

**GOVERNMENT OF INDIA**  
**MINISTRY OF EARTH SCIENCES**  
**RAJYA SABHA**  
**UNSTARRED QUESTION No.3225**  
**TO BE ANSWERED ON 31<sup>st</sup> March 2022**

**MINIMIZING LOSS DUE TO NATURAL DISASTERS**

3225. SHRI SANJAY SETH :

Will the Minister of EARTH SCIENCES be pleased to state:

- (a) whether Government is developing a scientific mechanism to predict precisely, to the maximum extent possible, the occurrence of landslides and rockslides, glacial lake outburst floods, extreme weather based events like cloudbursts and flash floods etc;
- (b) if so, the details thereof; and
- (c) the steps Government is taking to work jointly with affiliated institutions in this direction so that the loss of life and property caused by natural disasters can be minimised?

**ANSWER**

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

(a)-(b) Yes Sir.

For landslides and rockslides, glacial lake outburst floods

- Geological Survey of India (GSI) under Ministry of Mines (MoM) is carrying out National Landslide Susceptibility Mapping (NLSM) programme since 2014 for entire landslide prone hilly terrain of the country with an aim to generate Landslide susceptibility maps for spatial prediction of landslides in 1:50, 000 scale and the baseline national-level landslide database. A cumulative target of approx. 4.2 lakh sq.km landslide prone hilly terrain of the country will be completed under this programme by March 2022. The NLSM output, in the form of classified landslide susceptibility map (depicting High, Moderate and Low Susceptibility zones) of 3.63 lakh sq.Km, with approximately 62,000 landslide polygons and nearly 29,000 field validated landslides are uploaded in OCBIS portal(<http://bhukosh.gsi.gov.in/Bhukosh/Public>) for public viewing and downloading. This database has been shared with NDMA and other stakeholders in GIS format for use in regional developmental planning of hill areas and research studies for use in management of landslide disaster in the country.
- For temporal prediction of regional landslide occurrence, GSI in collaboration with the British Geological Survey (BGS) under the National Environmental Research Council

(NERC), UK funded, multi-consortium LANDSLIP project ([www.landslip.org](http://www.landslip.org)) has developed a prototype regional Landslide Early Warning System (LEWS) for India, and the same is currently being evaluated and tested by GSI in two pilot areas in India (Darjeeling district, West Bengal, and the Nilgiris district, Tamil Nadu). The similar testing procedure is also extended in Kalimpong district, West Bengal. The LANDSLIP is in the process of transferring the above tools of regional LEWS to the national nodal agency (GSI) for carrying out a similar endeavour in multiple landslide-prone states in India. Since 2020 monsoon, GSI has also started issuing daily landslide forecast bulletins during monsoon to the district administrations in two pilot areas (Darjeeling district, West Bengal, and the Nilgiris district, Tamil Nadu).

- GSI has not carried out any study to predict glacial lake outburst floods (GLOF) events. GSI has conducted studies on melting of the glaciers by assessment of mass balance studies and monitoring the recession/ advancement of selected Himalayan glaciers. GSI has compiled an inventory of glacial lakes of northwest Himalaya. As per the Inventory of Glacial Lakes, a total of 486, 533 and 925 glacial lakes located in lower reaches of ablation zone have been demarcated in Uttarakhand, Himachal Pradesh, and Jammu & Kashmir (including Ladakh) respectively and out of which a total of 49, 65 and 41 potentially vulnerable lakes have been identified in Uttarakhand, Himachal Pradesh, Jammu & Kashmir (including Ladakh) respectively. The reports had been shared with National Disaster Management Authority (NDMA). The NDMA has formulated and published a detail guideline for GLOF and LLOF managements. These includes monitoring and early warning system for the above hazards. Details may be accessed through the link <https://ndma.gov.in/sites/default/files/PDF/Guidelines/Guidelines-on-Management-of-GLOFs.pdf>.

For Extreme Weather Events, Flash Floods

India Meteorological Department (IMD) issues various outlook/forecast/warning for Public as well as Disaster Management Authorities for the preparedness and for mitigation measures related to extreme weather events.

IMD follows a seamless forecasting strategy. The long-range forecasts (for the whole season) issued are being followed with extended range forecast issued on every Thursday with a validity period of four weeks. To follow up the extended range forecast, IMD issues short to medium range forecast and warnings daily valid up to next five days with an outlook for subsequent two days. The short to medium range forecast and warning at district and station level are issued by state level Meteorological Centres (MCs)/Regional Meteorological Centres (RMCs) with a validity of next five days and are updated twice a day. The short to medium range forecast is followed by very short range forecast of severe weather up to three hours (nowcast) for all the districts and 1089 cities and towns. These nowcasts are updated every three hours.

Forecast is issued for 36 meteorological sub-divisions from National Weather Forecasting Centre, IMD HQ and updated four times a day. The forecasts and nowcasts

are issued at District Level and Station Level by State Level Meteorological Centres and Regional Meteorological Centres.

While issuing the warning suitable colour code is used to bring out the impact of the severe weather expected and to signal the Disaster Management about the course of action to be taken with respect to impending disaster weather event. Green color corresponds to no warning hence no action is needed, yellow color corresponds to be watchful and get updated information, orange color to be alert and be prepared to take action whereas red color signals to take action.

Intense rainfall activity is one of the reason for landslides, flash floods etc. For addressing such impacts due to extreme weather events, IMD is implementing Impact Based Forecast (IBF) which give details of what the weather will do rather than what the weather will be. It contains the details of impacts expected from the severe weather elements and guidelines to general public about do's and don'ts while getting exposed to severe weather. These guidelines are finalised in collaboration with National Disaster Management Authority (NDMA) and is already implemented successfully for cyclone, heat wave, thunderstorm and heavy rainfall. Work is in progress to implement the same for other severe weather elements.

Recognizing the damage potential of Flash Floods and a general lack of flash flood warning capabilities, IMD in joint collaboration with the US National Weather Service, the US Hydrologic Research Center (HRC) and USAID/OFDA has developed a Flash Flood Guidance System (FFGS) for South Asian region. The FFGS has been in operational mode since October 2020.

The Flash Flood Guidance is a robust system designed to provide the necessary products in real-time to support the development of warnings for flash floods about 6-24 hours in advance at the watershed level with resolution of 4kmx4km for the Flash Flood prone South Asian countries viz. India, Nepal, Bhutan, Bangladesh and Sri Lanka, covering most of the Himalayan region. Around 30000 nos. of small watersheds of size varying from 10 – 16 sq.km. The flash flood guidance value is a diagnostic value that estimates the amount of rainfall of a given duration within a watershed that is required to produce flooding at the outlet of the catchment/ watershed.

- (a) GSI initiated R & D activities and the ground work for developing regional landslide early warning system (LEWS) in other test areas like Uttarakhand, Kerala, Sikkim from 2021 and already planned to add areas in five additional states (e.g., Himachal Pradesh, Karnataka, Assam, Meghalaya, Mizoram) from 2022. The evaluation and calibration of the models will continue during the next few monsoon years and the regional LEWS will be made operational in phases in all such 10 states after successful ground evaluation in phases. Landslide Forecasting requires multi institutional inputs, GSI is collaborating and signed MoUs with IMD, National Remote Sensing Agency (NRSC), various SDMA's, and has also extended the MoU with BGS till 2025. To execute the

above multi-disciplinary task, GSI has also initiated MoUs with other national organizations like National centre for Medium Range Weather forecasting (NCMRWF) etc. GSI also has initiated the process for establishing the National Landslide Forecasting Centre (NLFC) to integrate, generate and disseminate daily landslide forecast for multiple states from GSI headquarters, Kolkata.

- After the recent Chamoli disaster, the NDMA has constituted an expert team by involving scientists from various institutes/ organization from relevant Ministries, including GSI, National Institute of Hydrology (NIH), NRSC/ ISRO, Wadia Institute of Himalayan Geology (WIHG), Defence Geoinformatics Research Establishment (DGRE), IIT-Roorkee etc. One of the main objectives of the above study is also to explore the possibility of suggesting methods of monitoring and early warning to forecast such type of very site-specific rock/ snow avalanche events including GLOF/ LLOF and reducing the cascading impacts like flash flood and landslides etc. as domino effects in the downstream areas.

MoES has made several significant reforms towards improving weather forecasts and their dissemination for disaster management through its institutions— India Meteorological Department, Delhi; Indian Institute of Tropical Meteorology, Pune; and the National Centre for Medium-Range Weather Forecasting, Noida. Improvement in weather and climate services was accomplished due to systematic efforts in augmenting atmospheric, coastal, and ocean observations, developing adequate modelling strategy, conducting cutting edge research, investing in human resources development, improving decision support systems, and establishing a robust dissemination strategy.

- In collaboration with MoES institutes, IMD is implementing the urban flood early warning system to address the issue of urban floods in the country. It is already in place for Mumbai and Chennai.
- Under the joint efforts with the India Meteorological Department / MoES & the National Cyclone Risk Mitigation Project (NCRMP) of National Disaster Management Authority (NDMA), MHA, a Web- based Dynamic Composite Risk Atlas – Decision Support System (Web-DCRA- DSS) has been developed for utilization in the Cyclone prone coastal states including Tamil Nadu.
- IMD started issuing Impact Based Forecast (IBF) in collaboration with National Disaster Management Authority (NDMA) and is already implemented successfully for cyclone, heat wave, thunderstorm and heavy rainfall. Work is in progress to implement the same for other severe weather elements.
- Flood Meteorological Offices (FMOs) at Chennai and Bengaluru issue daily hydro-meteorological bulletins comprising of Quantitative Precipitation Forecast (QPF) and heavy rainfall warnings for 3 days and outlook for subsequent 4 days for the river basins in Tamil Nadu to the Central Water Commission (CWC) during the Southwest and Northeast monsoon seasons, to support the flood warning services of CWC.
- The common Alert Protocol (CAP) developed by NDMA is also being implemented for dissemination of warning by IMD.NDMA in collaboration with Department of

Telecommunication (DoT) DoT and Centre for Development of Telematics (C-DoT) has initiated an integrated Warning Dissemination System using Common Alert Protocol for the country which is a multiagency, multi warning dissemination system.

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