सत्यमेव जयते

Guidelines for Preparation of Action Plan - Prevention and Management of Thunderstorm & Lightning/Squall/Dust/Hailstorm and Strong Winds

2018

National Disaster Management Authority
Government of India

Guidelines

for

Preparation of Action plan - Prevention and Management of

Thunderstorm & Lightning/ Squall/Dust/Hailstorm and Strong Winds

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प्रधान मंत्री

Prime Minister

MESSAGE

It is heartening to learn that National Disaster Management Authority (NDMA) has prepared guidelines for preparation of an action plan for the prevention and management of thunderstorms, lightning, squall, dust, hailstorm and strong winds.

NDMA has been bringing out a series of guidelines on various natural calamities. These guidelines provide instructions on do's and don'ts to be followed, as well as steps to be taken by the common people during the times of natural disasters.

The preparation of the action plan for prevention and management of thunderstorms, lightning, squall, dust, hailstorm and strong winds is an extremely timely and relevant initiative. These natural phenomena often strike the poor and the disadvantaged sections of our society. It is hoped that the preparation of these guidelines will go a long way in reducing the impact of such natural phenomena.

The guidelines will surely have drawn from the latest and best international practices adopted to deal with such natural phenomena. May the guidelines be disseminated widely to reach out to the maximum number of people.

Best wishes for successful publication of the guidelines.

(Narendra Modi)

New Delhi
28 February, 2019

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Guidelines for preparation of Action Plan – Prevention and Management of Thunderstorm & Lightning / Squall /Dust / Hailstorm and Strong Winds(TLSD/HSW)

FOREWORD

India, with approximately 1.32 billion people, is the second most populous country in the world. A high density of population makes our country one of the most vulnerable to disasters. Thunderstorm &Lightning / Squall/ Dust Storm/Hailstorm and Strong Winds have emerged as major weather hazards in recent years affecting different parts of the country.

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. A dust storm, associated with a thunderstorm and strong winds, generally occurs in arid and semi-arid regions. It lifts loose dust from dry land area.

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/dust storms will rise in the years ahead. India may also experience an increase in the severity and frequency of these incidents in future. Hence, there is a need for prevention, preparedness and mitigation measures, and to invest in Disaster Risk Reduction (DRR) which will save lives, livestock, property and infrastructure. This is also in line with the Sendai Framework to which India is a signatory.

The "Guidelines for preparation of Action Plan – Prevention and Management of Thunderstorm & Lightning/ Squall Dust/Hailstorm and Strong Winds" aim to facilitate and improve the capacity of the States in preparing their Action Plans and respond promptly and effectively to mitigate the adverse effects of these incidents. It will help 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.

We take this opportunity to express our appreciation of the commitment of all the stakeholders who extended their support and cooperation in our efforts. We are grateful to the members of the Expert Groups/ Subgroups for their expertise and valuable contribution.

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Member, NDMA

(Dr. D. N. Sharma)
Member, NDMA

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Member, NDMA

ACKNOWLEDGMENTS

I am thankful to the members of the Expert Group/Subgroups for their unrelenting cooperation extended to me for preparing the National "Guidelines for Preparation of Action Plan – Prevention and Management of Thunderstorm & Lightning/ Squall, Dust/Hailstorm and Strong Winds". I would like to place on record the significant contributions made by the Ministry of Home Affairs, Ministry of Earth Sciences, India Meteorological Department, New Delhi, Indian Institute of Tropical Meteorology, Pune and Indian Institute of Technology, Mumbai.

I express my sincere thanks to the representatives of Andhra Pradesh, Karnataka, Bihar, Jharkhand, Rajasthan and Uttar Pradesh governments, scientific and technical institutions, eminent professionals, non-governmental organisations, the private sector and Air Vice Marshal (Retd.) Prof. Ajit Tyagi, Former Director General of Meteorology and Member, World Meteorological Organisation Working Group on Tropical Meteorology for their valuable inputs, which helped us improve the content and the presentation of this document.

I thank Shri Anup Kumar Srivastava, Consultant (Drought & Food Security) and Shri Abhishek Shandilya, Sr. Consultant (Information, Education and Communication), NDMA, for their cooperation. I also thank Lt. Col. Rahul Devrani, Joint Advisor (Rehabilitation and Recovery) and Shri M. L. Sharma, Under Secretary (Rehabilitation and Recovery), NDMA, for their help in organising various workshops and meetings towards preparation of these Guidelines. Finally, I would like to express my gratitude to Shri R. K. Jain, former Member, NDMA and Shri Kamal Kishore, Member, NDMA, for chairing and co-chairing the Expert Committee meetings and providing valuable guidance. I would also like to thank all the other Members of NDMA for their patient reading of various drafts, constructive criticism, guidance and suggestions in formulating these guidelines.

I am confident that this document will help Central Ministries and Departments, States and Union territories in formulating effective Action Plans for Prevention and Management of Thunderstorm, Lightning/ Squall, Dust/Hailstorm and Strong Winds which will improve our preparedness and response to these incidents in the future.

New Delhi — Dr. V. Thiruppugazh

January, 2019

ABBREVIATIONS

The following abbreviations and acronyms appear in the text:

AICTE	All India Council of Technical Education
AIR	All India Radio
ATIs	Administrative Training Institutes
CBOs	Community-Based Organisations
CC	Cloud-to-Cloud lightning
CG	Cloud-to-ground lightning
COA	Council of Architecture
COR	Relief Commissioner
DDMA	District Disaster Management Authority
IC	Intra-cloud lightning
IE	Institution of Engineers
IIT	Indian Institute of Technology
IITM	Indian Institute of Tropical Meteorology, Pune
IMD	India Meteorological Department, New Delhi
IPCC	Intergovernmental Panel on Climate Change
LLN	Lightning Location Network
MHA	Ministry of Home Affairs
MHRD	Ministry of Human Resource Development
MoA&FW	Ministry of Agriculture and Farmers' Welfare
MoES	Ministry of Earth Sciences
MoHFW	Ministry of Health and Family Welfare
NCC	National Cadet Corps
NCRB	National Crime Records Bureau
NDMA	National Disaster Management Authority
NDRF	National Disaster Response Force
NEC	National Executive Committee
NGO	Non Governmental Organisation
NIDM	National Institute of Disaster Management
NIH	National Institute of Hydrology
NIT	National Institute of Technology
NOAA	National Oceanic and Atmospheric Administration, USA
NRSC	National Remote Sensing Centre
NSS	National Service Scheme
NYKS	Nehru Yuva Kendra Sangathan
PIB	Press Information Bureau
SDMA	State Disaster Management Authority
SDRF	State Disaster Response Force
SEOC	State Emergency Operation Centre
SMS	Short Message Services
TLSD/HSW	Thunderstorm/Lightning, Dust/Hailstorm, Squall and Strong Winds
UGC	University Grants Commission
UNISDR	United Nations International Strategy for Disaster Reduction
WMO	World Meteorological Organisation

Executive Summary

Thunderstorm, Lightning, Dust storm, Hailstorm, Squall and Strong Winds have emerged as major weather hazards in recent years and have affected different parts of the country. Thunderstorms have some typical characteristics which lead to 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. They have a devastating impact on agriculture and aviation sectors in addition to surface transport, power, communication and other socio-economic sectors. These may also lead to loss of human lives, assets/ property/ livelihoods, etc.

IMD data (1950-1980) shows that more than 80 thunderstorm and lightning days occur over the northeast, and some parts of Kerala and Jammu &Kashmir each year. In India, more than 2,500 people die due to thunderstorm and lightning every year. The country may also witness in future an increase in the severity and frequency of thunderstorms and dust storms.

To safeguard our developmental gains, we should aim at reducing the impact of extreme weather incidents by improving our understanding of the hazards and the factors that influence vulnerability.

Genesis:

During May 2018, severe dust storms, thunderstorms and lightning hit several parts of India resulting in a large number of casualties/loss of lives and severe economic losses. These incidents as well as experiences from the past led to the realization that the formulation of national "Guidelines for preparation of Action Plan – Prevention and Management of Thunderstorm & Lightning/ Squall Dust/Hailstorm and Strong Winds" is a must for improving the capacity of the States to deal with these incidents in a scientific and planned manner. The Guidelines will help develop measures and strategies for assessment, forecast, preparedness and mitigation through coordinated efforts with multiple agencies and undertake reconstruction to build disaster-resilient infrastructure. NDMA followed a nine-step process for the preparation of these Guidelines, involving all relevant stakeholders through a series of interactive, reciprocal and supplementary actions.

Thunderstorm & Lightning, Dust/Hailstorm, Squall and Strong Winds have got lesser attention as compared to other disasters but these incidents cause as much damage as other incidents do. Managing these, therefore, requires active and continuous participation of all the stakeholders.

NDMA constituted expert group/sub-groups, including representatives of various ministries/departments and state governments along with other stakeholders, to build consensus on the content of these guidelines.

Objectives:

To provide help to vulnerable states in preparing their Action Plans, and developing tools for Early Warning, Preparedness, Mitigation as well as coordinated strategies to minimize losses to lives and property.

Structure of the Guidelines

Sharing of past learning experiences, academic and institutional research, action taken by states and historical data helped in preparing these guidelines. It has seven chapters:

Chapter 1 - Background and Introduction: This chapter examines different weather hazards which pose a risk to life and public property, their impact and definitions.

Chapter 2 - Preparation of Action Plan: This chapter explains the rationale behind these guidelines and lists its major objectives. It also lists the key strategies required to prepare for and respond to these severe weather incidents at the local level besides the steps involved in developing an Action Plan.

Chapter 3 - Early Warning and Communication: This chapter explains the entire system of issuing weather forecast and early warning. Short to medium range forecast indicates the potential areas at risk with the probability of occurrence of the phenomena. Nowcasting provides specific information about the place and time of occurrence. The chapter also draws early warning/alerts communication and dissemination strategy along with public awareness, community outreach and Information Education Communication (IEC) plan at various levels so that timely information reaches officials as well as the general public.

Chapter 4 - Prevention, Mitigation and Preparedness Measures: This chapter deals with the concept of structural and non-structural Prevention, Mitigation and Preparedness measures, including actions to be taken before, during and after an extreme weather incidents. 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 avoided, however, their harmful effects can be minimized through a number of measures as suggested in the chapter.

Chapter 5 - Capacity Building and Training: This chapter emphasizes the creation of greater awareness by making TLSD/HSW education a part of educational curricula. This would result in fostering a culture of prevention, mitigation and preparedness as well as effective and rapid response, relief, rehabilitation and recovery.

Chapter 6 - Role & Responsibilities and Implementation Plan: This chapter clearly lays down the roles/responsibilities of all stakeholders in a matrix format. It also provides a brief insight into how an SEOC , its system and procedures should be designed for rapid dissemination of information to all stakeholders to enable effective decision-making and quick response during an emergency.

Chapter 7 - Record of Data and Documentation: The chapter underlines the need and importance of exhaustive data collection and validation at the district level and compilation at the State and Central level, which in turn would feed data into the national-level disaster database and enable policy decisions.

1. Background & Status

1.1 Background and introduction:

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). Out of the 29 States and 7 Union Territories, 22 states and union territories are disaster prone. 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.

They have a devastating impact on agriculture and aviation sectors in addition to surface transport, power, communication and other socio-economic sectors. These may also lead to loss of human lives, assets/ property/ livelihoods, etc.

Experts believe that due to rising global temperature and climate change (IPCC Special Report, 2018 - Global Warming of 1.5 °C)[1], the severity and frequency of thunderstorms/dust storms will rise in the years ahead. India may also experience an increase in the severity and frequency of these incidents in future.

Thunderstorms have some important characteristics such as the formation of a squall, strong updraft and downdraft, towering cumulonimbus clouds which are associated with turbulence and icing, in-cloud electrification and associated lightning, localized strong rain and hailstorm.

IMD data (1950-1980) shows that more than 80 thunderstorm days occur per year over the northeastern part of India, some parts of Kerala and Jammu & Kashmir. The eastern and northeastern parts of our country, i.e. Gangetic West Bengal, Jharkhand, Bihar, Odisha, and northeastern States, get affected by severe thunderstorms during the pre-monsoon months of March to May.

A dust storm associated with a thunderstorm generally carries very little rain in them and the strong winds lift loose dust from dry land in arid and semi-arid regions. Sometimes, heavy rain and hail occur which causes severe damage along with strong winds.

Lightning is yet another weather-related disaster associated with thunderstorms. Lightning occurs due to electrically charged regions in a cloud which is called intra-cloud lightning (IC) or 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 becomes a strike if it involves an object on the ground. The flow of electric charges can affect any electrically conductive body. Hence, electrical appliances, if operated during a lightning strike, can affect their normal functioning and have a risk of becoming faulty. Similarly, living beings coming in contact with lightning, either directly or indirectly through electrical conductors, can be affected, which may lead to severe burns or even death. Lightning strikes the Earth 50 to 100 times each second[2].

[1]IPCC special report on the impacts of global warming of 1.5 °C (Policymakers was formally approved at the First Joint Session of Working Groups I, II and III and accepted by the 48th Session of the IPCC, Incheon, Republic of Korea, 6 October 2018.)
[2]Dr Sunil D. Pawar, IITM, Pune, and Oliver, John E.(2005) National Oceanic and Atmospheric Administration (NOAA), USA

As there were no Guidelines on thunderstorm & lightning/ squall /strong winds at the national level, it remained a challenge for disaster managers to take standardised preventive and mitigation measures.

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.

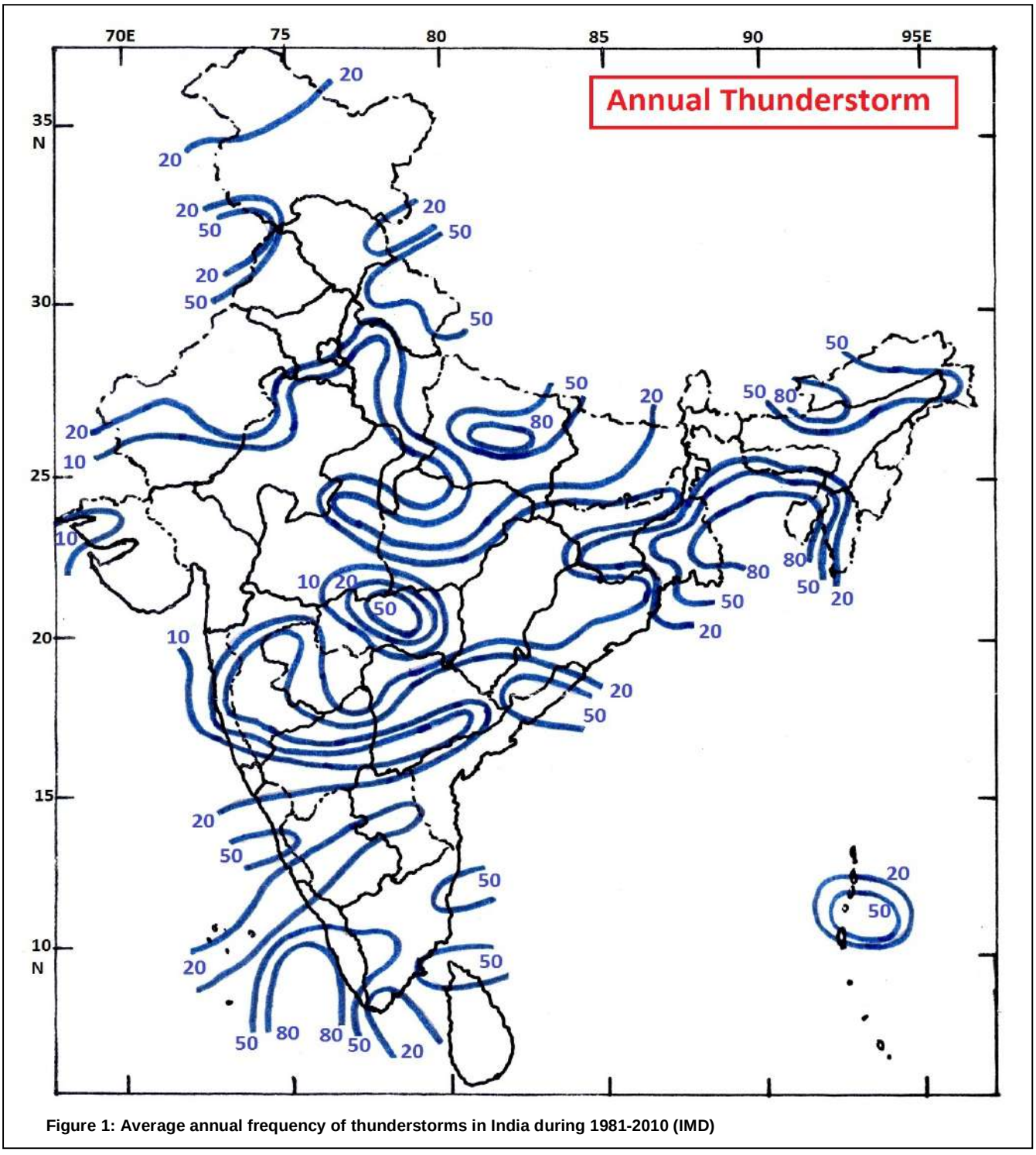


Figure 1: Average annual frequency of thunderstorms in India during 1981-2010 (IMD)

1.2 Impact of Thunderstorm/Lightning, Dust/Hailstorm, Squall, and Strong Winds in India

In India, on an average, more than 2,500 deaths are recorded due to thunderstorm and lightning every year (Source: Annual Report, NCRB). It accounted for about 39 per cent of deaths from natural disasters in the country from 1967 to 2012. (Illias et al., 2014). During May 2018, severe dust storms, thunderstorms and lightning hit several parts of India, resulting in a large number of deaths and injuries across Rajasthan, Uttar Pradesh, Telangana, Uttarakhand and Punjab.

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

Year	Number of Deaths
2001	1507
2002	1383
2003	1792
2004	1842
2005	2064
2006	2387
2007	2790
2008	2553
2009	2113
2010	2622
2011	2550
2012	2263
2013	2833
2014	2582
2015	2641
2016^	1489
2017^	2057
2018*	328

*= as per media reports from 2nd May 2018 to 10th July 2018 ^= Provisional
Source: Compiled from Annual Reports of NCRB and Ministry of Home Affairs, Government of India

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 86% of the total lightning-related deaths in Maharashtra were reported from amongst people working in the fields (Source: IITM, Pune: 2004-2009). 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.

A moderate thunderstorm can damage thatched huts, *kutcha* roads, standing crops, orchards, power and communication lines.

A severe thunderstorm can cause major damage to thatched houses/ huts. 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. Dust storms also lead to breathing problems. Hailstorms may cause

injury to human beings, livestock, and can cause damage to standing crops. The probability of occurrence of hailstorms is highest in Maharashtra (91-95%).

Indian Institute of Tropical Meteorology (IITM), Pune, an autonomous institute under the Ministry of Earth Sciences, Government of India, has initiated a project to study the characteristics of lightning by using Lightning Location Network (LLN). This network can accurately detect the location of occurrence of a lightning strike and can help forewarn the public at least 1-2 hours before the occurrence of a thunderstorm. Population density, literacy rate and urbanization along with the density of lightning strikes and the region's topography are the major factors affecting lightning deaths. Maharashtra has established a 20-sensor network with its Central Processing Station at IITM, Pune, on an experimental basis. Each sensor has a coverage of about 200 km. This network is also complemented with a mobile app that not only shows an ongoing lightning event but also sends out warning Short Messaging Services (SMSes) to people.

State Governments undertake necessary measures to minimise the impact of these incidents. Experiences of some of the vulnerable States is placed at Annexure 3.

1.3 Definitions & Classification of Thunderstorms and associated 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 northeastern 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. Dust storm:

Northwest India experiences convective dust storms, locally called *"aandhi"*, during the pre-monsoon season with maximum frequency and intensity in May. The frequency of dust storms is maximum over Rajasthan followed by Haryana, Punjab and West Uttar Pradesh. It is of three types:

- **Slight dust storm**: If the wind speed is up to 41 kmph and visibility is less than 1,000 metres but more than 500 meters.
- **Moderate dust storm**: If the wind speed is between 42-74 kmph and visibility is between 200 and 500 metres.
- **Severe dust storm**: If the surface wind speed (in gusts) exceeds 74 kmph and visibility is less than 200 metres.

E. 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.

2. Preparing Action Plan

2.1 Rationale for preparation of Action Plan – Prevention and Management of Thunderstorm & Lightning, Squall, Dust storm, Hailstorm and Strong Winds

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)

Many States are severely affected by thunderstorms & lightning, squall, dust storms, hailstorm and strong winds during one or the other part of the year with varying frequency. While these incidents have received lesser attention as compared to other disasters, these cause 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 national level strategy and plan to reduce the adverse effects of these disasters. NDMA, therefore, plans to develop an institutional mechanism for undertaking prevention, mitigation and preparedness measures for these incidents with active participation from all stakeholders.

A comprehensive preparedness, mitigation and response plan requires the involvement of government authorities, non-governmental organizations (NGOs) and civil society.

2.2 Objectives:

A. To help the States 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 States.
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.

2.3 Key Strategies

Severe and extended incidents of thunderstorm & lightning/ squall / dust storm /hailstorm /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 plan.

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

2.4 Steps to Develop an 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, each state can form a dedicated policy decision-making committee chaired either by the Principal Secretary of the State or the State Disaster Management Authority (SDMA) and develop an implementation strategy with the 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 fulfil 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 localised 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, well-trained and informed for the thunderstorms and lightning season. The State should develop a clearly defined inter-agency emergency response plan with clearly marked out roles and information flows.

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) play 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 every year 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)

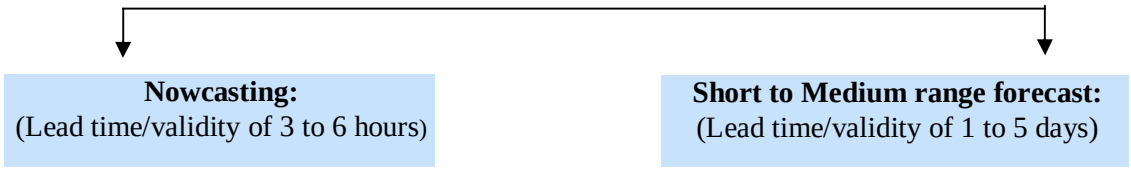
States should undertake mitigation strategies to reduce the impact of climate change on extreme weather incidents. For e.g., developing disaster-resilient infrastructure and implementing the "Manual on Hazard Resistant Construction in India" for non-engineered buildings.

3. Early Warning & Communication

3.1 Forecast and Issuance of Alerts/ Warning

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, State Control Rooms, 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.

3.2 Early Warning/Alerts: Dissemination and Communication Strategy

A. Dissemination strategy of Warning Messages

The dissemination strategy should aim at reaching the last person as soon as possible. The following points should be kept in mind:

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/dust 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.

B. 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.

3.3 Public Awareness, Community Outreach and Information Education Communication (IEC)

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

A. **National level:**

- Mass awareness campaigns involving Print, TV, Radio, Social Media, etc;
- 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);

- Special list of Do's and Don'ts for animal and livestock safety;
- Encourage line departments of the Central Government, State Governments and local authorities to widely disseminate Do's and Don'ts.

B. **State level:**

- Carry out mass awareness campaigns in local languages;
- Develop media and communication strategies and plans considering local socio-economic and behavioural factors;
- Involve recognised artists of the State, such as folk singers, dancers, and other performers for stronger recall value;
- Conduct regular awareness programmes in all districts;
- Conduct regular training programmes for inter-personal communication activities.

C. 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 –

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

3.4 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.

4. Prevention, Mitigation and Preparedness Measures

4.1. 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. Information, Education and Communications strategy for mass awareness generation has been discussed in detail in section 3.3.

4.2. 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 *patwari/ gram pradhan* 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 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).

Besides SDMAs and DDMAs, *tehsil*-level Disaster Management Group (TMG) at sub-division/ *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 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 neighbourhood and society.

4.3. 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 non-structural 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 arrestors 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.

4.4. 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. Cordless and wireless phones not connected to wall outlets are OK to use.
iii. Avoid contact with electrical equipment or cords.
iv. 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.
v. Stay away from windows and doors, and stay off porches.
vi. Do not lie on concrete floors and do not lean against concrete walls.
vii. Avoid natural lightning rods such as a tall, isolated tree in an open area.
viii. Avoid hilltops, open fields, the beach or a boat on the water.
ix. Take shelter in a sturdy building. Avoid isolated sheds or other small structures in open areas.
x. Avoid contact with anything metal - tractors, farm equipment, motorcycles, golf carts, golf clubs, and bicycles.
xi. 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.

5. Capacity Building

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.

The MHA and MoES (Ministry of Earth Sciences), in consultation with the Ministry of Human Resource Development (MHRD) and the State governments, will endorse these efforts, which will be based on the development of high-quality information, Education and Communication (IEC) materials, textbooks and field training, including specially designed material for women, elderly and differently abled.

Disaster management-linked modules have already been introduced by the Central Board of Secondary Education (CBSE) for classes VIII, IX and X. The CBSE would be encouraged to introduce modules of TLSD/HSW in classes XI and XII. The State governments/ SDMAs would encourage their school boards to develop similar content in their school curricula.

The MHA and MoES in consultation with the MHRD, NIDM, All India Council of Technical Education (AICTE), University Grants Commission (UGC), Council of Architecture (COA), Institution of Engineers (IE) and the State governments would also develop suitable modules for architecture and engineering courses to equip students with the knowledge of TLSD/HSW-proof design and construction techniques.

The issue of disaster medicine covers topics such as trauma care, epidemic control, alternative medical care by paramedics and emergency medical technicians, and telemedicine. Detailed attention would be given to Disaster Risk Reduction-related aspects at the undergraduate level so that graduating doctors have a better understanding of and are able to handle emergencies. This would be facilitated by the MHA in consultation with the Ministry of Health and Family Welfare (MoHFW), MoES and other related agencies.

The State governments/ authorities should also introduce a regular capacity enhancement programme for teachers and professionals to continuously evolve the quality of the educators and address the gaps, if any. The trainees would also be tested and issued certification on successful completion of the training.

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 Defence, 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 Defence in coordination with State governments/SDMAs/DDMAs will conduct these training programmes.

Capacity Building of Professionals

The National Institute of Disaster Management (NIDM) 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 national 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. State governments/SDMAs 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.

Training

The MoES will categorize leading institutes and universities, and encourage dedicated chair positions for faculty members working in the area of related education and research. These faculty members would also contribute to capacity building and training activities specified in these guidelines (Section 6.1)

The NIDM, under the guidance of the NDMA at the national level and SDMAs /State governments and Administrative Training Institutes (ATIs) at the State level, will also organize training of elected representatives (Members of Parliament, Members of Legislative Assemblies, Councillors, panchayat members, etc.) and administrative personnel from all central ministries and departments and State governments.

The NIDM will also 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 by March 2019.

Research and Development

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

Scenario analysis and simulation modelling are extremely useful for undertaking long-term DM measures and strengthening preparedness, mitigation and response efforts. Risk assessment and scenario projections require data on the built environment, existing infrastructure and economic activities, the lack of which can lead to assumption-based scenarios. The MoES will, with the support of IITM, IMD, NRSC and the State governments, 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 MoES will also evolve, in collaboration with the NDMA, a procedure for undertaking pilot projects in risk assessment and scenario analysis, and publish peer-reviewed reports.

The quantification of TLSD/HSW risk for a specified area requires detailed information on a number of factors, such as the source of moist air, unstable atmosphere, trigger mechanism, wind flow, latent heat, the topography of the area including close contour large-scale maps and Digital Hodographs. Information on the type of construction along with the economic value of the buildings, structures, infrastructure, industries, etc., is also required. These studies will guide the development of appropriate land-use zoning regulations for important urban areas and areas with critical structures and vital installations. These studies will follow a multidisciplinary approach with a focus on the requirements of the end users (e.g., urban planners, design engineers, and emergency managers).

The MoES, IITM and the IMD will provide necessary assistance to the state governments in this regard.

All currently available maps are small-scale maps unsuitable for hazard and risk analyses at the district level. The MoES will, in collaboration with nodal scientific agencies and institutions such as IITM, NRSC, IMD, etc., will prepare large-scale hazard maps of vulnerable areas. The reliability of TLSD/HSW hazard maps will depend on the accuracy of base maps and the approach followed in their GIS-based integration and subsequent validation. Unplanned urbanisation, neglect of slope maintenance, poor surface and subsurface drainage network in the area, deforestation, and poorly planned and substandard constructions greatly increase the damage potential. The MoES will, in collaboration with the State governments, IMD and IITM, undertake this activity and complete the same at the earliest.

The state governments will design such shelters keeping in mind the climatic conditions of the affected area and the functional needs of the affected people. The State governments/ SDMAs will ensure that these shelters are used for purposes such as running schools and/or *anganwadis*, etc. during normal times to ensure proper maintenance so that these are available in good condition as and when required.

Appropriate locations for constructing such shelters will be identified and data collected on the minimum health and hygiene standards that need to be ensured in such shelters.

The State governments, in collaboration with MoES and IMD, will carry out studies aimed at developing TLSD/HSW shed models suitable by using remote sensing information as inputs, in order to predict TLSD/HSW flow under ‘inadequate’ or ‘no data’ situations. Efforts will be intensified to evolve more and more mathematical models and use them for better decision-making.

The State governments/SDMAs will undertake mathematical model studies for long reaches complemented by physical model studies for problem reaches for TLSD/HSW works of a permanent nature, e.g. retrofitting of buildings, spurs, revetments, etc involving huge costs and significantly impacting wind behaviour. They will also upgrade the facilities in their respective research stations.

The MoES and IMD will, in collaboration with the State governments and other Institutions such as IITM, National Institute of Hydrology (NIH), IITs, universities and expert organisations/consultancy firms, undertake comprehensive morphological studies – wind shear, moisture, instability, and lifting that cause TLSD/HSW to predict wind behaviour over short, medium and long periods, identify vulnerable spots/ reaches vulnerable to TLSD/HSW and

evolve eco-friendly and cost-effective measures. It will encourage the state governments to enhance the capability of their institutes and undertake more such studies through them within their territory.

The MoES will equip officials of concerned organisations and the State governments with the knowledge and skills necessary to undertake such studies.

Documentation

The MoES will facilitate the preparation of films, manuals and other documents targeting various stakeholders to inculcate a culture of TLSD/HSW safety. State governments will make available TLSD/HSW related information in multiple formats so that different groups of stakeholders can gather the information relevant to them. State governments/SDMAs through websites and portals will disseminate all TLSD/HSW related information to stakeholders groups.

This information will include specific details on TLSD/HSW risk and vulnerability of different areas, TLSD/HSW risk mitigation measures and their effects on safety of the built environment.

The State governments 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. National and regional libraries and information centres will be encouraged to build significant repositories of relevant technical resources (books, reports, journals, electronic documents, and others).

The implementation of these guidelines requires participation from a wide spectrum of professionals. The NIDM, 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.

The MoES will also undertake the documentation of these incidents in India. A number of relevant documents on the subject have now become difficult to access or are out of print. The MoES will launch a special initiative to digitise these documents from various sources and save the archives in an electronic format for future safe keeping.

The documentation will be used for learning lessons from past experiences and factoring improvements into future planning for preventive, preparatory, mitigative, relief and response measures.

6. Roles and Responsibility

All the stakeholder Ministries/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 centre 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 centre 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 6.1.

6.1 Roles and Responsibilities Matrix for Management of Thunderstorm, Lightning, Dust/Hailstorm, Squall and Strong Winds

S. No.	Tasks/ Activities	Central/ State Agencies & Their Responsibilities			
		Centre	**Responsibility**	**State**	**Responsibility**
Understanding Risk					
1	Preparation of policy, guidelines and Action Plans	NDMA	• Prepare Guidelines for preparation of State Action Plans	State Governments / SDMAs/Commissioner of Relief (COR)	• Prepare State Action Plan and ensure its implementation • Prepare detailed department-wise SOPs
Interagency Coordination					
2	Early Warning and Communication	**Nodal Agency**: IMD (Ministry of Earth Sciences)	• Issue area-specific warnings/ alerts and weather forecasts • Strengthen infrastructure for forecast/Early Warning	State Governments/ SDMAs/DDMAs/Distrct Admn.	• Disseminate information received from the IMD to the public • Promote installation of lightning arresters and Doppler Radars • Create a network of community-based early warning systems • Establish State-level monitoring and warning dissemination system to supplement warning(s) from the IMD[3].
		<u>Early Warning Dissemination</u> Ministry of Information and Broadcasting (PIB, AIR, Doordarshan)	**In case of forecast / warnings of extreme /severe nature:** • Dissemination of specific information to the public through print/ electronic and social media	State Governments / SDMAs/COR Department of Public Relations	• Dissemination of specific information to the public through print/electronic/social and other mass media at the local level
		Department of Telecommunications	• Push SMS by telecom service operators to all active mobile connections in the identified area	State Governments / SDMAs/COR and concerned dept.	• Ensure push SMS by telecom service operators to all active mobile connections in the affected area.
		Ministry of Power	• Dissemination of specific message to concerned power	State Governments / SDMAs/COR/	• Activate all concerned DISCOM office/officials

[3]States should also establish their own Early Warning System in parallel.

			generation, transmission, distribution and supply offices	Dept. of power & energy	• To ensure cutting off of power supply[4] and its restoration • Ensure emergency power supply to critical facilities
		Ministry of Home Affairs (MHA)	• Send specific message through the control room to all concerned central ministries/departments/State(s) for action	State Governments /SDMAs/COR/DDMAs	• Activate the district administrations along with line departments as soon as a specific warning is received
		Ministry of Agriculture and Farmers' Welfare (MoA&FW)	• Disseminate specific information to its concerned departments and State(s)	State Governments /SDMAs/COR/ Dept. of Agriculture/Other concerned departments	• Follow and quickly implement the instructions of central/State govt.
3	Relief & Response	**Nodal Agency**: Ministry of Home Affairs	• Coordination with concerned agencies and stakeholders with clear roles and responsibilities • Deployment of NDRF as per requirement	**Nodal Agency:** State Governments / SDMAs/ 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
4	Monitoring and Review of the Guidelines	NEC NDMA	• Implementation of the Guidelines • Periodic review/updating	State Government/ COR SDMAs/DDMAs	• Nodal officer(s) to act as the contact person for each dept. / agency • Monitor State/District level Plan • Collect updated data / information and give feedback for reviewing/updating the State Action Plan and National Guidelines

[4]In the event of thunderstorm, power supply may further pose additional threats of electrocution.

Investing in DRR – Non-structural measures					
5	Prevention, Mitigation and Preparedness measures	**Nodal Agency: NDMA** (with other concerned Ministries/Departments)	• Inter-agency coordination • Issue relevant advisories • Give directions to concerned ministries/departments.	**Nodal agency:** State Government/ COR SDMAs / Urban Local Bodies/PRIs (with other concerned Department/Agencies)	• Inter-agency coordination and implementation of Central/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 • Ensure strict adherence to fire safety norms • Ensure essential services and facilities at vulnerable places
		1. Ministry of Commerce	• Construct shelters/ sheds, bus stands as per the BIS code		
		2. Ministry of Rural Development	• Disseminate information to public on structural mitigation measures • Conduct drives to check the structural strength of trees, old structures, etc.		
		3. Ministry of Housing and Urban Development			
		4. Department of Telecommunications	• Set up alternative or emergency communication systems	Dept. of Information and Public Relations	• Establish public information facilities. • Set up alternative or emergency communication systems
		5. Ministry of Power	• Deal with power cuts and ensure emergency power supply, whenever needed • Start a drive to check and maintain/replace old electrical equipment/cables	State Governments /SDMAs/COR/ and concerned Dept. Of Energy & Power Supply	• 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. Ministry of Road Transport and Highways	• Ensure road connectivity and access to vulnerable areas	Public Works Dept. (PWD)	• Ensure quick restoration of road connectivity and access to vulnerable areas

		7. Ministry of Health & Family Welfare	• Create posts for medical staff for emergency situations • Hospital preparedness, including training of human resources	State Governments / SDMAs/COR/ Dept. Of Health	• 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 Cooperation & Farmers Welfare	• Ensure adherence to crop safety norms • Construction of safe crop storage shelters for farmers	State Governments /SDMAs/COR/Departments of Ag. and AH	• Promote crop/animal insurance • Construct thunderstorm safe crop storage shelters for farmers
		9. Ministry of Environment Forests and Climate Change	• Set up awareness programmes	Forest Department	• Ensure adherence to fire safety norms • Protect property/infrastructure and environment from damage by a fire
6	Record of data and Documentation	**Nodal agency:** MHA and all concerned departments	Collect post-disaster data from States and maintain a national-level database.	**Nodal agency:** State Govt. /COR/SDMAs	• Assessment of damage from weather-related incidents • Collect post-disaster data from field and reporting to State/national level
Investing in DRR – Structural measures					
7	Structural Mitigation Measures	**Nodal Agency:** - Ministry of Housing & Urban Development - Ministry of Panchayati Raj - Bureau of Indian Standards and other concerned Ministries/Departments • Ministry of Commerce and Industry • Department of Telecommunications • Ministry of Power • Ministry of Road Transport and	• Inter-agency coordination, and review and update precautionary measures and procedures to be followed • Develop and update relevant Indian standards • Comply with Building Bye Laws while installing conductors /arresters atop buildings • Promote installation of lightning arresters • Start a drive to check the structural strength of hoardings and similar old structures • Start a drive for sample	**Nodal agency:** State Govt. /COR/SDMAs (with other concerned Departments/Agencies) DDMAs/Local Bodies	• Inter-agency coordination, and review and update precautionary measures and procedures to be followed • Ensure Building Bye Laws are complied with and make it mandatory for all G+2 and above buildings to install lightning conductors /arresters • Promote installation of lightning conductors / arresters in schools, industries, Government and private buildings • Undertaken drives to check the structural strength of hoardings and old structures

		Highways • Department of Consumer Affairs	inspection of medical & hospital equipment at places		
Capacity Development					
8	Capacity Building and Training	**Nodal agency:** NIDM (with respective training institutes of all central Ministries / departments)	Training programmes for all concerned functionaries/stakeholders	**Nodal agency:** State Govt. /COR/SDMA**s** (with respective state training /DM institutes)	• Conduct training programme for all concerned officials/ volunteers • Conduct training programmes and drills on usage of various fire protection equipment and preventive systems
7	Mass awareness campaigns and IEC activities	**Nodal agency:** NDMA and concerned Ministries/ Departments, including Ministry of Information and Broadcasting	• Extensive IEC campaigns to generate awareness through print, electronic and social media • Push SMS by various telecom service operators to all active mobile connections	**Nodal agency:** State Govt. /COR/SDMAs and Department of Information and Public Relations	• 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

7. Record and documentation

To enable policy decisions and take necessary mitigation measures, detailed, uniform and validated data on these incidents are required.

Weaker sections of society such as small and marginal farmers, vendors, street hawkers, construction workers and field workers are the most vulnerable to the adverse impacts of these incidents.

A database of incidences of lightning strikes, resultant damages, identified and mapped vulnerable areas that experience frequent lightning strikes, the level of preparedness of the local administration and the general public in the vulnerable areas needs to be developed and shared with all stakeholders. This database will help in understanding the frequency and severity of these incidents, and prioritize and develop customized action plans.

Formats for reporting and compiling data at the district, State and national levels is given at Annexure 2A to 2C. DDMAs will collect district-level data and report the same to their respective SDMAs, which, in turn, will collate and share the same with the Centre (Ministry of Home Affairs/National Disaster Management Authority). MHA/NDMA will maintain the national-level Disaster Database.

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.

Note: States may customize the contents of the Guidelines for their own use depending on their local experiences and best practices. Further action needs to be undertaken by respective State Governments.

Annexure 2

Format A: For reporting Thunderstorm, Lightning, Squall Dust/Hailstorm and Strong Winds (District Report to State Government)

Name of the District: …….. Period of Reporting: ……..

S. N.	Name and address of affected persons (In case of Govt. office – organisation name/ department and place)	Age / Sex (M, F, TG)	Occupation (Farmer, Labourer, Seller, Student, etc.)	Category (BPL/ APL)	Date and time of Incident	Type(s) of Incident(s) (Thunderstorm, Lightning, Squall, Dust/Hailstorm and Strong winds)	Place of Incident (Indoor/ Outdoor / Rooftop /Field)	Injured (Severe / Minor)	Deaths	House damaged/ destroyed (Kutcha/ Pucca)	Crop loss (in Hect.)	Livelihood losses			Loss to Govt. Infrastructure / Assets	Total estimated cost of losses
												Livestock affected/ deaths	Kiosk / Shop	Others (Ag. Equip/ machinery, etc.)		
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
	Total															

Other relevant information (if any):…….

Name: …….…….. Designation: …….…….. Signature with Date:…….……

Submitted to:

----------*----------

Format B:For reporting Thunderstorm, Lightning, Squall Dust/Hailstorm and Strong Winds

(To be compiled at the State level and sent to the central Government)

Please **Tick** mark the Type(s) of Incident(s) (Thunderstorm, Lightning, Squall Dust/Hailstorm and Strong Wind)

Note: Please fill a separate sheet for each incident/disaster

State: …… Period of Incident(s): …… Date of Compilation: ……

S. N.	Name of the district	Total Affected population					Injured			Total Human loss										Livelihood Losses				Private houses damaged/ destroyed(Kutcha/ Pucca)	Loss to Govt. Infra structure / Assets/ property	Total estimated cost of losses
		Occupations groups								Sex				Category			Place of Deaths			Total livestock Loss (In Nos.)	Total Crop Loss (In Hect.)	Kiosk /Shop	Others			
		Farmers	Labourers	Hawkers	Others	**Total**	Severe	Minor	**Total**	Male	Female	TG	**Total**	BPL	APL	**Total**	Outdoor	Indoor	**Total**							
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**
	Total																									

Other relevant information (if any):……

Name: ……..……. Designation: ……..……. Signature with Date:……..……

Submitted to:

----------*----------

Format C:For reporting Thunderstorm, Lightning, Squall Dust/Hailstorm and Strong Winds

(To be **compiled** by the Central Government)

S. N.	Name of the State	No. of affected Districts	Total Affected population					Injured			Total Human loss										Livelihood Losses				House losses (Kutcha/ Pakka)	Loss to Govt. Infra structure / Assets/ property	Total estimated cost of losses
			Occupations groups								Sex				Category			Place of Deaths			Total Animal Loss (in Nos.)	Total Crop Loss (In Hect.)	Kiosk /Shop	Others			
			Farmers	Labourers	Hawkers	Others	**Total**	Severe	Minor	**Total**	Male	Female	TG	**Total**	BPL	APL	**Total**	Outdoor	Indoor	**Total**							
1	**2**		**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**
	Total																										

Name: …….....……. Designation: …….....……. Signature with Date:…….....……

Submitted to:

----------*----------

Annexure 3

State Experiences

Odisha

The State Government has enhanced the *ex-gratia* to the next of kin of the deceased in the case of a death due to lightning from Rs.10,000/- to Rs.50,000/- w.e.f. 01.06.2007 from its own funds.

Uttar Pradesh

The State has prepared an action plan for these incidents under the Uttar Pradesh Disaster Management Act, 2005. Besides various prevention and mitigation measures, sensitisation of all stakeholders and awareness generation among masses, it provides for ex-gratia relief to the victims in the event of a death and/or damage to crops and houses.

Andhra Pradesh

Andhra Pradesh is vulnerable to lightning and a large number of incidents are reported every year. In 2016, its SDMA signed a Memorandum of Understanding (MoU) with Earth Networks and established a Lightning Monitoring Mechanism in the SEOC.

As per the MoU, Earth Networks has installed 12 sensors across the State along with visualization tools. With the help of these sensors and tools, the SEOC actively monitors lightning incidents in the State. At the same time, IMD Doppler Weather Radar services for Visakhapatnam, Machilipatnam and Chennai regions are also used for detection of lightning and thunderstorms.

As soon as any lightning activity is observed by the SEOC, alert/information/warning is disseminated to Mandal Revenue Officers (MROs), District Revenue Officers (DROs), Revenue Divisional Officers (RDOs) and District Collectors. This is done through various modes of communication such as SMSes, WhatsApp messages, phone calls, BSNL near real-time location-based alerts, TV scrolls and FM Radio.

The mechanism for disseminating these alerts is as follows:

Social Media

- The alert messages are shared through WhatsApp on a group comprising MROs, stakeholder departments, RDOs and District Collectors.
- The alert text message meant for TV/radio/FM radio is sent on a WhatsApp group named "ALERT (Media)" created by the SEOC for the media.

Phone Calls

- The SEOC also makes phone calls to the MROs of the concerned *mandals*. In case an MRO does not respond to the phone call, the alert is escalated to the DRO.

In case of a severe lightning incident

- In case of severe lightning strikes in a district, the alert is escalated to the RDO, Joint Collector and Collector through phone calls.
- The SEOC also makes use of TV scrolls and FM Radio for alerting the masses.
- A caution message is issued to the affected *mandal* beforehand on the basis of information provided by Earth Networks' Detection System.

BSNL near real-time location-based alert system (Bulk Messaging for BSNL Subscribers)

- As soon as an imminent lightning is detected over a place, an alert message is sent to all the BSNL subscribers living in and around the area of the lightning activity, which is decided depending upon the severity of the incident as well as the terrain and population of the area where the lightning activity is about to happen.

Ground Truth of Lightning

- Observed lightning strikes are cross-checked with the district officials so that injuries, deaths, etc. can be accurately reported.

Awareness Programmes

- Awareness videos and posters are circulated to the all village, *mandal* and district level officials as well as other stakeholders for conducting awareness programmes during *gram sabha, anganwadi* and panchayat-level meetings. Similarly, awareness programmes are also run in all schools and colleges.
- These videos are also played at cinemas and on local TV channels.

Karnataka

Karnataka State Natural Disaster Monitoring Centre (KSNDMC), the first institutional mechanism in the country established for disaster monitoring in 1988, has adopted a proactive approach towards monitoring natural hazards. It provides early warning, forecast, alerts and advisories to various response agencies.

Real-time monitoring, data analysis, vulnerability mapping, risk assessment and planning, and executing long-term mitigation measures is the way forward to effectively tackle and minimize the losses caused by thunderstorms/lightning.

Weather Monitoring: KSNDMC has installed a network of solar-powered and GPRS-enabled Weather Monitoring Stations comprising 6,000 Telemetric Rain Gauges (TRG) every 25 Sq. Km. and 900 Telemetric Weather Stations (TWS)every 250 Sq. Km. The data on rainfall, temperature, relative humidity, wind speed and direction, solar radiation and sunshine hours are collected every 15 minutes. There is no manual intervention in measuring, recording, transmitting, analysing and disseminating this data.

Lightning Early Warning System (LEWS): It has recently been operationalized in Karnataka. An LEWS requires a broad multidisciplinary knowledge base, building on the existing discipline-based research in the geophysical, environmental and social science fields. There is a need for a more systemic, crosscutting and applied system which should include the following :-

1. Use of geospatial data models, risk maps and scenarios with respect to lightning strike incidents in a given region or a State.
2. Cost-effective real-time observation / monitoring systems.
3. Real-time data generation and assimilation.
4. Improvement of lightning prediction tools with the highest possible spatial and temporal resolutions.
5. Early Warning Dissemination System with location-specific advisories.
6. Periodical evaluation of the Early Warning System to minimize false alarms.

7. Creating awareness with visualization of impacts and response options for community preparedness.
8. Economic assessments of the warning system's effectiveness.

Dissemination of information plays an important role in Disaster Risk Reduction. KSNDMC disseminates all disaster-related information through various methods such as issuing alerts, advisories and early warnings to all the stakeholders in real time.

Appendix A

Members of the Expert Group

1.	Shri R. K. Jain, former Member, NDMA	Chairperson
2.	Shri Kamal Kishore, Member, NDMA	Co- Chairperson
3.	Dr. V. Thiruppugazh, Joint Secretary, NDMA	Convener
4.	Dr. M. Mohapatra, Scientist G, IMD	
5.	Dr. S. C. Bhan, Scientist F, IMD	
6.	Dr. Sunil D. Pawar, Scientist E, IITM	
7.	Prof. Ravi Sinha, Dept. of Civil Engineering, IIT Bombay	
8.	Prof. Kapil Gupta, Dept. of Civil Engineering, IIT Bombay	
9.	Dr. G. S. Srinivasa Reddy, Director, KSNDMC, Karnataka	
10.	Shri Kishan Sanku, In-charge-TS&L, SEOC, Govt. Of Andhra Pradesh	
11.	Shri M. Ramachandrudu, Addl. Secretary, Dept. Of DM, Govt. Of Bihar	
12.	Shri Ashok Kumar, IFS, Spl. Secretary, (Home, Prison and Disaster Management), Govt. Of Jharkhand	

Coordination and Technical Support

13.	Shri Abhishek Shandilya, Sr. Consultant (IEC Cell), NDMA	
14.	Shri Anup Kumar Srivastava, Consultant (D&FS), NDMA	
15.	Ms. Anshupriya Jha, Consultant (IEC Cell), NDMA	

List of Subgroups of the Expert Group

S.N.	Name of the Subgroup	Members
1.	Early warning and Communication	1. Dr. M. Mohapatra and Ms. Soma Sen Roy,IMD 2. Shri Ashok Kumar, IFS, Spl. Sec., Jharkhand 3. Shri Kishan Shanku, SEOC, APSDMA 4. Dr. G. Srinivasa Reddy, Dir., KSNDMC 5. Dr. Sunil D. Pawar, IITM
2.	Information, Education and Communication	1. Shri Anurag Rana, JA(IT) 2. Shri Abhishek Shandilya, Sr. Cons., NDMA 3. Shri Anup Kumar Srivastava, Cons., NDMA
3.	Structural Mitigation Measures	1. Prof. Ravi Sinha, IIT Bombay 2. Prof. Kapil Gupta, IIT Bombay 3. Representative of Rajasthan 4. Representative of Uttar Pradesh
4.	Defining Roles and Responsibilities Matrix	1. Shri M. Ramachandrudu, Addl.Sec, DM Div., Bihar 2. Sh. Kishan Shanku, SEOC, APSDMA 3. Shri Anup Kumar Srivastava, Cons., NDMA
5.	Record of Data and Documentation	1. Dr. S. C. Bhan, IMD 2. Shri Anup Kumar Srivastava, Cons., NDMA
6.	Capacity Building and Training	1. Lt. Col. Rahul Devrani, JA (RR) and 2. RR Division, NDMA

Process followed for the preparation of Guidelines:

1. Draft chapters for the guidelines prepared by the subgroups and submitted to the expert group.

2. Based on the draft as well as available historical data, the expert group suggested inputs.

3. The inputs given by the expert group were incorporated in the draft guidelines.

4. The revised draft was circulated to the members of the expert group, external/field experts, concerned Ministries and selected States for their comments.

5.Comments thus received were incorporated and the draft was uploaded on the NDMA website seeking comments/views from the public. The same were again incorporated and circulated to the members of the expert group as well as uploaded on the NDMA website.

6. Three meetings of the expert group were held to arrive at the final draft of the Guidelines.

Appendix B

Contact Us

For more information , please contact:

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