6. Annual Lightning Report 2024-25 - Reports

According to the Annual Lightning Report 2024-25, Lightning is responsible for more deaths in India than any other natural disaster.

Annual Lightning Report 2024-25- Publication- The Report is compiled by the Climate Resilient Observing Systems Promotion Council (CROPC) and India Meteorological Department (IMD)

Lightning- Concept and Characteristics

Lightning is a rapid electrostatic discharge occurring

1. Within clouds (intra-cloud),
2. Between clouds (inter-cloud), or
3. Between cloud and ground (cloud-to-ground).

It is typically associated

1. Thunderstorms
2. Intense rainfall
3. Strong winds
4. Occasionally hailstorms

Lightning is a sudden-onset, highly localised hazard, making prediction and mitigation more difficult than slow-onset disasters such as droughts or heatwaves. It is among the deadliest weather-related hazards in India, particularly for outdoor workers such as farmers, construction labourers, shepherds, and fishermen.

Annual Lightning Report 2024–25- Key Highlights

Rising Incidence- The report indicates a nearly 400% increase in lightning strikes between 2019 and 2025. This sharp rise reflects both

1. Increased thunderstorm activity linked to climate variability.
2. Improved detection and reporting through satellite and ground-based sensors.

Shifting Geography and Emerging Hotspots

New lightning hotspots are emerging in

1. Northern India
2. Western India
3. Arid and semi-arid regions, including Rajasthan, Gujarat, and Delhi

Traditionally lightning-prone regions such as Madhya Pradesh, Bihar, Himachal Pradesh continue to record the highest fatalities. Rajasthan and Gujarat, previously considered relatively low-risk, are witnessing a notable increase in lightning frequency, signalling a geographical shift in hazard patterns.

Fatalities and Human Impact

From 2014 to 2025, over 3,500 lightning-related deaths were reported in Madhya Pradesh and Bihar alone. Lightning deaths often exceed fatalities from floods and cyclones in certain years, yet receive comparatively less policy attention. Victims are predominantly

1. Rural residents
2. People working outdoors
3. Individuals lacking access to real-time warnings or safe shelters

District-Level Vulnerability

A District-Level Vulnerability Analysis identified 207 districts as highly vulnerable to lightning strikes. High vulnerability is linked to

1. Frequent thunderstorm occurrence
2. High population exposure
3. Occupational patterns involving outdoor activity
4. Limited access to early warning systems

Detection Gaps in Rural and Hilly Areas- Lightning detection and monitoring capabilities remain weak in rural, hilly, and mountainous regions. Factors contributing to this gap include

1. Sparse sensor networks
2. Poor mobile and internet connectivity
3. Difficult terrain limiting infrastructure deployment

This significantly reduces the effectiveness of early warnings and last-mile communication.

Role of Climate Change and Geography

Climate Change Linkages- Global warming increases atmospheric instability by

1. Raising surface temperatures
2. Increasing vertical convection

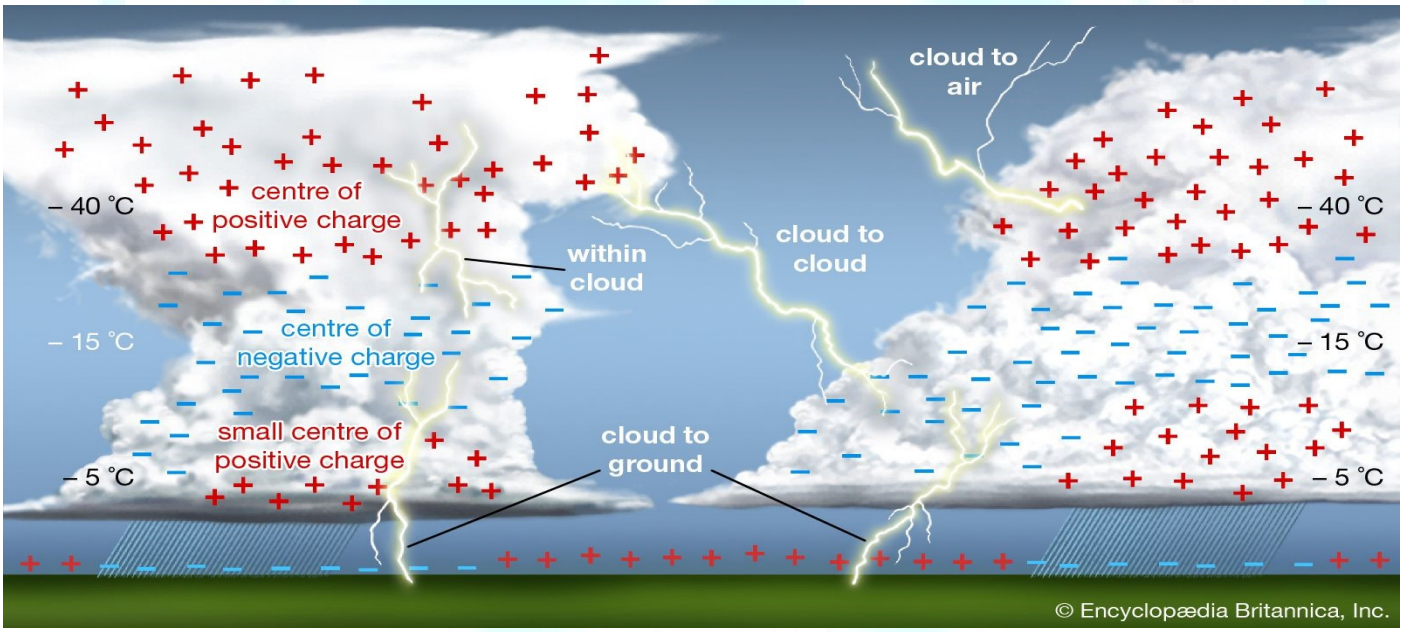
Warmer air holds more moisture, leading to

1. More intense thunderstorms
2. Higher frequency of cloudbursts and extreme rainfall

These conditions enhance charge separation within clouds, increasing the probability and intensity of lightning strikes.

Geographical Influences- Certain geological formations are more prone to lightning due to higher atmospheric electrical activity

1. Rocky terrains and elevated plateaus
2. Western Ghats
3. Uttarakhand's limestone hills



Orographic lifting in mountainous regions further enhances thunderstorm formation, increasing lightning risk.

Atmospheric Electricity- Scientific Context

Atmospheric electricity refers to electrical phenomena occurring in the Earth's atmosphere.
It includes

1. Electrical charges in clouds
2. Lightning discharges
3. The electrical potential difference between the Earth's surface and the ionosphere

Thunderstorms act as natural generators of atmospheric electricity, maintaining the global electric circuit. Understanding atmospheric electricity is essential for improving Lightning prediction models Aviation safety Climate modelling

Mitigation and Early Warning Systems in India

Institutional Framework- The India Meteorological Department (IMD) is the nodal agency for weather forecasting and lightning warnings. The National Disaster Management Authority (NDMA) coordinates national-level lightning risk management. The Indian Space Research Organisation, through the National Remote Sensing Centre (NRSC), provides satellite-based lightning detection services.

Early Warning Applications- IMD and NDMA have launched several digital platforms for public alerts-

1. Mausam – Weather forecasts and warnings
2. Damini – Dedicated lightning alert application
3. Sachet – Integrated disaster alert dissemination system

These platforms provide

1. Location-specific warnings
2. Short lead times enabling preventive action, such as seeking shelter

Technological Improvements- Enhanced lightning forecasting now uses

1. Multi-model ensemble approaches
2. Integration of satellite, radar, and ground-based data

This improves

1. Forecast accuracy
2. Lead time for evacuation and precautionary measures

Guidelines and Protocols

NDMA issued Lightning Safety Guidelines in 2019, focusing on

1. Public awareness
2. Safe behaviour during thunderstorms
3. Structural and non-structural mitigation measures

Adoption of the Common Alert Protocol (CAP) ensures

1. Uniform alert formats
2. Seamless dissemination across states and platforms
3. Reduction in confusion during emergencies

Challenges in Lightning Risk Reduction- Low public awareness, especially in rural areas Behavioural risks, such as taking shelter under trees or continuing fieldwork during storms Inadequate lightning-safe infrastructure (shelters, grounding systems) Limited integration of lightning risk into local disaster management plans

Way Forward

Expand lightning sensor networks in vulnerable and remote regions. Integrate lightning risk education into

1. School curricula
2. Agricultural extension programmes

Promote lightning-safe shelters in fields, highways, and open work sites Strengthen last-mile communication using

1. Local language alerts
2. Community radio and panchayat-level dissemination

Mainstream lightning as a priority disaster risk under State and District Disaster Management Plans

Source- https-//www.downtoearth.org.in/natural-disasters/lightning-remains-an-understated-disaster-in-india-as-experts-call-for-deeper-understanding-of-atmospheric-electricity