

GOVERNMENT OF INDIA  
MINISTRY OF EARTH SCIENCES  
LOK SABHA  
UNSTARRED QUESTION NO. 2524  
TO BE ANSWERED ON WEDNESDAY, 16<sup>TH</sup> MARCH, 2022

**HYDRO-METEOROLOGICAL CALAMITIES**

2524. DR. SHASHI THAROOR:

Will the Minister of EARTH SCIENCES be pleased to state:

- (a) whether the Minister concurs with the statement made by the Union Minister of Agriculture and Farmers Welfare on India losing 5.04 million hectares in 2021 and 36 million hectares of crop area since 2016 due to hydro-meteorological calamities and if so, the details thereof;
- (b) whether the Ministry has identified districts in Kerala particularly prone to soil loss due to soil erosion caused by heavy rains and if so, the details thereof and if not, the reasons therefor;
- (c) whether the Ministry has implemented measures to improve soil quality for improving durability to heavy rains if so, the details thereof and if not, reasons therefor;
- (d) the details of the increasing number of instances of hydro-meteorological calamities predicted for this decade, due to climate change;
- (e) whether the Ministry can ascertain accurate prediction of similar future events by the weather forecasting systems despite increasing uncertainty; and
- (f) if so, the details thereof and if not, the reasons therefor?

**ANSWER**

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

- (a) This is the information provided by the Hon'ble Union Minister of Agriculture and Farmers Welfare during a reply to the Lok Sabha question through the data available with the respective ministry. Ministry of Earth Sciences (MoES) is mandated to issue forecasts and warnings related to day to day weather events through India Meteorological Department (IMD). Operational Agromet Advisory Services (AAS), *i.e.* Gramin Krishi Mausam Sewa (GKMS) scheme, rendered by IMD jointly with Indian Council of Agricultural Research (ICAR) and State Agricultural Universities, is a step towards weather-based crop and livestock management strategies and operations for the benefit of farming community in the country. Under the scheme, medium range weather forecast at district and block level is generated and based on the forecast, Agromet Advisories are prepared by the 130 Agromet Field Units (AMFUs) located in State Agricultural Universities, ICAR Institutes, IITs etc. and 199 District Agromet Units (DAMUs) at KVKs under ICAR network and communicated to the farmers on every Tuesday and Friday.
- (b) Indian Institute of Soil and Water Conservation (IISWC) a research institution under ICAR has identified few districts of Kerala prone to erosion using process based estimation of soil erosion. Based on the comparison between prevailing and permissible rate of soil erosion, the districts namely Ernakulam, Idukki, Kollam, Kottayam, Kozikode, Mallapuram, Palakad, Thiruvananthapuram, Thrissur and Waynad are identified as vulnerable to soil erosion.



- (c) Ministry of Earth Sciences (MoES) has not implemented measures to improve soil quality for improving durability to heavy rains. However, Government of Kerala had published various information on Kerala soils and is available at

<http://www.keralasoils.gov.in/index.php/2016-04-27-09-26-39/soils-of-kerala#red-soils>

- (d) As per the latest IPCC reports, global warming is likely to continue and there is high probability for these extreme events to increase. The trends of various extreme weather events over Indian region are computed and are given in figures (1 & 2) in Annexure-I. It contains the ratio of severe cyclonic storm to the total cyclonic storms over the North Indian Ocean for the period 1891 to 2020 (Fig.1) and the trend of heavy rainfall events occurred during monsoon season (JJAS) for the period 1989 to 2018 (Fig.2).

- (e)-(f) 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 seasonwise 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.-3 in Annexure-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.-4 in Annexure-I)**
- The annual average Tropical Cyclone (TC) 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 TC 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.-5 in Annexure-I)**
- The TC 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.-5).**



- The annual average absolute error(AE) in the TC 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.-5)
- Probability of Detection (POD) for thunderstorm warning with 24 hr lead period is 86% in 2021 against 31% in 2016. (Fig.-6 in Annexure-I)
- Probability of Detection (POD) for thunderstorm warning with 3 hourly nowcast during March to June 2021 has been 79%.

Moreover, various new initiatives, as mentioned below, have been undertaken by IMD, MoES for betterment of prediction and dissemination of warnings of extreme weather events that may cause natural disasters.

1. The observational network of the department has been enhanced with installation of more number of Automatic Weather Stations (AWSs) and Automatic Raingauges (ARGs) across the country.
2. Thirty three Doppler Weather Radars (DWRs) are operational across the country with 4 DWRs being commissioned in January 2022 at New Delhi, Leh, Mumbai and Chennai. Doppler Weather Radars provide adequate warning in the event of approach of Cyclonic Storms, Monsoon Depressions, Thunderstorms etc. DWR network also provides vital information for nowcasting purposes on mesoscale convective weather developments anywhere in the country.
3. Multi-Mission Meteorological Data Receiving & Processing System has been established and dedicated to the nation for augmentation of satellite derived products.
4. 203 new rain gauge stations have been added in the District-wise Rainfall Monitoring Scheme taking the total number of stations to 4940.
5. Location specific forecast for 7 days and nowcast for next 3 hours have been extended to 1164 and 1089 stations respectively covering 739 districts in the country.
6. NWP Model based gridded rainfall data are provided to Central Water Commission for their flood forecasting model for all 153 river catchments and Extended Range model products for 10 river basins alongwith quantitative precipitation forecast for all river catchments valid upto next five days.
7. With operationalization of Flash Flood Guidance system, generation and issue of Flash Flood Guidance has commenced for all watersheds of the country.
8. Impact based forecast is already in practice for cyclone. The same is extended to heavy rainfall and heatwaves.
9. Common Alert Protocol (CAP) has been implemented as per WMO standard for severe weather warning. It is being utilized for Global Multi-Hazard Alert System of WMO.
10. The multi-model ensemble (MME) based Extended range prediction system and long range forecasting system have been developed and implemented in IMD.
11. IMD has launched seven of its services (Current Weather, Nowcast, City Forecast, Rainfall Information, Tourism Forecast, Warnings and Cyclone) with 'UMANG' mobile App for use by public. Moreover, IMD had developed mobile App 'MAUSAM' for weather forecasting, 'Meghdoot' for Agromet advisory dissemination and 'Damini' for lightning alert. The common Alert Protocol (CAP) developed by NDMA is also being implemented for dissemination of warning by IMD.



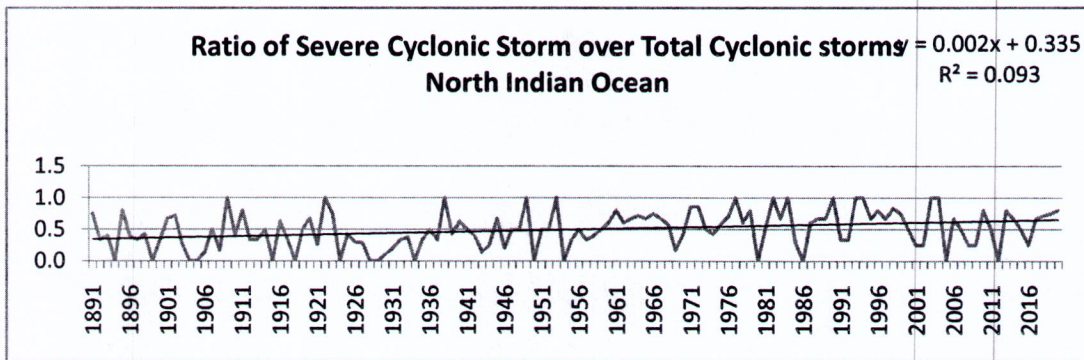


Fig.1. The time series of ratio of severe Cyclonic storms to total cyclonic storm over North Indian Ocean for the period (1891 to 2020).

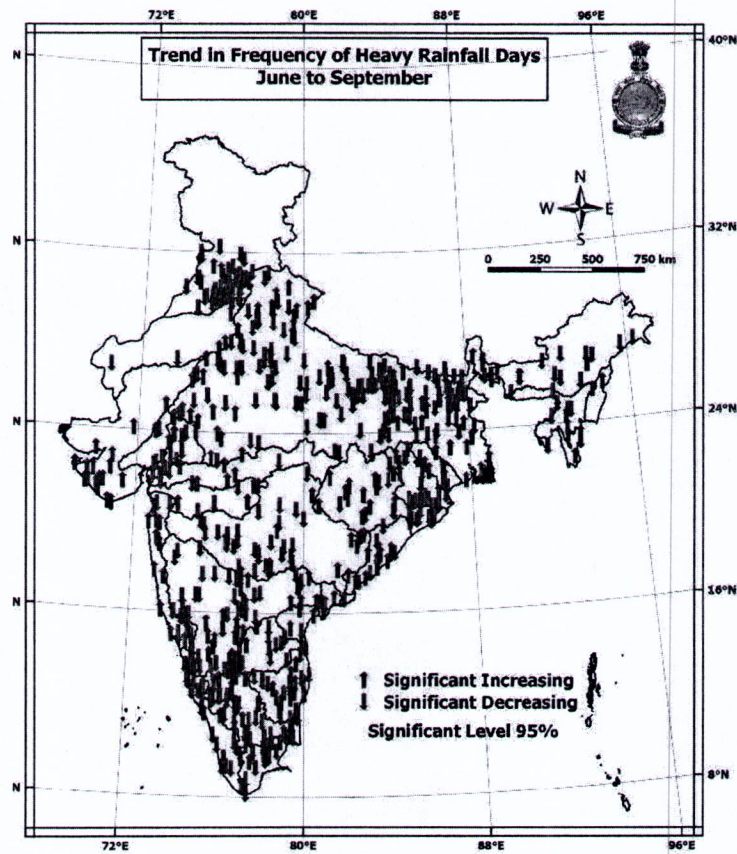


Fig. 2: Trend in Frequency of Heavy Rainfall Days during monsoon (JJAS) season for the period (1989-2018).

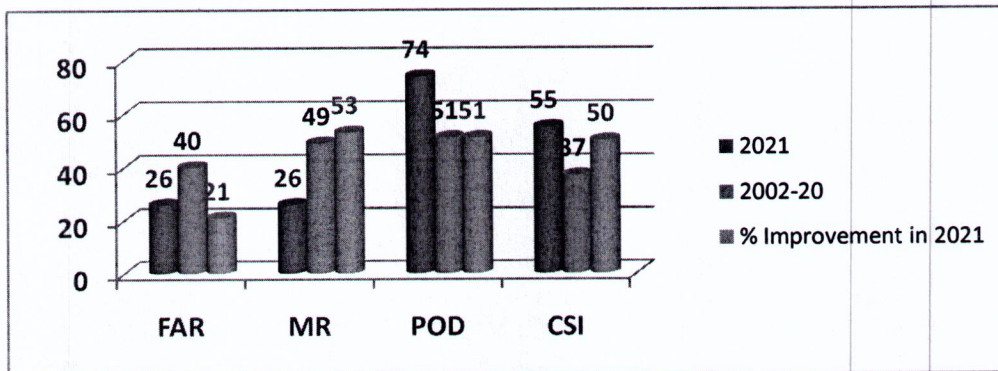
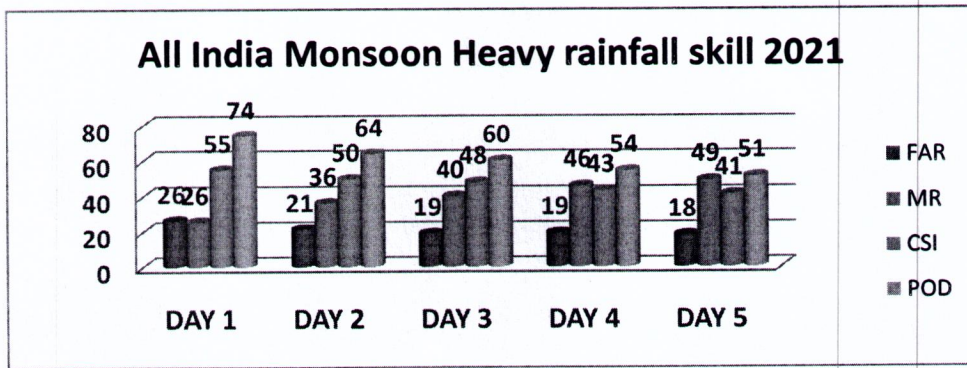


Fig. 3: Heavy rainfall warning skill during 2021(FAR (False Alarm Rate), MR(Missing Rate), PoD (Probability of Detection) and CSI (Critical Success Index).IMD has high skill for heavy rainfall warning upto Day 5 as POD for Day 5 is more than 50%.

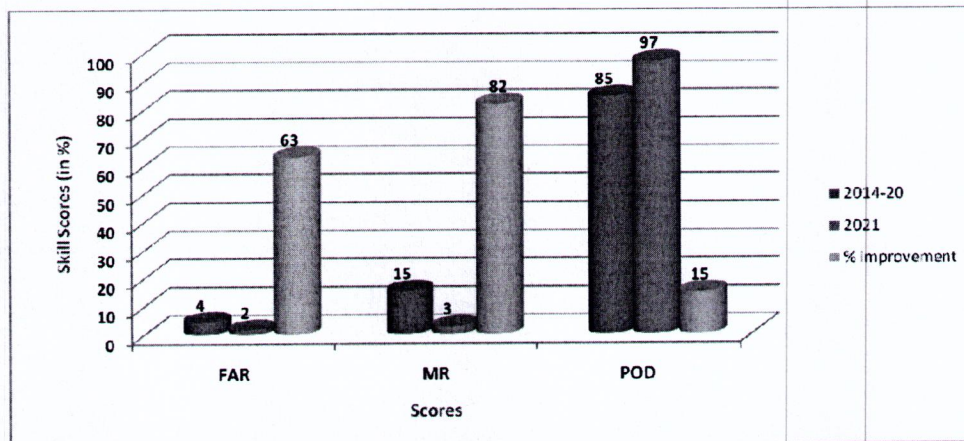


Fig.4: All India Summer months (April to June) 2021vs 2014-20 heat wave skill scores



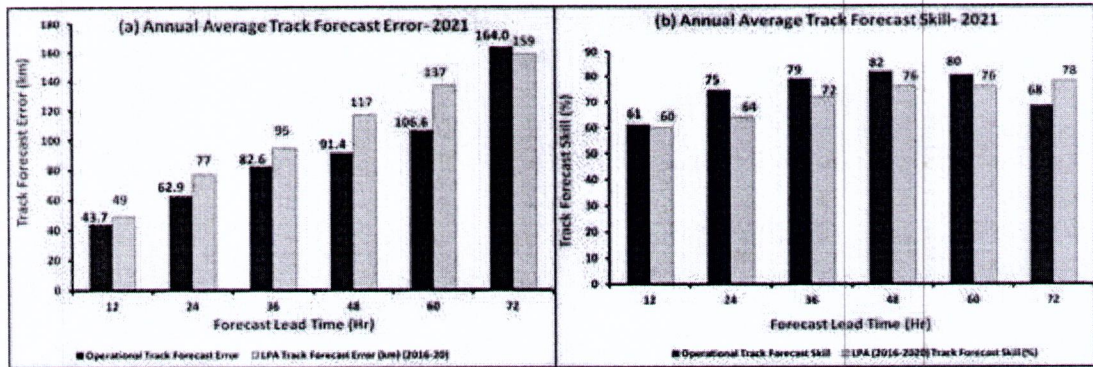


Fig.5: Annual average (a) track forecast errors (km) and (b) track forecast skill (%) during 2021 compared to long period average errors during 2016-20.

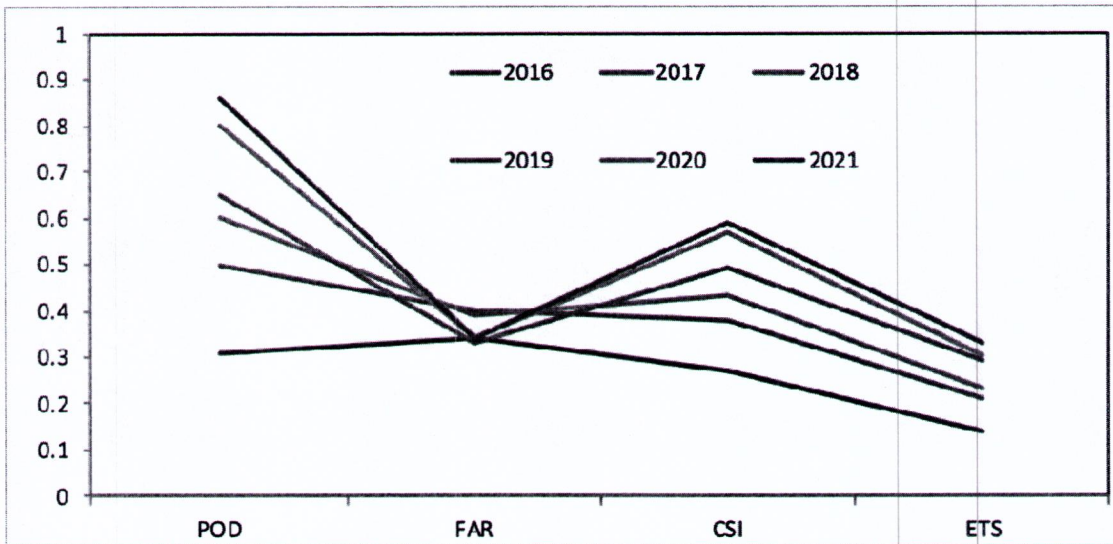


Fig.6: Skill Scores for 24 hr Thunderstorm forecast by IMD during past 6 years (2016 to 2021)

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