GOVERNMENT OF INDIA
MINISTRY OF EARTH SCIENCES
RAJYA SABHA
UNSTARRED QUESTION NO. - 4026
ANSWERED ON – 07/04/2022

CYCLONES IN MAHARASHTRA

4026. DR. VIKAS MAHATME:

Will the Minister of EARTH SCIENCES be pleased to state:

(a) the number of cyclones that have affected the State of Maharashtra in the past five years;
(b) the economic loss, property damage as well as loss of life that occurred in the past five years due to cyclones in Maharashtra;
(c) the details of victims identified, compensation given till date and rehabilitated by Government in Maharashtra; and
(d) steps that have been taken by Government to mitigate the impact of cyclones and initiatives taken to reduce the loss of life and property to minimal, the details thereof?

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

(a) During the period 2017-2021, one severe cyclonic storm Nisarga crossed Maharashtra coast close to south of Alibag on 3rd June, 2020 and another cyclone viz. Extremely severe cyclonic storm Tauktae (14-19 May, 2021) passed close to Maharashtra and affected Goa and south coastal Maharashtra during 15th -16th and north Maharashtra during 16th -17th.

The salient features of these systems along with their tracks are given in Annexure.

(b) The details of damage etc. due to above systems follow:

Damage due to Nisarga:

- A joint survey conducted by the National Fishworkers' Forum and Maharashtra MachhimarKritiSamiti has recorded extensive damage to plantations, houses and fishing boats incurring loss of about Rs 1,000 crore in the coastal districts of Raigad and Ratnagiri. But, timely warning and evacuation helped to save lives.

- Impact on Fishermen: The damages to fishing boats alone was about Rs 25 crore.

- Impact on Farmers: People living along the coast of Raigad and Ratnagiri have suffered huge losses. Majority of the houses went roofless and some houses suffered wall and slab collapse. A large number of plantations of coconut, betel, mango were flattened.

- Official survey by the Raigad district collector has estimated Rs 200 crore losses due to Cyclone Nisarga in 13 Tehsils of the district. These include damages to 1.4 lakh houses, 1.6 lakh trees uprooted, and over 20,000 hectares farmland affected. (SOURCE: - Gaon connection dated 18th June, 2020)

Damage due to cyclone Tauktae:

- Ten districts of Maharashtra were impacted due to Tauktae. About 1576 houses were damaged in Maharashtra.
- Train services were suspended due to flooding and fallen trees on tracks, which were blocking routes.
- Two barges were adrift off the coast of Mumbai due to the cyclone, containing about 400 people.
- The Chhatrapati Shivaji Maharaj International Airport was shut for over 11 hours with 55 flights cancelled and several flights routed to other cities.
- The Wankhede Stadium also experienced major damage due to a 16 ft (4.9 m) sightscreen of the North Side being damaged by powerful winds.
- In Raigad district alone around 800 homes were damaged.
- In Kokan region (Maharashtra's costal area) around Rs 500 Crores of worth Alphanso crops were damaged.
- The Bandra–Worli Sea Link was closed because of strong winds.
- It was the most powerful storm to affect Mumbai since Cyclone Nisarga in 2020.
- The Government of Maharashtra approved a compensation of ₹252 crore towards the losses due to 'Tauktae'.

(c) Details not available with IMD. However, as per media reports about 6 persons lost their lives due to Cyclone 'Nisarga' and 19 persons due to Cyclone 'Tauktae'. Compensation to the affected are coming under the purview of State Government and this ministry doesn't keep a centralised information in this regard.

(d) IMD has the responsibility to issue early warning for cyclones over North India Ocean.

IMD has one of the best Early Warning Services in the world related to Cyclones.IMD has demonstrated its capability to provide early warning for Cyclones with high precision. As a result, the vulnerable population gets evacuated from the damage prone areas in a timely manner to safe shelters thereby reducing the human death toll to a bare minimum, in the recent years. It is noteworthy that death due to cyclones has been reduced to less than 100 in recent years.

IMD has continuously expanded its infrastructure for meteorological observations, data exchange, monitoring & analysis, forecasting and warning services using contemporary technology. IMD uses a suite of quality observations from Satellites, Radars and conventional & automatic weather stations for monitoring of cyclones developing over the Bay of Bengal and Arabian Sea. It includes INSAT 3D, 3DR and SCATSAT satellites, Doppler Weather Radars (DWRs) along the coast and coastal automated weather stations (AWS), high wind speed recorders, automatic rain gauges (ARGs), meteorological buoys and ships.

IMD has best forecasting systems for predicting tropical cyclones using high resolution advanced mathematical models (including global, regional and cyclone specific models) for predicting tropical cyclones crossing both west and east coast of India and associated adverse weather over India.

IMD has a very effective Decision Support System for analyzing various observations at a single platform and predicting track and intensity of cyclones as well as the adverse weather like heavy rain and wind. IMD also utilizes storm surge and coastal inundation models and wave models output from Indian National Centre for Ocean Information Services (INCOIS), Hyderabad) for issuing storm surge warning.

IMD has a well-defined Standard Operation Procedure for monitoring & forecasting the cyclones and issue related warning. The Cyclone Warning Division (CWD) at IMD, New Delhi acts as a Regional Specialised Meteorological Centre for monitoring, predicting and issuing warning services on tropical cyclones developing over north Indian Ocean. It also carries out research on track, intensity, landfall and adverse weather associated with cyclones like heavy rainfall, gale wind and storm surge monitoring and prediction.

IMD has three Area Cyclone Warning Centres at Chennai, Kolkata & Mumbai and four Cyclone Warning Centres at Ahmedabad, Bhubaneswar, Thiruvananthapuram and Visakhapatnam for carrying out operational warning activities at state level and to carry out related research & development activities. There is a Cyclone Warning Research Centre at IMD Chennai to carry out the research on tropical cyclones.

To support the Disaster Management Authorities, there are continuous efforts towards vulnerability assessment & resilience building related to cyclones. Towards this, the Government of India (GoI) has initiated the National Cyclone Risk Mitigation Project (NCRMP) with a view to address cyclone risks in the country. The overall objective of the Project is to undertake suitable structural and non-structural measures to mitigate the effects of cyclones in the coastal states and UTs of India. National Disaster Management Authority (NDMA) under the aegis of Ministry of Home Affairs (MHA) will implement the Project in coordination with participating State Governments and the National Institute for Disaster Management (NIDM). The Project has identified 13 cyclone prone States and Union Territories (UTs), with varying levels of vulnerability.

The main objective of the NCRMP is to reduce vulnerability of coastal communities to cyclone and other hydro meteorological hazards through

- Improved early warning dissemination systems
- Enhanced capacity of local communities to respond to disasters
- Improved access to emergency shelter, evacuation, and protection against wind storms, flooding and storm surge in high areas
- Strengthening Disaster Risk Management (DRM) capacity at central, state and local levels in order to enable mainstreaming of risk mitigation measures into the overall development agenda.

Also, under this programme, there are efforts to provide a more precise quantitative assessment of the likely impacts of cyclones over the coastal belt, via a Web-based decision support system called Web – DCRA (Dynamic composite Risk Atlas). This has been developed jointly by India Meteorological Department / MoES and National Disaster Management Authority (NDMA), MHA under the National Cyclone Risk Mitigation Project (NCRMP) for 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.

Apart from NCRMP, the GoI also has set up various committees to develop processes & procedures for Hazard resilience development. The Bureau of Indian Standards (BIS) is also working towards the design aspects of cyclone resilient infra-structures as well as cyclone shelters over the coastal regions.

ANNEXURE

The salient features of the Nisarga system were as follows:

i. It was the first cyclonic storm over the AS during 2020. The last cyclone, which crossed Maharashtra coast was cyclonic storm, Phyan which crossed coast on 11th Nov., 2009. Prior to the SCS, Nisarga, an SCS crossed Maharashtra coast on 24th May, 1961. It was also the fourth cyclone crossing Maharashtra coast during the 1961-2020 .

ii. It had a clockwise recurving track as it moved initially northwards till 1200 UTC of 2nd June and thereafter recurvednortheastwards. The total track length of the system was 1294 km. It was mainly steered by an anticyclonic circulation in middle & upper tropospheric levels to the east of the system centre. 2

iii. .It moved with a 12-hour average translational speed of 15.8 kmph against the Long Period Average (LPA-1990-2013) of 10.5 kmph for SCS category over the AS during monsoon season.

iv. The peak MSW of the cyclone was 110-120 kmph (60 knots) gusting to 130 kmph (70 knots) during 0600 UTC of 3 rd to 0900 UTC of 3 rd June over the Eastcentral AS. The lowest estimated central pressure was 984 hPa during the same period.

v. The system crossed Maharashtra coast close to south of Alibag near 18.35ºN/72.95ºE, as an SCS with maximum sustained wind speed of 110-120 kmph (60 knots) gusting to 130 kmph (70 knots) between 1230-1430 hrs IST (0700-0900 UTC) of 3rd June.

vi. The system maintained the cyclonic storm intensity for almost 7 hours after landfall till 1500 UTC of 3rd June.

vii. The life period **Depression to Depression** (**D to D**) of the system was 84 hours (3 days & 12 hours) against long period average (LPA) (1990-2013) of 85 hours (3 days & 13 hrs) for SCS category over the AS during monsoon season.

viii. The Velocity Flux, Accumulated Cyclone Energy (a measure of damage potential) and Power Dissipation Index (a measure of loss) were 2.65 X102 knots, 1.21 X 104 knots2 and 0.58 X106 knots3 respectively against the long period average during 1990-2013 of 2.12 X102 knots, 1.4 X 104 knots2 and 1.0 X106 knots3 respectively for tropical cyclones over the AS during monsoon season.

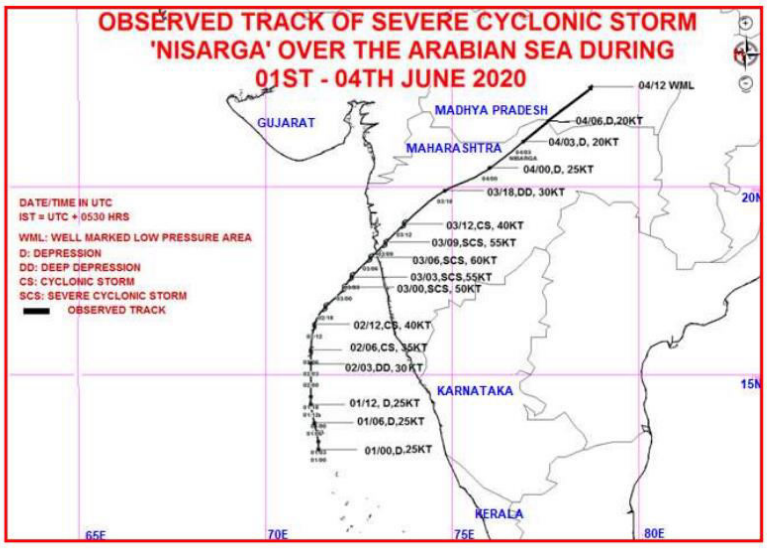

Fig. 1: Observed track of Severe Cyclonic Storm "NISARGA" over the east\central and adjoining southeast Arabian sea during 1st-4 th June, 2020)

The salient features of the Tauktae system were as follows:

i. TAUKTAE was the first CS over the north Indian Ocean during the year 2021.

ii. During satellite era (1961-2021), Tauktae was the most intense cyclone after Kandla cyclone in 1998. The cyclone Tauktae had the same intensity as that of Kandla cyclone of June, 1998 at the Page 2 of 65 time of landfall as both had maximum sustained surface wind speed of 160-170 kmph gusting to 185 kmph at the time of landfall. However, life time maximum intensity was higher in case of Tauktae, as it had the maximum intensity of 180-190 gusting to 210 kmph over the east-central Arabian Sea during early morning to afternoon of 17th May 2021.

iii. Tauktae was a very rare cyclone causing adverse weather and damage over entire west coast states and Union Territories and Lakshadweep as it moved parallel to west coast and crossed Gujarat.

iv. It had a longer period of the impact of cyclone intensity over Gujarat (about 24 hrs from 1730 IST of 17th to 1730 IST of 18th May).

v. The track length of the cyclone was 1880 km.

vi. It had rapid intensification for about 24 hrs period during 16th morning (0530 IST/0000 UTC) to 17th morning (0530 IST/0000 UTC), with increase in maximum sustained wind speed (MSW) from 65 knots at 0530 IST of 16th to 100 knots at 0530 IST of 17th.

vii. The peak MSW of the cyclone was 180-190 kmph (100 knots) gusting to 210 kmph during 0530 IST (0000 UTC) 0f 17th to 1130 IST (0600 UTC) of 17th over the EC AS. The lowest estimated central pressure (ECP) was 950 hPa during the period with a pressure drop of about 50 hPa at the centre as compared to the surroundings.

viii. The life period **D to D** of the system was 129 hours (5 days & 9 hours) against long period average (LPA-1990-2013) of 165 hours (6 days & 21 hrs) for VSCS categories over the Arabian Sea during pre-monsoon season.

ix. It moved with 12-hour average translational speed of 14.4 kmph against LPA (1990-2013) of 11.8 kmph for VSCS category over Arabian Sea during pre-monsoon season.

x. The Velocity Flux, Accumulated Cyclone Energy (a measure of damage potential) and Power Dissipation Index (a measure of loss) were 10.6 X102 knots, 7.7 X 104 knots2 and 6.11 X106 knots3 respectively.

xi. The operational track forecast errors for 24 and 48 hrs lead period were 73 and 113 km respectively against the average long period average (LPA) track forecast errors of 77 and 117 km during last five years (2016-20) respectively.

xii. The operational absolute error (AE) of intensity (wind) forecast for 24 and 48 hrs lead period were 4.4 and 8.9 kt against the LPA of 7.9 and 11.4 kt respectively.

xiii. The operational landfall point errors were 27 and 71 km for 24 and 48 hrs lead period against LPA of 32 and 62 km.

xiv. The operational landfall time errors were 3.5 hrs and 6.5 hrs for 24 and 48 hrs lead period against LPA of 2.5 hrs and 5.0 hrs.

xv. As the cyclone moved parallel to west coast, it caused heavy to extremely heavy rainfall activity, strong wind and tidal waves affecting Lakshadweep on 13th -14th, Kerala on 14th - 15th, Karnataka on 15th, Goa and south coastal Maharashtra on 15th -16th, north Maharashtra on 16th -17th, Gujarat, Daman & Diu, Dadra & Nagar Haveli on 17th and 18th. It's remnant also impacted northwest India with heavy to very heavy rainfall activity at isolated places over Rajasthan, Haryana, Chandigarh, Delhi, Uttar Pradesh, Uttarakhand on 19th May 2021.

xvi. It also caused strong winds along the west coast of India as well as over Lakshadweep. Agathi reported maximum sustained wind speed of 45 kts on 14th May, Panaji reported 46 kts on 16th, Diu reported 85 kts on 17th .

xvii. A total of 41 national bulletins, 30 RSMC bulletins to WMO/ESCAP Panel member countries, 9 Press Releases, 15 hourly bulletins on the day of landfall, 18 bulletins for International Civil Aviation, 83 lakh SMS to fishermen, farmers & coastal population, very frequent updates on social networking sites were sent to trigger mass response and sensitize masses about the impending disaster in association with the system.

xviii. While 3 hourly bulletins were issued commencing from cyclone stage, hourly updates were provided on the day of landfall.

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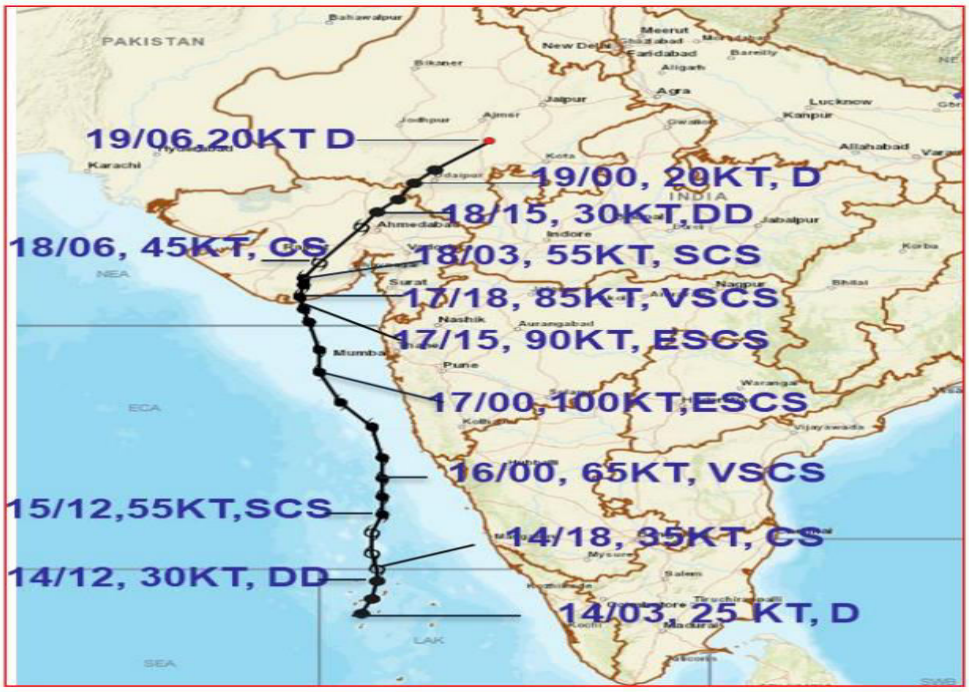

Fig.1: Observed track of ESCS TAUKTAE during 14th -19th May, 2021

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