GOVERNMENT OF INDIA
MINISTRY OF EARTH SCIENCES
LOK SABHA
UNSTARRED QUESTION NO. 2831
TO BE ANSWERED ON WEDNESDAY, 17TH DECEMBER, 2025

RISING THREATS OF CLIMATE CHANGE

2831. SHRI ANURAG SHARMA:

Will the Minister of EARTH SCIENCES be pleased to state:

(a) whether the Government is aware of the rising threats posed by climate change, soil degradation, groundwater depletion and the rapid deterioration of natural resources across various regions of the country and if so, the details thereof;
(b) the steps taken/being taken by the Government to strengthen Earth science research and education particularly in the areas of geological surveys, environmental monitoring and long-term climate assessment;
(c) the details of initiatives underway to upgrade national capabilities for data collection, early warning and forecasting systems for floods, droughts, landslides and other natural disasters;
(d) whether additional support is being planned for advanced remote sensing and Earth system modelling and if so, the details thereof;
(e) whether the Government proposes to promote enhanced collaboration among national research institutions, universities, ISRO, IMD and international scientific agencies to accelerate innovation in this field; and
(f) if so, the details thereof and the expected outcomes of such initiatives?

ANSWER
THE MINISTER OF STATE (INDEPENDENT CHARGE) FOR
MINISTRY OF SCIENCE AND TECHNOLOGY
AND EARTH SCIENCES
(DR. JITENDRA SINGH)

(a)-(b) The Government has taken due note of the climate change across the country. The Ministry of Earth Sciences (MoES), Government of India, through its Climate Change report titled "Assessment of Climate Change over the Indian Region (https://link.springer.com/book/10.1007/978-981-15-4327-2)" has assessed the impact of climate change across the country. Since the middle of the twentieth century, India has witnessed a rise in average temperature; a decrease in monsoon precipitation; a rise in extreme temperature and rainfall events, droughts, and a rise in sea levels; and an increase in the intensity of severe cyclones. The soil degradation and groundwater depletion is emerging as one of the most serious environmental and socio-economic challenges.

The Government has undertaken multiple initiatives to advance Earth science research, capacity building, and educational infrastructure across the country. Dedicated institutes under the MoES e.g., Indian Institute of Tropical Meteorology (IITM), India Meteorological Department (IMD), National Centre for Medium Range Weather Forecasting (NCMRWF), Indian National Centre for Ocean Information Services (INCOIS), National Centre for Coastal Research (NCCR), National Centre for

Seismology (NCS), National Centre for Polar and Ocean Research (NCPOR), National Institute of Ocean Technology (NIOT), Centre for Marine Living Resources & Ecology (CMLRE), National Center for Earth System Sciences (NCESS) are advancing research in the interactions between the atmosphere, oceans, and polar systems, focusing on their role in regional climate dynamics and extreme weather patterns. IITM lead the flagship capacity-building initiative under MoES, the Development of Skilled Manpower in Earth System Sciences (DESK) program, with the objective to develop academic habit through training on targeted areas and semester-based coursework in Earth Sciences. Efforts are also being made to strengthen the scientific community's capacity in climate science and assessment through training programs, workshops, and knowledge exchanges, ensuring that India has the necessary expertise to understand and respond to the complex climate challenges.

(c)-(d) The Ministry of Earth Sciences (MoES) has developed advanced early warning systems for severe weather events such as cyclones, heavy rainfall, droughts, 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, droughts, 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.

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. 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 Geological Survey of India (GSI) is mandated to conduct landslide studies in landslide-prone areas in the country. In July 2024, with the inauguration of the National Landslide Forecasting Centre (NLFC) at Kolkata, GSI achieved a milestone by operationalizing landslide forecasting in three districts in two States, viz. Darjeeling and Kalimpong districts of West Bengal and the Nilgiris district of Tamil Nadu. At present, RLFS covers 21 districts (04 operational and 17 experimental) in eight states (West Bengal, Tamil Nadu, Uttarakhand, Himachal Pradesh, Sikkim, Nagaland, Karnataka, and Kerala). These bulletins forecast information on the possibility of occurrence of landslides up to the taluk / sub-divisional level daily for the next 48 hours.

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, droughts, 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.

- IMD developed a mobile App, 'MAUSAM' for weather forecasting, 'Meghdoot' for Agromet advisory dissemination, and 'Damini' for lightning alerts.

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://imdpune.gov.in/hazardatlas/abouthazard.html. This atlas will help State Government authorities and disaster management agencies identify the hotspots and plan and take appropriate action to tackle extreme weather events. This product helps build Climate Change resilient infrastructure.

The Government of India has recently launched Mission Mausam, a national initiative, under the Ministry of Earth Sciences with a goal of making Bharat a "Weather-ready and Climate-smart" nation to mitigate the impact of climate change and extreme weather events and strengthen the resilience of communities. Under Mission Mausam, initiatives are undergoing to develop a hybrid Earth System Modeling framework (dynamical model with AI based parameterisation) for weather predictions and climate projections. In addition, India has augmented its HPC power by commissioning state-of-the-art High-Performance Computing (HPC) systems 'Arka' (at the Indian Institute of Tropical Meteorology, Pune) and 'Arunika' (at the National Centre for Medium-Range Weather Forecasting, Noida) for Earth System Modeling. Enhancing the HPC facilities and Earth System Modeling capabilities are planned under Mission Mausam.

(e)-(f) Various initiatives were undertaken to foster enhanced collaboration among national research institutions within India. Major national missions, such as the Mission Mausam, Monsoon Mission, and Deep Ocean Mission, are designed to enhance collaboration across various national institutes like IITM, IMD, ISRO, NCMRWF, INCOIS, NIOT, and national research institutions and universities. Joint research initiatives integrate satellite data from ISRO with forecasting systems of IMD and research inputs from academic institutions. India is actively collaborating with international programs like the Coupled Model Intercomparison Project (CMIP), the World Climate Research Programme (WCRP), the World Weather Research Program, etc., on weather and climate research and to develop and improve weather and climate models. These models aim to simulate and predict the interactions between the atmosphere, ocean, and polar regions, crucial for understanding regional extremes and climate impacts. These collective actions contribute to a more robust understanding of Earth System interactions, which is essential for enhancing India's resilience to extreme weather and climate change impacts.

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