

Disaster Risk Management during Cyclone Nisarga in Mumbai, India

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Abstract- India is disaster prone zone where various hydrological and meteorological disasters takes place at different regions. But due to climate change, frequency and intensity of natural disaster have increased. For disaster risk reduction in India, the National Disaster Management Authority of India had set up under National Disaster Management Act 2005, for developed disaster preparedness and emergency protocols. Disaster warning is important for disaster preparedness for such a big metro city like Mumbai. Mumbai is generally safe for cyclone and last severe cyclonic storm to hit close to Mumbai was in the month of June 2020 since 1891.

An area of low pressure developed over the Eastern Arabian Sea on May 31, 2020 and remained as a well marked low pressure area over the same region till the evening of same day, red warning was issued by the Indian Meteorological Department (IMD), for Maharashtra, while several districts along Gujarat's coast are also expecting heavy rainfall. The Union Home Ministry held a meeting with disaster management department and response forces for minimize the impact of cyclone on society. The central and state government departments had evacuate the hazard prone area before the landfall of cyclone and got success to minimized the impact of cyclone. In this paper covered the steps taken by disaster management authorities, losses due to cyclone and coordination between the various department for minimize the impact of cyclone on Mumbai and set an unforgettable example for disaster risk management in India.

Keywords: Disaster risk mitigation, Cyclone Nisarga, landfall, evacuate, early warning

1) INTRODUCTION

National Disaster Management Plan (2016) India has aligned its National plan with the Sendai Framework for Disaster Risk Reduction for year 2015-2030, to which India is a signatory. The objective of the plan is to make India disaster resilient, achieve substantial disaster risk reduction. Due to climate change, frequency and intensity of natural disaster have increased. Every part of India is facing the natural hazard and extreme weather condition. Mumbai also affected by several extreme weather condition with

hydrometeorological disasters such as flood, high tide, water logging and now Cyclone which affected the Mumbai after the year 1891.

Mumbai (old name Bombay), the economical capital; most populated city of India as well as 4th most populated city in the world and capital of Maharashtra. First human evidence deduced from the time of stone age^{1&2}. Mumbai is built by connecting of old seven Island, i.e. Colaba, Little Colaba (Old Woman's island), Island of Bombay, Mazagaon, Parel, Worli and Mahim³. The Bombay were planned to developed as major seaport at Western-Central India, under the Hornby Vellard project⁴, for business from western & gulf countries and joined all the seven island by filling of sea⁵ during the mid-18th century. Accordingly, Bombay developed as economical & educational hub of India in the 19th century.

Due to economical & education hub, Mumbai infrastructure as well as population has been increases at rapid rate, now the population density of Mumbai is about 73,000 per square mile. In Mumbai, more than 60% population lives in slums, with no running water and drainage. Many people travels in public transport and approximate 6 million people are traveling through local train transport in a day.

Climatically Mumbai is falling under tropical zone having wet and dry weather with moderately hot & high humidity percentage. The average temperature is about 27-28° C and normal annual rainfall varies between 1800 millimetre (mm) to 2400 mm. The Mumbai have varying topographical features, most of area is flat and Mumbai is surrounded by north-south trending hill range, coastal area and having creeks. Mahim river, Mithi river, Palsar and Dahisar river with Pawai, Vihar & Tulsi lake are major water bodies in Mumbai. Apart from these water bodies Thane creek, Manori, Malad & Mahim creek are present and increases the mud flanges and swamps at main land area. Geologically Mumbai is make up of Basaltic lava flow, which dipping towards west about 10°-20°. Mr Sethna S F (1999)⁷ has identified seven distinct lava flows in different time period from Upper Cretaceous to lower Eocene (60 to 50 million years). Basalt, Volcanic breccia, Rhyolite,

Trachytes, shale are the main rocks exposed at various location in Mumbai.

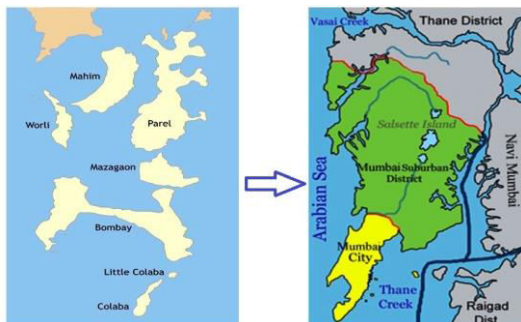


Fig 1: Seven Island modified into present Mumbai (After⁶).

2) DISASTER RISK MANAGMENT

Disaster Management can be defined as the organization and management of resources and responsibilities for dealing with all humanitarian aspects of emergencies, in particular preparedness, response and recovery in order to lessen the impact of disasters. Disaster management is a multidisciplinary activity involving a number of departments/agencies spanning across all sectors of development. Emergency managers think of disasters as recurring events with four phases: Mitigation, Preparedness, Response, and Recovery. The National Disaster Management Authority of India, set up under National Disaster Management Act 2005, has developed disaster preparedness and emergency protocols. It would be imperative for the civil administration at the state and district levels in India to develop their disaster management plans using these protocols and guidelines. On 23 December 2005, the Government of India enacted the Disaster Management Act, which envisaged the creation of National Disaster Management Authority (NDMA), headed by the Prime Minister, and State Disaster Management Authorities (SDMAs) headed by respective Chief Ministers, to spearhead and implement a holistic and integrated approach to Disaster Management in India. A systematic flow chart for acting on disaster management is shown in figure 2 and process follow from top to bottom. Disaster management cell is controlled by Home Ministry, government of India and policies/instructions are passed accordingly.

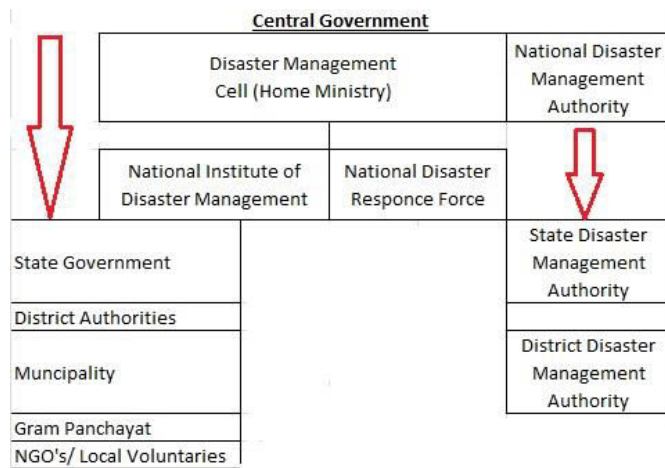


Figure 2: Systematic flow chart for disaster management department in India.

Organisations and Policies related to Disaster Management Framework at National level are discussed below:

I) National Disaster Management Authority of India (NDMA)

It was established in 2005, under the Disaster Management Act 2005. The objective of NDMA is, to build a safer and disaster resilient India by a holistic, proactive, technology driven and sustainable development strategy. The NDMA is chaired by the Prime Minister of India and has a vice chairman with the status of Cabinet Minister and eight members with the status of Ministers of State. The NDMA Secretariat is headed by a Secretary and deals with mitigation, preparedness, plans, reconstruction, community awareness and financial and administrative aspects.

II) National Disaster Management Plan (NDMP)

It was released in 2016, it is the first ever national plan prepared in the country for disaster management. With National Disaster Management Plan (2016) India has aligned its National plan with the Sendai Framework for Disaster Risk Reduction 2015-2030, to which India is a signatory. The objective of the plan is to make India disaster resilient, achieve substantial disaster risk reduction. It aims to significantly decrease the losses of life, livelihoods, and assets in terms of economic, physical, social, cultural, and environmental. To maximize the ability to cope with disasters at all levels of administration as well as among communities.

III) State Disaster Management Authority (SDMA)

At State level, State Disaster Management Authorities are established under Disaster Management Act 2005. SDMA is chaired by the Chief Minister of the State and has not more than eight members who are appointed by the Chief Minister. The SDMA prepares the state disaster management plan and implements the National Disaster Management Plan.

IV) District Disaster Management Authority (DDMA)

Under Disaster Management Act 2005, every State government shall establish a DDMA for every district in the State. The DDM Authority shall consist of:

- **Chairperson** - the Collector or District Magistrate or Deputy Commissioner act as Chairperson of DDMA.
- **Co-Chairperson** - is the elected representative of the local authority. In the Tribal Areas, the Chief Executive Member of the district council of autonomous district is the co-chairperson.

There are not more than seven other members in DDMA. The Disaster Management Committee governed under District Magistrate will formulate village level disaster management plans for concern villages. The DDMA makes District Disaster Management Plan and implements the state Disaster Management Plan.

2.1 Disaster Risk Management Plan for Mumbai

Mumbai is a coastal city and occasionally affected by water logging due to rainfall and high tide in sea. Flood is the main natural disaster and affected in year 2005 and year 2017. As a highly vulnerable city to major natural disasters, Mumbai has experienced several major extreme weather events within the past decade that have effectively brought the city to a standstill and caused severe human and economic losses. In response to the growing need for a contingency plan, the city of Mumbai drafted the Disaster Risk Management Master Plan that outlines the city's commitment to mitigating future risk and damages that could potentially result through future natural disasters.

Building upon the 2005 Disaster Risk Management Plan (DRM,) Mumbai released an updated and more comprehensive disaster relief and emergency operations plan in 2010. Since the city of Mumbai is an extremely vulnerable city to major flooding events, the 2005 Disaster Relief Management plan focused largely on efforts related to flood control.

Massive public works projects were established to

help reduce the risk of the city to future floods and the consequences of such events. The plan also outlined steps to protect human health before, during and after these extreme weather events to help combat the spread of communicable diseases around the city. In addition, the plan also included the enhancement of advanced monitoring and warning systems that would alert Mumbai's population of nearly 13 million of impending disasters.

Municipal Corporation of Greater Mumbai has prepared the Disaster Risk Management plan with following aim:

- EVALUATE the physical and socio-economic impacts of hazards
- ACQUIRE the competency to plan for and effectively manage emergencies
- DETERMINE a series of options to reduce risks
- DEVELOP a coherent approach to managing the overall risk
- ASSESS risk scientifically
- IMPROVE coordination among stakeholders
- ENHANCE capacity building

State government has prepared the Stander Operating Processor (SOP) with list of activities to be do and not to done by local public, which circulated in hazards prone area for public safety.

3) CYCLONE NISARGA

Mumbai is generally safe for cyclone and last severe cyclonic storm to hit close to Mumbai was in the month of June since 1891. An area of low pressure developed over the Eastern Arabian Sea on May 31, 2020 and remained as a well marked low pressure area over the same region till the evening of same day. It strengthened into a depression over east-central and south-east Arabian Sea in the early morning the of June 01, 2020 when it was centred about 340 km south-west of Goa, 630 km south-southwest of Mumbai and 850 km south-southwest of Gujarat⁸. Its eye (the region of calm at the centre of a cyclonic storm) was about 80km in diameter, it was every bit the severe cyclonic storm that the states were bracing for. However, cyclones tend to lose speed the more they travel inland, and by June 03, 2020 night, Nisarga made its way towards Pune and was headed in the north-east direction towards Madhya Pradesh at a speed of 60-70kmph.

Around afternoon on 2 June, the deep depression intensified into a cyclonic storm and thereby receiving the name Nisarga⁹. At 12:30 IST (07:00 UTC) June, 03, 2020, Nisarga made landfall near the town of Alibag, at peak intensity¹⁰ and recorded a wind speed of 102 km/h (63 mph), while

nearby Murud-Janjira seen a wind speed of 111 km/h (69 mph) as the Cyclone was strongest at its south southwest section. Path of cyclone Nisarga is shown in figure 3.

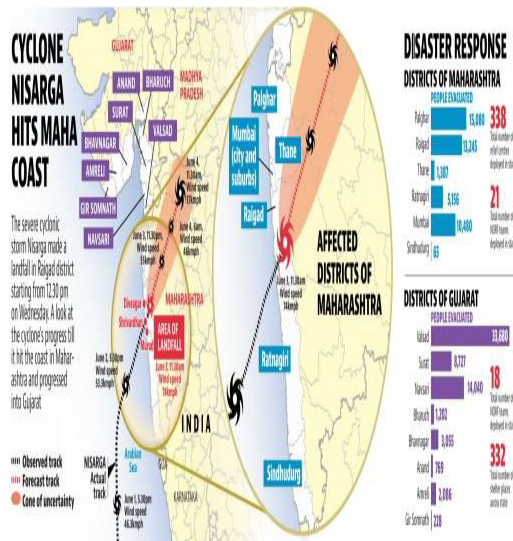


Fig 3: Path of cyclone Nisarga¹⁰

3.1 Preparedness

The Indian Meteorological Department (IMD) has issued a red alert for at least seven coastal districts of Maharashtra, while several districts along Gujarat's coast are also expecting heavy rainfall and the Union Home Minister Amit Shah, held a preliminary review meeting with officials of National Disaster Management Authority, National Disaster Response Force (NDRF), India

Meteorological Department and the Indian Coast Guard on June 01, 2020. On the same day, 33 team of NDRF were deployed in the coastal region of both the state. Fishermen from Maharashtra were alerted to return back from the sea. The Prime Minister of India Shri Narendra Modi on 2 June 2020, assured to Chief Minister of Maharashtra, Chief Minister of Gujarat and Administrator of Dadra and Nagar Haveli and Daman and Diu while assuring all possible support and assistance from the Central Government. As a precaution, 100,000 people were evacuated ahead of the storm.

For preparedness of this Cyclone, Central and state government had deputed the Indian Navy and 15 teams of the NDRF, SDRF were deployed in coastal areas of Maharashtra, including Mumbai. They evacuated about 45000 locals out of danger zone in Mumbai and 100000 from coastal area of Maharashtra, Airport secures assets and several flights were canceled and Mumbai airport was suspended for 3 hours. State government of Maharashtra had issued the SOP and list of activities 'Do's and Don't' for safety of public and circulated in public via media, news paper, advertise and social media.

A day before Cyclone Nisarga hits Mumbai, the Police Commissioner of the city issued curfew

orders under Section 144 of the CrPC restricting any presence or movement of persons in public places along the coast like beaches, promenades, parks and other such places near the coastline to prevent loss of life and property. The prohibitory orders remain in effect from midnight today till 12 noon on Wednesday.

Teams of NDRF, SDRF, Indian coast guard and Indian Navy were near the coast for saving the life from any accident. Some person were evacuated from shelter homes due to water logged in that area.

3.2 Impact of Cyclone Nisarga

On the June 03, 2020 morning, the cyclone Nisarga landfall process has begun near Alibaug with speed of 110-125 km/h winds; which is about 50 km away from Mumbai city, as the cyclonic cycle lays centred over East central Arabian Sea near LAT. 18.1°N and Long. 72.8°E lies very close to Raigad coast. Mumbai, which is on the path of the cyclone, saw heavy showers and is likely to receive very heavy rainfall upwards of 164 mm. A predicted storm surge of about 1-2 metre height above astronomical tide into inundate low lying areas of Mumbai, Thane and Raigad districts and 0.5-1 metre height above the astronomical tide is likely to inundate low lying areas of Ratnagiri district during the time of landfall.

As per state government, 70 tree-branch fall, six wall collapsed and nine short circuit incidents reported in Mumbai. No one sustained any injury in these incidents due to cyclone Nisarga. Power supply to more than 25 lakh consumers of Maharashtra State Electricity Distribution Company (MSEDCL) in four districts of Raigad, Palghar, Thane and Pune has been interrupted due to the cyclone Nisarga. The state utility cut the power supply to many substations in these districts as precautionary measure.

Cyclone Nisarga and its accompanying rains seem to have had a positive impact on Mumbai overall air quality index, which improved to 17 on June 03, 2020, the best reading for this year as of now. The current air quality of Mumbai recorded at noon falls in the good category, that poses little or no health risk, according to the official website of the System of Air Quality and Weather Forecasting and Research (SAFAR). Maharashtra Chief Minister had visited personally the affected area and granted the relief package.

4) CONCLUSION

As per government monitoring, planning and execution for mitigate the impact of Cyclone Nisarga, showing the full coordination and best live example of Disaster risk management. As IMD had issued the warning in sufficient time. The team of

NDRF, SDRF and Indian Navy had taken the relief action before disaster. Various Security persons, Coast guard, NDRF team were at affected area for quick response. After the cyclone passed, the disaster mitigation team had cleared the roads and connectivity by cutting fallen trees and provides food, shelter homes for needed person. Later on State government had approved the relief package. It was best live example disaster management.

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