

## Cyclone: Factors, vulnerability, consequences and management

A cyclone is a vast, violent whirl in the atmosphere which moves from the high seas towards the coastal areas. A cyclone will often bring with it heavy rains that can cause flooding. In order for a cyclone to form, the ocean waters need to be warm, at least 26°C. Above the warm ocean, water evaporates and forms clouds. If there is low air pressure where the clouds are formed, it pulls them in and they begin to rotate. It is the earth rotating and spinning on its axis that causes the cyclone's clouds to rotate. Cyclones are caused by atmospheric disturbances around a low-pressure area distinguished by swift and often destructive air circulation. Cyclones are usually accompanied by violent storms and bad weather. The air circulates inward in an anticlockwise direction in the Northern hemisphere and clockwise in the Southern hemisphere. Cyclones are classified as: (i) extra tropical cyclones (also called temperate cyclones); and (ii) tropical cyclones.

### Factors:

There are six conditions favorable for this process to take place. The conditions are listed first below, and then their dynamics are described in greater detail:

1. The temperature of the surface layer of ocean water must be 26.5 °C (80 °F) or warmer, and this warm layer must be at least 50 meters (150 feet) deep.
2. A preexisting atmospheric circulation must be located near the surface warm layer.
3. The atmosphere must cool quickly enough with height to support the formation of deep convective clouds.
4. The middle atmosphere must be relatively humid at a height of about 5,000 meters (16,000 feet) above the surface.
5. The developing system must be at least 500 km (300 miles) away from the Equator.
6. The wind speed must change slowly with height through the troposphere—no more than 10 meters (33 feet) per second between the surface and an altitude of about 10,000 meters (33,000 feet).

### Classification of cyclones

Cyclones are classified according to their wind speed, however, the classification, varies from region to region. In the United States, they are classified into 5 different categories on the basis of their wind speed as measured on the Saffir-Simpson scale (SS scale). This classification is given in Table,

| Scale Number<br>(Category) | Sustained Winds in m/h | Damage       | Storm Surge (ft.) |
|----------------------------|------------------------|--------------|-------------------|
| 1                          | 74-95                  | Minimal      | 4-5               |
| 2                          | 96-110                 | Moderate     | 6-8               |
| 3                          | 111-130                | Extensive    | 9-12              |
| 4                          | 131-155                | Extreme      | 13-18             |
| 5                          | 156 or above           | Catastrophic | >18               |

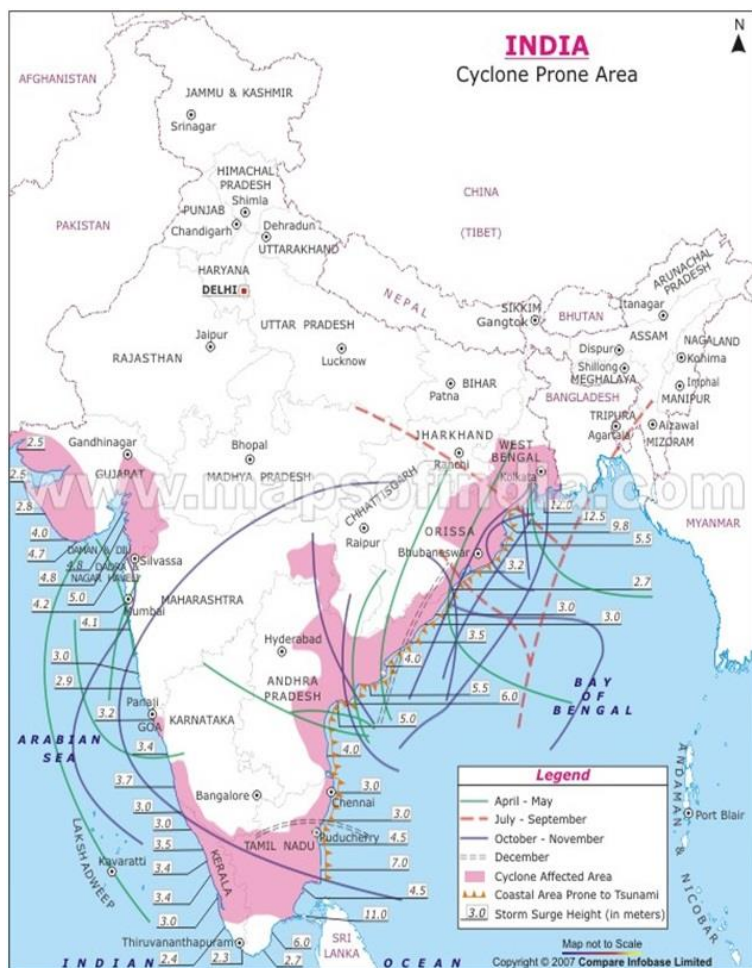
Source: NWS, NOAA

### Vulnerability & Consequences

UNISDR defines vulnerability as- the characteristics and circumstances of a community, system or asset that makes it agreed or susceptible to the damaging effects of a hazard. In other words, vulnerability is the inability to resist a hazard or to respond when a disaster has occurred. According to IPCC vulnerability is the degree to which a system is unable to cope with adverse effect of climate change.

Indian sub-continent is the worst affected region of the world, having a coast line of 7516 kms. (5400 kms along the mainland, 132 kms in Lakshadweep and 1900 kms in Andaman and Nicobar Islands) is exposed to nearly 10% of the world's Tropical Cyclones. There are 13 coastal states/UTs encompassing 84 coastal districts which are affected by

cyclones (Fig. 1). Four States (Andhra Pradesh, Odisha, Tamil Nadu and West Bengal) and one UT (Pondicherry) on the East Coast and One State (Gujarat) on the West Coast are more vulnerable to cyclone disasters. 40% of the total population lives within 100 km of coastline. Analysed data for the period 1980-2000 shows that on an average, annually 370 million people are exposed to cyclones in India.



**Major Tropical Cyclones in Indian Sub-continent:** The major Tropical cyclones which struck the coastal districts in India during the period 1891-2002 are as under:

| WEST COAST       |                   |                 | EAST COAST          |                               |                 |
|------------------|-------------------|-----------------|---------------------|-------------------------------|-----------------|
| State            | Coastal Districts | No. of Cyclones | State               | Coastal Districts             | No. of Cyclones |
| Kerala (3)       | Malappuram        | 1               | West Bengal (63)    | 24 Paragana (North and South) | 35              |
|                  | Kozikode          | 1               |                     | Midnapur                      | 34              |
|                  | Kannur            | 1               |                     |                               |                 |
| Karnataka (2)    | Dakshina Kannada  | 1               | Odisha (36)         | Balasore                      | 32              |
|                  | Uttar Kannada     | 1               |                     | Cuttack                       | 32              |
| Maharashtra (13) | Sindhudurg        | 3               |                     | Puri                          | 19              |
|                  | Ratnagiri         | 3               |                     | Ganjam                        | 15              |
|                  | Mumbai            | 3               | Srikakulam          | 14                            |                 |
|                  | Thane             | 4               | Vishakhapatnam      | 9                             |                 |
|                  |                   |                 | East Godavari       | 8                             |                 |
| Goa (2)          | Goa               | 2               | Andhra Pradesh (73) | West Godavari                 | 5               |
|                  |                   |                 |                     | Krishna                       | 15              |
|                  |                   |                 |                     | Guntur                        | 5               |
|                  |                   |                 |                     | Prakasam                      | 7               |
|                  |                   |                 |                     | Nellore                       | 16              |
| Gujarat (28)     | Surat             | 1               | Tamil Nadu (54)     | Chennai                       | 18              |
|                  | Kaira             | 1               |                     | Cuddalore                     | 7               |
|                  | Bhavnagar         | 4               |                     | Southarcot                    | 5               |
|                  | Amereli           | 4               |                     | Tanjavur                      | 12              |
|                  | Junagarh          | 7               |                     | Pudukkottal                   | 5               |
|                  | Jamnagar          | 6               |                     | Ramnathpuram                  | 3               |
| Gujarat (28)     | Kachchh           | 5               | Pondicherry (8)     | Tirunelveli                   | 2               |
|                  |                   |                 |                     | Kanyakumari                   | 2               |
|                  |                   |                 |                     | Pondicherry (UT)              | 8               |
|                  |                   |                 |                     |                               |                 |
|                  |                   |                 |                     |                               |                 |

The impact of tropical cyclone destruction on the society as been so large and do not affect people equally. Cyclone cannot be prevented, but their impact on people's lives can be reduced to a considerable extent. Disaster management covers all aspects of preventive and protective measures, preparedness, rescue, relief and rehabilitation operations. Impacts of cyclone effects economy, social and cultural activities of people and county .Some of the major impacts are as follows,

- Several tropical cyclones are responsible for large number of damage to properties and resources of the country.
- Cyclone mostly affects coastal districts. Several people in coastal villages who depended only on fishing had lost access to food and clean drinking water as fishing was prohibited.
- Cyclone, which is responsible for much loss of life, damage to property and deterioration of day to day life.
- Collapse of buildings, accidents and disease from contaminated food in the post cyclone period is also the reason for loss of life.
- Abnormal rise in sea level caused by cyclone is known as storm surge.
- Cyclones cause a lot of damage on the human environment.
- Cyclone may result in heavy rainfall and floods which is the next devastation to the environment.
- Due to flood caused by the cyclone can cause water log in unwanted places which causes many diseases.
- Almost everything is destroyed and thousands of people are left homeless due to cyclone.
- Coastal areas finds difficult without power supply, communication, emergency responses due to cyclones.
- Large scale evacuations are common, when countries are severely damaged by powerful forces of nature, many people have to abandon their homes and seek shelter in other regions.
- Damage to infrastructures such as roads, bridges, revetment results in loss to both public and Government.
- Health complications among survivors of natural disasters without emergency relief from the organizations can also rise the death rate even after danger has passed.
- Food scarcity is the main impact of cyclone as they loss their agricultural supplies.

- Devastation of crop may result in reduced income for farmers, increased prices for food, unemployment, increased crimes which in turn human populations are at higher level of risk.
- The impact of a natural disaster may also cause inequalities. The poor, who suffer from income fluctuations, and also have limited access to financial services, in the aftermath of a disaster, may be more prone to scarcity.
- There is no health without mental health. Confronted with scenes of destruction and death of friends and loved ones many children develop post-traumatic stress disorder.
- Physical impacts of disaster includes casualties and property damage. Losses of structures, animals also are important measures of physical impacts, and these are rising exponentially in developing countries such as India.
- Social impacts, which include psychosocial, sociodemographic, socioeconomic, and sociopolitical impacts, which can develop over a long period of time. Sociodemographic impact of a disaster is the destruction of households. Such an impact can be a very long process of disaster recovery for some population segments.
- Impacts of cyclone cause direct economic losses such as loss in asset value, reduction in investments which is a socioeconomic impact of a disaster.
- Effects of a cyclone on the economy leads to less income from exports and general economic downturn.

## **Management**

Mitigation means measures taken prior to the impact of a disaster to minimize its effects. Mitigation measures for cyclone include both structural and non-structural measures. These measures need government intervention as well as community participation.

### **a) Hazard mapping**

- ❖ Hazard mapping for cyclones represents the results of cyclone hazard assessment on a map, showing the frequency/probability of occurrences of various intensities or durations. It will be useful to estimate the severity of the cyclone and potential damage intensities in the region. The map is prepared with data inputs of past climatological records, history of wind speed, frequency of flooding etc.

### **b) Land use planning**

- ❖ Land use planning should be systematically considered for cyclones so that least critical activities are placed in vulnerable areas.

### **c) Engineered structures**

- ❖ Structures need to be built to withstand wind forces. Good site selection is also important. The public infrastructures including buildings for electricity services, communication facilities, hospitals, schools, rural healthcare centers and community centers should be engineered structures.

### **d) Cyclone Shelters**

- ❖ Cyclone Shelters are necessary for areas vulnerable to recurrent cyclones. The construction of cyclone shelters require substantial funding, therefore, generally linked to support from government or external donors. For construction of cyclone shelters, the most appropriate sites should be selected, using the Geographical Information System (GIS) method, after a detailed consideration of the density of population, transportation and communication conditions, distance from areas where the cyclones took landfall in the past and the topography of the area. The location of the cyclone shelter should have road links to main routes and to surrounding rural communities so that people can reach the shelters during emergencies without delay.

### **e) Flood management**

- ❖ Flooding will result from a cyclonic storm. Storm surges will flood the coastal areas. Heavy rains will bring in flash floods. embankments along the rivers, sea walls along the coasts may keep water away from the flood plains. Water flow can be regulated through construction of reservoirs, check dams and alternate drainage channels/routes. Community people should also take up the following flood mitigation activities:
  - Improving drainage system in the area by clearing gutters, drains, creeks and streams of any debris so that they can carry rainwater away quickly and reduce the risk of flooding.
  - Raising platforms for flood shelter for human beings and cattle and/or raising the public utility installations above flood levels.
  - Elevate shelter on stilts. The shelter floor should be at least 3 feet above the ground.
  - Create sufficient drainage under and around the shelter.
  - Avoid storing materials under the shelter which may obstruct water drainage.
  - Compact solid earth around the footings to avoid standing water.

**f) Improving vegetation cover**

- ❖ Improvement of the vegetation will increase water infiltration capacity of the soil. The roots of the plants and trees will keep the soil intact and prevent erosion and slow runoff to prevent or reduce flooding.

**g) Mangrove plantation**

- ❖ Mangroves protect the coastal area from storm surge and wind which accompanied with cyclones.

**h) End to end warning system**

- ❖ There is a need for an end to end early warning which will enable people at all levels to respond quickly and effectively. The Department of Meteorology and Hydrology is the nodal department for issuing cyclone warning and special weather news for the public. The community should be well aware of the warning system, the warning signals and the source where they can get the early warning of cyclones.

1. Cyclone Disaster Mitigation And Management In India - N. Venkatachalam<sup>1</sup> and Dr. S. Ganesan<sup>2</sup>. IJSET - International Journal of Innovative Science, Engineering & Technology, Vol. 2 Issue 11, November 2015.

2. <https://www.britannica.com/science/tropical-cyclone/Life-of-a-cyclone>

3. MANUAL-ON-CYCLONE-Causes-Effects-Preparedness

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