

GOVERNMENT OF INDIA
MINISTRY OF EARTH SCIENCES
RAJYA SABHA
UNSTARRED QUESTION NO. 1481
ANSWERED ON 12/02/2026

MONSOON FORECAST ACCURACY AND IMPROVEMENTS

1481. DR. FAUZIA KHAN:

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

- (a) the accuracy rate of India Meteorological Department's (IMD) seasonal monsoon forecast during the last three years;
- (b) the major factors identified for any deviations between forecasted and actual rainfall;
- (c) the steps taken to integrate advanced climate-modeling tools and high-resolution satellite data to improve forecast precision; and
- (d) the timeline and budgetary allocation for operationalizing the next-generation dynamic monsoon prediction system?

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

- (a) The performance of the India Meteorological Department's (IMD) seasonal monsoon forecast during the past three years (2023-25) is given below:

Year	ALL India Monsoon Rainfall (% of Long Period Average (LPA))		Remark
	Actual	Forecast $\pm$ Model error	
2023	95	96 ± 4	Actual Rainfall was Within the forecast limits and Accurate
2024	108	106 ± 4	Actual Rainfall was Within the forecast limits and Accurate
2025	108	106 ± 4	Actual Rainfall was Within the forecast limits and Accurate

The performance of operational forecast during 2023–2025 shows that the actual rainfall during each of these 3 years were within the forecast limits and were accurate. The average absolute error of the forecast during the 3 years period was 1.9% of the LPA.

- (b) The deviations between forecasted and actual seasonal rainfall mainly arise due to uncertainties associated with large-scale climate drivers and their representation in forecast models. Seasonal rainfall forecasts are sensitive to the evolution of ENSO and its influence on the Indian summer monsoon. In addition, the Indian Ocean Dipole (IOD) and its interaction with the monsoon circulation introduces further uncertainty. The substantial intra-seasonal variability during the monsoon season also restricts forecast reliability, particularly under climate-change conditions. Furthermore, shortcomings in simulating synoptic-scale systems, such as Monsoon Low Pressure Systems and their associated rainfall, reduce the accuracy of early predictions over central India and neighbouring regions.
- (c)-(d) The India Meteorological Department under the Ministry has taken several steps to integrate advanced climate-modelling tools and high-resolution satellite data to improve forecast precision. These include the operational use of outputs from coupled global and regional climate models through Multi-Model Ensemble (MME) systems, and advanced data assimilation techniques to effectively utilize different types of observations. High-resolution satellite data/imageries from Indian and international satellites are routinely used for monitoring of clouds, rainfall, sea surface temperatures, winds, and other atmospheric parameters. In addition, enhanced high-performance computing facilities, advanced Numerical Prediction Models, and emerging techniques such as artificial intelligence (AI) and machine learning (ML) are being adopted under initiatives like Mission Mausam to further improve forecast accuracy, spatial resolution, and lead time across different time scales.

IMD is already using the latest available technologies and forecasting techniques for the forecasting of monsoon rainfall. However, improvement of accuracy of the forecasting is a continuous process, and IMD will always remain open to adopt new technologies and forecasting techniques as and when it is realized.
