GOVERNMENT OF INDIA
MINISTRY OF EARTH SCIENCES
LOK SABHA
UNSTARRED QUESTION NO. 2856
TO BE ANSWERED ON WEDNESDAY, 3RD AUGUST, 2022

UPGRADATION OF FORECAST SYSTEMS

2856. SHRIMATI NUSRAT JAHAN RUHI:

Will the Minister of EARTH SCIENCES be pleased to state:

(a)   the status and details of the 'Upgradation of Forecast System' programme under Atmosphere and Climate Research - modelling Observing System and Services (ACROSS) scheme;
(b)   whether the programme has resulted in increased accuracy of weather forecast;
(c)   if so, the details thereof and if not, the reasons therefor; and
(d)   the steps taken by the Government to improve the accuracy of India Meteorological Department (IMD) forecast in the country, specially in the State of West Bengal?

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

(a)   For modernization, expansion and improvement in Weather & Climate services, various plans are underway in India Meteorological Department (IMD) under the umbrella Central Sector Scheme ACROSS. There are 4 sub-schemes of IMD under ACROSS namely, Atmospheric Observation Network (AON), Upgradation of Forecast System (UFS), Weather & Climate Services (WCS) and Commissioning of Polarimetric Doppler Weather Radars (DWR). Main activities of the sub-scheme Upgradation of Forecast System undertaken during 2017-21 are as follows:

Upgradation of Forecast System (UFS)

- Upgradation and sustenance of Communication Systems for Data and Product transmission.
- Development of an advanced Operational Forecast System, Delivery System for Forecast and other services.
- Conduct of special campaign for improving Cyclone, Thunderstorm and Fog forecasting through provision of additional observations.
- Integrated Himalayan Meteorological Programme for Western & Central Himalayas.
- Capacity Building, Outreach, Planning and sustenance of specific process related observing systems over India.

(b)-(c) Yes Sir. During the past few years, IMD has been continuously improving weather prediction services in terms of accuracy, lead time and associated impact. The forecasts and warnings are issued by IMD at the national, State and district levels. It has a network of State Meteorological Centres for better coordination with State and district level agencies. With the upgradation of observations and prediction system, noticeable improvements have been made in the recent past in the skill of prediction, especially with respect to heavy-rainfall, heat-wave, thunderstorm and cyclones.

The weather forecast accuracy is verified by IMD and errors and skill scores are calculated season wise and annually.

**Details of improvement in Weather Forecast Accuracy are follows:**

- Probability of Detection (POD) for heavy rainfall warning with 24 hr lead period is 74% in 2021, which has improved by 51% in year 2021 as compared to their skill between 2002-20. False Alarm Rate (FAR) and Missing Rate (MR) are 26% in 2021, which has improved by 21% & 53% respectively in year 2021 as compared to their skill between 2002-20. **(Fig.-I)**

- Probability of Detection (POD) for heat wave warning with 24 hr lead period is 97% in 2021, which has improved by 15% as compared to their skill between 2014-20. False Alarm Rate (FAR) and Missing Rate (MR) are 2% & 3% respectively in 2021, which has improved by 63% & 82% respectively as compared to their skill between 2014-20. **(Fig.-2)**

- The annual average landfall point forecast errors in 2021 have been 16.4 km, 10.6 km and 19.8 km respectively for 24, 36 and 48 hrs against the past five year (2016-2020) average error of 31.9 km, 43.7 km and 61.5 km based on data of 2016-2020. Considering the diameter of the central region (eye) as 10-15 km, there was almost zero error in landfall point forecasts of cyclone in 2021 upto 48 hours in advance.

- The annual average track forecast errors in 2021 have been 63 km, 91 km and 164 km respectively for 24, 48 and 72hrs lead period against the past five year (2016-2020) average error of 77, 117 and 159 km based on data of 2016-2020. **(Fig.-3)**

- The track forecast skills compared to climatology and persistence forecast have been 75%, 82% and 68% respectively for the 24, 48 and 72 hrs lead against the long period average (2016-2020) skill of 64%, 76% & 78% respectively. **(Fig.-3)**

- The annual average absolute error(AE) in intensity (wind) forecast has been 6.2 knots, 9.5 knots and 10.8 knots (108 nautical miles per hour) respectively for 24, 48 and 72 hrs lead period of forecast against the past five year(2016-2020) average error of 7.9, 11.4 and 14.1 knots. The skill in intensity forecast as compared to persistence forecast was 63.2%, 78.4% and 85.6% against the long period average (2016-20) skill of 52.2, 72.1 and 75.1 for 24, 48 and 72 hours lead period. **(Fig.-3)**

- Probability of Detection (POD) for thunderstorm warning with 24 hr lead period is 86% in 2021 against 31% in 2016. **(Fig.-4)**

- Probability of Detection (POD) for thunderstorm warning with 3 hourly nowcast during March to June 2021 has been 79%.

(d)   In order to increase the accuracy of forecast for all states/ U.T.s of the country including West Bengal, IMD has initiated to expand and modernize its observational network with special emphasis on expansion of DWR network, replacement of old Radars with new ones having state of the art technology especially in the cyclone prone areas. Expansion of surface observational network is also one of the major thrust areas and Automatic Weather Stations and Automatic Rain Gauges are being installed across the country in order to cover all data gap areas. Apart from that, Climate Services, Aviation forecast services and Environment monitoring services are also being enhanced.

As mentioned earlier, under ACROSS Scheme, following steps are being taken to further improve the accuracy of forecast

(i)   Implementing the monsoon mission programme which improved the prediction capabilities in systematic and timely manner.

(ii)   Upgradation of Atmospheric Observations Network (AON) including Doppler Weather Radars (DWRs), Automatic Rain Gauges (ARGs), Automatic Weather Stations (AWSs), Upper Air, Surface and Environmental Observatories etc.

(iii)   Upgradation of Forecast System (UFS)

(iv)   Upgradation of Weather & Climate Services (WCS)

(v)   Upgradation of HPC System

(vi)   Usage of state-of-art Coupled Atmosphere Ocean Model, and Multi-Model Ensemble methods.

(vii)   Adopting 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, short to medium range forecast and warnings at 36 meteorological sub-divisions levels daily four times valid up to next five days with an outlook for subsequent two days. 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.

(viii) Issuance of warning using suitable colour code 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 colour corresponds to no warning hence no action is needed, yellow colour corresponds to be watchful and get updated information, orange colour to be alert and be prepared to take action whereas red colour signals to take action.

(ix)   Issuing 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.
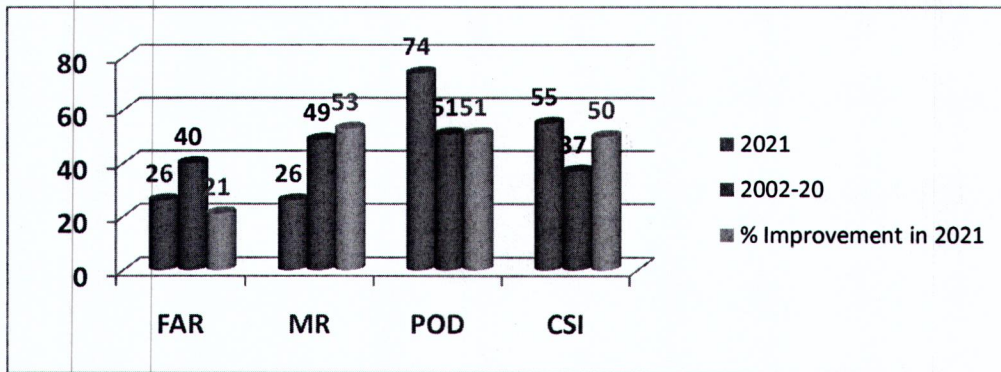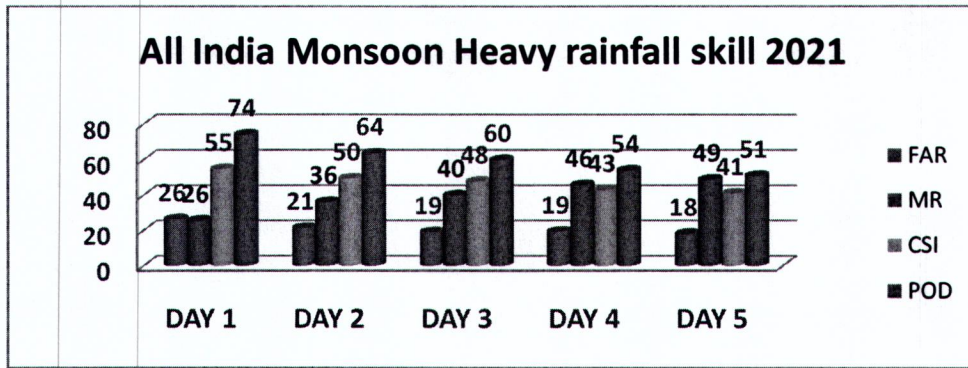
Fig 1: Heavy rainfall warning skill during 2021(FAR (False Alarm Rate), MR(Missing Rate), PoD (Probability of Detection) and CSI (Critical Success Index).IMD has high skill for heavy rainfall warning upto Day 5 as POD for Day 5 is more than 50%.
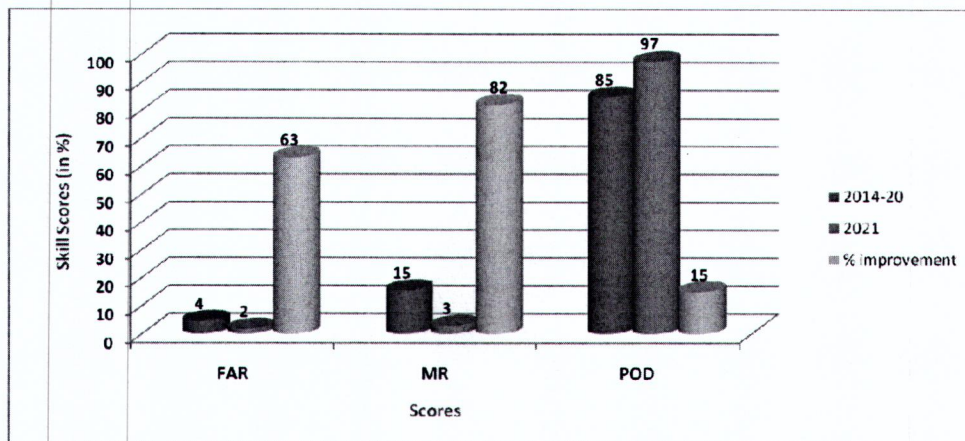
Fig 2: All India Summer months (April to June) 2021vs 2014-20 heat wave skill scores
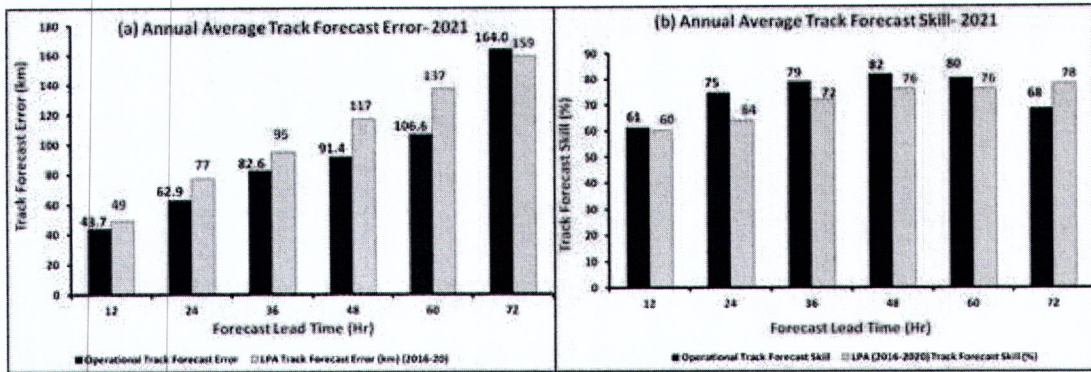
Fig 3: Annual average (a) track forecast errors (km) and (b) track forecast skill (%) during 2021 compared to long period average errors during 2016-20.
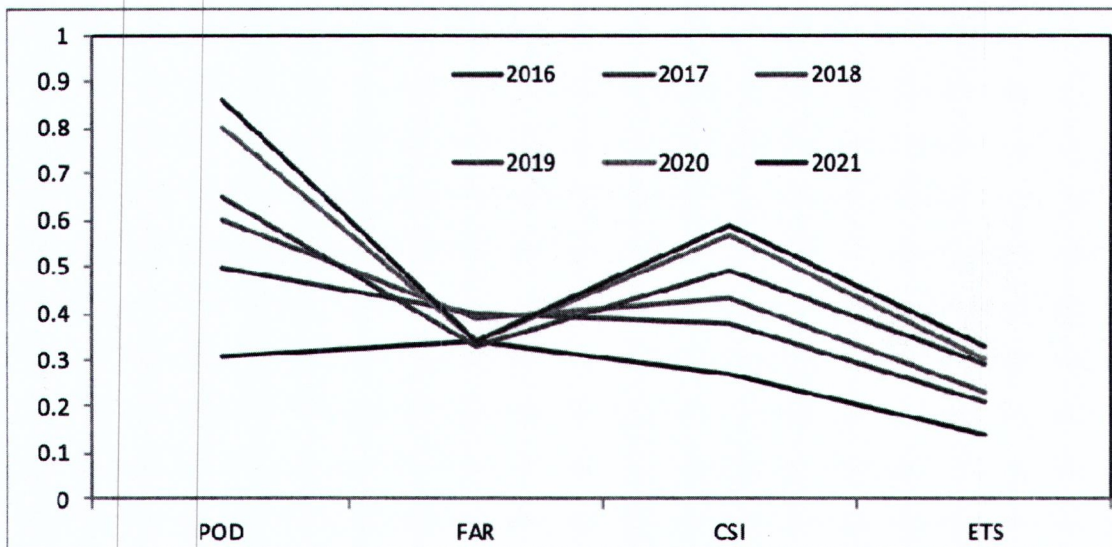
Fig.4. Skill Scores for 24 hr Thunderstorm forecast by IMD during past 6 years (2016 to 2021)

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