



THUNDERSTORM AND LIGHTNING

TACKLING WEATHER HAZARDS



REFORMS THAT TRANSFORMED



NATIONAL DISASTER MANAGEMENT AUTHORITY
MINISTRY OF HOME AFFAIRS, GOVERNMENT OF INDIA

TACKLING WEATHER HAZARDS

Introduction

India, with approximately 1.35 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. Thunderstorms, associated with lightning strikes, have emerged as one of the major weather hazards of recent years in many parts of the country. The severity and frequency of thunderstorms/dust storms are expected to rise in the years ahead due to rising global temperatures.

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



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.



- Shri Narendra Modi, Prime Minister
Release of Guidelines (28 Feb 2019)



Issue and challenges

No strategy in place to mitigate loss from thunderstorms and lightning strikes

Every year, on average, nearly 2,500 people lose their lives to lightning strikes in the country (Source: Annual Report, NCRB). From 1967 to 2012, lightning strikes accounted for about 39 per cent of the deaths that resulted from natural disasters in India. In the years 2013, 2014 and 2015, loss of lives due to lightning in India amounted to 2,833, 2582 and 2,641, respectively. 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. Despite the fact that lightning strikes are a major killer, concrete efforts were not made to address this hazard, and there were no national guidelines for mitigating the impact of thunderstorms and lightning strikes. The year-wise loss of life in India on account of thunderstorms and lightning strikes is presented in the Table 1:

Table 1: Deaths from thunderstorms and lightning-strikes in India

Years	Number of Deaths	Years	Number of Deaths
2001	1507	2011	2550
2002	1383	2012	2263
2003	1792	2013	2833
2004	1842	2014	2582
2005	2064	2015	2641
2006	2387	2016	1489
2007	2790	2017	2057
2008	2553	2018	2028
2009	2113	2019*	1771
2010	2622	2020*	946

Source: NDMA Guidelines for Action Plan on Thunderstorm & Lightning/Squall and Strong Winds

* Note: Death counts only from the south-west monsoon period

Though loss of life due to thunderstorm and lightning have been very high, these hazards have received less attention than other disasters. The situation could have been different if India had a strategic action plan for mitigation of the danger of thunderstorms and lightning to life and property.

Weaker sections and rural areas most affected

Thunderstorms and lightning strikes mainly affect the weaker sections of the population – small and marginal farmers, vendors, street hawkers, construction workers, fishermen, field officials/employees. It is mostly the weaker sections of the population that are at greatest danger from this hazard. As these people work in the open, they are the most affected. Most of the deaths also occur in rural areas, among those who engage in farming and related activities, such as grazing cattle. Children are also more vulnerable, as they assist their parents in outdoor activities and tend to play outdoors.

It has been observed that the majority of deaths caused by thunderstorms and lightning strikes occurred amongst males, they



“ We express our sincere thanks to the Government of India for preparing the 'Guidelines for Preparation of Action Plan- Prevention and Management of Thunderstorms & Lightning/ Squall/ Dust/ Hailstorm and Strong Winds'. The Guidelines help disaster managers at the state level to take preventive and mitigation measures through preparation of an Action Plan. Further, the state is extensively using the TVCs and Pocketbook on Do's and Don'ts prepared by the NDMA. Our state has also customized the Pocket Book on Do's and Don'ts taking into consideration local experiences and best practices.”

- Shri Pradeep Kumar Jena (IAS),
Additional Chief Secretary and
Managing Director, OSDMA



being more likely to be working outdoors than females. Rural areas are more prone to such disasters in comparison to urban areas, considering that more people there work in the open. Loss of life and injuries due to thunderstorm and lightning strikes affect the economic conditions of the affected persons and their families. Thunderstorms and lightning strikes are potentially hazardous for the aviation sector, and for the transport, power, communication and other socio-economic sectors too.

Damage to infrastructure, loss of revenue, livelihoods

Thunderstorm and lightning strikes result in loss of life and injuries, loss of livestock, livelihoods, and damage to infrastructure, thereby affecting the output of people and impacting revenue-generation.

Destructiveness of thunderstorms and lightning strikes underestimated

Though loss of lives and injuries due to thunderstorms and lightning strikes in India have been high, these disasters received very little attention, as compared with other disasters. However, they cause as much damage as the other disasters do. There were no guidelines or action plan to deal with thunderstorms and lightning strikes, whether at the national or state levels, for prevention, preparedness and mitigation measures. It therefore became a challenge for disaster managers to take preventive and mitigation measures through preparation of an action plan to deal with this particular kind of disaster.

It was in 2018, when severe thunderstorms and lightning hit several parts of India that their destructiveness was highlighted – a large number of human casualties and severe economic losses resulted. In north-west India, during May 2018, thunderstorms resulting in the death of at least 124 people and injury to 300 others across five states (Rajasthan, Uttar Pradesh, Telangana, Uttarakhand, and Punjab) became a major concern.

Twenty-two states and union territories are prone to thunderstorms and lightning strikes. Out of these, the eastern and north-eastern parts of India – i.e., Gangetic West Bengal, Jharkhand, Bihar, Odisha and the north-eastern states – are affected by severe thunderstorms during the pre-monsoon months of March to May.



“ We are grateful to the Government of India for the Guidelines on thunderstorms and lightning. They are really useful to states in the preparation of their own Action Plan. We are also using the TVCs and the Pocketbook issued by the NDMA on Do's and Don'ts. To ensure last-mile reach of information, the state is using real-time, automated, customised SMS-based systems to disseminate thunderstorm and lightning warnings issued by IMD.”

- Shri Manish Tiwari,
Joint Secretary, Government of Jharkhand



Work done by the Government

Vision

The Sendai Framework on Disaster Risk Reduction (2015-2030) sets out the overall objective of substantially reducing disaster risk and loss of lives, livelihoods and health, and reducing damage or loss to the economic, physical, social, cultural and environmental assets of persons, businesses and communities. As per the objective of the Sendai Framework, the vision of the Government of India is to safeguard developmental gains to reduce the impact of extreme weather incidents by improving our understanding of the hazards and the factors that influence vulnerability to them. Accordingly, NDMA went by the four priorities of action in the Sendai Framework, namely (i) Understanding disaster risk, (ii) Strengthening disaster risk governance to manage disaster risk, (iii) Investing in disaster risk reduction for resilience and (iv) Enhancing disaster preparedness for effective response and to 'build back better' in recovery, rehabilitation and reconstruction. Accordingly, NDMA initiated action for preparation of the necessary guidelines.

Commitment

Hon'ble Prime Minister and Chairman of the National Disaster Management Authority, Shri Narendra Modi, during the inauguration of the Asian Ministerial Conference on Disaster Risk Reduction (AMCDRR) in New Delhi in 2016, highlighted the importance of political commitment on the part of governments towards preventing and reducing risk as well as strengthening resilience by accelerating implementation of disaster management measures.

Approach towards mitigation of thunderstorm and lightning-strike impacts

As per the directions and guidance of the Hon'ble Prime Minister, several steps were undertaken for risk reduction. The hitherto neglected area of thunderstorms and lightning strikes became one of the focus areas for arresting the number of disaster-related deaths in the country.

National plan for thunderstorm and lightning

NDMA initiated action to reduce the adverse impacts of thunderstorms and lightning strikes, squalls, hail/dust-storms and strong winds. It plans to develop an institutional mechanism for mitigation measures for these disasters, roping in the responsible government departments for preparing an Action Plan to deal with these disasters. NDMA drew up the national 'Guidelines for Preparation of Action Plan – Prevention and Management of Thunderstorm & Lightning/Squall Dust/Hailstorm and Strong Winds' for improving the capacity of the states to deal with these incidents in a scientific and planned manner. NDMA also followed the forecast of the India Meteorological Department (IMD) on the western disturbance and climate change leading to increasingly high temperatures, and their effects of thunderstorm and lightning/squall; this forecast covered most of the states. The increase in occurrence and severity of these events is a wake-up call for all the concerned agencies to take appropriate action for prevention, preparedness and mitigation to save lives, livestock, property and infrastructure.



Fig 1: Guidelines for Preparation of Action Plan – Prevention and Management of Thunderstorm & Lightning/Squall Dust/Hailstorm and Strong Winds

For preparing the National Guidelines, NDMA followed a nine-step process involving all the relevant stakeholders through a series of interactive, reciprocal and supplementary actions. The Guidelines contained measures and strategies for assessment, forecast, preparedness, and mitigation through coordinated efforts with multiple agencies, and also strategies for reconstruction to build disaster-resilient infrastructure.

The objective of the National Guidelines was '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 minimise losses to lives and property'. This would improve the capacity of the states and other stakeholders in preparing their own Action Plans with reference to the measures for the assessment, forecast, preparedness and mitigation of the impact of the thunderstorms and other disasters, as prescribed by the Guidelines.

While preparing the guidelines, NDMA constituted expert groups/sub-groups, including representatives of various ministries/departments and state governments, along with other stakeholders. Upon finalisation, the guidelines were released by NDMA in 2019. The entire process of flagging the issue and releasing the Guidelines was completed in just nine months. The Guidelines were circulated to all the States/UTs and uploaded on the NDMA website for the public.



NDMA has initiated preparation of the 'Guidelines and Action Plan for Prevention and Management of Thunderstorms & Lightning/Squall/ Dust/ Hailstorm and Strong Winds'. Such an initiative is very helpful for mapping the vulnerability of states/districts prone to thunderstorms and lightning. As per the recommendations of the Guidelines, IMD is issuing thunderstorm and lightning warnings to states for taking the necessary measures.

- Dr. Mrutyunjay Mohapatra,

DGM, India Meteorological Department



Roles and responsibilities assigned by the Guidelines

The National Guidelines on thunderstorm and lightning identified the issues pertaining to such disasters and defined the roles and responsibilities of the Central government and the states/UTs in matrix format. This matrix consists of segments corresponding to the thematic areas of understanding risk, inter-agency coordination, investing in DRR – non-structural measures and structural measures – and capacity development.

Implementation of the Guidelines and strategies at the ground level

NDMA reconstituted the Expert Group on Thunderstorm & Lightning to examine the implementation of its Guidelines and Action Plan and sought their feedback from time to time. NDMA also constituted three working groups under this Expert Group, consisting of ministries/ departments and states for drawing up specifications for lightning sensors and arrestors, and for a risk assessment framework and modifications in the IEC materials. The Expert Group constituted by the NDMA would update/revise the guidelines based on the feedback received.

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

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

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

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

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

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

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

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

NDMA organized meetings with IMD and discussed issues pertaining to early warning for thunderstorms and lightning, the dissemination of these warnings, and the way forward for better forecasting. NDMA regularly reviewed the preparedness and mitigation measures on thunderstorms and lightning with the ministries/departments as well as with the most vulnerable States/UTs.

NDMA coordinated with the State governments and UT administrations to press upon them the importance of conducting mock drills to create awareness among the public, for which NDMA formulated a scheme of Rs. 1lakh for each district.

The mitigation funds available at the national and state level – such as the National Disaster Mitigation Fund (NDMF) and the State Disaster Mitigation Fund (SDMF) – are available for utilisation for mitigation measures, such as bus shelters equipped with lightning arrestors.

Community sensitisation

To reduce mortality from thunderstorm and related disasters, NDMA has taken timely action and prepared IEC materials (audio-visuals, print materials, do's and don'ts) in English and in Hindi and sent them to the States for further dissemination to the public. The States were requested to translate these materials into vernacular languages if necessary. Apart from these measures, an extensive social media campaign on lightning safety is being undertaken. All types of creatives





– on consolidated do's and don'ts, individual social media cards and videos – are being continually posted on Twitter and Facebook. A special panel discussion on television, 'Aapda ka Saamna' was also broadcast.

Review meetings

NDMA conducted regular meetings with most of vulnerable states prone to thunderstorms and lightning strikes and reviewed their preparedness and the mitigation measures, such as the actions they had taken for early warning and dissemination of the same, community-based warning systems and disaster management, creation or arrangement of shelters, IEC actions for behavioural change and long-term mitigation measures.



Fig 2 : Review meeting on thunderstorm and lightning preparations held on 3 July 2020 with States



Technical assistance

During its review meeting with states, NDMA discusses preparation of their Action Plan on Thunderstorms and Lightning and the mechanisms to prevent and manage the impact of these disasters. The Expert Committee reconstituted by the NDMA provides technical assistance to the states and to NDMA itself, as per need, on the issues related to thunderstorms and lightning.

Thunderstorm and lightning warnings

There is no doubt that area-specific warning is required to contain casualties in any disaster. In view of the devastation caused by the severe thunderstorms during the pre-monsoon months of March–May over different parts of India, and particularly the northern and north-western regions, the Ministry of Earth Sciences (MoES) convened a brainstorming meeting on 1 June 2018. Subsequently, the MoES formed a Working Group and developed tools for predicting thunderstorms and lightning probability, heavy rain, gusty winds, etc. with a 24-hour lead time, and for issuing outlooks with a 48-hour lead time.

Under this new initiative, IMD, Indian Institute of Tropical Meteorology (IITM) and National Centre for Medium Range Weather Forecasting (NCMRWF) developed a holistic tool for nowcasts (up to 1 hour), for 24-hour forecasts from a high-resolution model and for 48-hour outlooks from high-resolution global model thunderstorm-specific products. For improving the nowcast of thunderstorm location and associated lightning, high-resolution satellite observations, lightning-sensor observations (from IITM and Indian Air Force) and RADAR observations have been merged to develop a user-friendly high spatio-temporal-frequency-based operational product.

Using the technologies mentioned above, IMD issues thunderstorm nowcasts for around 450 stations and 24-hour-ahead thunderstorm forecast guidance for the country as a whole. To communicate these predictions and warnings to the public/society and stakeholders, a



I would like to express my thanks to the National Disaster Management Authority and other members of the expert group for deliberating on and preparing the 'Guidelines for Preparation of Action Plan– Prevention and Management of Thunderstorm & Lightning/Squall/ Dust/ Hailstorm and Strong Winds'. Deliberations were carried out at NDMA with members of the expert committee and other stakeholders on issues relating to thunderstorms and lightning. The Guidelines have been formulated after reviewing all available relevant information. It is expected that the Guidelines prepared by the NDMA will be very helpful to states/UTs in managing and reducing casualties due to thunderstorms/lightning/squall/ dust/hailstorms and strong winds. ”

- Prof. Kapil Gupta,

IIT Bombay (Member, Expert Committee on thunderstorm and lightning constituted by NDMA)

dedicated website has been created. Apart from this, nowcast bulletins by IMD are also made available through mobile, radio, SMS and WhatsApp. IMD also sends emails to the concerned authorities at the state level. In addition to all this, the Regional Meteorological Centre alerts the respective SDMAs at the state level and also issues press releases as and when required.

IITM has installed sensors across the country for lightning forecast; the institute developed the DAMINI App in the year 2018 to disseminate lightning warnings. States are widely using lightning warnings provided through the DAMINI App, and there are plans to integrate information from the DAMINI App with location-based alert systems. Some states are also disseminating thunderstorm and lightning warnings through the COVID Savadhan App developed by the Department of Telecommunications.



Impact

Preparation of Action Plans by States/ Uts

To reduce the adverse effects of thunderstorms and lightning, it is necessary for states to prepare their own Action Plans for these disasters. In view of this, NDMA developed an institutional mechanism for undertaking prevention, mitigation and preparedness measures for these disasters with active participation from all stakeholders. Steps to help states develop their Action Plans have been identified and mentioned in the National Guidelines. Based on the Guidelines released in 2019, some states have prepared their Action Plan, and others are in the process of preparing it.

Measures taken as part of Thunderstorm & Lightning Action Plan

Going by the National Guidelines, States and UTs have taken the necessary preparedness and mitigation measures to prevent loss of life. States are extensively using the Television Commercials (TVCs) and the Pocketbook on Do's and Don'ts prepared by NDMA; some states have done voice covers on the TVCs in regional languages. Some states have customized the Pocket Book on Do's and Don'ts, taking into account their local experiences and best practices, and have translated it into their regional language.

States are currently disseminating information through the DAMINI App developed by IITM. Some states have also signed MoUs with Earth Networks for lightning forecast and warning. To disseminate the warnings at the village level in real time, the states have also integrated a location-based alert system with their warning system, for which they have signed MoUs with BSNL, private networks and cable networks. Some states have developed their own apps, like VARUNA MITRA, SIDILU, SATARK and INDRAVAJRA, to disseminate thunderstorm and lightning warnings directly to all District Magistrates and district-level and block-level officers. Further, the local administration is alerting the people using public address systems in selected districts where severe warnings have to be made.

This wide communication of warnings helps the entire community, including the marginalized sections of the society, i.e., women, children, the poor, farmers, labourers, etc. How helpful such dissemination of warnings is may be gauged from Table 1, which carries statistics on thunderstorm and lightning-strike deaths in India.

Inter-agency coordination

For strengthening governance, inter-agency coordination is happening between the concerned ministries/departments of the Central and state governments, the India Meteorological Department, the Indian Institute of Tropical Meteorology, and other academic and research institutes and NGOs.

Process for data collection

The Guidelines contain three formats for reporting on thunderstorms and lightning. As requested, the states prepare/revise their Action Plans as per the prescribed format of the Guidelines to ready their strategy for tackling the hazard of lightning strikes. The data on deaths is compiled after the loss figures are reported by the respective state governments.

Decline in thunderstorm and lightning deaths recorded in thunderstorm and lightning-prone states

The National Guidelines were released in February 2019, specifying various actions to be undertaken by the different stakeholders. Due to regular monitoring and efficient implementation of the Guidelines, the number of deaths on account of thunderstorms and lightning strikes almost halved in the very next year. There were only 946 deaths in 2020 from these disasters during the months of the south-west monsoon, as opposed to the corresponding figure of 1,771 in 2019 (Table 1 on page 2).





“India's motto is
'Reform, Perform, Transform'.”

Prime Minister **Shri Narendra Modi**