

PARLIAMENT QUESTION: EARLY WARNING SYSTEMS FOR NATURAL DISASTERS

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The Ministry of Earth Sciences (MoES) has developed advanced early warning systems for severe weather events such as cyclones, heavy rainfall, and other extreme conditions. Early warning for severe weather events is supported by a state-of-the-art observation network that includes surface, upper air, remote sensing observations, seamless forecasting systems based on high-resolution dynamical models, and GIS-based tools for generating alerts and warnings. The entire system is integrated with modern telecommunication technologies to ensure the timely and effective dissemination of information.

Recently, the India Meteorological Department (IMD), in coordination with other centres in the MoES, has developed an end-to-end GIS-based Decision Support System (DSS), which has been working as the front end of the early warning systems for the timely detection and monitoring of all-weather hazards across the country, including the States regularly affected by cyclones and other natural disasters. It is supported with specific severe weather modules to provide timely impact-based early warnings for extreme weather events like cyclones, heavy rainfall, etc., which devastate human lives, livelihoods, and infrastructure. The system utilizes historical data, including extreme events, as well as real-time surface and upper-air meteorological observations available for the Indian region and its neighbouring areas. It also includes RADAR observations, available every 10 minutes, and satellite products every 15 minutes. It also uses

numerical weather prediction products from a suite of models run in the MoES institutions. These include hyperlocal, regional, and global models. Further, IMD plays a crucial role in safeguarding lives and property through its advanced observational network and forecasting systems, enabling timely preparedness and response in close collaboration with the National Disaster Management Authority (NDMA). This coordinated approach ensures that accurate and timely weather information reaches authorities and the public, enhancing disaster risk reduction efforts across the country.

Presently, there is no scientific technique available anywhere in the world to predict an earthquake precisely in terms of time, location, and magnitude; hence, no proven system exists in the country to provide early warning of earthquakes. However, the National Centre for Seismology (NCS) under the Ministry is monitoring the earthquakes occurring in and around the country through its seismological network and provides information about the earthquake occurrence with an intensity map. These details are made available to various disaster management authorities, other stakeholders, and the public as soon as possible through the NCS-MoES website, app, SMS, FAX, email, WhatsApp, X, and Facebook.

The Central Water Commission (CWC) is mandated to issue short-range flood forecasts with a lead time of up to 24 hours to concerned State Governments at identified locations. Timely flood forecasts are being issued when a certain threshold limit is reached.

IMD has adopted new techniques and technology from time to time to detect, monitor, and provide timely early warnings for the entire country, including the States regularly affected by all types of extreme weather events like cyclones, heavy rainfall, etc., which have devastating impacts on human lives, livelihoods, and infrastructure. There has been significant progress in this direction with:

- Strengthening of the observing system with installation of additional AWS, ARG, and

DWR, etc.

- Improvement of the data integration and development of GIS-based DSS.
- Improvement of NWP models and climate models, as well as a real-time seamless monitoring, forecasting, and early warning system.
- Shifting from conventional weather forecast and warning to sector-specific color-coded Impact-based forecast (IBF) and risk-based warning (RBW) up to district/sub-city levels with dynamical impact and risk matrix.
- Application of AI/ML.
- Customisation of bulletins and warnings.
- Substantial increase of computational power to integrate voluminous data and to run meso-scale, regional, and global models at a further higher resolution scale with improvement of process understanding and model physics. Supercomputers (Arka and Arunika) are being used for this purpose.
- Panchayat Mausam Seva.
- A state-of-the-art dissemination system with the use of a mobile app, Common Alerting Protocol (CAP), WhatsApp groups, etc.

Recently, a new Central Sector Scheme, "Mission Mausam", was launched by the MoES to make Bharat a "Weather-ready and climate-smart" nation.

IMD consistently issues timely alerts and forecasts to the public and concerned stakeholders. Various steps have been taken to ensure effective dissemination of warnings to vulnerable populations. IMD's weather information, including alerts and warnings to the public, is provided through various platforms:

- Mass Media: Radio/TV, Newspaper network (AM, FM, Community Radio, Private TV), Prasar Bharati, and private broadcasters.
- Weekly & Daily Weather Video.
- Internet (email), FTP
- Public Website (mausam.imd.gov.in)
- IMD Apps: Mausam/Meghdoot/DAMINI/RAIN ALARM
- Social Media: Facebook, X, Instagram, BLOG

1. X: <https://twitter.com/Indiametdept> Facebook: <https://www.facebook.com/India.Meteorological.Department/> Blog: <https://imdweather1875.wordpress.com/> Instagram: https://www.instagram.com/mausam_nwfc YouTube: https://www.youtube.com/channel/UC_gxTREoq07UVARm87CuyQw

IMD has also brought out a web-based online "Climate Hazard & Vulnerability Atlas of India" prepared for the thirteen most hazardous meteorological events, which cause extensive damage and economic, human, and animal losses. The same can be accessed at <https://imd pune.gov.in/hazardatlas/about hazard.html>. This atlas will help State Government authorities and disaster management agencies to identify the hotspots and plan and take appropriate action to tackle extreme weather events. This product helps build Climate Change resilient infrastructure.

IMD has launched seven of its services (Current Weather, Nowcast, City Forecast, Rainfall Information, Tourism Forecast, Warnings, and Cyclone) with the 'UMANG' Mobile App for use by the public. Moreover, IMD developed a mobile App, 'MAUSAM' for weather forecasting, 'Meghdoot' for Agromet advisory dissemination, and 'Damini' for lightning alerts. The Common Alert Protocol (CAP), developed by the NDMA, is also being implemented to disseminate warnings by the IMD.

The CWC has taken several steps by adopting various dissemination mechanisms to get maximum reach to the flood warnings, so that mitigation measures can be adopted by State Governments, SDMA, NDMA, and the public. Further, with an aim of disseminating information related to the flood situation in the country and flood forecasts up to 7 days on a real-time basis to the public through mobile phones, version 2.0 of the 'FloodWatch India' mobile application has been developed by the CWC, which provides current information on flood conditions across the country. Further, it also provides additional information regarding the storage positions of 150 major reservoirs in the country, which helps in a better understanding of the possible flood situation in their downstream areas. The 'FloodWatch India' app is available for download.

The North Indian Ocean region, including the Bay of Bengal and Arabian Sea, experiences about 7% of global cyclone frequency. However, it has seen some of the deadliest cyclones. The 1999 Odisha Super Cyclone caused 10,000 deaths in Odisha. However, in the recent 10 years, there has been a paradigm shift in the monitoring and forecasting of tropical cyclones. It has resulted in a reduction of the death toll due to any cyclone to a single/double digit. It was zero casualties due to Cyclone Biparjoy, which hit the Gujarat coast in 2023, and Cyclone Dana, which hit the Odisha coast in 2024. It has also resulted in worldwide accolades for the India Meteorological Department, Ministry of Earth Sciences. DGM, IMD has been conferred with the UN Sasakawa award 2025 for Disaster Risk Reduction (DRR), which is the highest award in the field of DRR.

This information was given by Dr. Jitendra Singh, Union Minister of State (Independent Charge) for Science and Technology, Earth Sciences, MoS PMO, MoS Personnel, Public Grievances & Pensions, Department of Atomic Energy and Department of Space, in a written reply in the Lok Sabha today.

NKR/PSM

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