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Chapter 2

Cyclone disaster in India, mitigation and their impacts

Desastre ciclónico en India, mitigación y sus efectos

Sahdev, [1,*] Dr. Bharat Lal Sahu, [2] Dr. Shobhana Ramteke [3]

[1, 3] School of Studies in Environmental Science, Pt. Ravishankar Shukla University, Raipur, Chhattisgarh – 492010

[2] Department of Chemistry, Guru Ghasidas Vishwavidyalaya (A Central University), Bilaspur, CG, India

Email - *sahdevsahurkb@gmail.com

ABSTRACT

The problem of the cyclone is arising in the coastal areas of India. If we look at the history of the cyclone, from 1999 to 2021, it has caused a lot of devastation; it remains a threat to the lives of people located on the coast. The cyclone has caused a lot of loss of population so far. It caused damage to homes, farms, animals, and plants. The cyclone-affected areas are- Odisha, West Bengal, Andhra Pradesh, Tamil Nadu, Kerala, Karnataka, Maharashtra, and Gujarat. People have also lost their lives due to the cyclone in these states. In this review, the causes, damages, cyclone measures, and mitigation have been discussed in detail.

Keywords: Cyclone, types, biggest cyclone ever in India, impact, mitigation measures for cyclone.

RESUMEN

El problema de los ciclones está surgiendo en las zonas costeras de la India. Mirando la historia del ciclón de 1999 a 2021, ha causado mucha devastación; Representa una amenaza para la vida de las personas ubicadas en la costa. El ciclón ha causado una pérdida significativa de población hasta el momento. Causó daños a viviendas, granjas, animales y plantas. Las áreas afectadas por el ciclón son Odisha, Bengala Occidental, Andhra Pradesh, Tamil Nadu, Kerala, Karnataka, Maharashtra y Gujarat. Las personas también han perdido la vida debido al ciclón en estos estados. En esta revisión, se analizan en detalle las causas, los daños, las medidas de ciclón y la mitigación.
PALABRAS CLAVE: Ciclón, Tipos, El ciclón más grande jamás visto en India, Impacto del ciclón, Medidas de mitigación.

INTRODUCTION

Cyclones In meteorology, a cyclone is a closed circular motion in which liquid continues to rotate in the same direction as the earth. In this, the wind usually rotates in a spiral shape, clockwise in the northern hemisphere of the Earth and counterclockwise in the southern hemisphere. A cyclone is called a strong hot air storm around low atmospheric pressure. In the Southern Hemisphere, these warm winds are known as "cyclones" and they move clockwise. While these warm winds in the Northern Hemisphere are called "hurricanes" or "typhoons". They move counterclockwise [1]. Cyclones are the rapid circulation of air within a low-pressure area. Air circulates counterclockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere. Cyclones are usually accompanied by severe thunderstorms and bad weather [2].

Figure: 1 Tropical cyclone kyarr as seen on October 27, 2019, by NASA's aqua satellite. at the time, kyarr was the second strongest tropical cyclone ever seen in the Arabian Sea, with winds of 250 mph and a central pressure of 928 mb. Credit: NASA

Source: https://blogs.scientificamerican.com/eye-of-the-storm/tropical-cyclone-kyarr-150-mph-winds-arabian-seas-2nd-strongest-storm-on-record/

CAUSES OF CYCLONE

The causes of the cyclone are as follows:-

The points mentioned below also answer the question why the cyclone occurs. The causes of dot cyclones are:-

- Hurricanes are caused in areas of low pressure.
- Cyclones occur at the equator.
- Cyclones are caused by warm air rising above the surface of the sea.
- As warm air rises, cold air escapes into the space.
- Then, the cold air is warmed and rises in the atmosphere.

- This process (cyclonic cycle) takes place continuously.
- This process of rapidly rising hot air creates an eye in the center of the cyclone.
- Similarly, the low pressure area is filled by anticyclonic winds [4].

Therefore, the cyclone occurs in this way. The previous points explain the causes of the cyclone [4].

TYPES OF CYCLONES

The types of cyclones are as follows:

Tropical cyclones: Tropical cyclones occur in the tropical ocean region. There are 2 types of tropical cyclones: hurricanes and typhoons. The Northeast Pacific and Atlantic Oceans experience hurricanes, while the Northwest Pacific experiences typhoons [5].

Extratropical cyclones: These cyclones arise in mid-latitudes and are therefore also called extra-tropical or mid-latitudes. Winds in the extra-tropical zone are relatively weaker. However, the temperature drops quite sharply [5].

Polar cyclones: Occurs in the Northern Hemisphere and is also known as the Arctic hurricane. Also, the heat sets the water in the air and releases latent heat, creating more clouds. These types of hurricanes are difficult to predict because they take less than 24 hours to form [5].

Mesocyclone: Mesocyclones are the heaviest and most powerful types of cyclones that cause thunderstorms. In the convective storm, the mesocyclone appears as a vortex. This vortex rotates along the vertical axis. In a given hemisphere, both this airflow and the low-pressure system point in the same direction and this mesocyclone is created by the rotation of the air during the storm [5].

INDIAN METEOROLOGICAL DEPARTMENT

Table: 1 The criteria below have been formulated by the Indian Meteorological Department (IMD), which classifies the low-pressure systems in the Bay of Bengal and the Arabian Sea based on capacity to damage, which is adopted by the WMO [6].

Type of Disturbances	Wind Speed in Km/h	Wind Speed in Knots
Low Pressure	Less than 31	Less than 17
Depression	31-49	17-27
Deep Depression	49-61	27-33
Cyclonic Storm	61-88	33-47
Severe Cyclonic Storm	88-117	47-63
Super Cyclone	More than 221	More than 120

Source: https://ndma.gov.in/Natural-Hazards/Cyclone

1 knot - 1.85 km per hour

Table: 2 Cyclones are classified into five different levels based on wind speed. They are further divided into the following categories according to their capacity to cause damage:-

Cyclone Category	Wind Speed in Km/h	Damage Capacity
01	120-150	Minimal
02	150-180	Moderate
03	180-210	Extensive
04	210-250	Extreme
05	250 and above	Catastrophic

Source: https://ndma.gov.in/Natural-Hazards/Cyclone

BIGGEST CYCLONE EVER IN INDIA:

Table: 3 Biggest cyclones ever in India

Year	List of cyclones	About the cyclone
2021	Cyclone Toute	Cyclone Toute caused heavy rainfall and powerful strong winds over South India, Gujarat, Goa, and Maharashtra. It also landed on the southern coast of the Saurashtra Peninsula in Gujarat.
2020	Cyclone Amphan	The storm made landfall on June 3 near the coastal city of Alibaug in Maharashtra. It was the first cyclone to make landfall in Maharashtra after Cyclone Phyan in 2009.
2019	Cyclone Fani	Fani was a severe cyclonic storm that hit the Indian state of Odisha. More than 40 people died due to the massive destruction, destruction of trees and the circulatory system. Fani rapidly intensified into an extremely severe cyclonic storm and reached its peak intensity as a high-end extremely severe cyclonic storm on May 2. This was the equivalent of a high Category 4 major hurricane.
2018	Cyclone butterfly	Cyclone Titli brought heavy rainfall to western Uttar Pradesh and the Indian capital New Delhi. Uttar Pradesh's Meerut received the highest rainfall, which received 226 mm of rain in 24 hours. Yamuna river emergency. The level was crossed and went up to 205.5 m by 29 July, resulting in the

		evacuation.
2017	Cyclone Ockhi	Cyclone Ockhi was powerful and one of the most active tropical cyclones of the 2017 North Indian Ocean cyclone. From the Arabian Sea, the Ockhi struck the coastal areas of Kerala, Tamil Nadu, and Gujarat as well as the mainland of India. Due to the impact of this cyclone, 245 people lost their lives.
2016	Cyclone Vardahi	Varda caused heavy rainfall in the Andaman and Nicobar Islands and then crossed the east coast of India affecting Chennai, Kancheepuram, and Visakhapatnam. 38 people had lost their lives after the cyclone. Originating as a low-pressure area near the Malay Peninsula on December 3, the storm has designated a depression on December 6. It gradually intensified into a deep depression the next day, dissipated from the Andaman and Nicobar Islands, and intensified into a cyclonic storm. on 8 December.
2015	Cyclone Komen	Cyclone Komen entered India after hitting Bangladesh and caused the most severe floods in eastern India, killing 285 people.
2014	Cyclone Hudhud	Cyclone Hudhud was a heavy tropical cyclone that hit Visakhapatnam in Andhra Pradesh. Visakhapatnam or Vizag along with Odisha was mostly raised by Hudhud. At least 124 people lost their lives and caused great destruction.
2013	Cyclone spreads	Cyclonic Storm Phailin was the most powerful tropical cyclone ever. The system was first observed on October 4, 2013, as a tropical depression within the Gulf of Thailand, west of Phnom Penh in Cambodia.
2012	Cyclone Neelam	Neelam was the most dangerous tropical cyclone to immediately affect South India since Cyclone Jal in 2010. It reached near Mahabalipuram on 31 October and seawater reached about 100 meters (330 ft) inland. 75 deaths were recorded in this cyclone.
2011	Cyclone Thane	Cyclonic Storm Thane made landfall over Cuddalore in Tamil Nadu on December 30, indicating the most advanced date of a cyclone to make landfall anywhere in the Indian Ocean.
2010	Cyclone Laila	Hurricane Laila caused heavy damage and killed 65 people. It survived the first cyclone to hit South India during the pre-monsoon season in 20 years.
2009	Cyclone Fan	Phyan emerged as a Tropical Disturbance on November 4, 2009, southwest of Colombo in Sri Lanka. It made its knock in southern India on 7 November. Cyclone Phyan brought substantial rainfall to Tamil Nadu, Maharashtra, and

		Gujarat.
1999	Cyclone Odisha	The Odisha cyclone was the most energetically registered tropical cyclone in the north Indian Ocean and the deadliest cyclone in the region. It intensified into a tropical depression in the Andaman Sea on October 25. Destruction causes 15,000 deaths. Also on record as the biggest cyclone in India.

Source: https://www.safalta.com/blog/list-of-cyclone-in-india-in-hindi

Many states including Andhra Pradesh, Maharashtra most affected by natural calamities like a cyclone: Study

Assam, Andhra Pradesh, Maharashtra, Karnataka, and Bihar are the states at the highest risk for climate-related natural disasters like floods, droughts, and cyclones in India. This information has been given in the study by Council for Energy, Environment, and Water (CEEW) [8].

According to the CEEW statement, India's 27 states and union territories are vulnerable to extreme climate-related events that often damage local economies and lead to the displacement of vulnerable communities [8].

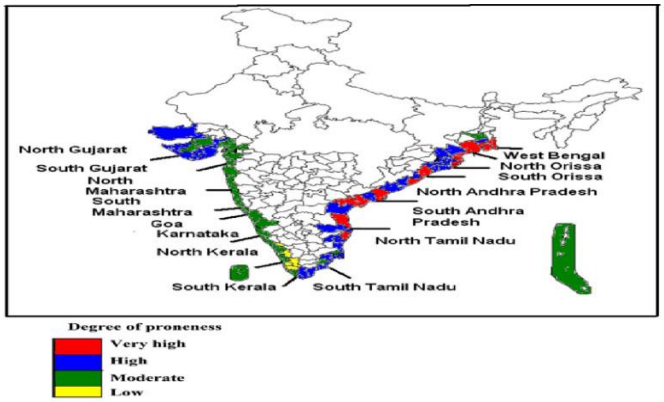

Figure: 2 Cyclone hazard prone districts of India [9].

IMPACT OF CYCLONES IN INDIA

If you know how a cyclone forms, you should know that it is often accompanied by strong winds, torrential rains, and storm surges. Essentially, these three elements do the following:

- High winds damage infrastructure, uproot trees, and cause other disasters.
- Torrential rains cause unprecedented flooding and damage to homes and buildings.
- Storm surges cause sea level rise and flood-prone coastal areas.
- Beaches and dykes are also affected by rising sea levels.
- Severe cyclone storms leading to flooding can damage vegetation and livestock.

- Strong winds and floods make the soil barren [10].

Furthermore, cyclonic storms lead to the loss of human, plant, and animal life and affect the country's economy [10].

MITIGATION MEASURES FOR CYCLONE

Mitigation refers to actions taken before a disaster occurs to minimize its impact. Cyclone mitigation measures include both structural and non-structural measures.

Risk Mapping: A risk map illustrates the areas vulnerable to the cyclone and associated storm surge and flooding at any given time. It will be useful to estimate the severity of the cyclone and the intensity of potential damage in the area. The map is created with data inputs from past climate records, wind speed history, flood frequency, etc. [11].

Land use planning: Land use planning should be systematically considered for cyclones so that the least critical activities take place in vulnerable areas. The location of settlements in floodplains is most at risk. The location of major structures should be marked in the land use. There should be policies to regulate land use and enforcement of building codes. Vulnerable areas should be preserved for parks, grazing areas, or flood diversions rather than human settlements [11].

Works of art: Works must be built to resist the forces of the wind. A good choice of location is also important. Public infrastructure, including buildings for electricity supply, communication facilities, hospitals, schools, rural health centers, and community centers should be technical structures [11].

Renovation of non-technical buildings: A large portion of Indians live in self-designed non-technical buildings. Knowledge about strengthening non-technical buildings should be shared with the community. Local engineers and craftsmen can participate in the construction and adaptation of buildings to their place and demonstrate to people how to build a disaster-proof construction [11].

CYCLONE SHELTERS

Cyclone shelters are needed for areas prone to recurring cyclones:

Flood Management: Floods are caused by a hurricane. Storm surges will flood coastal areas. Heavy rains cause flash floods. Embankments along rivers and levees along coasts can direct water away from floodplains. Water flow can be regulated by constructing reservoirs, dams, and alternative canals/drainages [11].

Improved vegetation cover: Improved vegetation increases the water infiltration capacity of the soil. Plant and tree roots keep the soil intact, preventing erosion and slowing runoff to prevent or reduce flooding. Trees planted in rows serve as windbreaks. Coastal protection plantations can be developed to break strong winds as they minimize the devastating impacts [11].

Mangrove plantation: Mangroves protect the coastal area from storm surges and winds accompanied by cyclones. The tangle of branches slows the flow of water. A community should also participate in the mangrove plantation

which could be organized by local authorities, NGOs, or the community itself. Mangroves also help in erosion control and coastal conservation [11].

Salt dams: Another activity that can be addressed as part of community-based mitigation is the construction of salt dams to protect homes, crops, and important coastal installations from seawater flooding caused by storm surges [11].

Embankments or elevated embankments: Elevated embankments above high levels of flooding or storm surges should be identified or built in an easily accessible site that can serve as a gathering point for various activities in normal weather conditions and as a good shelter in the event of storms and high violent floods [11].

NATIONAL INSTITUTE FOR DISASTER MANAGEMENT (NIDM)

Under the provisions of Chapter VII of the DM Act, the Government of India has established the National Institute of Disaster Management (NIDM) under an Act of Parliament as the lead institute for disaster management capacity development. disasters in India and the region. The vision of NIDM is to create a disaster-resilient India by building capacity for disaster prevention and preparedness at all levels [12]. NIDM has been entrusted with key responsibilities in human resource development, capacity building, training, research, documentation, and policy advocacy in the field of disaster management. NIDM has established strategic partnerships with various departments and departments of central, state, and local governments, academic, research, and technical organizations in India and abroad, and other bilateral and multilateral international organizations. It provides technical support to state governments through the Disaster Management Centers (DMCs) of the State and Union Territory (ATI) Administrative Training Institutes. It currently supports up to 30 of these centers. Six of these are being developed as centers of excellence in specialized areas of risk management: floods, earthquakes, cyclones, droughts, landslides, and industrial disasters [12].

CONCLUSION

The problem of the cyclone is increasing continuously in India. Many people have been harmed by the cyclone. So far many people have lost their lives and there has been a considerable economic loss. To deal with this, keep an eye on these areas with GIS and make adequate security arrangements in these areas in time. People should be given all the information related to a cyclone. Awareness should be spread through NGOs.

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