GOVERNMENT OF INDIA
MINISTRY OF EARTH SCIENCES
LOK SABHA
STARRED QUESTION NO. *272
TO BE ANSWERED ON FRIDAY, 6TH AUGUST, 2021

TROPICAL CYCLONES

*272. **SHRI SUBRAT PATHAK:**
SHRI CHANDRA SEKHAR SAHU:

Will the Minister of EARTH SCIENCES be pleased to state:

(a) whether the track and intensity forecasts of tropical cyclones have improved in the country during the last few years and if so, the details in this regard;
(b) whether the Government has made any assessment to analyse the benefits of the improved forecasts to the people living in tropical cyclone prone areas and if so, the details thereof;
(c) whether Indian Meteorological Department has also launched the Flash Food Guidance Services in the country;
(d) if so, the details of the locations at which infrastructure for such services has been set up in the country; and
(e) the further steps taken/being taken by the Government to improve the forecasts of natural calamities in the country?

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

(a)to (e): A Statement is laid on the Table of the House.

STATEMENT LAID ON THE TABLE OF THE LOK SABHA IN REPLY TO (a) to (e) OF STARRED QUESTION NO. *272 REGARDING "TROPICAL CYCLONES" TO BE ANSWERED ON FRIDAY, AUGUST 6, 2021

(a) Yes Sir. There has been a continuous improvement in the track & intensity forecasts of Tropical Cyclones over the Indian region during the last few years. Due to modernization programme of IMD and other initiatives of MoES, the improvement has been more significant since 2009. Also they were more perceptible in the past 5 years as described below.

(i) Track forecast: The annual average track forecast errors in 2020 have been 72 km, 85 km and 111 km, respectively for 24, 48 and 72hrs against the past five years average error of 80, 125 and 177 km based on data of 2016-2020. The errors have been significantly lower during last year (2020) as compared to long period average (2015-19) for all lead periods upto 120 hours.

Similarly, when we compare the track forecast errors of 2016-2020 against that of 2011 – 2015 as shown in **Fig.1.** There has been continuous improvement in track forecast accuracy with decrease in track forecast errors and increase in skill. The track forecast error has decreased from 97, 145 and 183 km during 2011-15 to 77, 117 and 159 km during 2016-2020 for forecast issued 24 hours, 48 hours and 72 hours ahead. Similarly, the skills of cyclone track forecast have improved from 49%, 63% & 69% during 2011-15 to 64%, 76% & 78% during 2015 to 2020 for forecast issued 24 hours, 48 hours and 72 hours ahead.

(ii) Landfall forecast: The annual average landfall point forecast errors for the year 2020 have been 18 km, 70 km and 43 km for 24, 48 and 72 hrs lead period against the long period average of past five years during 2015-19 of 47 km, 70 km and 110 km. The landfall point forecast error from 56 km ,94 km, 106 km during 2011-15 to 32 km, 62 km and 92 km during 2016-20 for forecast issued 24 hours, 48 hours & 72 hours ahead of landfall of cyclone.

Fig. 2 provides a comparison between 2016-2020 & 2011 – 2015.

(iii) Intensity forecast: The average absolute errors in intensity represented by the maximum sustained wind speed, during 2020 have been 7.1 nautical miles per hour (knots), 8.8 knots and 9.3 knots respectively for 24, 48 and 72 hrs lead period of forecast against the long period average errors of 8.9, 13.0 and 15.4 knots during 2015-19. One nautical mile per hour is equal to 1.86 kmph.
As regards improvement in intensity forecast over the past 10 years (**Fig.3**) there has been decrease in errors.

The intensity (wind) forecast errors have decreased from about 12, 17, 18 knots during 2011-2015 to 8, 11, 14 knots during 2016 to 2020 for the forecast issued 24, 48 and 72 hours ahead.

(b) Yes. Assessment on the benefit produced by the improvement in the Cyclone Early warning System as a whole has been conducted under the aegis of National Cyclone Risk Mitigation Project (NCRMP) by NDMA in collaboration with IMD.

As against the death toll of nearly 10,000 happened during the 1999 Odisha Super cyclone, the death toll in the recent years has reduced to less than 100 due to any cyclone crossing the coast as shown in the table below.

Year	Name of Cyclone	Death Toll
2010	Laila	6
	Phet	5
	Jal	54
2011	Thane	48
2012	Nilam	75
2013	Phailin	21
	Helen	6
2014	Hudhud	46
2016	Vardah	6
2018	Titli	78
	Gaja	45
	Phethai	8
2019	Fani	64
	Bulbul	41
2020	Amphan	98
	Nisarga	4
	Nivar	4
	Burevi	7
2021(Till date)	Tauktae	118
	Yaas	14

The death toll figures during 2010 – 2020 are depicted in the **Figure. 4**.

During extremely severe cyclonic storm Phailin of 2013 and Hudhud of 2014, actionable & accurate forecasts and a well coordinated approach by the Disaster Management Agencies made it possible to minimize loss of human lives to 21 & 46 respectively in Odisha and in Andhra Pradesh far below the thousands of fatalities in previous cyclones of similar intensity.

Similarly, during extremely severe cyclonic storm 'Fani', based on the IMD's accurate forecast of its track, landfall, and intensity and timely and adequate action by the concerned Disaster Managers led to reducing the number of fatalities to 64 people. With effective warning, fishing activities were suspended before the landfall and 200,000 fishermen were evacuated from the vulnerable coastal areas, resulting in zero casualty of fishermen.

During the Super Cyclone Amphan, among the surveyed households, about 74% reported to have moved to a safe shelter. The number of deaths could be reduced to 98 in West Bengal. In recent, extremely severe cyclonic storm "Tauktae" and very severe cyclonic storm 'Yaas' which crossed Gujarat and affected west coast states and Odisha-West Bengal respectively, the death toll could be reduced to 118 and 14 only.

Overall, the improvement in the Cyclone forecast skill is very much reflected in the reduced number of human casualties in recent years.

The improved cyclone warning which are provided to 13 other countries have also helped them to minimize the loss of the life & property.

An independent survey conducted by National Centre for Applied Economic Research in 2020 also indicated benefit to coastal population including fishermen.

(c)-(d) 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. 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. Around 30000 nos. of small watersheds of size varying from 10 – 16 sq.km have been delineated based on SRTM 30 meters digital DEM.

India Meteorological Department has highly advanced capabilities with respect to computing power, Numerical Weather Prediction, vast observational network (ground, air and space based), and an internationally acclaimed Weather Forecasting System. Therefore, WMO has entrusted India with the responsibility of Regional Centre of South Asia Flash Flood Guidance System for coordination, development and its implementation.

Guidance for flash floods in the form of Threats (6 hours in advance) and Risks (24 hours in advance) is provided by Regional Centre to National Meteorological & Hydrological Services, National and State Disaster Management Authorities and all other stake holders for taking necessary mitigation measures to reduce the loss of life and property in the Himalayan Region countries and Sri-Lanka. This enables all the member countries for issuing impact-based flash flood forecasting at watershed and also city level as per the following colour codes.

Low Probability	**<30% probability of flash flood occurrence**	
Moderate Probability	**30 - 60% probability of flash flood occurrence**	
High Probability	**> 60% probability of flash flood occurrence**	

This service was implemented on test basis in Monsoon 2020. After seeing its satisfactory performance, the South Asia Flash Flood Guidance System (SAFFGS) was launched in October 2020 and is operational now.

(e) It is being planned to further enhance the accuracy of weather forecasts and their more effective & timely dissemination in the ensuing years. For this purpose, under the Umbrella Scheme entitled 'Atmospheric & Climate Research – Modeling Observing Systems & Services (ACROSS), a sub-scheme has been planned viz., 'up gradation of Forecast services'. This along with further improvements in the observational network and numerical modeling capability as has been planned under ACROSS are also expected to increase the accuracy of weather forecasts.

Under the joint efforts with IMD & 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. The purpose of this tool is mainly for static pre-event planning and dynamic response (responding to a real-time cyclone) for cyclone prone States/UTs.

This system includes development of Probabilistic Risk Assessment Maps / Products (stochastic scenario based approach to Probabilistic Risk Modeling) for depiction of cyclone risk and storm surge flooding / coastal flooding vulnerability maps for the coastline of India. These products visualized through an interactive map viewer.

As a part of this project it is also envisaged to develop an App (the web-DCRA App) specifically meant for communicating with the users (Disaster managers and all other Stake holders including General public) to access the Cyclone warning related updates during the event while on move as well as to provide pertinent information related to mitigation activities.

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 is being enhanced with installation of more number of Automatic Weather Stations (AWSs) and Automatic Rain gauges (ARGs) across the country.
2. 27 Doppler Weather Radars are operational across the country to 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 raingauge 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 within the capital cities and nowcast for next 3 hours have been extended to 526 and 1084 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.
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. Efforts are on to extend the same to all types of severe weather.
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.

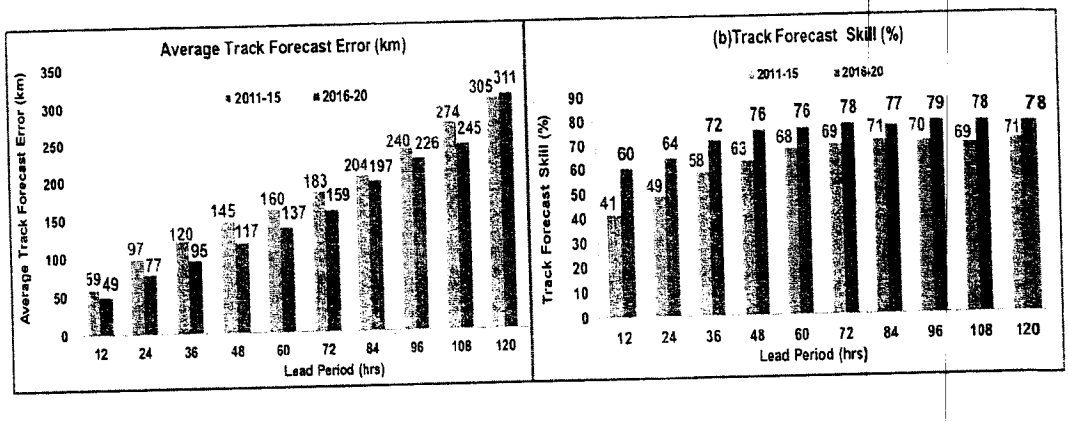

Fig.1: Comparative Average track forecast (a) error and (b) skill during 2016-2020 vis-à-vis 2011-2015

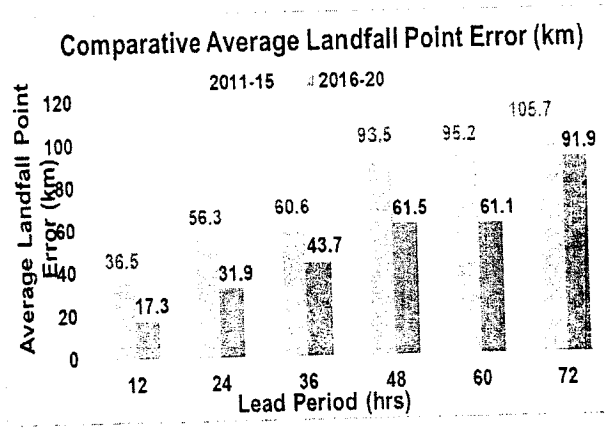

Fig. 2: Comparative Average landfall point forecast errors during 2016-20 vis-à-vis 2011-15

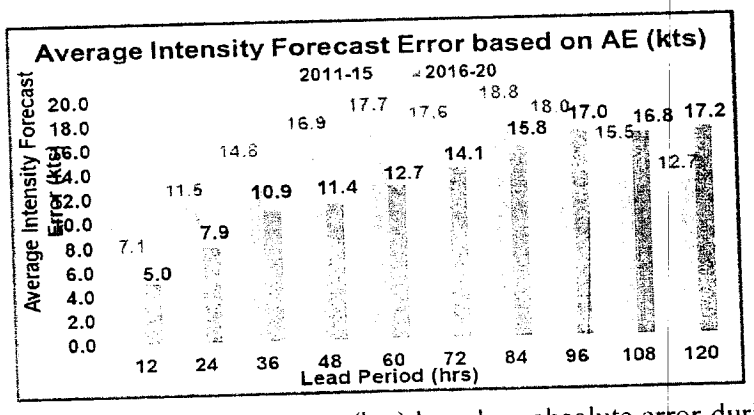

Fig.3.Comparative Average Intensity forecast errors (kts) based on absolute error during 2016-20 vis-à-vis 2011-15.

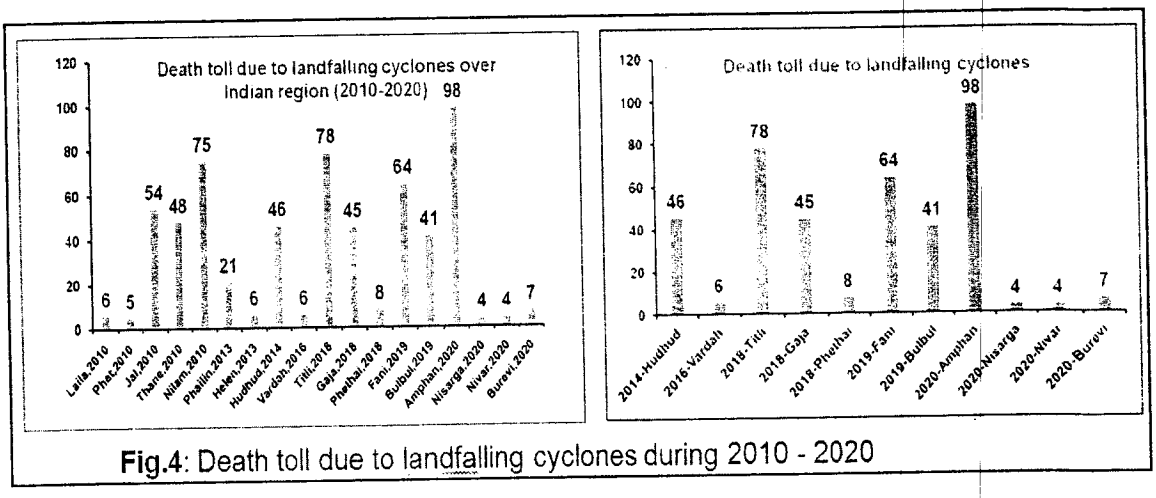

Fig.4: Death toll due to landfalling cyclones during 2010 - 2020

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