**GOVERNMENT OF INDIA**
**MINISTRY OF EARTH SCIENCES**
**LOK SABHA**
**UNSTARRED QUESTION NO. 4072**
**TO BE ANSWERED ON WEDNESDAY, 12TH AUGUST, 2026**

# FLOOD FORECASTING AND EARLY WARNING SYSTEM IN NORTHEAST INDIA

**4072. SHRI GAURAV GOGOI:**

Will the Minister of **EARTH SCIENCES** be pleased to state:

(a) whether the India Meteorological Department (IMD) issued advance rainfall alerts before the July 2026 floods in upper Assam and if so, the details thereof including the classification of rainfall and the associated weather system;
(b) whether the IMD has assessed the accuracy and lead time of its rainfall forecasts and warnings issued for flood-affected districts of Assam during the 2026 monsoon season and if so, the details thereof;
(c) whether El Niño and Indian Ocean Dipole conditions are factored into seasonal rainfall and flood-risk assessments for Northeast India and if so, the details thereof; and
(d) whether steps are being taken to improve the spatial resolution and accuracy of rainfall forecasts and extreme-weather warnings at the sub-district level in Northeast India and if so, the details thereof?

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

(a) Yes. The India Meteorological Department (IMD) issued advance district-level rainfall forecasts and colour-coded impact-based warnings for all districts of Upper Assam, including Jorhat, Golaghat, Sivasagar, and Charaideo, prior to and during the heavy to very heavy rainfall activity from 18th to 20th July 2026. The forecasts issued by IMD for the State captured the occurrence of the heavy and very heavy rainfall events with a lead time of 7 days, accompanied by daily colour-coded warnings valid for the subsequent 7 days. Standard rainfall classifications per IMD guidelines were followed, categorizing rainfall intensity levels across light, moderate, heavy, and very heavy precipitation alongside spatial distribution scales ranging from scattered to widespread coverage.

The high rainfall event was driven by key synoptic weather systems and atmospheric components during 17th to 20th July 2026. On 17th July 2026, the mean sea level monsoon trough extended towards the Northeast Bay of Bengal, accompanied by a low-pressure area over Gangetic West Bengal and adjoining regions, along with an upper air cyclonic circulation over Northeast Assam and its neighborhood extending up to 1.5 km above mean sea level. Between 18th and 20th July 2026, the upper air

cyclonic circulation over Northeast Assam shifted towards Central Assam and adjoining Nagaland between 1.5 km and 3.1 km above mean sea level and persisted through 20th July. Additionally, an upper air cyclonic circulation over North Jharkhand and adjoining Bihar, along with a connected atmospheric trough extending across Gangetic West Bengal and Bangladesh to Tripura, further sustained the strong monsoonal activity across Upper Assam. Daily weather bulletins detailing the episode remain archived and available with the Regional Meteorological Centre, Guwahati.

(b) Yes. IMD regularly assesses the performance, accuracy, and lead time of its extreme heavy rainfall forecasts and warnings across all regions of Assam, divided into sub-regions including West Assam, South Assam, Central Assam, and Northeast Assam. The evaluation parameters primarily measure overall accuracy, detection probability, threat handling, and false alarm frequencies for lead times spanning from Day 1 to Day 5. In West Assam, the overall forecast accuracy expressed as Percentage of Correct forecasts (PC) ranges from 72.14% on Day 1 to 80.94% on Day 5. The Probability of Detection (POD) stands at 0.6345 for Day 1 and gradually decreases to 0.1209 on Day 5. Correspondingly, the False Alarm Ratio (FAR) ranges from 0.738 on Day 1 to 0.9613 on Day 5, while the Critical Success Index (CSI) moves between 0.1936 on Day 1 and 0.0264 on Day 5.

In South Assam, the Percentage of Correct forecasts remains consistently high, ranging from 60.48% on Day 1 up to 84.68% on Day 5. The Probability of Detection records a value of 0.525 for Day 1 and decreases to 0.0425 for Day 5. The False Alarm Ratio varies from 0.855 on Day 1 to 0.75 on Day 5, whereas the Critical Success Index records values ranging between 0.12 on Day 1 and 0.0425 on Day 5. In Central Assam, the forecasting system demonstrates high overall accuracy, with the Percentage of Correct forecasts improving from 66.36% on Day 1 to 80.18% on Day 5. The Probability of Detection starts at 0.6929 on Day 1 and shifts to 0.0757 by Day 5. The False Alarm Ratio ranges from 0.8114 on Day 1 to 0.8883 on Day 5, while the Critical Success Index records a performance ranging between 0.1671 on Day 1 and 0.0429 on Day 5.

In Northeast Assam, the Probability of Detection is notable at 0.7229 on Day 1 and 0.1857 on Day 5, supported by a lower False Alarm Ratio ranging between 0.3913 on Day 1 and 0.5538 on Day 5. The Critical Success Index shows strong performance ranging from 0.4275 on Day 1 to 0.19 on Day 5. The overall forecast accuracy in terms of Percentage of Correct forecasts for Northeast Assam remains stable across the lead times, measuring 58.47% on Day 1 and 51.61% on Day 5.

(c) India Meteorological Department considers large-scale climate drivers, including the El Niño–Southern Oscillation (ENSO) and the Indian Ocean Dipole (IOD), while preparing seasonal rainfall forecasts over India, including Northeast India. IMD's seasonal forecasting system utilizes a combination of dynamical coupled climate models and statistical techniques that incorporate various oceanic and atmospheric parameters such as sea surface temperatures, atmospheric circulation, ENSO, IOD, and other climate indicators. These factors are assessed collectively to generate probabilistic forecasts of seasonal rainfall.

For Northeast India, ENSO and IOD influence rainfall variability. While El Niño is generally associated with below-normal southwest monsoon rainfall over most parts of India, Northeast India receives normal to above-normal rainfall during some El Niño years. The relationship between El Niño and rainfall over Northeast India is relatively weak and complex compared to the rest of the country, as rainfall over the region is strongly influenced by factors such as Bay of Bengal moisture transport, monsoon circulation, and orographic effects. Consequently, the impact of El Niño on Northeast India's seasonal rainfall is not uniform and varies from one event to another. Currently, moderate El Niño conditions are prevailing, while IOD remains neutral, and these conditions have been incorporated into IMD's seasonal rainfall outlooks. However, flood risk over Northeast India also depends on short-duration extreme rainfall events, river basin conditions, and catchment characteristics; therefore, flood-risk assessments are based on both seasonal climate outlooks and operational weather forecasts.

With regard to flood-risk assessment, IMD's rainfall forecasts and weather warnings form important meteorological inputs for flood forecasting. Operational flood forecasting in the country is carried out by the Central Water Commission (CWC), which integrates IMD's weather forecasts with hydrological observations, river gauge data, and hydrological models for issuing flood forecasts and warnings. Thus, ENSO and IOD contribute to seasonal assessment of rainfall variability and flood potential, while actual flood forecasts are based primarily on observed and forecast rainfall, river conditions, and hydrological modelling.

(d) Yes. To improve spatial resolution and accuracy at the sub-district level in the Northeast India, the advanced Numerical Weather Prediction model development has been operationalized, featuring the high-resolution New Bharat Forecasting System (BharatFS) at 6 km to cater to block and panchayat levels, supported by the enhanced computing power of the "Arunika" and "Arka" systems. Under Mission Mausam, the advanced Multi-Hazard Early Warning-Decision Support System (MHEW-DSS) has been introduced for real-time monitoring and forecasting. Furthermore, the observational network over Northeast India is being enhanced through the installation of state-of-the-art observing systems.

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