



Karnataka State Disaster Management Authority (KSDMA)
Revenue Department (Disaster Management)
Government of Karnataka



KARNATAKA STATE THUNDERSTORM & LIGHTNING ACTION PLAN - 2022



GOVT. OF KARNATAKA

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**Revenue Department
(Disaster Management)
Government of Karnataka**



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R. ASHOKA

Revenue Minister and Vice Chairman,
Karnataka State Disaster Management Authority

MESSAGE

The Indian subcontinent is among the world's most disaster-prone land masses. Almost 85% of India's geographical area is vulnerable to one or the other hazard(s). India, with approximately 1.32 billion people, is the second most populous country in the world. A high population density increases our vulnerability to various hazards. Thunderstorm & Lightning/Squall/Dust Storm/Hailstorm and Strong Winds have emerged as major weather hazards in recent years affecting different parts of the country.

Thunderstorm & Lightning associated with Hailstorm/Squall and Strong winds can lead to dangerous consequences and can cause loss of human and animal lives. Thus, it is necessary for the concerned authorities to take appropriate Preparedness and mitigation measures to minimize the impact of Thunderstorm & Lightning on the population in the vulnerable areas.

Karnataka state has always been taking innovative and proactive steps towards Disaster preparedness and mitigation measures. Continuing that tradition, the Karnataka State Disaster Management Authority (KSDMA) has prepared Karnataka Thunderstorm & Lightning associated with Hailstorm/Squall and Strong winds Action Plan 2022. It is intended to minimize the probable hardship faced by the community due to Thunderstorm & Lightning in the state.

I applaud Dr Manoj Rajan, Commissioner KSDMA for proactively developing this comprehensive Thunderstorm & Lightning associated with Hailstorm/Squall and Strong winds Action Plan 2022 for the state. I urge all the concerned Departments and Agencies to make use of this action plan to take necessary measures and implement Thunderstorm & Lightning with associated weather phenomena mitigation measures suggested therein.

Also, I recommend the departments to conduct community outreach programs to create awareness amongst the public about the dangers posed by these type of Natural Disasters and remedial measures to be taken at community level as well as an individual.

Sri R Ashoka
Hon'ble Revenue Minister
Government of Karnataka



Tushar Giri Nath, IAS



Principal Secretary to Government
Revenue Department (DM)
Government of Karnataka

FOREWORD

Thunderstorm and lightning and associated strong winds have emerged as major weather related natural hazards in recent years affecting different parts of the State. In recent years, the severity and frequency of thunderstorms and lightning events have been increased many folds, due to rising in global temperatures and climate change. In-cloud lightning comprises of the vast majority of lightning activity in the atmosphere and often serves as a precursor to extreme weather conditions that include heavy rain and hail, and gusty winds, dangerous cloud to ground lightning strikes.

These natural events often strike the poor sections of our society. Karnataka has witnessing of deaths every year due to cloud to ground lighting events. Hence, there is need to formulate preparedness and mitigation measures and to invest in disaster risk reduction, which will save lives, live stock and property.

Consequently, KSDMA has prepared a Thunderstorm and Lightning action plan - 2022 for Karnataka State for the first time as per the NDMA guidelines focused on preparedness, mitigation measures, capacity building and the early warning mechanism and departmental wise the roles and responsibilities defining.

The efforts of Dr. Manoj Rajan, Commissioner, KSDMA and his team in bringing out Thunderstorm & Lightning Action Plan – 2022 is highly appreciated. I am confident that this Action Plan will go a long way in mitigating the compounded risks arising from Thunderstorm & Lightning.

Tushar Giri Nath, IAS
Principal Secretary to Government
Revenue Department (Disaster Management)



Dr. Manoj Rajan



Commissioner
KSDMA
Revenue Department (DM)
Government of Karnataka

PREFACE

Lightning causes several deaths and loss of property in India. The high population density makes our Country one of the most vulnerable to disasters. Thunderstorms & Lightning/Squalls/Hailstorms and Strong Winds have emerged as major weather hazards in recent years, affecting different parts of the Country in both severity and frequency. More than 2,500 people are losing their lives due to lightning strikes in the Country every year.

Thunderstorms & Lightning have some typical characteristics such as the formation of a squall, strong updraft and downdraft, towering cumulonimbus clouds associated with turbulence and icing, in-cloud electrification and associated Lightning, localized heavy rain and hailstorm with strong winds, generally occurs in arid and semi-arid regions. Experts believe that due to rising global temperature and climate change (IPCC Special Report, 2018 - Global Warming of 1.5 °C), the severity and frequency of thunderstorms will rise in the years ahead, and it may also increase in the number of incidents in future.

The guidelines present salient features of thunderstorms and associated weather phenomena and guidance for early warning and communication, keeping in mind existing gaps, challenges and opportunities. These also draw the strategy to be followed by all stakeholder agencies with well-defined timelines, roadmaps and Standard Operating Procedures (SOPs) to follow. It will help to develop measures for the assessment, forecast, preparedness and mitigation through coordinated efforts with multiple agencies and undertake reconstruction as an opportunity to build disaster-resilient infrastructure.

I am sure that the District administration and field level functionaries will find this Thunderstorms & Lightning Action Plans 2022 useful and will take early and required steps at appropriate time in dealing with these Hazards to minimize the adverse impacts.

I acknowledge the efforts put in by Sri. Gavaskar and Sri. Prasad from KSNDMC for their contributions in preparing the Action Plan 2022.



Dr. Manoj Rajan

Commissioner

Karnataka State Disaster Management Authority
Revenue Department (Disaster Management)

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CHAPTER-I

INTRODUCTION

CHAPTER 1: INTRODUCTION

Thunderstorm and Lightning have emerged as one of the major weather hazard in recent years and have affected many parts of the Country. IMD data (1950-1980) shows that more than 80 thunderstorm and lightning days occur over the northeast, and some parts of Kerala, Jammu & Kashmir each year. In India, the mortality due to thunderstorm and lightning is more than 2,500 people every year.

As per recent studies, lightning activity have shown increasing trend over India in past two decades. North-East, East and parts of peninsular India have registered a sharp increase of lighting over the past 2 decades. The increase is minimal over Central India and moderate over rest of the country

Experts believe that due to rising global temperature and climate change (IPCC Special Report, 2018 - Global Warming of 1.5 °C), the severity and frequency of thunderstorms will rise in the years ahead and it may also increase in the number of incidents in future. Thunderstorms have some typical characteristics such as the formation of a squall, strong updraft and downdraft, towering cumulonimbus clouds associated with turbulence and icing, in-cloud electrification and associated lightning, localized strong rain and hailstorm.

Thunderstorm & Lightning have a devastating impact on agriculture and aviation sectors in addition to surface transport, power, communication and other socio-economic sectors also. Managing these, therefore, requires active and continuous monitoring and participation of all the stakeholders. NDMA had brought out extremely timely and relevant consensus guidelines for Thunderstorm & Lightning along with other natural hazards taking the inputs from the domain expert groups/sub-groups, including representatives of various ministries/departments and state governments along with other stakeholders.

Lightning is a sudden electrostatic discharge that occurs during a Thunderstorm. This discharge occurs between electrically charged regions of a cloud called intra-cloud lightning (IC), between Cloud to Cloud (CC lightning), or between a cloud and the ground (CG lightning). The charged regions in the atmosphere temporarily equalize themselves through this discharge referred to as a flash. A lightning flash can also be a strike if it involves an object on the ground. Lightning creates light in the form of black body radiation from the very hot plasma created by the electron flow, and sound in the form of thunder. Lightning may be seen and not heard when it occurs at a distance too great for the sound to carry as far as the light from the strike or flash. A huge amount of energy (about 1 billion joules) is released during a lightning strike. Consequently there are loss of lives and property across the world every year.

The lightning causes several deaths and loss of property in India and also more than 2,500 people have been killed by lightning strikes in the Country every year. From 1967 to 2012, lightning accounted for about 39% of deaths that resulted from Natural Disasters in India. In the year 2013, about 2,850 people died due to lightning strikes and in 2014 about 2,600 people lost their life due to this Natural Disaster. Lightning has a total path length of a few kilometers. Its peak power and total energy are very high, with the peak power discharge in the order of a 100 million watts per meter of the channel and the peak channel temperature approaching 30,000 °C. Peak currents in a lightning discharge range up to hundreds of kilo amperes (kA) with its typical value being 40 kA. Predicting the precise time and location of lightning is very difficult. However, a season or a period of lightning occurrence is known for many regions.

These Guidelines present salient features of thunderstorms and associated weather phenomena, and guidance for early warning and communication keeping in mind existing gaps, challenges and opportunities. These also draw the strategy to be followed

by all stakeholder agencies with well-defined timelines, roadmaps and Standard Operating Procedures (SOPs) to follow.

According to the India Meteorological Department (IMD) released Average annual frequency of thunderstorms in India during 1981 -2010 indicated in **Figure 1**.

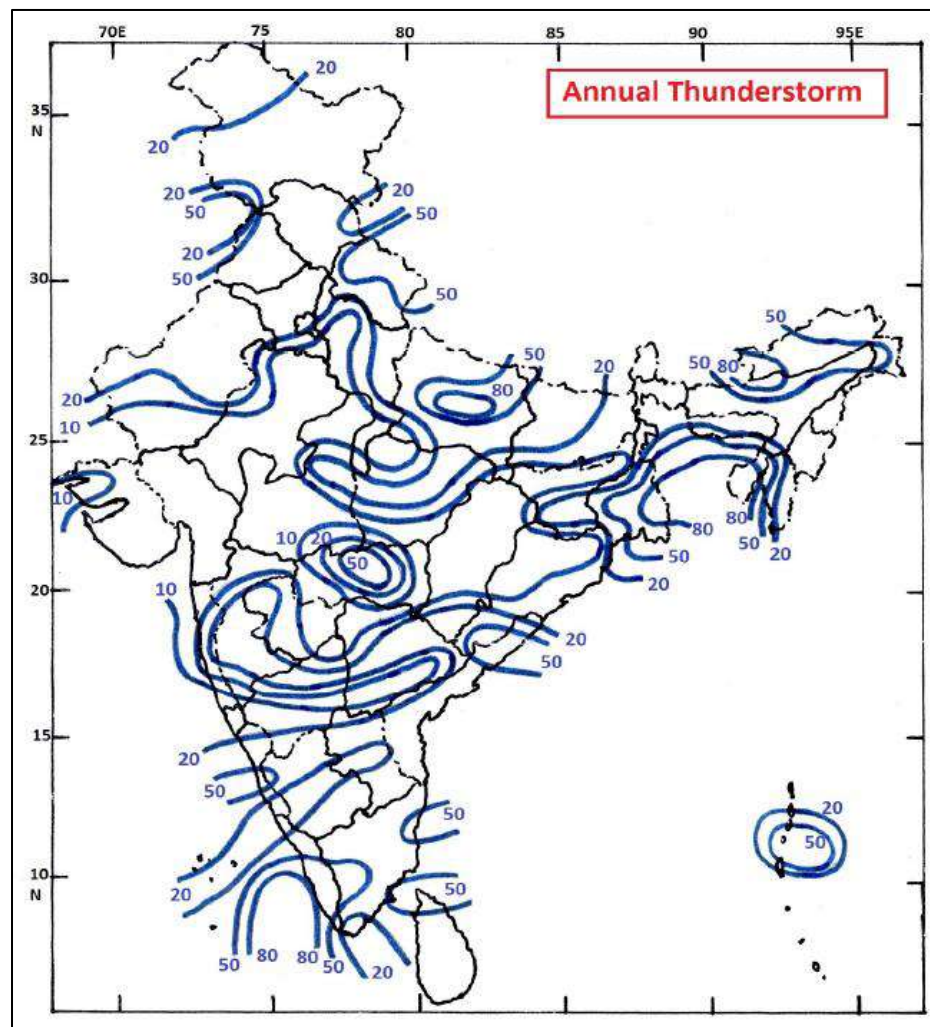


Figure 1: Average annual frequency of thunderstorms in India during 1981 -2010 (IMD)

The Cloud-Ground (C-G) lightning strikes distribution mapped for India during April 2020 to March 2021. The below map reveals lightning prone zones, also called as lightning hotspots.

1.1 Definitions & Classification of Thunderstorms and associated with weather phenomena

A. Thunderstorms

A thunderstorm is said to have occurred if thunder is heard or lightning is seen. Usually, the thunder can be heard up to a distance of 40 km from the source of origin. Thunderstorms fall in the category of Meso-gamma weather systems with a spatial extent of around 2~20 km and temporal scale of a few hours. Considering their intensity, the thunderstorms in India are categorised as follows:

- **Moderate thunderstorm:** Loud peals of thunder with associated lightning flashes, moderate to heavy rain spells and maximum wind speed of 29 to 74 kmph.
- **Severe thunderstorm:** Continuous thunder and occasional hailstorm, and maximum wind speed exceeding 74 kmph.

Thunderstorms occur round the year in different parts of the country. However, their frequency and intensity are maximum during summer months (March to June) as the most important factor for the occurrence of thunderstorms is the intense heating up of the atmosphere at the surface level.

B. Squall

A squall is defined as a sudden increase of wind speed of at least 29 kmph (16 knots) with the speed rising to 40 kmph (22 knots) or more and lasting for at least one minute. It is of two types:

- **Moderate squall:** If the surface wind speed (in gusts) is up to 74 kmph.
- **Severe squall:** If the surface wind speed (in gusts) is greater than 74 kmph.

The climatology of the spatial distribution of occurrence of a squall is almost the same as that of thunderstorms. The frequency and intensity of squall are maximum over eastern and north-eastern States. Also, its frequency is maximum during the pre-monsoon season

with an increasing trend from March to May in different parts of the country. However, there is a secondary maximum in the winter season over northwest India.

C. Hailstorm

India, with about 29 hail days of moderate to severe intensity per year, is among those countries in the world which experience a very high frequency of hail. Hailstorms are mainly observed during the winter and pre-monsoon seasons with virtually no events after the onset of the southwest monsoon.

It appears to be associated with a particular cell of convective cloud rather than storm as a whole. Hail occurs in the mature stage, if at all it occurs. Cells in which hails occur have updrafts of greater than average intensity, exceeding 15 meters per second. It is of three types:

- **Slight Hailstorm:** If it is sparsely distributed, usually small in size and often mixed with rain.
- **Moderate Hailstorm:** If it is abundant enough to whiten the ground.
- **Strong Hailstorm:** If it includes at least a proportion of large stones.

D. Lightning

Lightning is a high-energy luminous electrical discharge accompanied by thunder. It is of three types:

- 1) Thundercloud or Intra-cloud lightning (IC)
- 2) Cloud-to-cloud or Inter-cloud lightning (CC)
- 3) Cloud-to-ground lightning (CG)

The third type of lightning takes a toll on lives and property, and therefore, is of more concern to us. However, inter-cloud and intra-cloud lightning are also dangerous as they may hit aircrafts.

These are also the precursor to cloud-to-ground lightning. Lightning has a total path length of a few kilometres. Its peak power and total energy are very high, with the peak power discharge in the order of a 100 million watts per meter of the channel and the peak

channel temperature approaching 30,000 °C. Peak currents in a lightning discharge range up to hundreds of kilo amperes (kA) with its typical value being 40 kA. Predicting the precise time and location of lightning is very difficult. However, a season or a period of lightning occurrence is known for many regions.

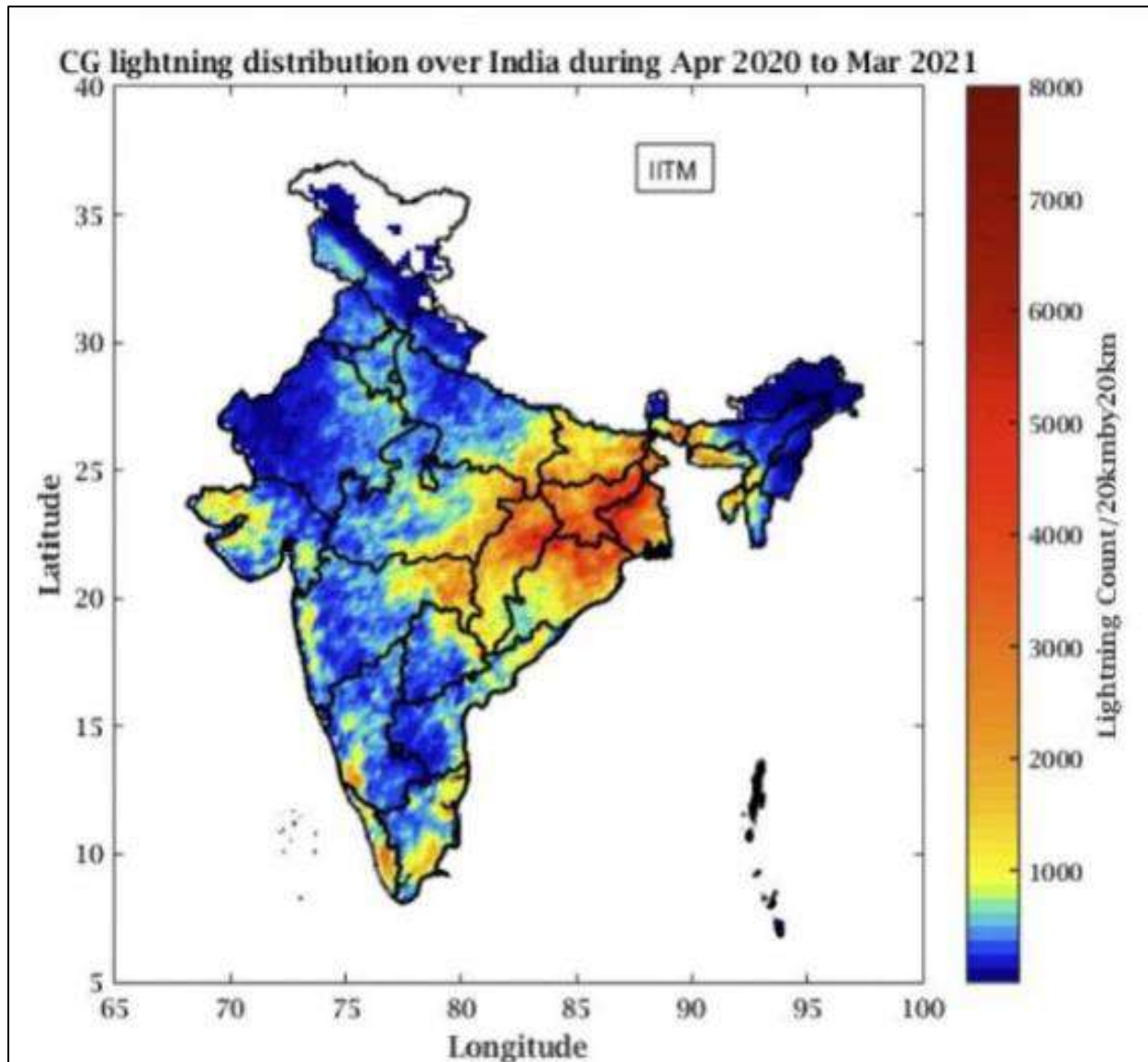


Figure 2: C-G Lightning strikes distribution over India during Apr 2020 to Mar 2021

CHAPTER-II

THUNDERSTORMS & LIGHTNING VULNERABILITY KARNATAKA

CHAPTER 2: THUNDERSTORMS & LIGHTNING VULNERABILITY

According to Lightning Distribution over India during April 2020 to March 2021 study done by IMD, indicates that southwestern parts of the Karnataka State is one of the vulnerable area for Cloud – Ground (C-G) Thunderstorm & Lightning (T&L) strikes. About 812 (**Table. 1**) people have died due to lightning strikes and also causing loss of life, property, livestock as well as infrastructure during the years from 2011-2021 in the Karnataka State.

Year	Number of Deaths
2011	37
2012	33
2013	38
2014	79
2015	72
2016	59
2017	96
2018	118
2019	101
2020	79
2021	100

Table. 1: Year-wise deaths reported due to Thunderstorm & Lightning – State

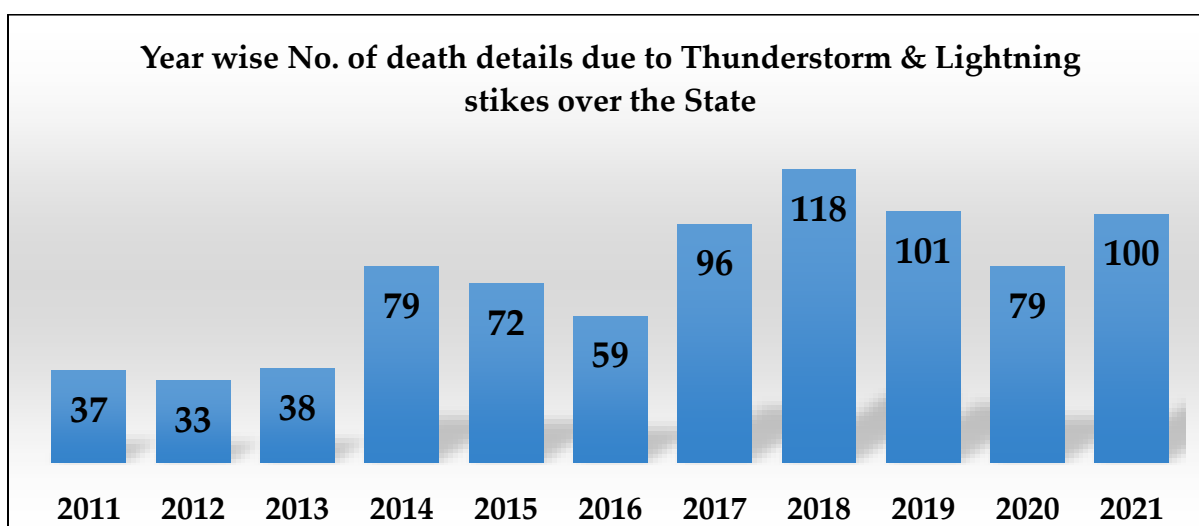


Figure 3: Year wise No. of deaths due to Thunderstorm & Lightning in the State

Lightning deaths were spread across all the districts of the State. The human deaths during last eleven years from 2011 to 2021 district wise has been provided in the given below table.

Sl. No	DISTRICT	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
1	Belagavi	5	4	13	8	13	8	8	10	6	4	6	85
2	Vijayapura	5	3	2	6	1	5	8	10	11	7	11	69
3	Gadag	0	0	0	13	3	3	14	9	5	5	4	56
4	Chitradurga	8	3	6	3	6	4	6	3	4	3	2	48
5	Tumakuru	3	4	0	5	5	1	5	7	8	4	6	48
6	Bidar	0	0	0	0	0	0	0	16	10	10	8	44
7	Koppal	2	3	6	8	4	3	3	6	3	2	3	43
8	Haveri	0	3	2	4	4	9	5	7	5	4	0	43
9	Yadgir	0	0	0	0	4	0	7	8	10	2	6	37
10	Dharwad	3	2	0	0	3	5	3	6	7	4	4	37
11	Ballari	0	0	1	5	1	3	5	6	7	6	1	35
12	Mysuru	0	1	1	0	4	1	15	1	8	1	0	32
13	Bagalkot	0	4	0	8	1	6	1	0	2	5	4	31
14	Raichur	2	2	0	3	2	1	1	1	3	7	7	29
15	Shivamogga	3	0	0	2	6	6	3	3	1	1	2	27
16	Chamarajanagar	4	4	3	4	7	1	2	0	0	2	0	27
17	Davangere	0	0	2	8	2	1	0	5	2	0	4	24
18	Chikkamagaluru	0	0	1	1	1	0	3	3	4	3	0	16
19	Udupi	2	0	1	1	3	0	0	2	0	3	2	14
20	Uttara Kannada	0	0	0	0	0	0	2	4	1	3	2	12
21	Dakshina Kannada	0	0	0	0	0	0	1	2	0	1	7	11
22	Mandya	0	0	0	0	1	2	0	4	0	2	2	11
23	Vijayanagara	-	-	-	-	-	-	-	-	-	-	10	10
24	Kalaburagi	0	0	0	0	0	0	0	0	0	0	7	7
25	Chikkaballapura	0	0	0	0	1	0	3	2	0	0	0	6
26	Hassan	0	0	0	0	0	0	0	3	2	0	1	6
27	Bangalore Urban	0	0	0	0	0	0	1	0	1	0	0	2
28	Bengaluru Rural	0	0	0	0	0	0	0	0	0	0	1	1
29	Kolar	0	0	0	0	0	0	0	0	1	0	0	1
30	Kodagu	0	0	0	0	0	0	0	0	0	0	0	0
31	Ramanagara	0	0	0	0	0	0	0	0	0	0	0	0
Total		37	33	38	79	72	59	96	118	101	79	100	812

Table. 2: District-wise human death details due to lightning for the last 10 years in State

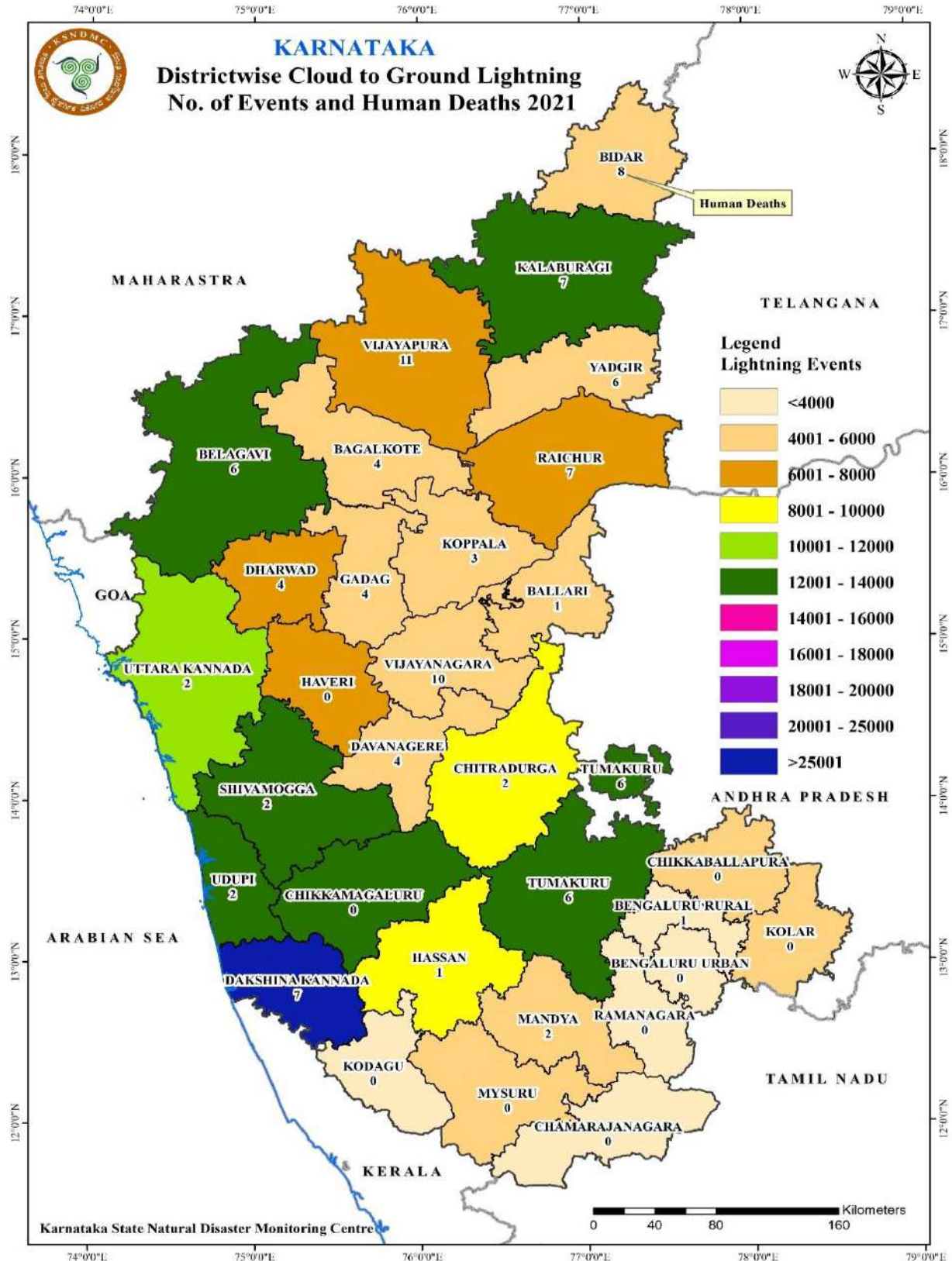


Figure 4: District wise deaths and No. of C-G lightning events during the year 2021

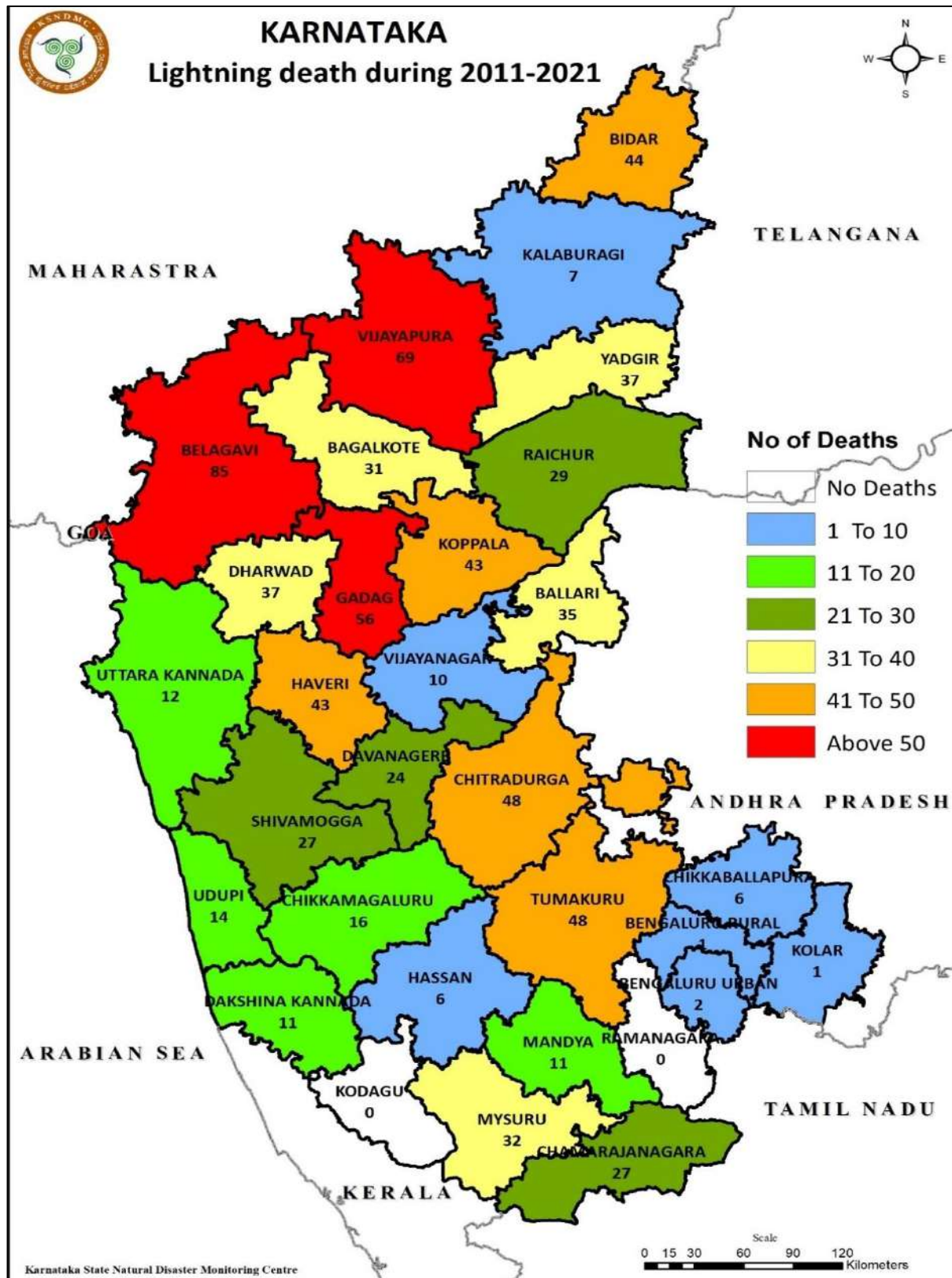


Figure 5: Last 10 years District wise No. of deaths due to Thunderstorm & Lightning.

Rural and forest areas are the most vulnerable given the presence of tall trees and water bodies. A majority of the lightning victims are people working in the fields in rural areas. For example, a study has shown that 96% of the total lightning-related deaths in the Country were reported from amongst people working in the fields mainly farmers in rural areas are more (Source: CROPC, Annual Lightning report 2020-2021). Lightning is also a major cause of electrical power breakdowns and forest fires. It can also damage communication and computer equipment and affect aircraft navigation systems.

Lightning has been generally observed in most of the part during second half of the day. However, during intense cloud movement with high wind speed, especially during monsoon and cyclonic activities, lightning may occur anytime. Lightning also depends on local geographical conditions like its different in coastal region, hilly areas and river basins

A moderate thunderstorm can damage thatched huts, kutcha roads, standing crops, orchards, power and communication lines. Rooftops may also blow off. Unattached or loosely tied metal sheets may fly. It can also damage power and communication lines as well as roads, besides flooding of escape routes, breaking of tree branches, uprooting of large trees, etc.

Since the inception of the lightning monitoring network in the State the total No. of Cloud to Ground (C-G) events were mapped district wise during June-2018 to Dec-2021. Based on these events, using GIS techniques; potentially vulnerable areas identified and more focus is being giving through DEWS and along with this in near future planning to conduct awareness programs and to take appropriate mitigating measures to minimise the impacts on humans, livestock & property due to lightning strikes.

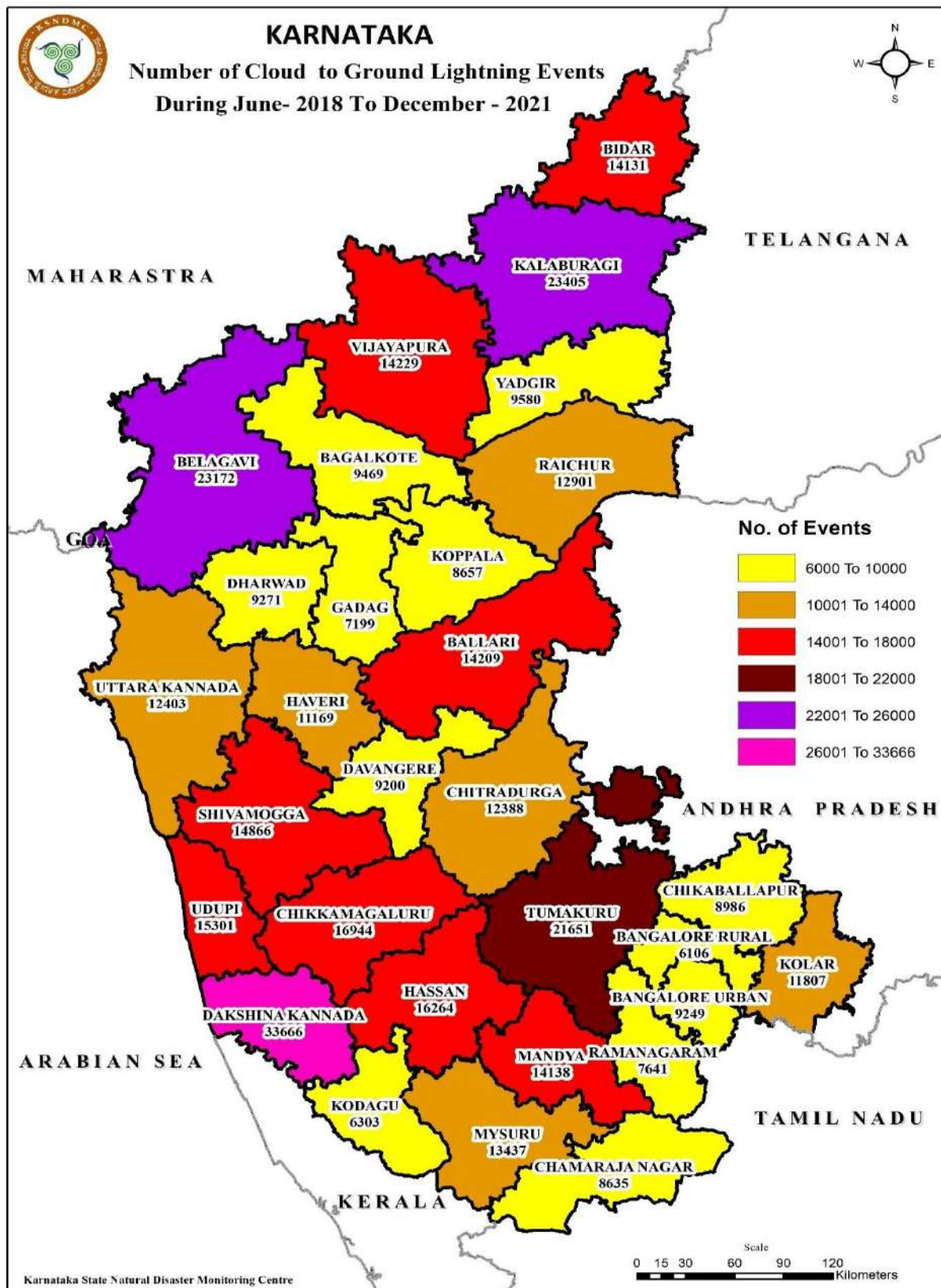


Figure 7: Cloud to Ground (C-G) total No. of events during June 2018 to Dec 2021

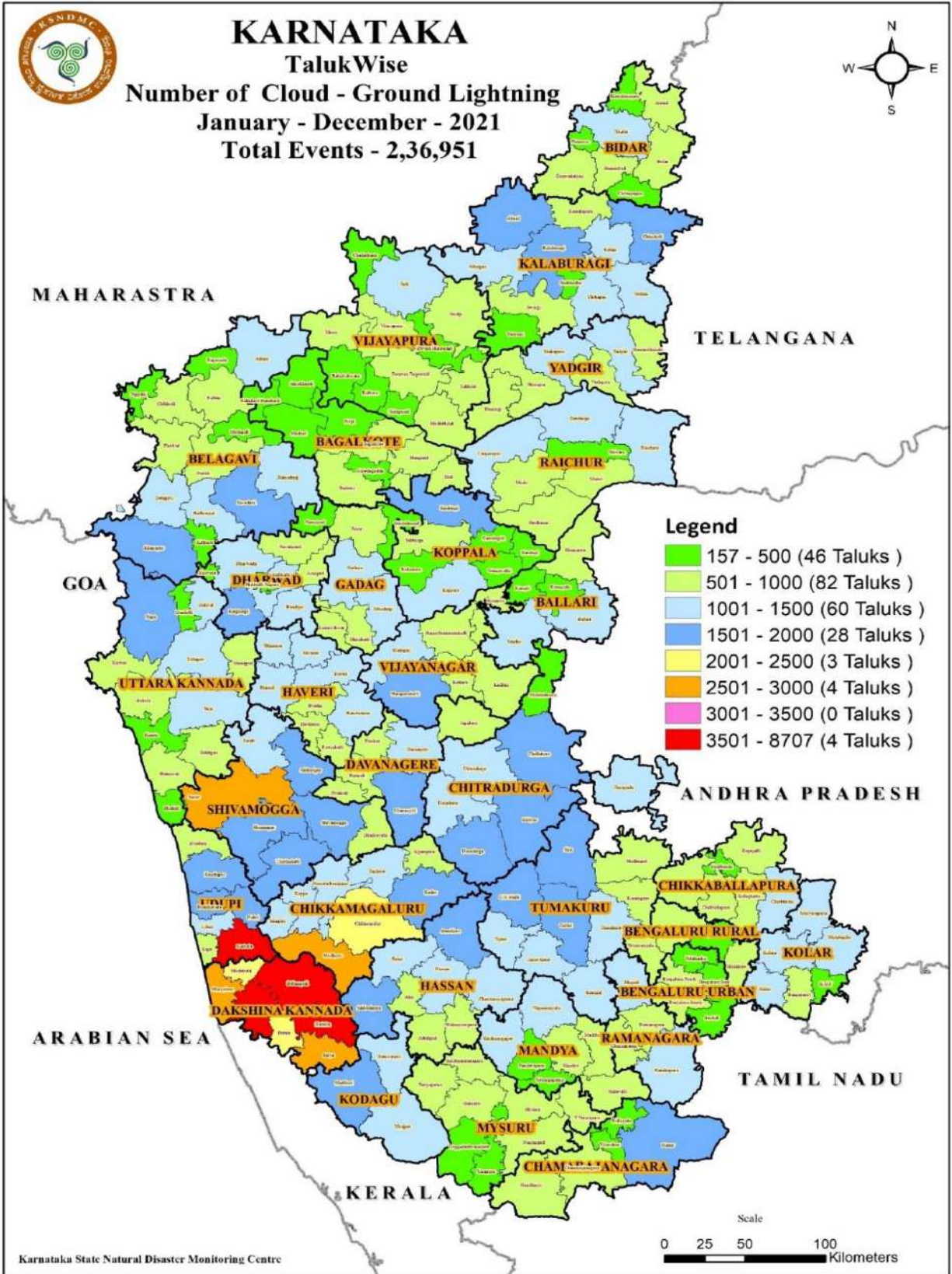


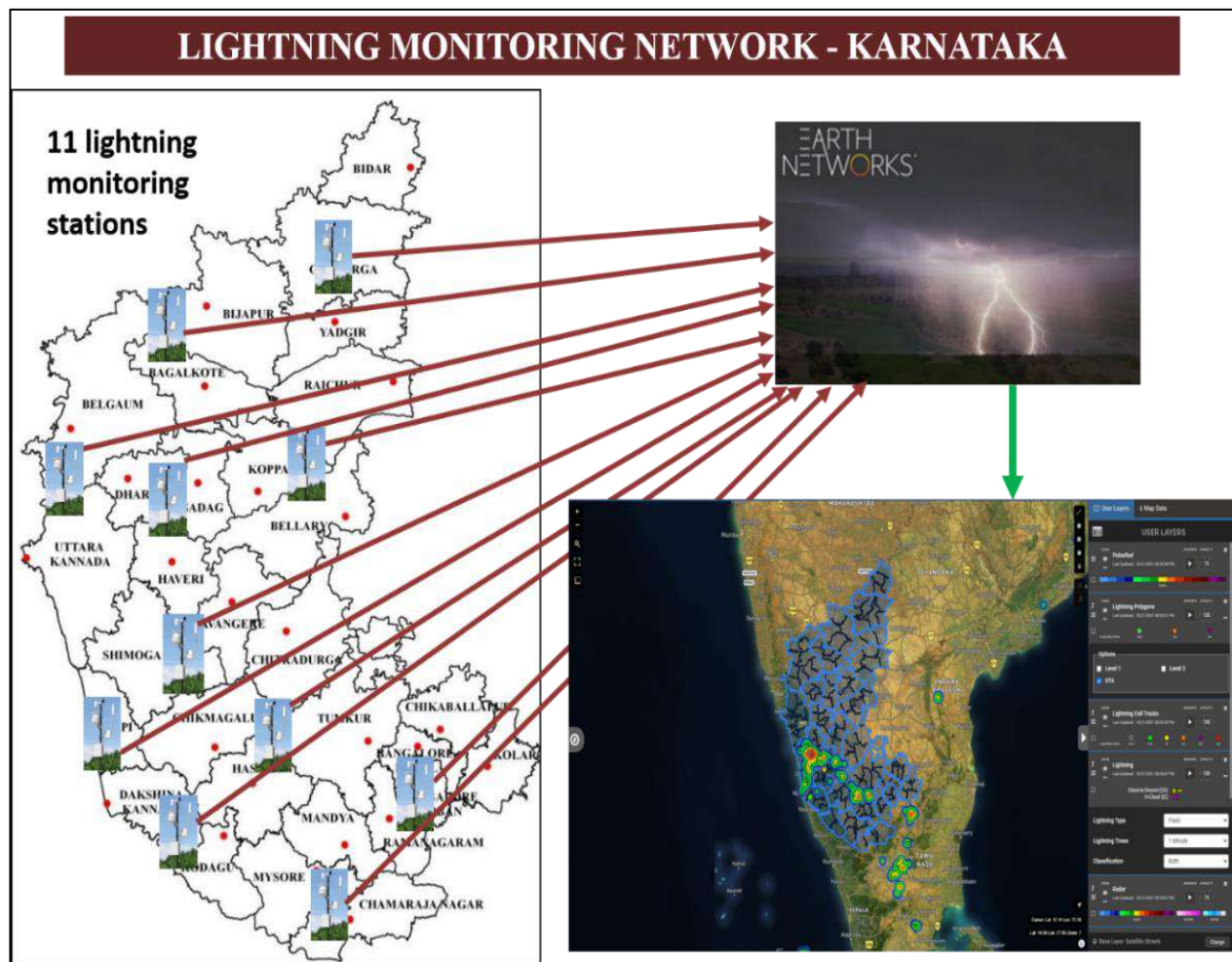
Figure 8: Taluk wise Cloud to Ground (C-G) total No. of events during the year 2021

CHAPTER-III

LIGHTNING MONITORING & EARLY WARNING SYSTEM (LEWS) - KARNATAKA

CHAPTER 3: LIGHTNING MONITORING & EARLY WARNING SYSTEM (LEWS)

In order to mitigate the losses due to Lightning strikes in the State, Karnataka State Natural Disaster Monitoring Centre (KSNDMC) has developed and operationalized a system to provide location specific Early Warnings to the Government Executives and general public across the State about the Thunderstorm & Lightning strikes. A network of Lightning Detection Sensor stations are installed in the State and providing data about the Thunderstorm and lightning (Cloud to Cloud and Cloud to Ground) to KSNDMC server on real time. Based on the real time data early warnings and advisories are being generated and disseminated to the public.



A dedicated link for spheric maps for lightning and thunderstorm events for to visualize in real time available for the State. Using these credentials, development of thunderstorm cell and its projection for movement of cell track and likely influencing area and type of lightning (C-C or C-G) also can be seen. Weather and satellite product layers also available, so that it is help full about track the movement of the thunderstorm cell and severity. In a nutshell the user can get more information about thunderstorm and lightning developments using spheric maps.

3.1 Early Warning & Dissemination

For effective dissemination of early warnings to the potentially vulnerable panchayats, KSNDMC has developed a unique integrated public alert and warning system called Disaster Early Warning System (DEWS). DEWS will provide rapid, reliable and effective communication to the public in case of major emergencies such as natural disasters like Floods, Heavy releases from upper catchment reservoirs/ Dams, Hailstorms, Earthquakes, Heavy rains, Lightning & Thunderstorms and Heat waves. Through this DEWS, potentially vulnerable panchayats were equipped by the integrated announcement systems. This system has features like text to speech, recording service, automated message service, scheduled broadcast of messages & group broadcasting. These pre-defined features will be issued during, pre & post disaster events, whenever crossing the limits of defined threshold values. The warning messages will be broadcasting to outdoor receivers with loudspeakers automatically using DEWS system at that particular Gram Panchayath office before any disaster takes place, with the help of the existing high dense weather observational, water level data, Lightning monitoring network and forecast mechanism in the State. A dedicated team of operators along with technical officer monitors regularly and will follow the criteria for each disaster and issue alert/ early warning accordingly to the likely affected community/area in advance to effectively minimize the loss of life and property in the State.



Fig 8: Different modes of dissemination of Information

3.2 Sidilu Mobile App

Dissemination of information plays an important role in Disaster Risk Reduction. KSNDMC has dissemination mechanism in various methods to issue early warnings to all the stakeholders in real time, such as area specific SMS alerts, VAUNAMTRA call Centre, Apps, email alerts, social media platform and based on the real time lightning data, KSNDMC has developed Mobile App “SIDILU” for disseminating the location specific information about Lightning Strikes in the State. Apart from the Early Warnings, the App also provides the advisory about the safety measures in the form of Do’s and Don’ts to the public which will help public to secure themselves during the Lightning activity to their location.

This APP will also be disseminates the Early Warnings through SMS to the mobile phones of the Panchayath Development Officers (PDO’s) and Revenue Inspectors (RI’s) of the

respective Grampanchayath. Early Warning about the lightning strikes will also be disseminated to the public in regional language through 24 x 7 Interactive Help Desk “VARUNA MITRA” operational at KSNDMC. The database, customized to every Grampanchayath, of about 28 lakh farmers / general public available at KSNDMC will also be used for disseminating Lightning Strike Early Warning.

The app offers a comprehensive map view of the real time occurrences of lightning(s) around the user’s current geo location within Karnataka. The concentric circles at the center of the map view show the lightning occurrences that span from a radius within 1 KM (RED – high danger); within 5 KM (ORANGE – moderate danger); within 15 KM (YELLOW – still within overall dangerous zone) from the user’s current geo location. If there are lightning occurrences happening within any of these radiating circles, push notifications will be sent to the mobile user, bringing his/her attention to the severe weather occurrence.

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This app can be downloaded free of cost from the Google Play store. The app issues warnings to smart phone users 30 to 45 minutes before the lightning strike by displaying information in different colors. An alert in red indicates that the user is in danger zone as there is a 90% probability of a lightning strike within one km radius of the location.

Orange shows the possible occurrence of the strike within 5 km radius and yellow in 15 km radius. At present, more than ten thousand android phone users are getting benefit from the SIDILU App.

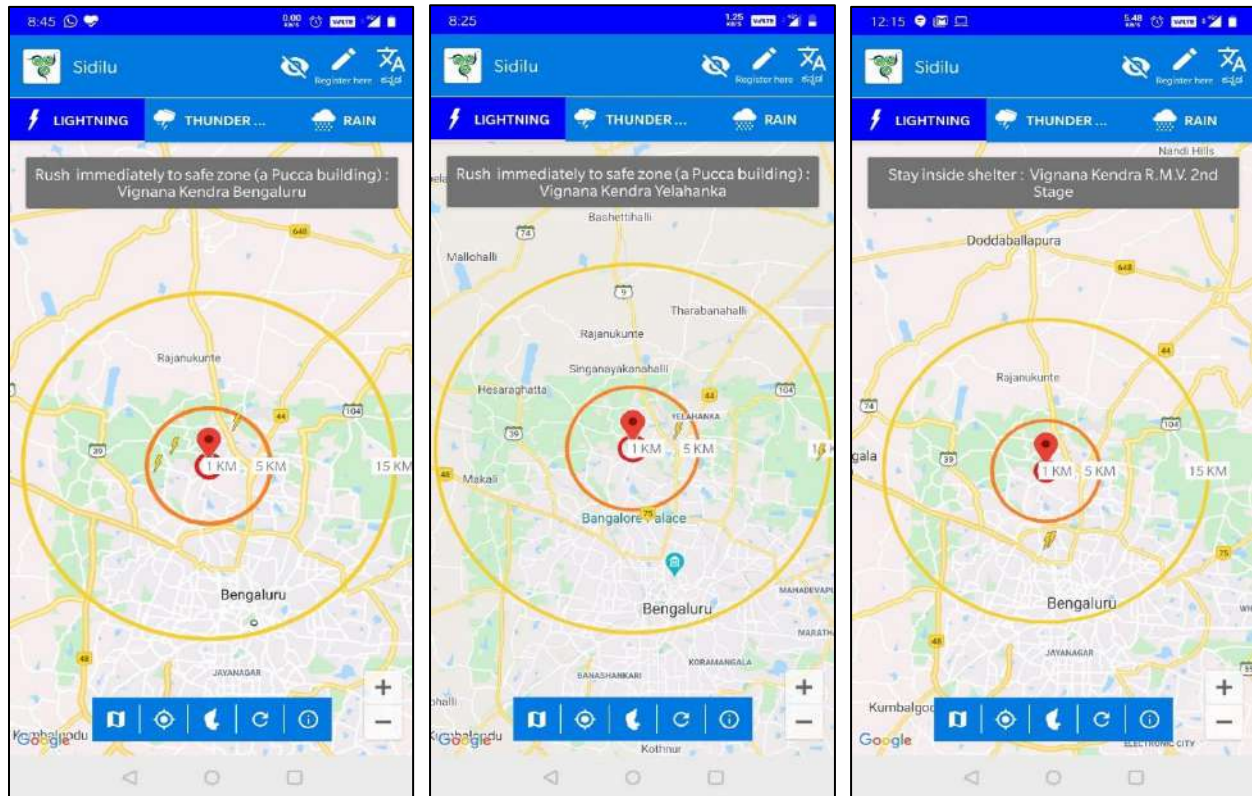
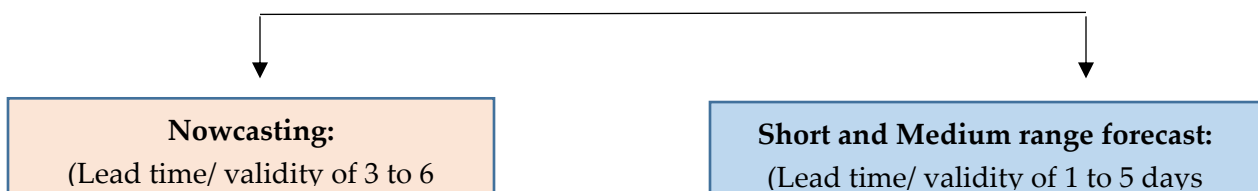


Figure 6: Screenshots of the App SIDILU:

3.1 Forecast and Issuance of Alerts / Warnings

India Meteorological Department (IMD), Ministry of Earth Sciences, is the nodal agency for providing current weather information and forecast, including warnings for all weather-related hazards. Besides, States should establish their own independent early warning and monitoring systems to supplement warnings from the IMD.

Forecasts (Based on Specific Range, Time Duration and Area)



While short to medium range forecast provides the potential areas with a probability of occurrence, nowcasting provides more specific information about the place/time of occurrence.

A thunderstorm is a small-scale phenomenon and has a life cycle of about three hours. It has a dimension of 2 km to 20 km, and therefore, its detection is difficult. Weather monitoring systems such as automatic weather stations (AWS) provide some basic parameters such as wind speed, wind direction, relative humidity, temperature, pressure, etc., but do not predict lightning.

Geostationary Weather Satellite captures images from a height of 36,000 km above the earth. It takes about half an hour to capture the image and another half an hour to process the data. So, by the time someone sees the satellite imagery on IMD's website, it is already one hour late. Due to the short life cycle of thunderstorms, a satellite cannot capture its initiation unless it is a large-scale thunderstorm activity.

The Doppler Weather Radar, which takes an observation every 10 minutes, can detect the occurrence of thunderstorms. Therefore, for better monitoring, there is a need for a wider network of Doppler Weather Radars in the country.

Lightning incidents can be detected by the ground-based Lightning Detection Network in real time. There is a need to create a high-density network in regions vulnerable to lightning strikes.

For measuring squall and gusty winds, a meso-network of observation stations are required in the country with anemometers that can measure wind speed up to about 200 kmph. Further, one to two high wind speed recorders can be installed in each squall-prone district.

On the day of occurrence of a severe weather incident/thunderstorm, State-level offices of the IMD start nowcasting. As nowcasting is valid for the next two to three hours, it

gives only a limited lead-time. This nowcast, which is at the district level, is provided to Relief Commissioners, SEOC, District Collectors, Disaster Management units, etc. This alert is specific and issued for a district with the time of occurrence and associated wind speed.

In the last decade, there has been a significant improvement in the monitoring and forecasting of thunderstorms. This can be attributed to a good network of Doppler Weather Radars, a dense AWS network, half-hourly satellite observations from INSAT 3D & 3DR satellites, better analysis tools, and advanced computational and communication capabilities. With these, IMD has started all India nowcast services for localised, high impact weather incidents such as thunderstorms, squalls and hailstorms with a lead time of up to 3 hours since 2013.

DWR-based observation is the main source of information for nowcast of thunderstorms and associated weather incidents. In the first phase, 403 cities and towns, which come under the coverage of DWRs, have been included for nowcasting of convective weather. This coverage would be increased so as to represent all districts by 2020 and all blocks by 2025 through expansion of DWR networks and forecasting systems.

To be effective and complete, an Early Warning System needs to comprise four indicating elements, namely:

- (i) Risk knowledge
- (ii) Monitoring and warning service
- (iii) Dissemination and communication
- (iv) Response mechanism and capacity building

Before the preparation of the Action Plan, especially for lightning, it is imperative that the following actions are taken:

- 1) Mapping of lightning-affected zones on the basis of:

- a. Available data of deaths and injuries (both humans and animals) at different places complete with latitude and longitude points,
 - b. Data of lightning incidents available with Radar/lightning detection System,
 - c. Data available from the National Crime Record Bureau.
- 2) Systemic study of past lightning occurrences by any expert agency or group (to be taken up with State-level knowledge institutions).
 - 3) Sharing of data between different agencies for preparation of mitigation plan.
 - 4) Installation of lightning and thunderstorm detection devices.
 - 5) Generation of a database for future planning.

CHAPTER-IV

THUNDERSTORM & LIGHTNING ACTION PLAN AND ITS APPROACH

CHAPTER-4: THUNDERSTORM & LIGHTNING ACTION PLAN AND ITS APPROACH

4.1 Rationale for preparing Action Plan

A “Disaster” is defined under section 2 (d) of the Disaster Management Act, 2005 as a catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or man-made causes, and is of such a nature or magnitude as to be beyond the coping capacity of the affected area.

“Disaster Management” has been defined under section 2 (e) of the “Disaster Management Act, 2005” as a continuous and integrated process of planning, organizing, coordinating and implementing measures which are necessary or expedient for

- (i) Prevention of danger or threat of any disaster
- (ii) Mitigation or reduction of risk of any disaster or its severity or consequences
- (iii) Capacity building
- (iv) Preparedness to deal with any disaster
- (v) Prompt response to any threatening disaster situation or disaster
- (vi) Assessing the severity or magnitude of effects of any disaster
- (vii) Evacuation, rescue and relief and
- (viii) Rehabilitation and reconstruction (Recovery)

Karnataka State also one of the State which is frequently affecting by thunderstorms & lightning, squall, hailstorms and strong winds during one or the other part of the year with varying intensity and frequency. While these incidents have received lesser attention as compared to other disasters, these incidents causing loss of lives, property, infrastructure, livestock and livelihoods, majorly affecting vulnerable and weaker sections of society (small and marginal farmers, vendors, street hawkers, construction workers, field officials/employees etc.). There is an urgent need to devise a State level strategy and plan to reduce the adverse effects of these disasters. Therefore, with the

support of NDMA guidelines, the present action plan has been brought out to mitigate and take measures for preparedness with active participation from all line departments and stakeholders.

4.2 Objectives

- A. To help the Districts and other stakeholders to prepare action plans to significantly reduce the loss of lives, injuries, economic losses and to improve the coping capacity of the State.
- B. To develop tools for assessment, and undertake preparedness and mitigation measures through coordinated inter-agency efforts.
- C. To evolve a coordinated strategy for Disaster Risk Reduction in the States by involving all the stakeholders (administration, line departments, scientists, engineers, Panchayati Raj Institutions, Non-Governmental Organisations, Community-Based Organisations and communities) in the planning process.

4.3 Key Strategies

Severe and extended incidents of thunderstorm & lightning/ squall/ hailstorms/ strong winds can disrupt social and economic services. Government agencies have a critical role to play in preparing and responding to such incidents at the local level, working closely with all stakeholders on a short, medium and long-term strategic plans.

- a) Establish a qualitative and effective Early Warning System
- b) Inter-agency coordination and communication
- c) Develop advanced preparedness, mitigation and response plan
- d) Preparedness at the local level for an effective incidence response plan
- e) Capacity building and training
- f) Public awareness and community outreach
- g) Collaboration with Non-Government Organisations and civil society
- h) Assessing the impact – getting feedback for reviewing and updating the plan

In order to mitigate the losses due to Lightning strikes in the State, Karnataka State Natural Disaster Monitoring Centre (KSNDMC) has taken up a project to provide location specific Early Warnings to the Government Executives and general public across the State about the Lightning strikes. The project has been implemented during June 2018. KSNDMC has installed a network of ELEVEN Lightning Detection Sensor stations in the State and collecting data about the Thunderstorm and lightning (Cloud to Cloud and Cloud to Ground) to KSNDMC on real time. Based on the data, early warning and related advisories are being generated and disseminated to the public.

Like any other natural disasters, the effect of Lightning strikes cannot be completely avoided. However, the Lightning Early Warning System (LEWS), developed with a broad multidisciplinary knowledge in geophysical, environmental and social science fields, using GIS based technology and also a robust mechanism in-place for generating maps, providing location specific alerts to local communities, periodical evaluation of LEWS to minimise false alarms, creating awareness with visualization of impacts and response options for community preparedness intended to effectively minimize the loss of life and property in the State.

4.4 Steps to Develop Action Plan

Step 1: Government Engagement

Setting up an Action Plan requires participation from the State and district administration, line departments, municipal authorities, health agencies, disaster management authorities and local partners. For example, at state level can form a dedicated policy decision – making committee chaired either by the Principle Secretary/ Relief Commissioner of the State or the State Disaster Management Authority (SDMA) and develop an implementing strategy with line departments.

Step 2: Appointing a Nodal Department and Officers

The State should appoint nodal officers at the State and district levels, and depute an agency to oversee the implementation of the Action Plan. It should also build the capacity of its key officials and agencies to fulfill their roles and responsibilities as mentioned in the State Action Plan. The State should conduct table-top exercises, simulations and drills before the thunderstorms and lightning season besides resolving communication gaps between all concerned departments, partners and the public.

Step 3: Vulnerability Assessment and Early Warning System

It is important to identify vulnerable areas, assets and populations in order to establish priority areas for Early Warning, forecast/ alerts activities. The State should coordinate with the IMD to develop reliable and accurate localized early warnings and dissemination plan.

Step 4: Drafting and Developing the Action Plan

The State nodal officer and agency should coordinate with all the concerned line departments and prepare an action plan with clearly defined roles and responsibilities

Step 5: Team Preparation and Coordination

State officials and agencies should be well-prepared and informed for the thunderstorms and lightning season. The State should develop a clearly inter-agency emergency response plan with clearly marked out roles and responsibilities.

Step 6: Implementation and Monitoring

While the government departments (and partners) are responsible for implementing many components of the Action Plan, the public should be made aware of how to respond to extreme weather incidents. Information, education and communication (IEC) plan an important role in widely disseminating key messages to communities in advance. Specific messages should be developed to cater to vulnerable groups. During the Season, “Do’s

and Don'ts" should be available in local languages and disseminated through various media channels. Pre-season consultations should be held at the State as well as the District level before the commencement of the peak season (summer season)

Step 7: Evaluating and Updating the Plan

The approach towards extreme weather incidents must be flexible and iterative to determine whether the strategies to deal with them are effective and have no unintended negative consequences. After every season, the State must assess the efficacy of its Action Plan, including the processes, outcomes and impacts. Stakeholders should then identify gaps and make improvements for the next season. The plan should be updated annually with name, designation, contact details, etc., of key officials and concerned department/ stakeholders should be made aware of these changes.

Step 8: Strategies for Adapting to Climate Change (Long-term plans)

State should undertake mitigation strategies to reduce the impact of climate change on extreme weather incidents. For e.g., developing disaster-resilient infrastructure and implementing the recommendations given in "Manual on Hazard Resistant Construction in India" for non-engineered buildings.

4.5 Dissemination & Communication strategies of Warning Messages

The dissemination strategy should aim at reaching the last person as soon as possible.

The following points are important while preparing Early Warnings/ Alerts:

- a. The warning messages from agencies such as IMD should contain safety directions to be followed; for e.g.; the nowcasting messages for severe thunderstorm storm may ask the public to take a safe shelter or move indoors in the wake of an inevitable disaster;
- b. The message should be short, clear, in simple language and action-oriented;
- c. Greater emphasis must be placed on inter-agency coordination while dissemination of warning messages, including public and private media; and

- d. The following activities may be considered for ensuring that everyone in the affected areas is warned in time –
- (i) Flash messages / tickers / ‘breaking news’ to be displayed on the local TV news channels;
 - (ii) Radio announcements through public and private broadcasters;
 - (iii) Flash messages / SMSes to the users by the mobile operators in the affected areas;
 - (iv) In case of rural areas and small towns, an early warning may be issued by the local authorities using loudspeakers, sirens, etc.; and
 - (v) Social Media, including group messaging services, should be extensively used.

4.6 Communication Strategy and Drafting of Key Do’s and Don’ts

- a. The communication strategy should be based on insights of the local population considering the nature of the–
- i. Messages;
 - ii. Messenger / Medium / Media; and
 - iii. Receiver.
- b. The Communication Strategy should aim at promoting a culture of DRR and behaviour change through mass awareness campaigns.
- c. The subject matter expert(s) should carefully draft Do’s and Don’ts / safety tips or techniques in consultation with the IEC expert(s). For this, IEC expert(s) may use Research Methodology, Rapid Rural Appraisals and Communication Gap Analysis techniques for better understanding of–
- (i) Behaviour patterns or tendencies;
 - (ii) Media consumption;
 - (iii) Local trends of the vulnerable population; and
 - (iv) Available facilities like shelter and contact details.

4.7 Public Awareness, Community Outreach & IEC

Awareness campaigns should be carried out based on communication strategy and research insights. Information Education Communication (IEC) activities should be planned at national, State and local levels.

A. State level:

- a) Carry out mass awareness campaigns in local languages;
- b) Develop media and communication strategies and plans considering local socioeconomic and behavioural factors;
- c) Involve recognised artists of the State, such as folk singers, dancers, and other performers for stronger recall value;
- d) Conduct regular awareness programmes in all districts;
- e) Conduct regular training programmes for inter-personal communication activities.
- f) Mass awareness campaigns involving Print, TV, Radio, Social Media, etc;
- g) Special list of Do's and Don'ts and safety tips for weaker and vulnerable sections of society (e.g. women, children, poor, elderly and differently abled);
- h) Special list of Do's and Don'ts for animal and livestock safety;
- i) Encourage line departments of the State Government and local authorities to widely disseminate Do's and Don'ts.

B. Local level:

The local authorities, due to their proximity to the affected population, are in the best position to ensure the last mile delivery of messages. They may –

- a) Conduct regular inter-personal communication activities;
- b) Demonstrate the safety tips to the vulnerable population in their local language, using local customs, cultural aspects and behaviour patterns; Local artists and art forms may be utilized for entertainment-based education programmes; Extensive

use of IEC tools and materials (such as flyers, calendars, comic books, etc.) should be made available for people for reference;

- c) Strengthen and involve local communities such as RWAs, Municipal bodies, NGOs, Panchayati Raj Institutions, *Anganwadis*, *Gram sabhas*, Medical professionals and other local bodies;
- d) Give special emphasis to dissemination in locations of “closed homogeneous groups” such as schools, colleges, offices, cinemas, etc.
- e) Carry out Out-of-Home campaigns using banners, posters, billboards, etc.
- f) Carry out special awareness programmes for the differently abled.

4.8 Review & Evaluation of the Early Warning System (EWS)

The reliability of EWS and its forecasting performance for natural hazards – in terms of hits, missed incidents and false alarms for different thresholds – has to be evaluated periodically. Its evaluation must include the benefits of risk reduction as well as and the negative consequences of missed incidents and/or false alarms. In addition, the reliability of EWS also depends on the probability of technical failures of system components. Therefore, it is also necessary to evaluate the efficiency of the technical reliability of the system components.

CHAPTER-V

PREVENTION, MITIGATION AND PREPAREDNESS MEASURES

CHAPTER-5: PREVENTION, MITIGATION AND PREPAREDNESS MEASURES

5.1. Preventive Measures:

Disaster prevention covers measures aimed at impeding the occurrence of a disaster incident and/or preventing such an occurrence from affecting communities. The occurrence of thunderstorm and squall can't be impeded. However, their harmful effects can be minimized through a number of measures.

- a) **Hazard and Vulnerability Assessment:** Micro-level hazard zoning should be done and vulnerable areas must be clearly marked on a map. The extent of vulnerability (mild, moderate or intensive) and the probable cost of damages to crops due to incidents of varying intensities must be included in the assessment report. With respect to a disaster, risk is specifically described using relative terms such as High Risk, Average Risk and Low Risk to indicate the degree of probability of the occurrence of the incident. The risk assessment includes an evaluation of all elements that are relevant to the understanding of the existing hazards and their effects on a specific environment. There are several steps in risk assessment based on the related processes of hazard mapping vulnerability analysis. They establish the nature, location and scale of risks to society and its assets. This information can assist decision makers in deciding what can and should be protected and up to which level.
- b) **Sensitization of Disaster Managers, Planners and Decision Makers:** Sensitization of planners and decision makers can immensely help in minimizing the harmful effects of these incidents on communities. The first and foremost need is awareness generation among policymakers, administrators, engineers, architects, the general public as well as the farming community.

- c) Awareness generation among masses: Public awareness and education help in improving the disaster resilience of masses.

5.2. Mitigation and Preparedness Measures

The lessons learnt from previous incidents, particularly regarding gaps in rescue and relief works and the shortcomings experienced in the process, should be dealt with carefully. Disruption of communication and transportation services and undue delays in clearing the fallen trees, electricity poles and hoardings on the roads and/or streets that further delay the immediate transportation of the injured to nearby hospitals remains a major challenge. The hierarchical structure for execution needs to be formalized so that all efforts are properly coordinated. Coordination for relief distribution is equally important to ensure qualitative and timely delivery; the lack of which may lead to duplication of efforts at some locations while leaving some others completely starved.

- a) **Enhanced understanding of preparedness and mitigation measures:** This will help us minimize the losses due to thunderstorms/ squall, etc.
- b) **Hazard Resistant Construction:** United Nations Development Programme (UNDP) and NDMA, Ministry of Home Affairs, Government of India, released a “Manual on Hazard Resistant Construction in India” for the non-engineered buildings in July 2008. The popular load-bearing masonry building systems, prevalent in different parts of the country, are covered in the manual. Relevant building codes and guidelines of the Bureau of Indian Standards form the basis for this manual. In addition, the two decades of work carried out by the authors focusing on the promotion of suitable building technologies in different parts of the country and the on-site training of building artisans and engineers, as well as the post-disaster assessments of damages in various disasters provide the backbone of this manual. It is hoped that this manual will contribute towards

ensuring better structural performance in the face of potentially destructive natural hazards and thus bring safety to the people, rich and poor alike, in India.

- c) **Laying underground electricity cables and telephone lines:** These are best suited, particularly for congested townships where thunderstorms/squall may cause falling of electricity and telephone poles, and snapping of cables.
- d) **Emergency Communication Systems:** Planning, updating and mobilization of existing radio communication resources in emergency situations and acquisition of satellite phones to make them available at the tehsil level to ensure prompt response in the event of occurrence of any disaster.
- e) **Integrating Development schemes with Disaster Management Schemes:** This would enable the creation of disaster-resilient localities by way of recommendations by gram pradhan/ gram adhyasharu that quality raw material and technology be used in all infrastructure/ construction projects.
- f) **Technical, Social, Organizational and Administrative preparedness:** The most urgent need of the hour is to develop a DSS (Decision Support System) for thunderstorm nowcast, which is currently being done using the existing network of Lightning Detection Network installed by KSNDMC and its observations, radars, satellites and lightning data. To accomplish this, the DWR and lightning network could be expanded over all thunderstorm prone areas across the country and information thus obtained could be merged with satellite observation to generate meaningful insights for different regions with a lead time of 1-2 hours. The nowcast alerts/warnings should be accompanied with actionable information (Do's and Don'ts) and potential impact (expected damage).
 - a. Besides SDMAs and DDMA's, tehsil-level Disaster Management Group (TMG) at subdivision/ tehsil level should be formed with representatives of various line departments, including Agriculture, Forest, BSNL and other telecom service providers, Electricity Board, Revenue, P.W.D, Health,

Police and Fire Brigade. Village Disaster Management Committees (VDMCs) should also be formed at the village level comprising local villagers. This would certainly strengthen the local response mechanisms to disasters.

- g) **Emergency Plan for Hospitals and Health Centres:** Emergency expansion plan for civil hospitals, community health centres, Primary Health Centres (PHCs) and additional PHCs, including schemes for mobile medical teams for a post-disaster situation, should be in place. A list of Army hospitals, Govt. Hospitals (both Centre and State), private hospitals and nursing homes in each district should be prepared. Phone numbers of all these medical facilities should be available in the District Control Room as well as in the SEOC. Based on the hazard assessment, emergency medicines, Operation Theatres and life-saving drugs should be kept ready. Vacant post of doctors and paramedical staff should be filled in all the government hospitals in order to make available the required number of medical workers at the time of an emergency. An Action Plan must be considered for training of doctors and paramedical staff on handling patient inflow and treating them in case of a disaster.
- h) **Focusing on Research and Establishing a Forecasting Centre for Thunderstorm and Squall:** to carry out the hazard zonation and vulnerability analysis for thunderstorm and squall using the available lightning data at KSNDMC in coordination with State-level knowledge institutions.
- i) **Making Disaster Risk Reduction (DRR) a part of school and college curriculum:** Youth and children can be taught about extreme weather incidents and the Do's and Don'ts to be followed before, during and after a disaster. They act as agents of change and bring about greater awareness in the neighborhood and society.

5.3. Structural Mitigation Measures

The most effective structural measures against thunderstorms, lightning, squall and strong winds are meant to protect against the strong, high-speed winds and against the electric discharge due to a lightning strike.

(a) Protection against Strong Winds

During cyclonic conditions, strong winds are able to reach velocities of more than 200 km/hr. The cyclonic winds are also associated with pressure differentials that can cause a huge pressure difference between the outside and the inside of a building resulting in a higher net effect of the wind storm. These high-velocity winds can cause severe damage to light structural and nonstructural systems such as claddings. Since the arrival of cyclonic storms is accompanied by suitable warnings, it is expected that people will not be found outdoor during a cyclonic storm. People are, therefore, safe against the most harmful effects of the high wind velocity provided they are inside cyclone shelters or other well-constructed buildings.

During strong winds associated with thunderstorms or squalls, the wind velocity is high but it rarely reaches cyclonic levels. Typical wind speeds during thunderstorms are in the range of 50- 80 km/hr. During severe thunderstorms, the wind speeds may reach around 100 km/hr. The wind velocity is highest in storms that are associated with extensive lightning activities.

Structures do not require any special protection against storms with wind speeds up to 100 km/hr if they are designed and constructed as per approved standards. Buildings that are constructed informally or those which are made using non-engineered materials may not be able to resist the wind forces. These may get damaged even in low wind speed unless special protection mechanisms are adopted. In general, components that provide

large areas for the application of wind forces are the first to be damaged. They can become loose and pose a threat to humans as flying debris. In buildings that use lightweight sheets for roofing, the panels may collapse on occupants.

Protection against the lightweight panels under such wind speeds can be provided by properly securing them with their supporting frames. The connection has to ensure that shearing or punching is avoided. Also, it has to be ensured that the panels themselves have the requisite strength to withstand the wind force. The supporting frames also need to have adequate strength to safely transfer the forces imposed on them.

(b) Protection against Lightning – Lightning Shields

Installation of lightning arresters and sound earthing for each building is essential. Lightning shields are the most commonly employed structural protection measure for buildings and other structures. A lightning shield consists of the installation of a lightning conductor at a suitably high location at the top of the structure. The conductor is grounded using a metal strip of suitable conductance. The grounding of the conductor is also specially designed to ensure rapid dissipation of the electrical charge of a lightning strike into the ground.

Lightning shields are not foolproof in their effectiveness. The ability of lightning shields to complete the cloud-to-ground circuit depends on several variables such as the height of the conductor, the shape and size of adjoining structures or natural conductors. The cone of protection is also highly variable and the angle of protective cone decreases with the increase in height of the shield's conductor. Very tall buildings may require lightning conductors at intermediate levels of the building in addition to the ones at its roof.

Internationally, lightning shields are not used for the protection of open areas such as agricultural fields due to their very high cost and reliability issues. However, they are

found to be very effective for the protection of individual structures or groups of structures in an area.

5.4. Action – Before, During and After

(a) Before Thunderstorm and Lightning

To prepare for a thunderstorm, you should do the following:

- I. Do remember that vivid and frequent lightning indicates the probability of a strong thunderstorm.
- II. Build an emergency kit and make a family communication plan.
- III. Remove dead or rotting trees and branches that could fall and cause injury or damage during a severe thunderstorm.
- IV. Postpone outdoor activities.
- V. Remember the 30/30 Lightning Safety Rule: Go indoors if, after seeing lightning, you cannot count to 30 before hearing thunder. Stay indoors for 30 minutes after hearing the last clap of thunder.
- VI. Secure outdoor objects that could blow away or cause damage.
- VII. Get inside a home, building, or hard top automobile (not a convertible). Although you may be injured if lightning strikes your car, you are much safer inside a vehicle than outside.
- VIII. Remember, rubber-soled shoes and rubber tyres provide NO protection from lightning. However, the steel frame of a hard-topped vehicle provides increased protection if you are not touching metal.
- IX. Unplug appliances and other electrical items such as computers and turn off air conditioners. Power surges from lightning can cause serious damage.
- X. Shutter windows and secure outside doors. If shutters are not available, close window blinds, shades or curtains.

- XI. Unplug any electronic equipment well before the storm arrives.

(b) Before/During a Hailstorm

- I. Farmers are advised to use hail net for orchard crops to protect from mechanical damage.
- II. Provide support to banana crops, young fruit plants and cropping up in sugarcane crop/staking of vegetables to prevent the crops from lodging.
- III. Keep harvested produces at a safe place.
- IV. Keep cattle/goats indoor during a hailstorm.

(c) During Thunderstorms and Lightning

If thunderstorm and lightning are occurring in your area, you should:

- I. Use your battery-operated radio/TV for updates from local officials.
- II. Avoid contact with corded phones and devices including those plugged for recharging.
- III. Cordless and wireless phones not connected to wall outlets are OK to use.
- IV. Avoid contact with electrical equipment or cords.
- V. Avoid contact with plumbing or pipes. Do not wash your hands, do not take a shower, do not wash dishes, and do not do laundry. Plumbing and bathroom fixtures can conduct electricity.
- VI. Stay away from windows and doors, and stay off porches.
- VII. Do not lie on concrete floors and do not lean against concrete walls.
- VIII. Avoid natural lightning rods such as a tall, isolated tree in an open area.
- IX. Avoid hilltops, open fields, the beach or a boat on the water.
- X. Take shelter in a sturdy building. Avoid isolated sheds or other small structures in open areas.

- XI. Avoid contact with anything metal - tractors, farm equipment, motorcycles, golf carts, golf clubs, and bicycles.
- XII. If you are driving, try to safely exit the roadway and park. Stay in the vehicle and turn on the emergency flashers until the strong rain ends. Avoid touching metal or other surfaces that conduct electricity in and outside the vehicle.

(d) After lightning strikes a human being

If lightning strikes you or someone you know, call for medical assistance as soon as possible. You should check the following when you attempt to give aid to a victim of lightning:

- I. Breathing – If breathing has stopped, begin mouth-to-mouth resuscitation.
- II. Heartbeat – If the heart has stopped, administer Cardiopulmonary Resuscitation (CPR).
- III. Pulse – If the victim has a pulse and is breathing, look for other possible injuries. Check for burns where the lightning entered and left the body. Also be alert for nervous system damage, broken bones and loss of hearing and eyesight.

CHAPTER-VI

CAPACITY BUILDING

CHAPTER-6: CAPACITY BUILDING

6.1 TLSD/HSW Education:

The state governments will emphasize on greater awareness by making TLSD/HSW education a part of educational curricula, covering all the relevant aspects. This would result in fostering a culture of prevention, mitigation and preparedness as well as effective and rapid response, relief, rehabilitation and recovery. Case studies of major previous incidents may be used as valuable inputs in the process.

Development of high-quality information, Education and Communication (IEC) materials, textbooks and field training, including specially designed material for women, elderly and differently abled. The State governments/ SDMAAs will encourage their school boards to develop similar content in their school curricula.

6.2 Target Groups for Capacity Building:

The target groups for capacity building include elected representatives, government officials concerned with DM functions, media professionals, urban planners, development experts, engineers, architects and builders, NGOs, community-based organisations (CBOs), social activists, social scientists, youth organisations such as National Cadet Corps (NCC), National Service Scheme (NSS), Nehru Yuvak Kendra Sangathan (NYKS), school teachers and school children. Besides, the capacity of police personnel, Civil Defense, Home Guards and the SDRFs should also be strengthened. The general public should be made aware of the need to keep an emergency kit containing medicines, torch, identity cards, ration card and non-perishable food such as dry fruits, roasted gram, etc. ready. They should also be trained in making and using improvised rescue tools with household articles. The NDRF, the SDRF and the Civil

Defense in coordination with State government/SDMA/DDMAs will conduct these training programmes.

6.3 Capacity Building of Professionals: The KSNDMC will, in consultation with reputed knowledge institutions like the Indian Institutes of Technology (IITs), National Institutes of Technology (NITs) and Indian Institute of Tropical Meteorology (IITM), etc., develop comprehensive programmes and a State level plan for creating a group of mentors from among trained faculty members of engineering and architecture colleges as also from among professionals in the relevant fields. KSDMA/KSNDMC will help identify these potential trainers for training programmes at basic, intermediate and advanced levels. These training programmes will be pilot tested, evaluated, continuously upgraded based on assessment and feedback from participants, documented, and peer-reviewed.

6.4 Training: The KSDMA /KSNDMC and Administrative Training Institutes (ATIs) at the State level, will organize training of elected representatives and administrative personnel from all concerned line State governments departments.

The KSDMA/ KSNDMC will evolve Action Plans and a National Strategy, in association with the ATIs and other technical institutions, to develop comprehensive curricula in the form of training modules for various target groups and initiate the design, development and delivery of the same at the earliest.

6.5 Research and Development

The State government will proactively develop the application-oriented research and developmental activities to address contemporary challenges, generate solutions, and develop new techniques to improve resilience against TLS/HSW.

The KSDMA/KSNDMC, will arrange for systematic data collection and its incorporation in its data bank with an efficient retrieval system. It will encourage the development of standardized methods for TLSD/HSW risk assessment and scenario development. The KSDMA evolve, a procedure for undertaking pilot projects in risk assessment and scenario analysis, and publish peer-reviewed reports.

The KSNDMC/KSDMA will seek the necessary assistance from the central institutes in this regard.

The State government will encourage and assist subject matter specialists from academia and industry to prepare technical documents on the concepts of the behaviour of these extreme weather incidents. Fine-tuning the technical specifications for making new and old buildings and structures TLSD/HSW resilient will be a priority. The implementation of these guidelines requires participation from a wide spectrum of professionals. The State and technical institutions like the IITs, NITs and other professional bodies will create and maintain a directory of professionals in India, who have experience in related fields, architecture and engineering and also those who are interested in contributing to the national efforts towards improving our resilience for ensuring TLSD/HSW safety in India.

CHAPTER-VII

ROLES AND RESPONSIBILITY

CHAPTER-7: ROLES AND RESPONSIBILITY

All the stakeholder Departments and agencies should work under a unified command to ensure effective implementation of prevention, preparedness and mitigation measures.

The Chief of Operations (Chief Secretary) will spell out the priorities and issue policy guidelines. The Relief Commissioner will coordinate the services of various stakeholders, including national/State agencies, and central government agencies.

The SEOC is the nerve center to support, coordinate and monitor disaster management activities at the State level, including training and research. It will, under normal circumstances, work under the supervision of the Relief Commissioner. During an emergency situation, it will work as the center for decision making as long as the need for emergency relief operations continues or until the long-term plans for rehabilitation are finalised. Respective line departments will manage long-term rehabilitation programmes.

The system and procedures of an SEOC should be designed for rapid dissemination of information to all stakeholders to enable effective decision-making and quick response during an emergency.

Academic institutions such as the IITs, the private sector and NGOs also complement the efforts of the government and provide necessary inputs/assistance to concerned Ministry/Department.

A detailed matrix clearly laying down the roles/responsibilities of all stakeholders is given in **Section 7.1 & 7.2**.

Annexure:1

THUNDERSTORM & LIGHTNING: DO'S AND DON'TS

If at home or work

Preparation

- Look for darkening skies and increased wind.
- If you hear thunder, you are close enough to be struck by lightning.
- Keep monitoring local media for updates and warning instructions.
- Stay indoors and avoid travel if possible.
- Close windows and doors, and secure objects outside your home (e.g. furniture, bins, etc.).
- Ensure that children and animals are inside.
- Unplug unnecessary electrical appliances (to isolate them from the main power supply which may conduct a power surge during a lightning storm).
- Remove tree timber or any other debris that may cause a flying accident.

Response

- Avoid taking a bath or a shower, and stay away from running water. This is because lightning can travel along metal pipes.
- Keep away from doors, windows, fireplaces, stoves, bathtubs, or any other electrical conductors.
- Avoid using corded phones and other electrical equipment that can conduct lightning.

If Outdoor

Response

- Go to safe shelter immediately – avoid metal structures and constructions with metal sheeting.
- Ideally, find shelter in a low-lying area and make sure that the spot chosen is not likely to flood.
- Crouch down with feet together and head down to make yourself a smaller target.
- Hair standing up on the back of your neck could indicate that lightning is imminent.
- Do not lie flat on the ground; this will make a bigger target.
- Keep away from all utility lines (phone, power, etc.), metal fences, trees, and hilltops.
- Do not take shelter under trees as these conduct electricity.
- Rubber-soled shoes and car tyres do not offer protection from lightning.

If travelling Response

- Get off bicycles, motorcycles or farm vehicles that may attract lightning.
- Get to a safe shelter.
- If boating or swimming, get to land as quickly as possible and take shelter.
- During a storm, remain in your vehicle until help arrives or the storm has passed (the metal roof will provide protection if you are not touching metal inside); windows should be up; park away from trees and power lines.

Treatment

- Take the person who is struck by lightning to a hospital.
- If possible, give basic First Aid.
- People struck by lightning carry no electrical charge and can be handled safely.
- Check for broken bones, loss of hearing and eyesight.
- A victim of a lightning strike can suffer varying degrees of burn. Check the impact point and where the electricity left the body for injury marks.



Caught in a storm outside ? Crouch to Survive a Lightning strike

Lightning likes to strike the tallest object around. Get as low as you can.

If your hair begins to stand on end or your skin starts to tingle, a lightning strike is imminent. However, lightning may strike without this warning.

Do not lie down. This increases your surface area and chances of getting struck. Also, the electric current can move along the ground surface after striking at a point.

Do not touch good conductors of electricity such as metals, metallic pipes, electrical systems, TV, wires, cables, water, etc. as it can give you an electric shock if lightning strikes.

Put your hands over ears to minimise hearing loss from the accompanying thunder.

Touch the heels of your feet together. If electricity from a ground strike enters through your feet, this increases the chances of the electricity going in one foot and out the other, rather than into the rest of your body.

The only thing touching the ground should be the balls of your feet. Lesser your contact with the ground, lesser are the chances of current entering your body.



Dos & Donts of Lightning



If at Home or Work- Preparation

**Look for darkening skies and
increased wind;**

**If you hear thunder then you are
close enough to be struck by
lightning**



If at Home or Work- Preparation

**Keep on monitoring
local media for
updates and warnings**



During Lightning



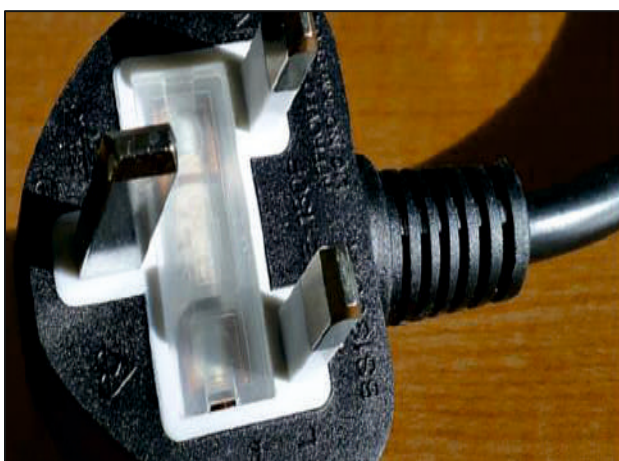
If at Home or Work- Preparation

**Stay indoors and avoid
travel if possible**



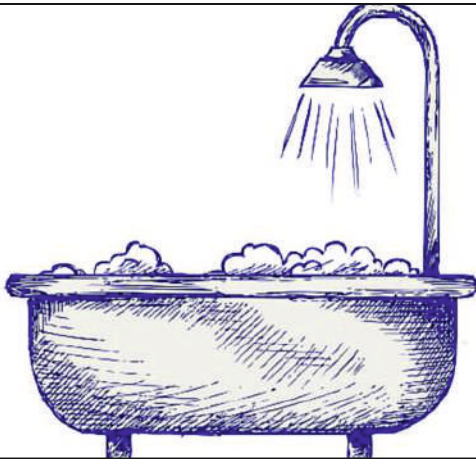
If at Home or Work- Preparation

**Ensure that children
and animals are inside**



Preparation

**Unplug unnecessary electrical
appliances
(to isolate them from the
main power supply which may
conduct a power surge during
a lightning storm)**



If at Home - Response

**Avoid taking a bath or shower
or running water for any
purpose;**

**This is because lightning
can travel along pipes**



If at Home - Response

**Keep away from doors,
windows, fire places,
stoves, bath-tubs, or any
other electrical charge
conductors**



If at Home - Response

**Avoid using corded phones
and other electrical
equipment (mobile or
cordless phones are safe)**



**Go to safe shelter
immediately - avoid metal
structures and or
constructions with
metal sheeting**



If on Foot - Response

**Crouch down with feet
together and head
down to make yourself
a smaller target**



Response

**Ideally find shelter
in a low lying area and
make sure that
the spot chosen is not
likely to flood**



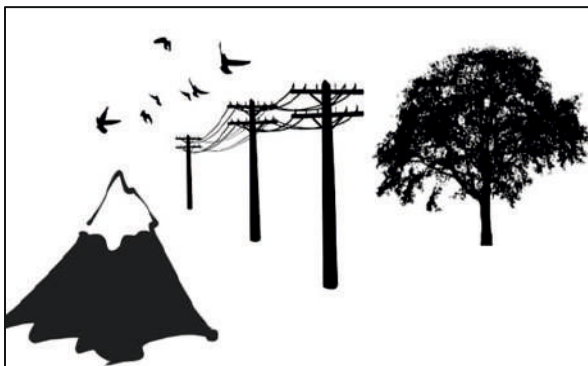
If on Foot - Response

Hairs standing up on the back of your neck could indicate that a lightning is imminent



If on Foot - Response

Do not lie flat on the ground; this will make a bigger target



If on Foot - Response

Keep away from all utility lines (phone, power, etc., metal fences, trees, and hill tops).



Awareness Videos Link : <https://ndma.gov.in/Resources/awareness/lightning>

Annexure: 2

7.1 Matrix of Karnataka State Action plans for Thunderstorms & Lightning:

Thunderstorm, Lightning			
Agencies and their Responsibilities			
Sl.No	Sub-Thematic Area for DRR	Agencies	Responsibility
1	Understanding Risk & Documentation	KSDMA KSNDMC IMD, Bangalore	- Preparing State Action Plan and its implementation. - Prepare detailed departmental SoPs by concerned department. - Documentation of incidents occurred in the State of Thunderstorm, Lightning, Squall/ Hailstorm & Strong Winds
2	Inter-Agency Coordination	KSNDMC	- To disseminate the information received from KSNDMC Lightning detection Network and from IMD nowcast bulletins to public at large. - Promote installations of lightning arresters and Doppler Radars. - Information, Alerts and Early Warnings, Reports, Weather forecast and related Advisories are being made available through SMS to the mobile phones, e-mail, Social Media and Web Portal to all the DC's, CEO's, HQA's, AC's, Tahsildars, JD's (Agri), AD's (Agri), Agri Officers, SP's, Raitha Samparka Kendras, Farmers facilitators under Bhoochethana Program, Krishi Vigyana Kendras (KVKs), Agriculture Universities, Civil Defense, Home guards, Print and Electronic Media.
		Information & Public relations	- Ensure specific message and information, dissemination to public at large through print/electronic/social and other mass media at all level. - Create a network of community based early warning systems.
		KPTCL	- To ensure power cuts and restoration of power supply and also provide emergency power supply to critical facilities. - Activate all concerned ESCOM office/officers.
		Education department	Institutionalised multi-agency coordination with clear role and responsibility.
		SDRF	Rescue and evacuation operations in coordination with the administration, NGOs and volunteers.

Thunderstorm, Lightning			
Agencies and their Responsibilities			
Sl.No	Sub-Thematic Area for DRR	Agencies	Responsibility
3	Investing in DRR – Non-structural measures	PWD	• Ensure road connectivity and access to vulnerable areas.
		KPTCL	• To ensure functional state of all electrical equipment and maintain the service or replace equipment from time to time. • Assessment of damage from weather events.
		Department of Animal Husbandry	• Treatment of animals. • Provision of vaccination. • Disposal of dead animals. • Arrange for timely care and treatment of animals during thunderstorm.
4	Capacity Development	ATI-CDM and ANSSIRD	• Training programme for all concerned department officials/volunteers. • Conduct training programmes and drills on usage of various protection equipment and preventive systems.
		Information and Public Relations	• Creation of public awareness. • Extensive IEC campaigns to generate public awareness through Print, Electronic and Social Media. • Ensure Push SMS by various telecom service operators to all active mobile connections.
5	Climate Change Risk Management	KSDMA	Recurring/ Continuous • Sensitization and awareness creation. • Support national CCA efforts. • Coordination with central agencies. • Sponsor and promote state-specific efforts and local efforts for GACC mitigation and adaptation. Short –Term (T1) • Develop local adaptation strategies and pilot projects. Medium -Term (T2) • Sponsor and promote state-specific efforts and local efforts. • Implementation of GACC adaptation programs. • Integrate adaptive measures in social protection programmes for the vulnerable groups.

7.2 Roles & Responsibility matrix for management of Thunderstorm & Lightning:

Sl. No.	Tasks/ Activities	Agencies/ District agencies and their responsibilities			
		Agencies	Responsibility	DDMA	Responsibility
Understanding Task					
1	Preparation of policy, guidelines and action plans	Revenue Department (DM)/ KSNDMA	Prepare Guidelines for preparation for State Action Plans	DDMAs consultation with concerned departments	• Prepare State Action Plan and ensure its implementation. • Prepare detailed department-wise SOPs

Sl. No.	Tasks/ Activities	Agencies/ District agencies and their responsibilities			
		Agencies	Responsibility	DDMA	Responsibility
Interagency Coordination					
2	Early Warning and Communication	Nodal Agency: KSNDMC & IMD with Information and Broadcasting (PIB, AIR, Doordarshan)	Issue area-specific warnings/ alerts and weather forecasts to all the concerned departments-DDMAs/KPTCL /RDPR/Health/ ULBs and other line departments	DDMAs consultation with concerned departments	• Disseminate information received from KSNDMC and IMD to the public • Promote Installation of lightning arresters and Doppler Radars • Create a network of community-based early warning systems
3	Relief & Response	Revenue Dept. (DM)/ KSDMA	• Coordination with concerned agencies and stakeholders with clear roles and responsibilities • Deployment of NDRF/SDRF as per requirement	DDMAs consultation with concerned departments COR(to coordinate with other concerned Departments/Agencies)	• Designate a nodal officer for emergency response • Coordination among all stakeholder agencies with clearly defined roles and responsibilities • Rescue and evacuation operations in coordination with the administration, NGOs and volunteers • Emergency medical response • Other necessary actions

Sl. No. 4: Prevention, Mitigation and Preparedness measures			
Agencies	Responsibility	DDMA	Responsibility
Interagency Coordination			
Nodal Agency: 1.KSDMA with other concerned Departments	• Inter-agency coordination • Issue relevant advisories • Give directions to concerned ministries/departments	Nodal agency: DDMA's consultation with concerned departments	• Inter-agency coordination and implementation of State directions • Implement assessment, preparedness and mitigation measures and implementing • Review and update precautionary measures and procedures • Public awareness and education for early warning response • Identify vulnerable places • Follow alerts/warnings, advisories • Disseminate Do's and Don'ts for general public and enable them to access safe places • Protect property/infrastructure and environment from damage from a fire
2. RDPR	Disseminate information to public on structural mitigation measures	DDMA's consultation with concerned departments	Ensure strict adherence to fire safety norms
3. Housing and Urban Development	Conduct drives to check the structural strength	DDMA's consultation with	Ensure essential services and facilities at vulnerable places
4. Department of Telecommunications	Set up alternative or emergency communication systems	DDMA's consultation with concerned departments	• Establish public information facilities. • Set up alternative or emergency communication systems

Sl. No. 4: Prevention, Mitigation and Preparedness measures			
Agencies	Responsibility	DDMA	Responsibility
Interagency Coordination			
5. Energy Department	• Deal with power cuts and ensure emergency power supply, whenever needed • Start a drive to check and maintain/replace old electrical equipment/cables	DDMAs with concerned Power corporations	• Ensure early restoration of electricity supply to essential services during emergencies and restoration of electric supply at the earliest • Ensure functional state of all electrical equipment and maintain the service or replace equipment from time to time
6. PWD & RDPR	Ensure road connectivity and access to vulnerable areas	PWD & RDPR	Ensure quick restoration of road connectivity and access to vulnerable areas
7. Health & Family Welfare	• Create posts for medical staff for emergency situations • Hospital preparedness, including training of human resources	DDMAs consultation with concerned departments	• Ensure appropriate medical staff and facilities at the place of incident • Strengthen health centres with a network of paramedical professionals • Ensure stockpiling of life-saving drugs, detoxicants, anaesthesia, and availability of Halogen tablets in vulnerable areas
8. Department of Agriculture & Horticulture	• Ensure adherence to crop safety norms • Construction of safe crop storage shelters for farmers	DDMAs consultation with concerned departments	• Promote crop/animal insurance • Construct thunderstorm safe crop storage shelters for farmers

Sl. No. 4: Prevention, Mitigation and Preparedness measures					
Agencies		Responsibility		DDMA	Responsibility
Interagency Coordination					
9. Forests and Environment		Set up awareness programmes		DDMAs consultation with concerned departments	• Ensure adherence to fire safety norms • Protect property/infrastructure and environment from damage by a fire
S. No.	Tasks/ Activities	Agencies/ District agencies and their responsibilities			
		Agencies	Responsibility	DDMA	Responsibility
Interagency Coordination					
5	Record of data & Documentation	Nodal agency: Revenue department (DM)	Collect post-disaster data from districts and maintain a District-level database.	DDMAs consultation with concerned departments	• Assessment of damage from weather-related incidents • Collect post-disaster data from field and reporting to State/national level



Karnataka State Natural Disaster Monitoring Centre (KSNDMC)
Revenue Department (Disaster Management)
Government of Karnataka