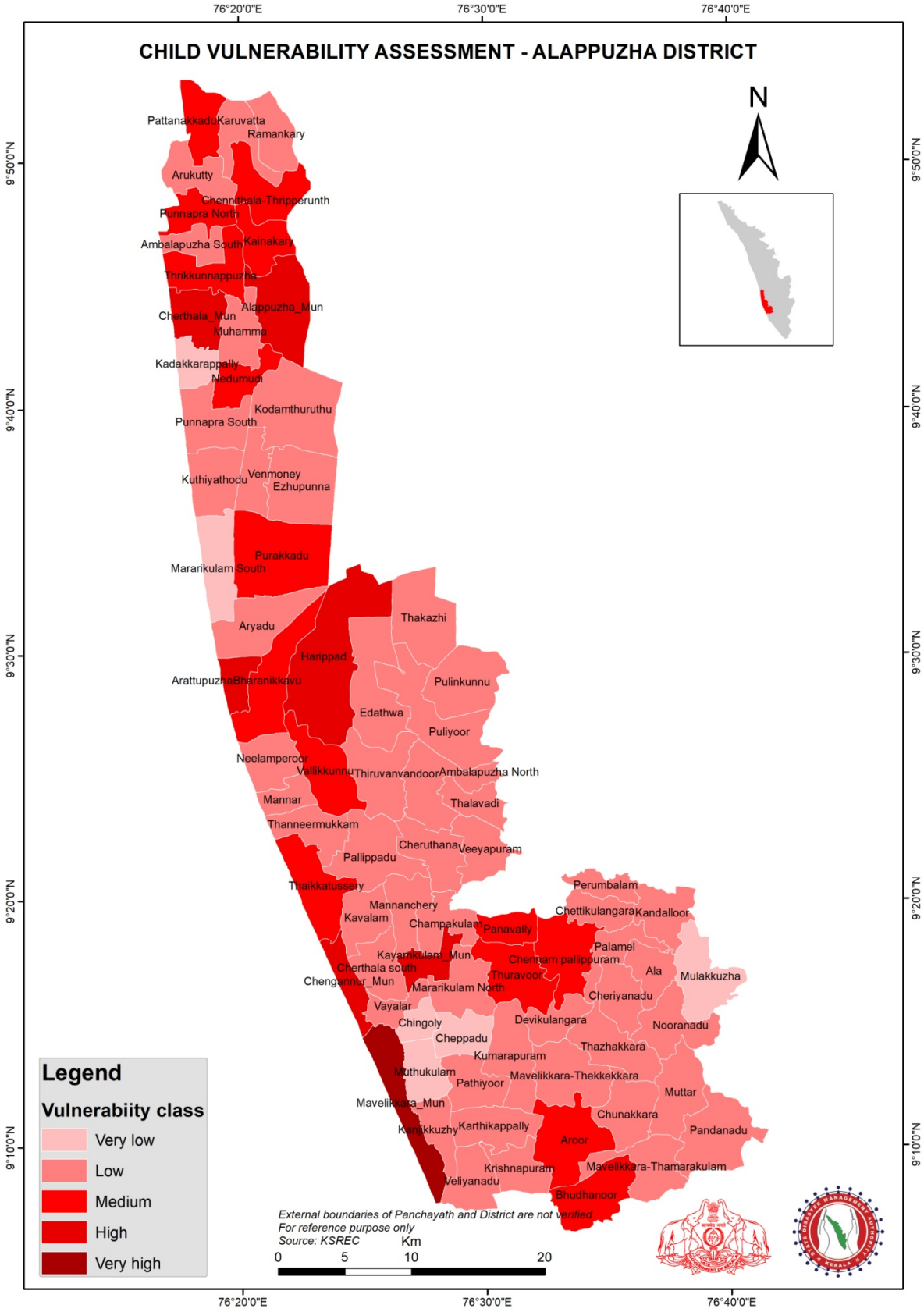
We have further refined and prepared maps indicating each anganwadi in the state. It is an indicative map and can be used by anganwadi workers too with the help of their mobile phones. This map gives the details of the hazards that an anganwadi is exposed to and the anganwadi worker can take preparatory measures to protect the children under her care. These maps can be used by the Child Development Project Officer (CDPO) for advocacy for children in the age group of 0 to 6 and for pregnant and lactating mothers and adolescent girls.

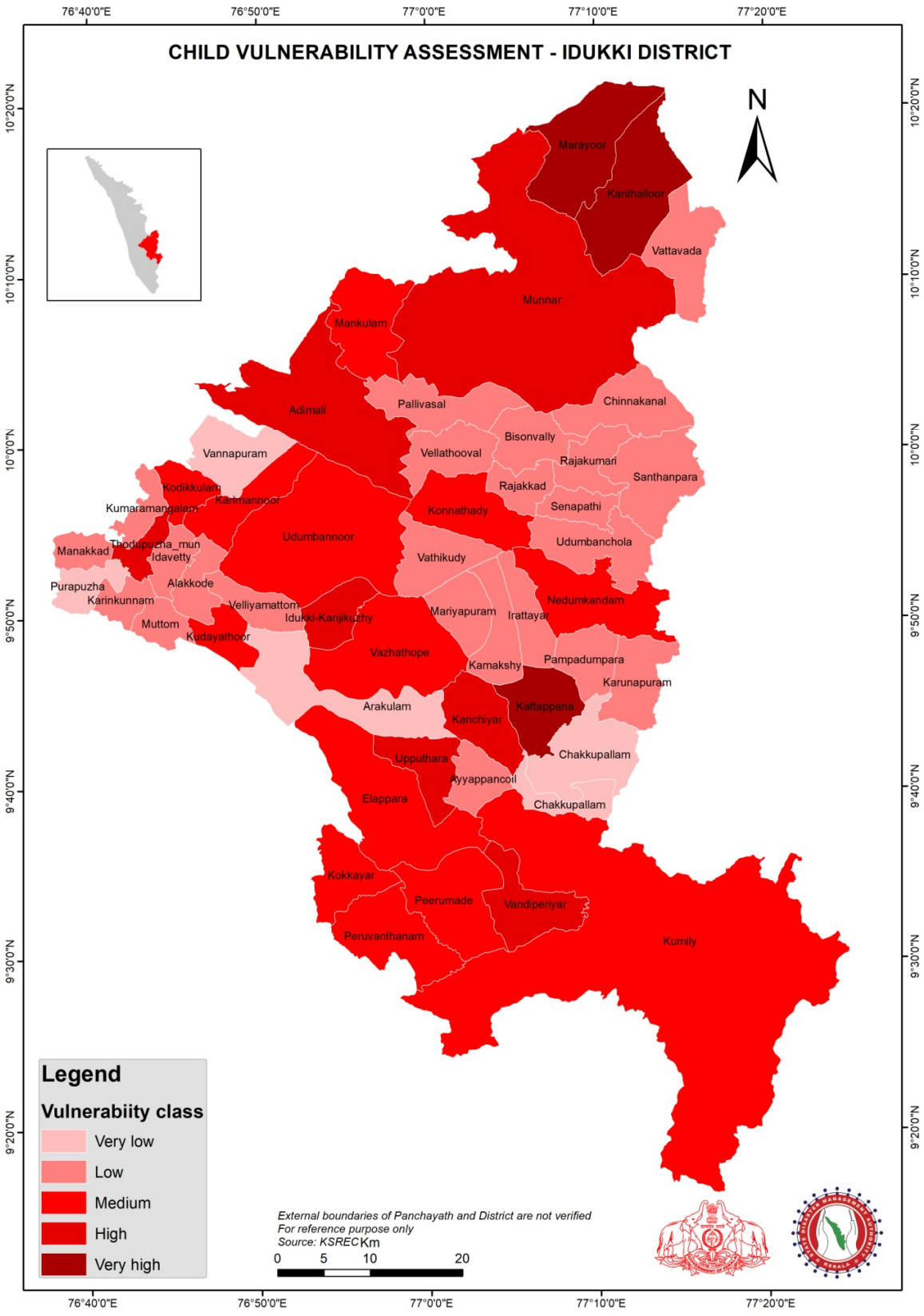
The panchayat level child centric risk map of 10 districts are given below. They are interactive in nature and the google earth icon below the maps will lead you to the concerned panchayat with the

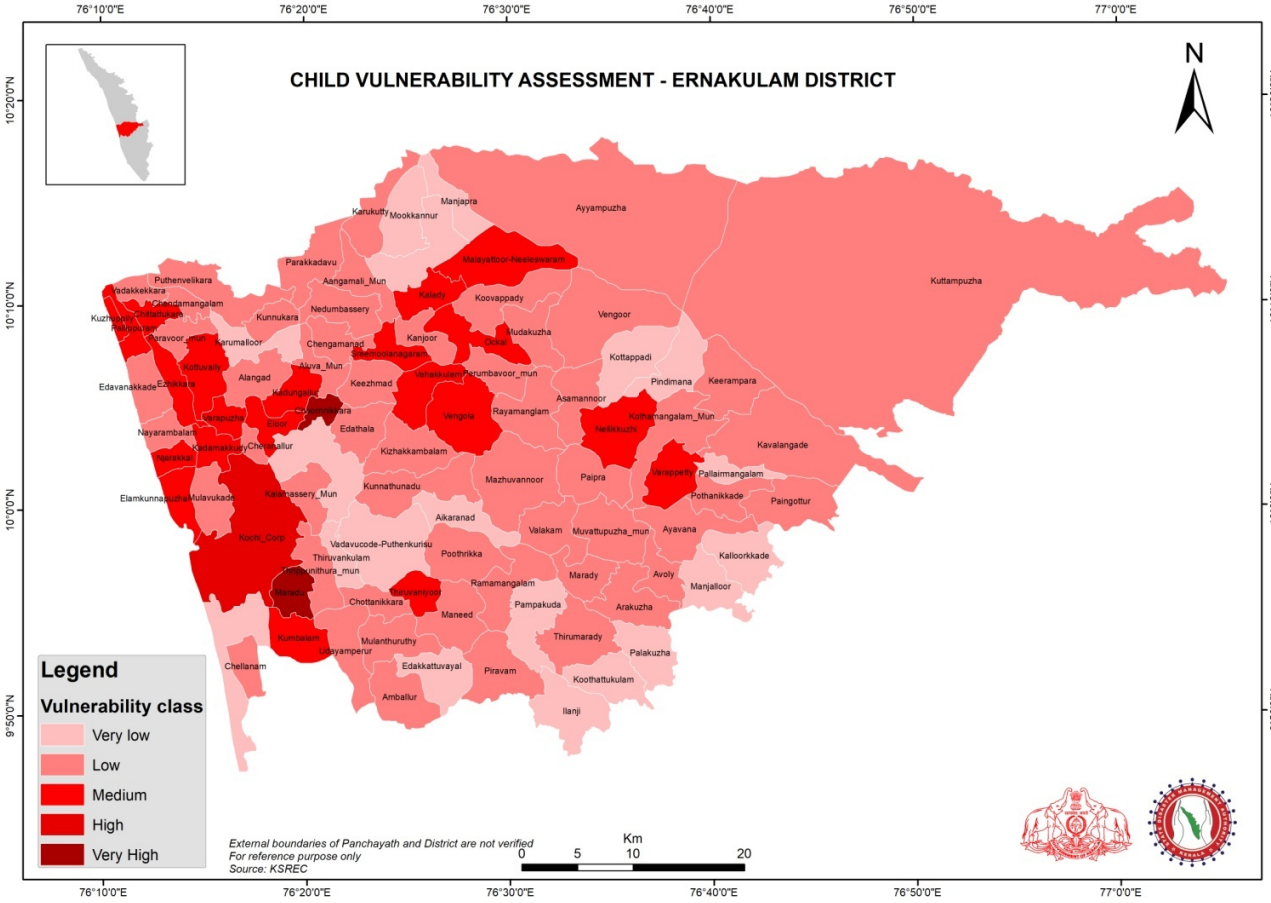
location of each anganwadi geotagged. Apart from this there is one map for the whole state which indicates the child centric district wise risk map. It also shows the ranking of each district.

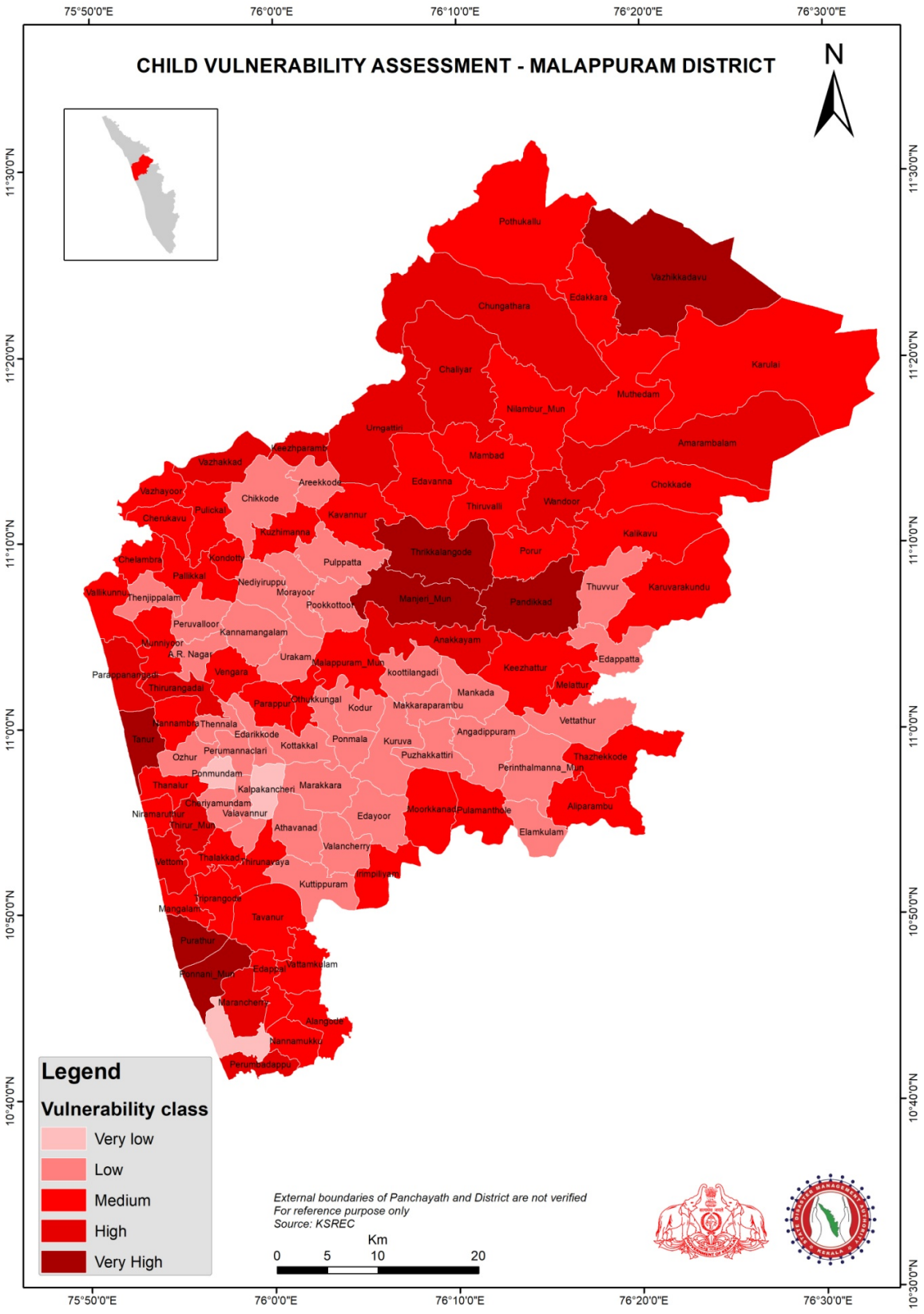
Alappuzha_AWC_Risk map.kmz

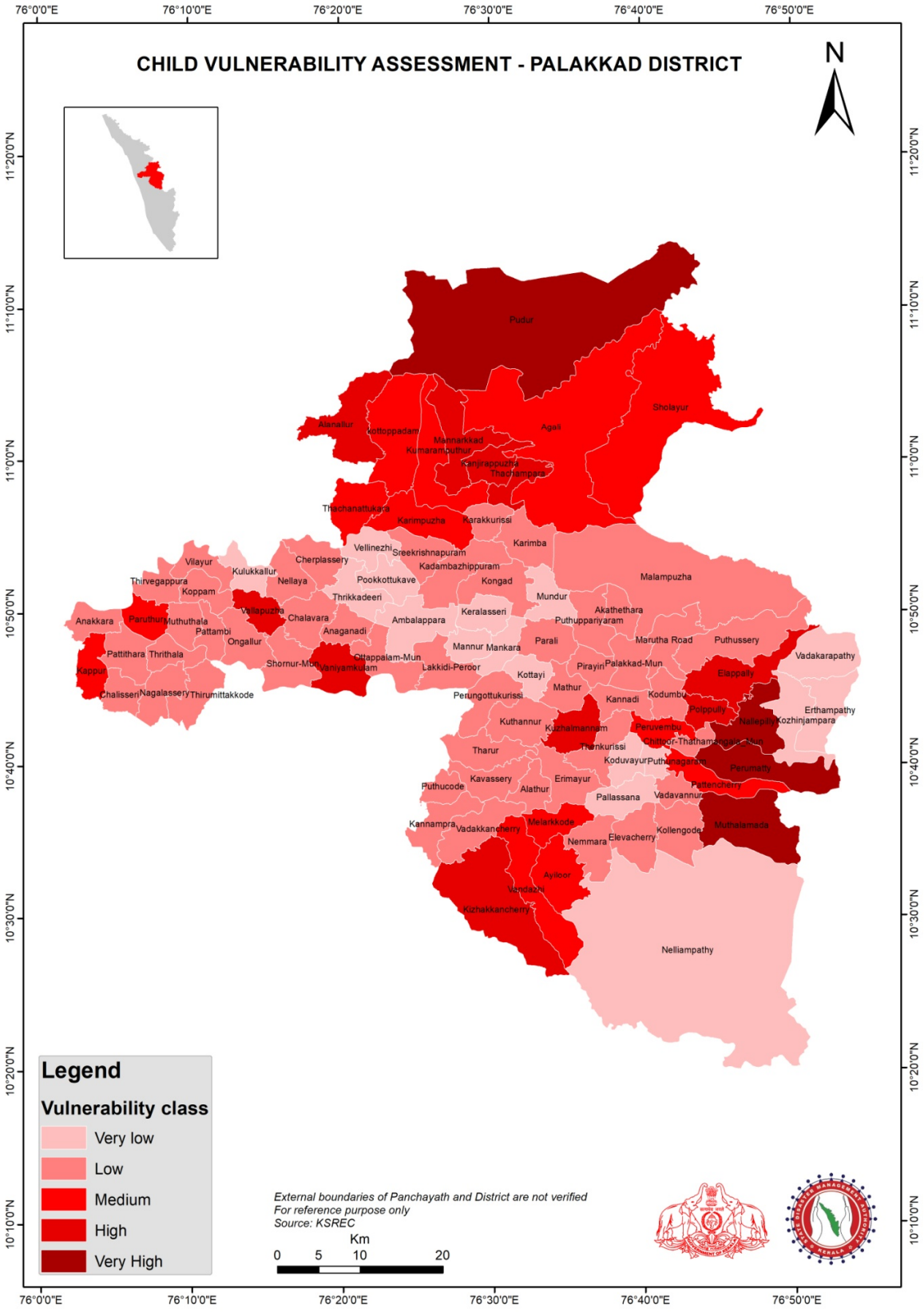


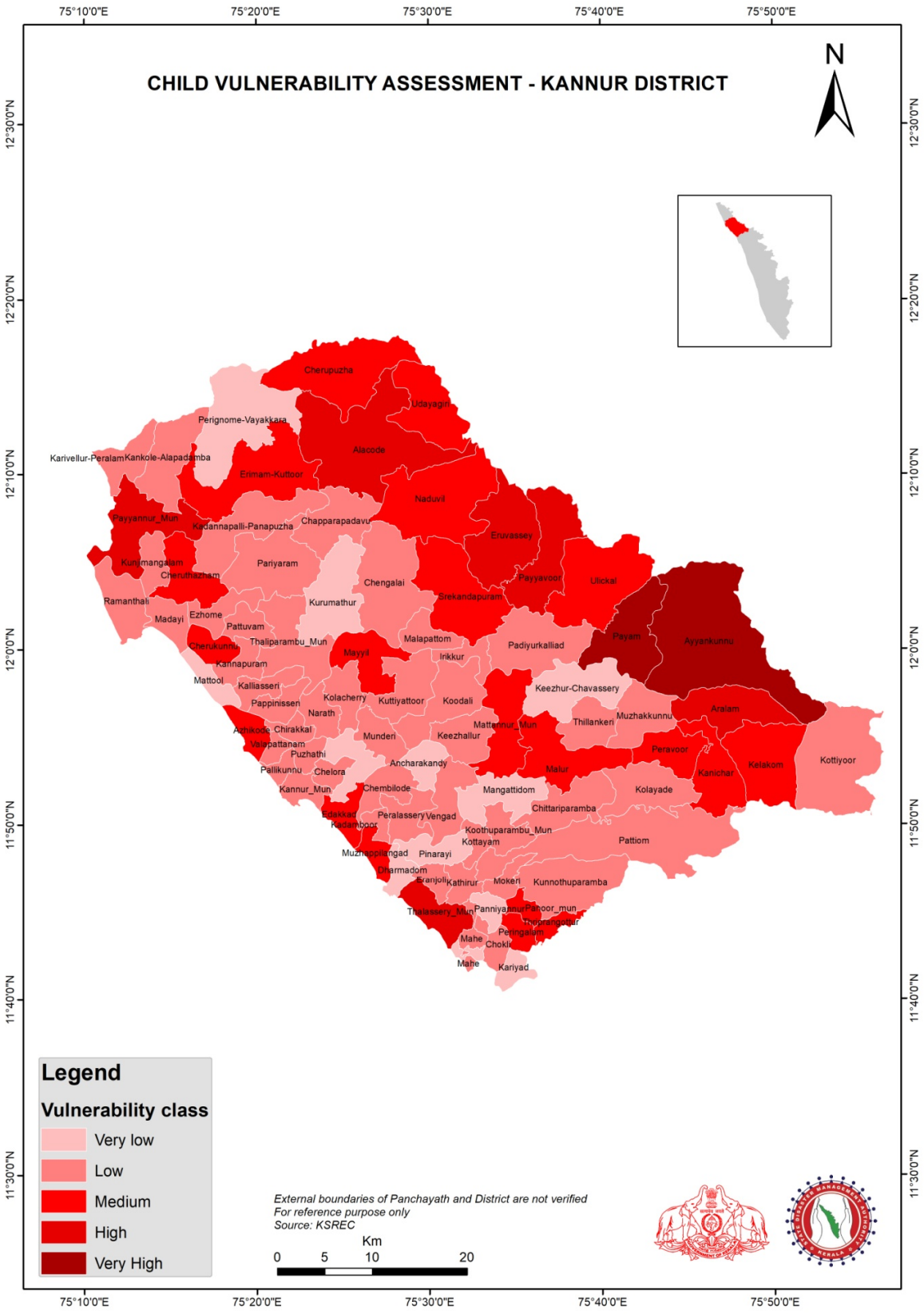

CHILD VULNERABILITY ASSESSMENT - ALAPPUZHA DISTRICT
76°20'0"E
76°30'0"E
76°40'0"E
9°50'0"N
9°40'0"N
9°30'0"N
9°20'0"N
9°10'0"N
N
Pattanakkadu
Karuvatta
Ramankary
Arukutty
Chennithala-Thripperunth
Punnapra North
Ambalapuzha South
Kainakary
Thrikkunnappuzha
Cherthala_Mun
Alappuzha_Mun
Muhamma
Kadakkarappally
Nedumudi
Kodamthuruthu
Punnapra South
Kuthiyathodu
Venmoney
Ezhupunna
Purakkadu
Mararikulam South
Aryadu
Thakazhi
Harippad
Arattupuzha
Bharanikkavu
Pulinkunnu
Edathwa
Puliyoor
Neelamperoor
Vellikkunnu
Thiruvanvandoor
Ambalapuzha North
Mannar
Thalavadi
Thanneermukkam
Cheruthana
Veeyapuram
Pallippadu
Thaikkattussery
Perumbalam
Mannanchery
Kavalam
Champakulam
Chettikulangara
Kandalloor
Panavally
Palamel
Kayamkulam_Mun
Chennam pallippuram
Cherthala south
Thuravoor
Ala
Mulakkuzha
Chenganniur_Mun
Mararikulam North
Cheriyanadu
Vayalar
Devikulangara
Chingoly
Nooranadu
Cheppadu
Thazhakkara
Kumarapuram
Muthukulam
Pathiyoor
Mavelikkara-Thekkekkara
Muttar
Mavelikkara_Mun
Chunakkara
Karimkkuzhy
Karthikappally
Aroor
Pandanadu
Krishnapuram
Mavelikkara-Thamarakulam
Veliyanadu
Bhudhanoor
Legend
Vulnerabiity class
Very low
Low
Medium
High
Very high
External boundaries of Panchayath and District are not verified
For reference purpose only
Source: KSREC
Km
0
5
10
20

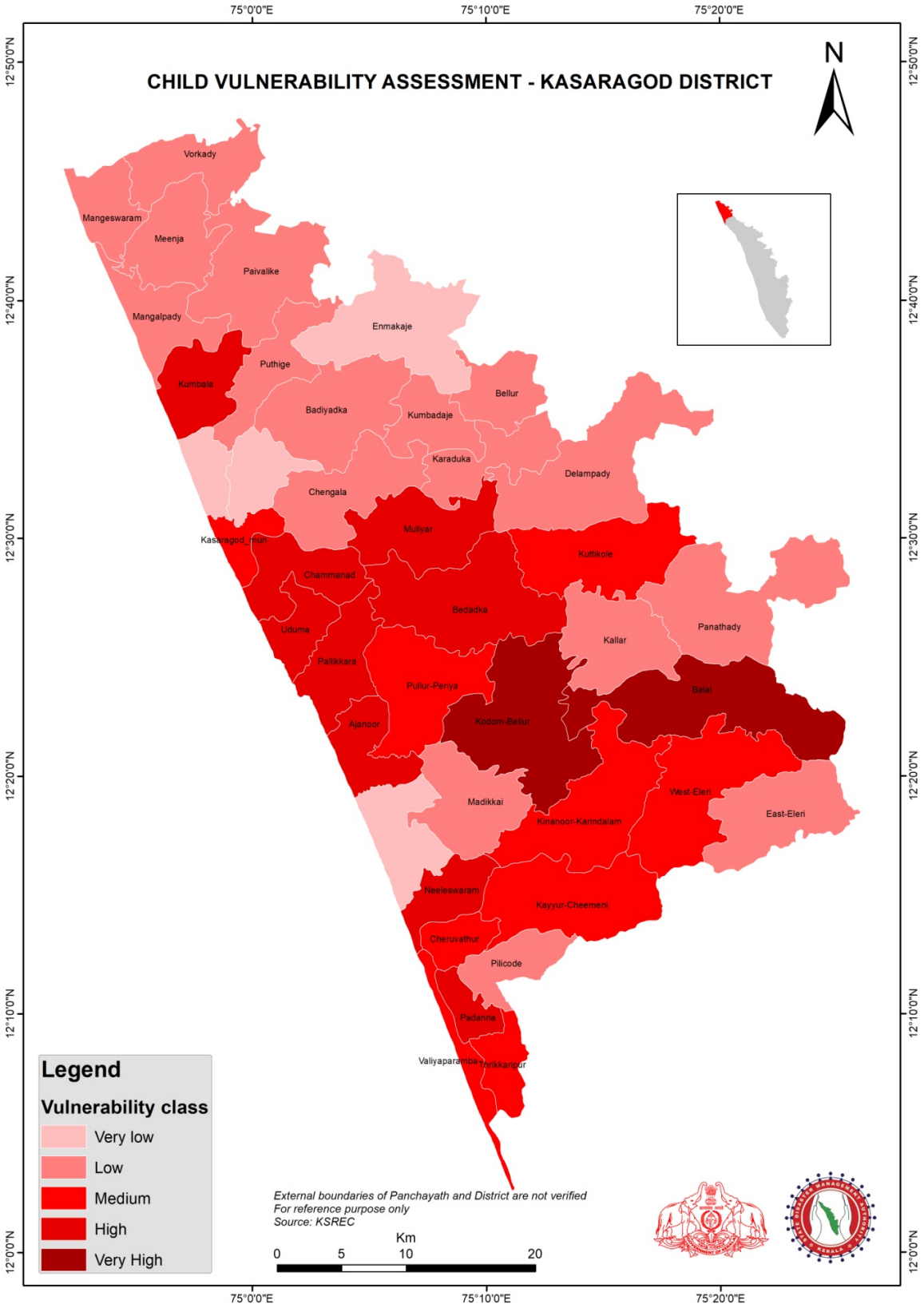

CHILD VULNERABILITY ASSESSMENT - IDUKKI DISTRICT
N
76°40'0"E
76°50'0"E
77°0'0"E
77°10'0"E
77°20'0"E
10°20'0"N
10°10'0"N
10°0'0"N
9°50'0"N
9°40'0"N
9°30'0"N
9°20'0"N
Marayoor
Kanthalloor
Vattavada
Munnar
Mankulam
Adimali
Pallivasal
Chinnakanal
Bisonvally
Vannapuram
Vellathooval
Rajakumari
Santhanpara
Kodikkulam
Karimannoor
Rajakkad
Kumaramangalam
Konnathady
Senapathi
Udumbannoor
Udumbanchola
Manakkad
Thodupuzha_mun
Idavetty
Vathikudy
Purapuzha
Alakkode
Nedumkandam
Karinkunnam
Velliyamattom
Mariyapuram
Irattayar
Idukki-Kanjikuzhy
Muttom
Kudayathoor
Vazhathope
Kamakshy
Pampadumpara
Karunapuram
Arakulam
Kattappana
Kanchiyar
Chakkupallam
Upputhara
Ayyappancoil
Elappara
Chakkupallam
Kokkayar
Peerumade
Vandiperiyar
Peruvanthanam
Kumily
Legend
Vulnerabiity class
Very low
Low
Medium
High
Very high
External boundaries of Panchayath and District are not verified
For reference purpose only
Source: KSREC
Km
0
5
10
20

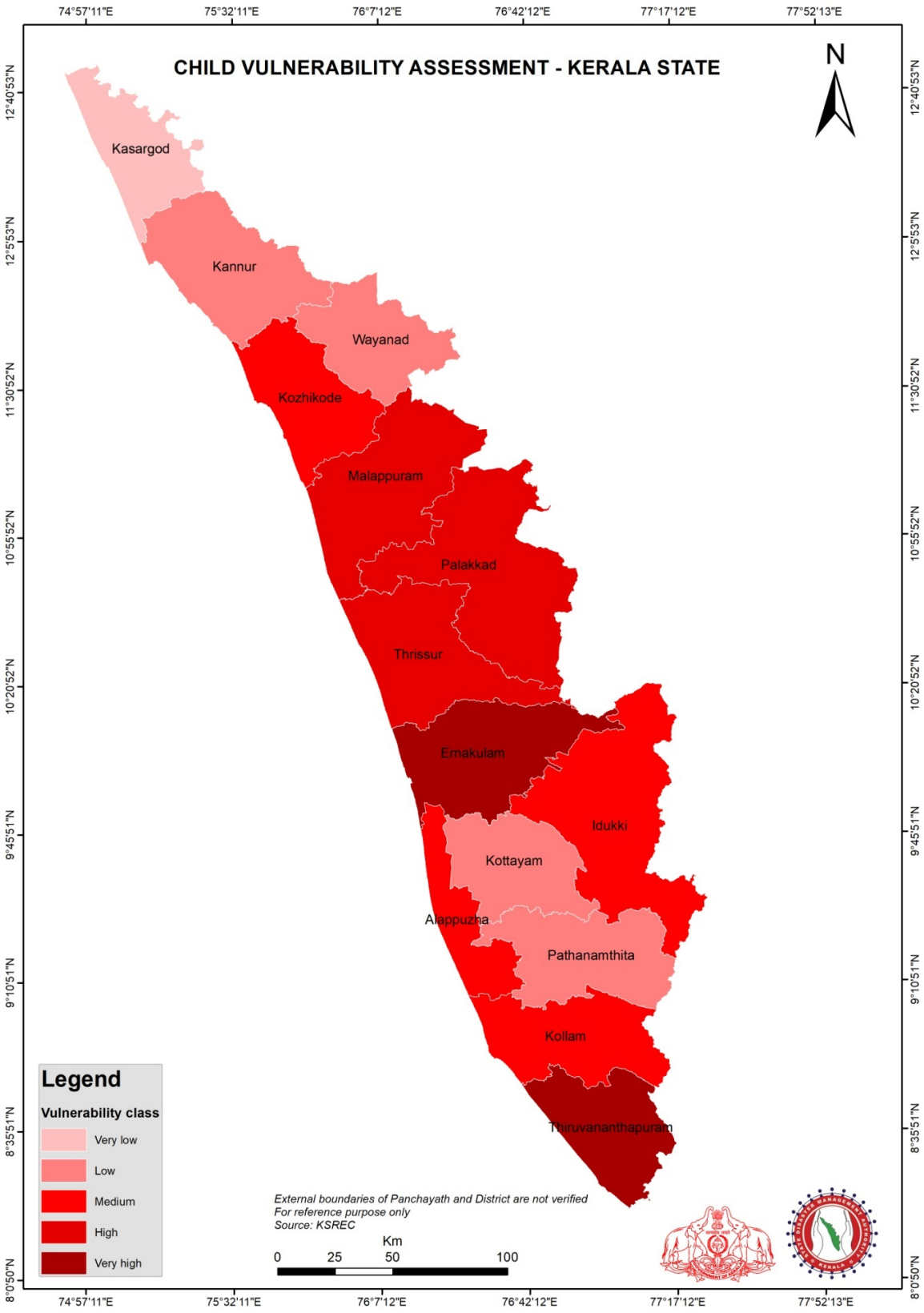

CHILD VULNERABILITY ASSESSMENT - ERNAKULAM DISTRICT
N
76°10'0"E
76°20'0"E
76°30'0"E
76°40'0"E
76°50'0"E
77°0'0"E
10°20'0"N
10°10'0"N
10°0'0"N
9°50'0"N
Legend
Vulnerability class
Very low
Low
Medium
High
Very High
External boundaries of Panchayath and District are not verified
For reference purpose only
Source: KSREC
Km
0
5
10
20
Manjapra
Karukutty
Mookkannur
Ayyampuzha
Malayattoor-Neeleswaram
Parakkadavu
Puthenvelikara
Aangamali_Mun
Kuttampuzha
Vadakkekkara
Kaladi
Koovappady
Nedumbassery
Kunnukara
Vengoor
Karumaloor
Chengamanad
Kanjoor
Mudakuzha
Okkal
Kottappadi
Alangad
Alava_Mun
Perumbavoor_mun
Pindimana
Keerampara
Edavanakkade
Keezhmad
Asamannoor
Vengola
Rayamanglam
Kothamangalam_Mun
Nayarambalam
Edathala
Nellikkuzhi
Kizhakkambalam
Kavalangade
Mazhuvannoor
Paipra
Varappetty
Pallarimangalam
Kunnathunadu
Pothanikkade
Paingottur
Aikaranad
Valakam
Muvattupuzha_mun
Ayavana
Kochi_Corp
Vadavucode-Puthenkurisu
Poothrikka
Kalloorkkade
Thiruvankulam
Marady
Avoly
Ramamangalam
Manjalloor
Chottanikkara
Pampakuda
Arakuzha
Maneed
Thirumarady
Mulanthuruthy
Palakuzha
Udayamperur
Chellanam
Edakkattuvayal
Piravam
Koothattukulam
Amballur
Ilanji


CHILD VULNERABILITY ASSESSMENT - MALAPPURAM DISTRICT
N
75°50'0"E
76°0'0"E
76°10'0"E
76°20'0"E
76°30'0"E
11°30'0"N
11°20'0"N
11°10'0"N
11°0'0"N
10°50'0"N
10°40'0"N
10°30'0"N
Pothukallu
Vazhikkadavu
Edakkara
Chungathara
Karulai
Chaliyar
Muthedam
Nilambur_Mun
Urngattiri
Amarambalam
Keezhparamb
Mambad
Vazhakkad
Areekkode
Edavanna
Chokkade
Vazhayoor
Chikkode
Thiruvalli
Wandoor
Pulickal
Cherukavu
Kavannur
Kalkavu
Kuzhimanna
Thrikkalangode
Porur
Chelambra
Kondotty
Pulppatta
Pallikkal
Nediyiruppu
Thuvvur
Karuvarakundu
Vallikunnu
Thenjippalam
Morayoor
Manjeri_Mun
Pandikkad
Pookkottoor
Peruvalloor
Kannamangalam
Anakkayam
Nunniyoor
A.R. Nagar
Urakam
Malappuram_Mun
Edappatta
Parappanangadi
Vengara
koottilangadi
Keezhattur
Thirurangadi
Melattur
Mankada
Othukkungal
Parappur
Kodur
Makkaraparambu
Vettathur
Nannambra
Thennala
Angadippuram
Edarikkode
Ponmala
Kuruva
Tanur
Kottakkal
Puzhakkattiri
Thazhekkode
Perumannaclari
Ozhur
Perinthalmanna_Mun
Ponmundam
Thanalur
Kalpakanchen
Marakkara
Cheriyamundam
Aliparambu
Niramaruthur
Valavannur
Moorkkanad
Pulamanthole
Edayoor
Thirur_Mun
Athavanad
Elamkulam
Valancherry
Vettom
Thalakkad
Thirunavaya
Kuttippuram
Triprangode
Mangalam
Tavanur
Purathur
Vattamkulam
Ponnani_Mun
Edapal
Maranchery
Alangode
Nannamukku
Perumpadappu
Legend
Vulnerability class
Very low
Low
Medium
High
Very High
External boundaries of Panchayath and District are not verified
For reference purpose only
Source: KSREC
Km
0
5
10
20


CHILD VULNERABILITY ASSESSMENT - PALAKKAD DISTRICT
N
76°0'0"E
76°10'0"E
76°20'0"E
76°30'0"E
76°40'0"E
76°50'0"E
11°20'0"N
11°10'0"N
11°0'0"N
10°50'0"N
10°40'0"N
10°30'0"N
10°20'0"N
10°10'0"N
Pudur
Sholayur
Agali
Alanallur
Kottoppadam
Malnarkkad
Kumaramputhur
Kanjirappuzha
Thachampara
Thachanattukara
Karimpuzha
Karakkurissi
Karimba
Vellinezhi
Sreekrishnapuram
Vilayur
Cherplassery
Kulukkallur
Kadambazhippuram
Thirvegappura
Nellaya
Pookkottukave
Kongad
Malampuzha
Koppam
Thrikkadeeri
Mundur
Vallapuzha
Chalavara
Keralasseri
Akathethara
Anakkara
Paruthur
Muthuthala
Ambalappara
Puthuppariyaram
Pattambi
Anaganadi
Parali
Marutha Road
Puthussery
Ongallur
Mannur Mankara
Pattithara
Thrithala
Ottappalam-Mun
Palakkad-Mun
Vadakarapathy
Shornur-Mun
Vaniyamkulam
Lakkidi-Peroor
Pirayiri
Kappur
Kottayi
Elappally
Mathur
Chalisseri
Nagalassery
Thirumittakkode
Perungottukurissi
Kannadi
Kodumbu
Polppully
Erthampathy
Kuthannur
Kuzhalmannam
Peruvembu
Nalleppilly
Kozhinjampara
Chittoor-Thathamangalam-Mun
Tharur
Thenkurissi
Koduvayur
Puthunagaram
Perumatty
Pattencheri
Puthucode
Kavassery
Erimayur
Alathur
Pallassana
Vadavannur
Kannampra
Vadakkancherry
Melarkkode
Kollengode
Muthalamada
Nemmara
Elevacherry
Ayilloor
Vandazhi
Kizhakkancherry
Nelliampathy
Legend
Vulnerability class
Very low
Low
Medium
High
Very High
External boundaries of Panchayath and District are not verified
For reference purpose only
Source: KSREC
Km
0
5
10
20


CHILD VULNERABILITY ASSESSMENT - KANNUR DISTRICT
N
75°10'0"E
75°20'0"E
75°30'0"E
75°40'0"E
75°50'0"E
12°30'0"N
12°20'0"N
12°10'0"N
12°0'0"N
11°50'0"N
11°40'0"N
11°30'0"N
Cherupuzha
Udayagiri
Perignome-Vayakkara
Karivellur-Peralam
Kankole-Alapadamba
Alacode
Erimam-Kuttoor
Naduvil
Payyannur_Mun
Kadannapalli-Panapuzha
Chapparapadavu
Eruvassey
Kunimangalam
Cheruthazham
Pariyaram
Payyavoor
Ulickal
Chengalai
Ramanthali
Kurumathur
Srekandapuram
Madayi
Ezhome
Pattuvam
Payam
Ayyarkunnu
Cherukunnu
Thaliparambu_Mun
Malapattom
Mayyil
Irikkur
Padiyurkalliad
Kannapuram
Mattool
Kalliasseri
Keezhur-Chavassery
Pappinissen
Kolacherry
Kuttiyattoor
Koodali
Aralam
Narath
Thillankeri
Muzhakkunnu
Azhikode
Chirakkal
Mattannur_Mun
Munderi
Keezhallur
Valapattanam
Peravoor
Puzhathi
Kelakom
Kottiyoor
Pallikunnu
Chelora
Ancharakandy
Malur
Kanichar
Kannur_Mun
Chembilode
Mangattidom
Kolayade
Chittariparamba
Edakkad
Peralassery
Vengad
Kadamboor
Koothuparambu_Mun
Kottayam
Pattiom
Muzhappilangad
Pinarayi
Dharmadom
Eranjoli
Kathirur
Mokeri
Kunnothuparamba
Thalassery_Mun
Panniyannur
Panoor_mun
Peringalam
Mahe
Chokli
Kariyad
Legend
Vulnerability class
Very low
Low
Medium
High
Very High
External boundaries of Panchayath and District are not verified
For reference purpose only
Source: KSREC
Km
0
5
10
20


CHILD VULNERABILITY ASSESSMENT - KASARAGOD DISTRICT
N
75°0'0"E
75°10'0"E
75°20'0"E
12°50'0"N
12°40'0"N
12°30'0"N
12°20'0"N
12°10'0"N
12°0'0"N
Vorkady
Mangeswaram
Meenja
Paivalike
Mangalpady
Enmakaje
Puthige
Kumbala
Badiyadka
Kumbadaje
Bellur
Karaduka
Delampady
Chengala
Muliyar
Kasaragod_mun
Kuttikole
Chammanad
Bedadka
Uduma
Kallar
Panathady
Pailikkara
Pullur-Periya
Balal
Ajanoor
Kodom-Belur
Madikkai
West-Eleri
East-Eleri
Kinanoor-Karindalam
Neeleswaram
Kayyur-Cheemeni
Cheruvathur
Pilicode
Padanna
Valiyaparamba
Thrikkaripur
Legend
Vulnerability class
Very low
Low
Medium
High
Very High
External boundaries of Panchayath and District are not verified
For reference purpose only
Source: KSREC
Km
0
5
10
20


CHILD VULNERABILITY ASSESSMENT - KERALA STATE
N
74°57'11"E
75°32'11"E
76°7'12"E
76°42'12"E
77°17'12"E
77°52'13"E
12°40'53"N
12°5'53"N
11°30'52"N
10°55'52"N
10°20'52"N
9°45'51"N
9°10'51"N
8°35'51"N
8°0'50"N
Kasargod
Kannur
Wayanad
Kozhikode
Malappuram
Palakkad
Thrissur
Ernakulam
Idukki
Kottayam
Alappuzha
Pathanamthita
Kollam
Thiruvananthapuram
Legend
Vulnerability class
Very low
Low
Medium
High
Very high
External boundaries of Panchayath and District are not verified
For reference purpose only
Source: KSREC
Km
0
25
50
100

4.3 SHOCKS/STRESS

4.3.1 FLOOD:

Geographic: The flood maps (pages 23 and 24)indicate that the low lying areas of Kerala especially the coastal region and the low lying areas of Kuttanad region, the Kole lands of Trichur ,and Ernakulam are highly risk prone to floods in normal monsoon years. The August 2018 and 2019 maps (which were extreme events in this century) also show that the coastal regions and the low lying areas are especially vulnerable to flooding. There are 222 fishing villages in the coastal plains of Kerala and the population there account for 7.96 lakh people out of the total population of 334 lakhs, constituting % of the total population of the state. The low lying areas of Kuttanand and Kole Nilams of Trichur are predominantly inhabited by small scale farmers and agricultural labourers..

Economic: Due to various enlightened policy initiatives of the government poverty has been almost wiped out of the state except for certain pockets like the tribal and coastal areas. The coastal areas which are subjected to floods are also one of the poverty stricken areas of the state. The fishermen sector of the state contribute significantly to the GDP of the state and earn valuable foreign exchange for the state apart from providing cheap and nutritious food to the people of Kerala.In the lowlying areas of Kuttanad and the Kole lands of Trichur the majority of the people are small scale farmers or agricultural labourers. The cessation of farming operations and total inundation of cultivated crops

Social: Families with disabled children or even worse mentally challenged children will be more vulnerable to floods than families with able bodied children whether in the rescue phase or relief phase. Since their mobility is restricted in times of emergency evacuation their vulnerability will be compounded. Since the sea will be usually rough fishermen will not be able to venture out into the sea. Women headed households will also be highly vulnerable during floods since many of them will not be

able to go out in search of jobs and this in turn will deprive the family, especially children of their daily nutritional requirements.

Capacities:

1. The people of Kerala are highly politically conscious and are aware of their rights to a safe and secure life free from disasters.
2. There is a well functioning, well coordinated state level disaster management authority in the state and 14 district level disaster management authorities with the District Collector chairing the same.
3. Well functioning state Emergency Operation Centre and 14 district emergency operation centres enhance the capacity of the state to deal with multiple hazards on an emergency basis.
4. Experience of two massive floods in August 2018 and 2019 has given the state the expertise to manage relief operations and more importantly coordinate the activities of various departments in emergency situations.
5. Statement of Procedures (SOPs) have been prepared and are being followed in flood situation
6. In addition to the existing 12 working groups in all local bodies a 13th working group has been established exclusively for disaster management , climate change, biodiversity and environment has been created

Lack of capacities:

1. Land use policies are not strictly implemented. Large scale conversion of paddy fields in the name of development and encroachments into river banks, and construction of heavy structures in eco fragile lands have diminished our preparedness to deal with floods.

2. The state's early warning system is inadequate to warn people sufficiently early of the disasters so that they may take preventive measures and save their lives.
3. Lack of periodically updated emergency and evacuation plans with special attention to the most vulnerable segments of society.
4. A general feeling of complacency that disaster will not strike oneself but will happen to others and hence not taking adequate preventive measures.

4.3.2 LANDSLIDES:

Vulnerabilities

Geographic: The land slide map illustrates that the highlands of Kerala are more prone to severe landslides. Wayanad, a tribal district and Kozhikode and the hilly district of Idukki and part of Kottayam are especially vulnerable to land slides. Landslides of lesser intensity are experienced in all other parts of the state too except in the district of Alapuzha.

Structural: Hardly any building, especially the pre 2018 buildings is built taking into account the possibility of landslides. They are not disaster resistant. Even public buildings like hospitals, and schools are not built following the government approved building codes or designs. Further very few buildings have adequate budgetary support for regular maintenance

Economic: When landslides are severe they wipe out communities completely leaving no trace of the existence of people there. All lives including human, cattle, poultry and vegetation were buried several feet under the earth suddenly as if the earth had done a somersault. This is what happened in Kavalappara (Malappuram district) and Puthumala (Wayanad district) in the landslides of 2019. Rebuilding life is like starting afresh on a clean slate which involves time and huge investment for locating alternative landslide free areas for building residential buildings and starting economic

activities like agriculture and allied activities and critical services for children like anaganwadi, schools, health care facilities, roads etc.

Social: One of the negative impacts of a landslide is the breaking of social ties built over generations. When landslides occur those of the survivors, if any are forced to search for lands away from the location of the landslides. This dispersal affects social bonding built through day to day interaction of community members. Children lose their friends and have to form new circles of friendship

Attitudinal and behavioural: There is a lack of awareness on the consequences of living on landslide prone areas. Diffusion of knowledge to grass roots level regarding landslide prone areas and its disastrous consequences has not happened. Even in cases where they are aware people are unwilling to move out due to several factors including economic and social.

Capacities:

1. Emergency response teams at the level of the local self government is planned and action has been initiated for training rescue teams and placing them in position.
2. Training is being given to all those involved in building like architects, engineers, masons, contractors etc both by government and private agencies so that construction of building conforms to nationally approved standards.

Lack of capacities:

1. Although training has started in safe construction, the volume of stake holders to be trained is disproportionately huge for the resources available
2. Lack of updated emergency and evacuation plans at grassroot levels.
3. Lack of school safety plans and anganwadi safety plans

4.3.3 DROUGHT

Vulnerabilities

Geographic: The map showing the drought prone areas of the state reveal that more than 50% of the state are under the grip of moderate to severe drought during the summer season.

Economic: When a drought occurs a major setback will be reflected in livelihood of the vulnerable segments of the population. Severely drought affected areas are in the highland and moderate drought is felt almost all across the state. Since majority of the vulnerable segments depend on agriculture as small farmers or agricultural labourers or as workers under MGNREGS, their livelihood will be severely impacted. Reduced agricultural produce will reflect not just in the state economy but also on the personal income of families and more importantly on their food intake specially of children .

Structural: The dams owned by the Kerala State Electricity Boards and Major Irrigation Department are not maintained properly as a consequence of which the holding capacity of the dams are reduced. Kerala is a place with highest well density and in drought many wells dry up even if they deepen the wells as part of mitigation. This makes women especially the marginalised women to trek long distances to get potable water.

Social: The most vulnerable groups like the tribes are highly vulnerable to drought conditions. This is especially so in Attappady (Palakkad) where migrants have displaced and driven the adivasis from close to the river bank to higher altitudes where they lack either piped water supply or river water in summers. Their farming operations become increasingly difficult during drought. Many depend on goat rearing to supplement their income. Feeding goats too become problematic in drought.

Capacities:

1. Many local self governments have started spending part of their resources in rejuvenating public ponds and wells and other water bodies.
2. Rainwater harvesting is actively encouraged both by government and private agencies

Lack of capacities:

1. The state has not developed SOP for drought preparedness and response.
2. The agriculture department has....
3. Lack of comprehensive policies to promote resilience in agriculture and allied sectors.
4. Lack of policy and programs to generally enhance the resilience of the population especially children and women.
5. Lack of data illustrating the effect of drought on various sectors of the economy and population especially children and women

4.3.4 LIGHTNING

Vulnerabilities

Geographic: The lightning frequency map of Kerala shows that almost the entire state is vulnerable to lightning.

Economic: Human exposure to lightning causes fatalities. This applies mainly to people who work in the open like manual laborers, agricultural laborers, housewives who run to take washed clothes from metallic lines etc. When fatalities occur to bread winners suddenly the income of the family stops making the family extremely vulnerable, especially the children in the family.

Structural: There are many government buildings that do not have preventive devices like lightning conductor. This makes these building highly vulnerable. Many schools and anganwadis are also not protected against lightning making them highly vulnerable.

Capacities:

1. Many training programs on disaster management have started incorporating materials on preventing lightning strikes.
2. KSDMA has developed materials on precautionary measures to be adopted to prevent being stricken by lightning.

Lack of capacities:

1. The training programs have yet to percolate down to grass roots level
2. Lack of a comprehensive policy on managing lightning related disasters

4,3,5 COASTAL EROSION

Vulnerabilities

Geographic: A major part of the whole length of the coast of Kerala is subject to coastal erosion.

Livelihood: Coastal ersosion impacts negatively the livelihood of fisherfolk . Not only do they lose their working days their livelihood implements like boats, country crafts, fishing nets etc are also damaged during coastal ersosion

Attitudinal and behavioural: Despite warning people in coastal area are quite reluctant to move out of their homes.

Capacities:

1. Successive governments have constructed RCC houses in lieu of their erstwhile thatched huts and this makes their dwelling places comparatively stronger

2. When warnings are issued by KSDMA they get the opportunity to relocate temporarily to shelters thus preventing loss of life.

Lack of capacities:

1. Poor enforcement of advisories issued by the Fisheries Department and the IMD and KSDMA
2. Lack of preparedness to move out of their own homes and live in temporary shelters

Chapter 5

Sectoral Impacts

5.1 Introduction:

Vulnerable groups of any society are the worst affected in situations of disasters and climate change. In Kerala over the years there has been a gradual shift in agriculture from food crops to cash crops, resulting in Kerala being dependent on other states for its food requirements. Food crops constitute 10.12% whereas cash crops like cashew not, pepper, cardamom, tea and coffee plants constitute 61.6% of the total cropped area. Coconut, rubber and rice occupy 29.5, 21.4, and 7.3 percent respectively. (Economic Review, Government of Kerala, 2018). Of the total economy of Kerala 19% is contributed by the primary sector (agriculture and allied activities), 28% by the secondary sector (manufacturing, gas and electricity, water supply, utility services and construction) and 53% by the tertiary sector consisting of services including financial services, communication, real estate etc.).

When a disaster strikes, its differential impacts are felt based on the exposure and coping capacities of people. One such coping capacity is embedded in sustainable livelihood options. The major livelihood options of the vulnerable population are Mahatma Gandhi National Rural Employment Guarantee Scheme and work in the plantation sector (rubber, tea, coffee, cardamom etc). Under MGNREGS in Kerala over 90% of the casual labourers are women. Disasters amplify the vulnerabilities of these households and vacuate the precious, gains they would have made brick by brick over a long period of struggling life. Compounding the miseries, has come climate change as an unwelcome guest casting its dark shadows on agriculture and upsetting the hydrological cycle. The worst sufferers are children and women. Climate change has globally increased the frequency of drought, floods, altered precipitation pattern, and extreme weather events and Kerala is no exception to this. The great flood of August 2018 and the repetition of the flood of almost the same intensity in 2019 and the sweltering heat

of the last couple of years with its attendant consequences are all testimonies to the fact that Kerala too is in the grip of climate change. How do natural disasters and climate change impact the most crucial sectors for children and women is dealt with in the following paragraphs.

5.2 Nutrition and Food Security:

The second among the Sustainable Development Goals aims to 'End hunger, achieve food security and improved nutrition and promote sustainable agriculture'. Food security has three dimensions namely availability, access and utilisation and all three have to be ensured adequately over a period of fairly long time. The intra-household allocation of food resources should also be such that each member of the household is guaranteed food resources according to each person's dietary and health needs. Here the nutrition of women gains salience since if a woman is under nourished she will give birth to undernourished children thus transmitting the under nourishment inter-generationally.

Extreme weather conditions and climate change will impact casual labourers who rely on MGNREGS or in the informal sector for their livelihood. When wages are negatively impacted for lack of work, the food that find entry to the home will get diminished as a consequence children will not get their normal quota of food. Plantation workers too will be affected. Extreme drought conditions will lessen the yield of rubber and other plantations resulting in reduced number of work days for the plantation labourers. Regarding other food items like rice and vegetables climate variability and extremity will reduce the quantum of produce resulting in price rise. When prices go up without a commensurate rise in wages, the purchasing power of vulnerable groups of people like small farmers, wage labourers in the farm sector and non formal sector will nose dive. In such cases the first casualty will be children's intake of food both in quantitative and qualitative terms. The malnourished children will get severely malnourished becoming prey to several morbidities.

In the case of tribal areas like Attappady when tribal women lose out on casual labour both under MGNREGS and in farms, like lactating mothers, pregnant women too become anaemic due to iron deficiency thus giving birth to low weight babies who die prematurely. Their intake of nutrients like energy, proteins, and fats will be less than the recommended level. The year 2016 was the year when high infant mortality rate was reported in the tribal areas of Attappady. That was preceded by the stoppage in 2013 of the project called AHADS, focussed on women's socio-economic empowerment including providing daily wage jobs to women. When extreme weather conditions like drought happen it will impact women, adolescent girls and children very badly. Their cultivation of sorghum and other vegetables will languish without adequate irrigation facilities.

Natural disasters like flooding and climate change induced storm surges will have serious repercussions on the health of children and women in coastal communities which are another vulnerable section of the population. Kerala has a long beach line of 590 kms and a rise of sea level of a few millimetres will have severe impact on the children. With one of the highest densities of population and open wells, floods in coastal areas will contaminate open wells and cause the outbreak of communicable diseases like diarrhoea, draining families of their small savings and children of their health and nutritional level.

5.3 Health:

In August 2018 the great deluge of Kerala occurred and, by September 2018 Kerala was subjected to water logging for extended number of days leading to the largest number of fatalities in the country related to dengue fever (35 deaths being 42% of the total deaths by dengue) and the third highest number of cases of dengue fever (3660) (Medibulletin October 21, 2018). Global warming is felt as high temperatures. Students who like to play outside can be exposed to sun burns and also dehydration which

if not treated urgently can lead to paralysis. Extreme temperatures can lead school going children to buying beverages and ice creams which may be made with contaminated water and have no quality control. This will lead to diseases like diarrhoea, cholera, typhoid etc.

Children in the age group of 0 to 6 years who go to the Anganwadis are likely to get infection post floods. If the anganwadis are not properly disinfected, moulds and fungi are likely to grow and cause fungal infection to children.

Children of all age groups are likely to need psycho social support when disasters strikes close at home affecting their family members and friends and neighbours as was documented in the post flood scenario of 2018.

5.4 Education:

Natural disasters have a direct bearing on the education sector. Kerala that has become a fully literate state by 1991. The female literacy is 92% and that of male 94%. Almost 6% of its GSDP is spent on education. There are about 16466 primary schools, 4770 secondary schools , 3000 higher secondary schools. Of the total students enrolled in schools girls constitute 49.01 % . Scheduled castes students constitute 10.45 % and Scheduled tribes constitute 2.02% as on 2018-19 (Economic Review 2018).

When severe floods, landslides, storm surges and other natural hazards affect an area, there will be temporary cessation of educational services. Schools will remain closed. Sometimes even if the schools are not closed people in remote areas like the tribal areas get marooned and isolated . For instance in the last flood bridges connecting tribal hamlets were washed away and so there was no means of transportation to reach the schools. In places like Kuttanad which lie below the sea level toilets are a huge problem. This is especially so in the case of girl children during their menstrual cycle.

The structural stability of many schools are questionable. Although the local self government engineers have to do audit of school buildings not all schools have been audited. Schools where annual maintenance and structural stability auditing has not been done is likely to be more exposed to disasters. During floods many schools are transformed into temporary shelters for one to two weeks. In certain cases the period is likely to be extended further. In such cases the regular enrolled students of the school lose out on education, mid day meal program and all other related services.

There are 33115 anganwadi centres in the state of Kerala. Many of the andanwadi centres are not housed in very strong buildings. Floods and landslides can cause structural damages or total destruction. Even when an anganwadi is not wiped off the essential utensils and stock of food get damaged disrupting the services rendered through the anganwadis. The structures can become unsafe for the children to continue there. There will be temporary cessation of pre school education of Anganwadi children.

5.5 Water and Sanitation:

The UN General Assembly has declared the decade starting on March 22, 2018 (The World Water Day) as the International Decade for Action on Water for Sustainable Development to bring home forcefully to all nations the need for sustainable management of water resources. Evaluation of the quality of drinking water in Kerala State, India by Karthick et al (2010) reveals that all water samples taken from all 14 districts of the state were contaminated by coliform bacteria and about 20% of tap water samples from Alapuzha and 15% from Palakkad districts were found to be beyond the limits prescribed by the Bureau of Indian Standards. This was because of the contamination of source water and inadequate treatment. During disasters especially during floods the situation deteriorates increasing water borne diseases to children. This is specially so for school going children since many of them have the habit of drinking water directly from the public tap without boiling it.

As regards Open Defecation Free (ODF) status, Kerala was way ahead of other states even prior to the announcement of Swatch Bharat Abhiyan. Although the rural areas of Kerala has been declared 100% ODF, in situations of flood there is the possibility of contamination since Kerala is one of the states with highest leach pit latrine density. So during floods incidence of diseases like diarrhoea, dysentery, hepatitis and leptospirosis are likely to go up affecting children specially children in low lying flooded areas.

Chapter 6

Risk Governance

The revenue minister holds the portfolio of the Department of Revenue and Disaster Management. The department of Revenue was renamed as the Department of Revenue and Disaster Management as per G.O (MS) no 240/2010/DMD dated 19/6/2010. It is this administrative department that prepares the agenda for the meetings of KSDMA, State Executive Committee (SEC), allocates and approves the utilisation of SDRF (State Disaster Response Fund) SDMF (State Disaster Mitigation Fund), issue necessary administrative orders based on the decisions taken in the meeting of the KSDMA and SEC, appoints staff, consultants and employees of KSDMA etc.

The apex body that implements and oversees disaster management activities in the state under the overall supervision of the department of revenue and disaster management is the Kerala State Disaster Management constituted in 2007 as per the Disaster Management Act of 2005. According to the DM act 2005, states are mandated to establish the State Disaster Management authority, the State Executive Committee and District Disaster Management Authorities. The Kerala State Disaster Management Rules were framed in 2007 vide Kerala Extraordinary Gazette S.R.O no 201/2007 dated 1/3/2007 (amended subsequently vide S.R.O no 583//2013 dated 17/7/2013 and S.R.O. no 263/2016 dated 2/3/2016) which also notified the State Disaster Management Authority, the State Executive Committee and the District Disaster Management Authorities.

The KSDMA comprises of 10 members and is chaired by the Hon'ble Chief Minister and convened by the Additional Chief Secretary, Revenue and Disaster Management. The Hon'ble Minister for Revenue and Disaster Management is the Vice Chairman of KSDMA. The Chief Secretary is the Chief Executive Officer of the KSDMA. The other members are three technically competent members

nominated by the Chairman, Minister for Home and Vigilance, Minister for Agriculture, Additional Chief Secretary Home, Head of State Emergency Operations Centre (member secretary of KSDMA)

KSDMA is the authority that approves all policies, programs and rules related to disaster management in the state. It advises the government to allocate funds for the implementation of the DM Act, manage different disasters, issue necessary guidelines, approve state disaster risk reduction plan, prescribe the roles of various departments in disaster risk reduction and ensure the mainstreaming of disaster risk reduction in their development programs.

The SEC (State Executive Committee) is formed as per section 20 of the DM Act. It is chaired by the Chief Secretary, the other members being Additional Chief Secretaries of the Departments of Revenue & Disaster Management, Home &Vigilance, Health and Finance. The objectives of the SEC are to prepare the state disaster risk reduction plan, implement the schemes of the central and state government regarding disaster risk reduction, ensure the coordination of disaster risk reduction activities and review the progress of implementation of the schemes, issue appropriate orders and instructions to concerned departments for ensuring disaster response in emergency situations, control the activities of the State Emergency Operations Centre and the virtual cadre for disaster risk reduction, utilisation of the State Disaster Mitigation Fund and State Disaster Response Fund.

The State Emergency Operation Centre(SEOC) under the leadership of the Additional Chief Secretary (Disaster Management), who is also the State Relief Commissioner oversees the analysis of disaster situations, data collection, issuance of SOPs for potential disasters, coordination of Central and State Disaster Response Force, conscientisation programs at the state level etc. At the district level there are District Emergency Operation Centres DEOCs).

At the district level there are the District Disaster Management Authorities (DDMAs) constituted as per the DM Act 2005. They are headed by the concerned district collectors. The other members of the

DDMA are the District Panchayat President (co- chairman), district heads of the police department, health department, Fire Protection officer, a district level officer of Major Irrigation, Agriculture, Fisheries, Civil Supplies, Public Works Department, or Revenue Divisional Officer.

There are three Emergency Operations Committee to manage disasters. The committee that looks into natural disasters is chaired by the Chief secretary and convened by the Additional Chief Secretary Revenue and Disaster Management. The committee that deals with man made disasters is chaired by the Additional Chief Secretary Home and Vigilance and convened by the Director General of police. The committee that looks into disasters in the mining sector is chaired by the secretary of the Industries department and convened by the Director of Geology Department.

SDRF/NDRF Norms

1. SDRF/NDRF Norms 2015-2020 – Declaration of Heat Wave , Sunstroke and Sunburn as State Specific Disaster(Released on 9/3/2019)
2. Updated Guidelines for damaged roads/bridges due to natural calamity released on 27/03/2018
3. SDRF/NDRF Norms 2015-2020 – Declaration of Soil Piping as State Specific Disaster (Released on 18/01/2017)
4. SDRF/NDRF Norms 2015-2020 Government Order (Released on 20/05/2015 applicable from 1st April 2015)
5. SDRF/NDRF Norms 2015-2020 Annexure to the Government Order (Released on 8/4/2015)
6. SDRF/NDRF Norms 2015-2020 – Declaration of Lightning, Coastal Erosion and 'Strong Winds less than cyclone that causes damage to life and property' as State Specific Disasters (Released on 23/7/2015)

STATE DISASTER MITIGATION FUND

1. Guidelines for Administration of State Disaster Mitigation Fund – SRO No. 5/2012

CIRCULARS

1. Monsoon contingency preparedness circular,2018
2. Drought Response Activities, 2018
3. Monsoon contingency preparedness circular, June to December 2017)
4. Drought Contingency Plan, November 2016 to May 2017 – Circular
5. Monsoon Preparedness Circular 2016 (English)
6. Drought mitigation measures January to March 2016
7. Monsoon Preparedness Circular 2015 – Govt. Letter to all stakeholder Departments
8. Monsoon Preparedness Circular 2015
9. Drought mitigation measures 2015

ACTS, RULES & GOVERNMENT ORDERS RELEVANT TO DISASTER MANAGEMENT

1. Prathyuthaanam Scheme for the vulnerable families whose houses were damaged (15%-100%) during floods & landslides of July, August 2018
2. GO(P) No 112 – 2018-Fin dated 21-07-2018
3. Appointment of Nodal Officers at State/District for heat wave mitigation activities
4. Kerala State Disaster Management Rules – Amendment – 2015
5. Kerala State Disaster Management Rules – Amendment – 2010
6. Members of Crisis Management Group – Anthropogenic Hazards, 2014
7. Members of Crisis Management Group – Mining, 2014
8. Members of Kerala State Disaster Management Authority 2013
9. Members of Crisis Management Group – Natural Calamity, 2011

10. Kerala State Disaster Management Policy 2010
11. District Disaster Management Authorities 2008
12. Kerala State Disaster Management Rules 2007
13. Creation of Disaster Management Department, 2005
14. Disaster Management Department – Work Distribution, 2018
15. National Disaster Management Act 2005
16. Approval of State Disaster Management Plan 2016
17. Approval of District Disaster Management Plans 2016
18. Streamlining Office of KSDMA
19. Streamlining KSEOC
20. Designating Director General, Civil Defence
21. State Disaster Response fund

DISASTER DECLARATION

1. Declaration of Drought Rabi 2017-18
2. Declaration of Drought Kharif and Rabi 2016-17
3. Declaration of Drought, Kharif 2016
4. Declaration of Flood affected in South-West Monsoon season of 2018

Apart from these norms, orders, circulars and G.O related to disaster management Government have constituted a working committee on biodiversity management, climate change, environmental protection and disaster management for all local self governments. The local body head will chair the committee and the secretary of the local self government will be the convenor.It is the responsibility of this working group to initiate various activities related to Climate change, biodiversity and disaster management.

Since the temperature is soaring there is a high chance of dehydration as well and increasing the intake of water is mandatory, the DMO adds. The department has instructed school students and labourers to avoid staying in sun for long from 11.30 a.m. to 3 p.m. In cases of severe sunburn, the victims should be immediately moved to places with shade and their body parts exposed to the sun should be wiped with cotton dipped in cold water.

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Global Humanitarian Overview 2019 by United Nations Office for the Coordination of Humanitarian Affairs https://www.unocha.org/sites/unocha/files/GHO2019.pdf

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Guidance on Risk Informed Programming, 2018 by United Nations Children's Fund(UNICEF) https://www.unicef.org/media/57621/file

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Acronyms

AHADS	Attappady Hills Area Development Society
CDPO	Child Development Project Officer
CGWB	Central Ground Water Board
CWRDM	Centre for Water Resources Development and Management
DRR	Disaster Risk Reduction
GDP	Gross Domestic Product
GIS	Geographic Information System
Ha	Hectares
IMD	India Meteorological Department
KSDMA	Kerala State Disaster Management Authority
KSDMP	Kerala State Disaster Management Plan
Mbgl	Meters Below Ground Level
MCM	Million Cubic Meter
MGNREGS	Mahathma Gandhi National Rural Employment Guarantee Scheme
Mm^3	Cubic mega meter
ODF	Open Defecation Free
SDRF	State Disaster Relief Fund
NDRF	National Disaster Relief Fund
SEOC	State Emergency Operations Centre
SOP	Statement of Procedures
UNICEF	United Nations Children's Fund
UNDRR	United Nations office for Disaster Risk Reduction
UNISDR	Former name of UNDRR