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**A Study Of Cyclone Disaster In India In The Special Context Of  
Amphan Cyclone**

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**Abstect-**

*India has been vulnerable to a large number of natural and man-made disasters, due to its various geo-climatic and socio-economic conditions. It is highly vulnerable to floods, droughts, cyclones, earthquakes, landslides, avalanches and forest fires. Out of 37 states and union territories of the country, 28 states are disaster prone. About 58.6 percent of the terrain is prone to earthquakes of very high intensity. 40 million hectares (12 percent) of land is at risk of flooding and river erosion; of the 7516 km long coastline, 5700 km is prone to cyclones and tsunamis; 68 percent of the cultivable area is prone to drought and there is a risk of landslides and avalanches in hilly areas.*

*India is one of the ten most disaster-prone countries in the world. The country suffers from natural and man-made disasters due to many factors; these include adverse geo-climatic conditions, topographical features, environmental degradation, population growth, urbanization, industrialization, non-scientific development methods, etc. Disaster risks in India are further compounded by increasing vulnerabilities related to changing demographics and socio-economic conditions, unplanned urbanization, and development within high-risk zones, environmental degradation, climate change, geological hazards, epidemics and pandemics. Clearly, all these contribute to a situation where disasters seriously threaten India's economy, its population and sustainable development.*

***Key words-*** Disaster, Tropical cyclone, Amphan, vulnerability.

**Introduction-**

Due to natural or human causes, that unexpected and adverse extreme event and outbreak which brings widespread destruction in a short time is called a disaster. Incidents that occur suddenly or such bad misfortunes that interfere with human infrastructure and the normal

functioning of the community are called disasters (UNO). 'This is an adverse condition that affects the human, physical environment and social functioning in a big way'. (2<sup>nd</sup> ARC Report) 'Disaster' refers to a demolition, destruction, disaster or very serious event in an area that occurs due to natural or man-made reasons or by accident or negligence and in which huge amount of human life is lost or human suffering. Or damage to property or environmental degradation and its form or result is such that it is beyond the ability of the community to cope with the affected area. (Disaster management Act-2005) Excess populations are also responsible for the intensity and frequency of disasters. Overpopulation has disrupted the life support system in the country.

Depending on the geological structure, the country can be divided into five different regions - the Himalayan region, the plains, peninsular plateau, the seaside area and the islands. These areas have their own specific problems towards disaster. While the Himalayan region is prone to disasters like earthquakes and landslides, almost every year the plains are affected by floods. While the desert region is affected by drought and famine, the coastal region remains highly vulnerable to cyclones and hurricanes.

The natural land structure of the country is the main reason for increased vulnerability. The characteristics of the Himalayan region and the surrounding alluvial plains make this region susceptible to earthquakes, landslides, water erosion etc. Although peninsular India has been considered to be the most stable part, the geo-tectonic processes are still known at its depth from occasional earthquakes in the region.

The rocks below the Indus- Ganga -Brahmaputra alluvial plain are an extension of the Himalayan rocks. Therefore, the geo-tectonic processes also occur in this plain. Due to this, the plain area is also heavily affected by seismic activities. The rivers are prone to silt due to various major river systems originating from the Himalayas and the large amount of sediment deposition brought by them. As a result, every year floods in the plains, especially in the states of Uttar Pradesh, Bihar, West Bengal, Assam etc.

The western part of the country, Rajasthan, Gujarat and parts of Maharashtra are greatly affected by the drought conditions. A cyclone is created by becoming a center of low pressure in the Indian Ocean. Due to which the coastal region is affected by cyclones. At the same time, the tsunamis generated as a result of the geo-tectonic activities at sea level also affect the coastal areas. Apart from these, excessive rainfall, snow and huge amount of snow accumulated in glaciers are other natural factors which make the country prone to various types of disasters.

Along with these natural factors, various human-induced activities are responsible for the rapid impact and increase in the frequency of disasters in the country, such as - demographic pressure, environmental degradation, deforestation, unscientific development, unplanned farming practices and grazing, unplanned urbanization, construction of large dams on river channels etc.

### Discussions -

**Cyclone** - On the basis of origin, disasters can be divided into two categories - natural disasters and anthropogenic disasters. Cyclone is a natural disaster. There are usually two types of cyclones - tropical cyclones and subtropical cyclones. Tropical cyclones are violent storms that originate over oceans in tropical areas and move over to the coastal areas bringing about large scale destruction caused by violent winds, very heavy rainfall and storm surges. It is one of the most devastating natural disasters in the world. They originate in the tropical oceans. Cyclones are rapid inward air circulation around a low-pressure area. The air circulates in an anticlockwise direction in the Northern hemisphere and clockwise in the Southern hemisphere. Cyclones are usually accompanied by violent storms and bad weather.

Favorable conditions for formation and intensification of tropical storms are as follows:

- ❖ Large sea surface, whose temperature should be more than 27°C.,
- ❖ Presence of Coriolis force.
- ❖ Small changes in vertical wind speed.
- ❖ Pre-existing weak low-pressure zones or low-level-cyclonic circulation.
- ❖ Upper deviation above sea level system.

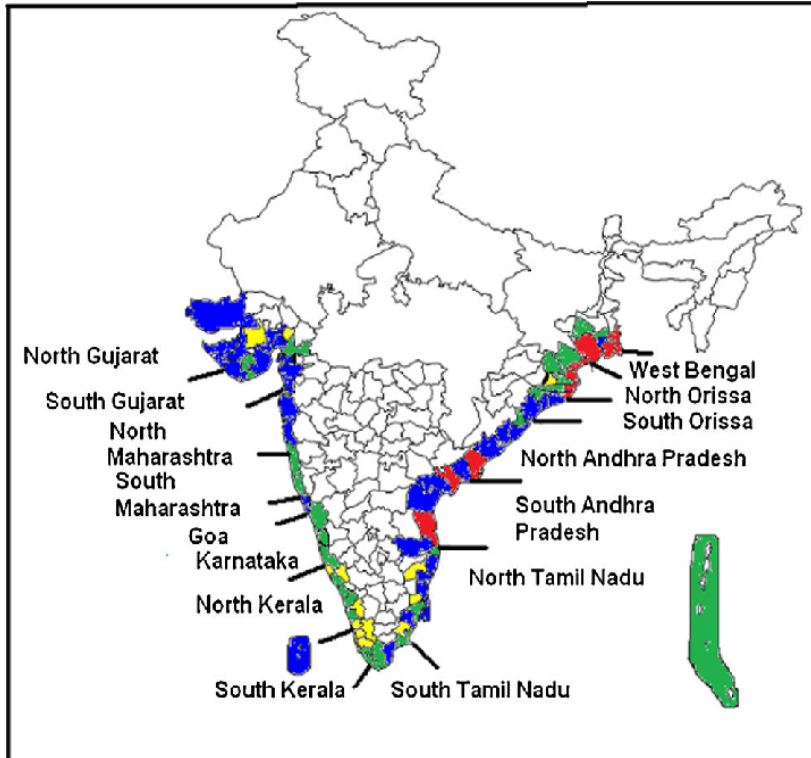


Fig.1. cyclone occurrence map of india

### Stages of Tropical Cyclone Formation-

The development cycle of tropical cyclones has three phases –

#### 1. Formation and Initial Development Stage

The formation and initial development of a cyclonic storm depends upon the transfer of water vapour and heat from the warm ocean to the overlying air, primarily by evaporation from the sea surface. It encourages formation of massive vertical cumulus clouds due to convection with condensation of rising air above the ocean surface.

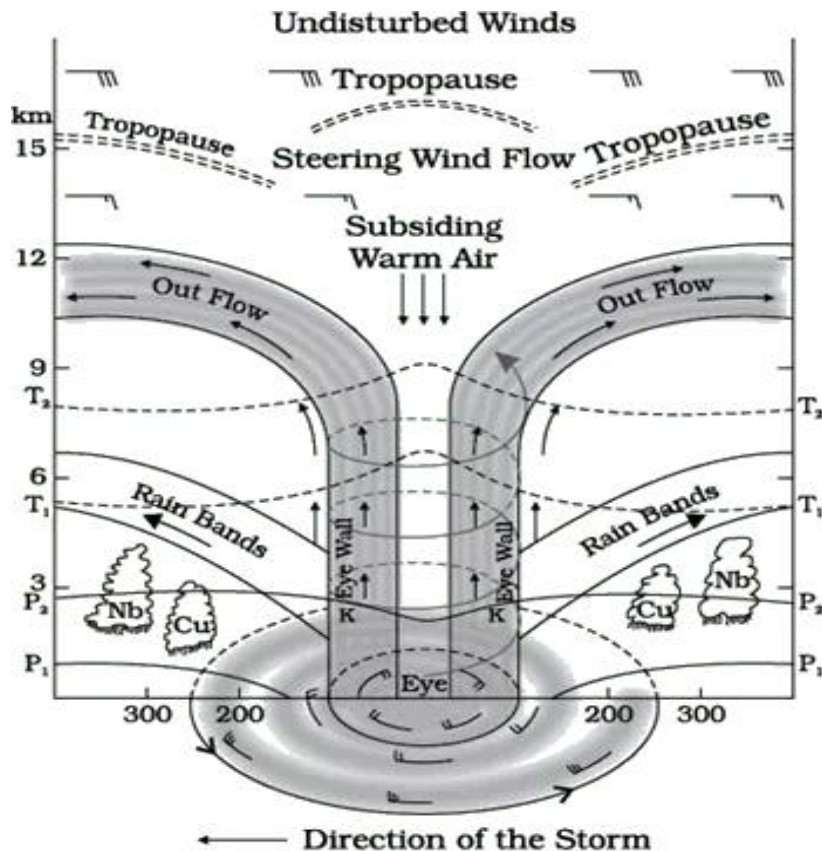


Fig.2. Vertical section of the tropical cyclone

## 2. Mature Stage

When a tropical storm intensifies, the air rises in vigorous thunderstorms and tends to spread out horizontally at the troposphere level. Once air spreads out, a positive pressure at high levels is produced, which accelerates the downward motion of air due to convection. With the inducement of subsidence, air warms up by compression and a warm 'Eye' (Low pressure centre) is generated. The main physical feature of a mature tropical cyclone in the Indian Ocean is a concentric pattern of highly turbulent giant cumulus thundercloud bands.

## 3. Modification and Decay

A tropical cyclone begins to weaken in terms of its central low pressure, internal warmth and extremely high speeds, as soon as its source of warm moist air begins to ebb or is abruptly cut off. This happens after its landfall or when it passes over cold waters.

### tropical cyclone and India : A study -

India's coastal areas are mainly affected by natural disasters such as cyclones and tsunamis. India has a coastline of 7516.6 km, with about 10 percent of the world's tropical cyclones. All

the states of this coastal region including the islands of Andaman, Nicobar and Lakshadweep are also prone to cyclones. On an average, about five or six tropical cyclones form in the Bay of Bengal and the Arabian Sea and hit the coast each year. On average, about two or three of these are of serious nature. When these cyclones hit the coast they cause severe damage or damage to coastal areas due to strong winds, heavy rainfall, storms and river floods.

Most of the cyclones that come in the northern Indian Ocean, about 80% are in the Bay of Bengal and 20% in the Arabian Sea. Both the Arabian Sea and the Bay of Bengal have a profound impact on the climate of India. However both are located at the same latitude and receive equal amounts of solar radiation. But in the northern Indian Ocean, the surface of the Bay of Bengal is warmer than the Arabian Sea while the Arabian Sea on the western side is colder. The cold ocean receives relatively few storms, but the Bay of Bengal has more storms than the Arabian Sea. Another reason for this is wind flow. Most of the storms that form on the west coast also turn towards Oman, which is unable to move towards Indian shores. Between 1891 and 2000, there were 308 storms on the east coast of India. During this time only 48 storms occurred on the west coast. (National Cyclone Risk Mitigation Project)

The incidence of cyclonic storms, with wind speeds between 65 Km/h and 117 Km/h and severe cyclonic storm with wind speeds between 119 Km/h and 164 Km/h, reaching Tamil Nadu and Andhra Pradesh is high during the north east monsoon season i.e. October – December, where as the highest annual number of storms, severe storms occur in the Orissa - West Bengal coast. On October 29, 1999, the super cyclonic storm that hit the coast of Odisha with winds of 250 km / h was the country's worst cyclone. Due to which there was widespread socio-economic and environmental damage. Millions of people became homeless and more than 10,000 died.

**The Amphan cyclone-** A storm turned into a super cyclone due to higher than normal temperatures in the Bay of Bengal. This made a big impact in the east coast of India as well as in Bangladesh, Sri Lanka and Bhutan. The Amphan cyclone originated on 13 May 2020 from a low pressure area 300 km east of Colombo (Sri Lanka). On 17 May, Amphan intensified into an extremely severe cyclonic storm within 12 hours. On 18 May, Amphan reached its peak intensity with 3-minute sustained wind speeds of 240 km/h (150 mph), 1-minute sustained wind speeds of 260 km/h (160 mph), and a minimum central barometric pressure of 925 mbar.

The storm began an eyewall replacement cycle shortly after it reached its peak intensity, but the continued effects of dry air and wind shear disrupted this process and caused Amphan to gradually weaken as it paralleled the eastern coastline of India. On 20 May the cyclone made landfall in West Bengal. At the time, Amphan's 1-minute sustained winds to be 155 km/h (100 mph). Amphan rapidly weakened once inland and dissipated shortly thereafter.

Reduced particulate matter emissions during the lockdown resulted in fewer aerosols, such as black carbon, that are known to reflect sunlight and heat away from the surface. Every year, the particulate pollution from the Indo-Gangetic plains is transported towards the Bay of Bengal which influences the formation of clouds over the ocean. The minimal presence of heat and

sunlight reflecting aerosols in BoB resulted in fewer clouds and more heat. Further, it raised the temperature of Bay of Bengal by 1-3°C higher than normal. Thus, the whole phenomenon has amplified the strength of the cyclone. The higher temperatures and minimal presence of aerosols helped the cyclone Amphan to intensify itself from a category-1 cyclone to category-5 in 18 hours that is an unusually quick evolution.

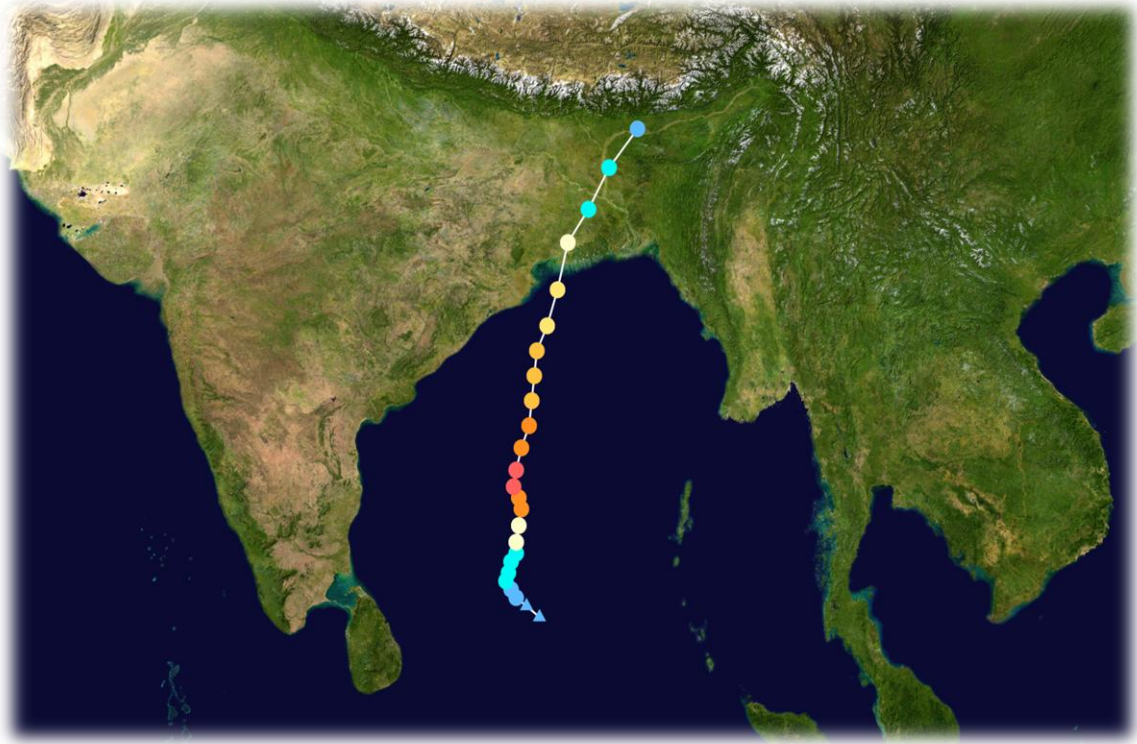


Fig.3. Amphan cyclone Track (source- google map)

**India-** Amphan made landfall near Bakhali in West Bengal on 20 May, buffeting the region with strong winds and heavy rains (*The New Indian Express*). West Bengal, the epicenter of the cyclone's landfall, saw the most widespread damage from Amphan. The storm was considered the strongest to hit the region in over a decade. (*BBC News*) About 86 people died in West Bengal. (*The Hindu*) Most of the disastrous events happened due to lightning or houses collapsed. In West Bengal, the storm caused at least 1 trillion (US \$ 13.2 billion) in damage and directly affected 70 percent of the state's population. (*Sud, Vedika; Rajaram, Prema*) The effect of the storm there is worse than COVID-19. (Chief Minister Mamata Banerjee) Kolkata, Hooghly, Howrah, East Midnapore, North 24 Parganas and South 24 Parganas districts in the coastal areas of Odisha as well as West Bengal were affected by the cyclone. It also caused extreme destruction in Bangladesh. (*BBC News*) Odisha saw significant effects, with wind gusts reaching 106 km/h (66 mph) and rainfall up to 197.1 mm (7.76 in) in Paradip. (*The Hindu*). In Bhadrak, rainfall reached 384.6 mm (15.14 in). (*The New Indian Express*) Approximately 1,167 km (725 mi) of power lines of varying voltages, 126,540 transformers, and 448 electrical substations were affected, leaving 3.4 million without power. Across the ten



affected districts in Odisha, 4.4 million people were impacted in some way by the cyclone. At least 500 homes were destroyed and a further 15,000 were damaged. Nearly 4,000 livestock, primarily poultry, died. (*republicworld.com*) From May 16, several districts of Kerala also received rain and strong winds from the outbreak. (*Deccan Chronicle*)

Bangladesh, Bhutan and Sri Lanka have also been affected due to the Amphan cyclone.

**Bangladesh-** At least twenty six people died in storm-related incidents. Damaging effects began in Bangladesh prior to the landfall of Amphan as coastal water levels rose. (*Reuters News*) Winds in Satkhira topped out at 151 km/h (94 mph).(*The Daily Star*) Nearly 220,000 homes were damaged, of which 55,667 were destroyed, rendering an estimated 500,000 people homeless.(*United Nations Office for the Coordination of Humanitarian Affairs*) Across 26 districts, approximately 1,100 km (680 mi) of roads and over 200 bridges were damaged.(*The Daily Star*)

**Bhutan -** The remnants of Amphan produced several days of unsettled weather across Bhutan, with the Tsirang District in particular seeing three days of heavy rain. Landslides and rockfalls across the nation blocked roadways and damaged homes . Rainfall proved beneficial for the country's hydroelectric power production with the Mangdechhu hydroelectric plant producing 791.39 MW of power, more than its intended capacity of 720 MW. (*Kuensel*)

**Sri Lanka-** Floods and landslides in the eastern part affected nearly 2,000 people due to heavy rain and strong winds due to the Amphan storm in Sri Lanka. Due to which 4 civilians were killed and more than 500 houses were damaged. (*Economy Next*)

<b>Table.1 fatalities by Amphan cyclone</b>	
<b>Country</b>	<b>Fatalities</b>
<i>Bangladesh</i>	26
<i>India</i>	98
<i>Sri Lanka</i>	4
<b>Total</b>	<b>128</b>

**Conclusion-**

The higher temperatures and minimal presence of aerosols helped the cyclone Amphan to intensify itself from a category-1 cyclone to category-5 in 18 hours that is an unusually quick evolution. The Amphan cyclone caused a lot of economic-socio-environmental damage. 128 people died and thousands of houses were damaged. Therefore, scientific management is essential for mitigation of such disaster. Conferences and strategies have been suggested from time to time at international, national and local level for mitigation and prevention of disaster, which is very important. The Government of India is trying to reduce the damage caused by disaster management. National Cyclone Risk Mitigation Project (NCRMP) was launched by Home ministry to upgrade the forecasting, tracking and warning about cyclones in states. National Disaster Response Force (NDRF) has done a commendable performance in rescuing and managing relief work.



### **Suggestions -**

1. There is a need of harmonizing the national and local level disaster resilient by laws, land use zoning, resource planning, early warning system establishments and technical competence.
2. Disaster Risk Reduction should be an important aspect of global poverty reduction initiatives.
3. Moving from a risk blind approach to a risk-informed decision when it comes to investments.
4. There should be a Disaster Risk Audit for the future developmental project for both public and private entities.
5. Disaster Risk Reduction program should be more people-centric.
6. There is a need for private sector participation in designing and implementing policies, plans, and standards.
7. Need of Disaster Management program to be inclusive including women, civil society, and academia. State governments should increase their engagements in scientific research institution for a better formulation of policies.

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