

DISASTER STUDIES - 18BGE35S

UNIT – III

Climatic disasters, Cyclones :

What is a Cyclone?

Cyclone is a region of low atmospheric pressure surrounded by high atmospheric pressure resulting in swirling atmospheric disturbance accompanied by powerful winds blowing in anticlockwise direction in the Northern Hemisphere and in the clockwise direction in the Southern Hemisphere.

They occur mainly in the tropical and temperate regions of the world.

Cyclones are called by various names in different parts of the world.

General Characteristics:

Cyclones in India are moderate in nature.

Some of the general characteristics of a cyclone are:

- A. *Strong winds*
- B. *Exceptional rain*
- C. *Storm surge*

Cyclones are generally accompanied by strong winds which cause a lot of destruction.

In some cases it is accompanied by heavy downpour and also the rise in the sea which intrudes inland there by causing floods. 29th October 1999, Super-cyclone with wind speed of 260-300 km/hour hit the 140 kilometer coast of Orissa with a storm surge created in the Bay-of-Bengal with water level 9 metres higher than normal.

The superstorm travelled more than 250 km inland and within a period of 36 hrs ravaged more than 200 lakh hectares of land, devouring trees and vegetation, leaving behind a huge trail of destruction. The violent cyclone was merciless and broke the backbone of Orissa's economy and killed thousands and devastated millions.

The development of a cyclone covers three stages namely

a) **Formation and initial development state:**

Four atmospheric/ oceanic conditions are necessary for the formation of a cyclone namely:

A warm sea temperature in excess of 26 degree centigrade, to a depth of 60 meters, which provides abundant water vapour in the air by evaporation. High relative humidity (degree to which the air is saturated by water vapor) of the atmosphere to a height of about 7000 meters, facilitates condensation of water vapor into droplets and clouds, releases heat energy and induces drop in pressure.

Cyclones are known by different names in different parts of the world:

- ◆ *Typhoons in the Northwest Pacific Ocean west of the dateline*
- ◆ *Hurricanes in the North Atlantic Ocean, the Northeast Pacific Ocean east of the dateline, or the South Pacific Ocean.*
- ◆ *Tropical cyclones - the Southwest Pacific Ocean and Southeast Indian Ocean.*
- ◆ *Severe cyclonic storm" (the North Indian Ocean)*
- ◆ *Tropical cyclone (the Southwest Indian Ocean)*
- ◆ *Willie-Willie in Australia*
- ◆ *Tornado in South America*

b) Fully matured: The main feature of a fully mature tropical cyclone is a spiral pattern of highly turbulent giant cumulus thundercloud bands. These bands spiral inwards and form a dense highly active central cloud core which raps around a relatively calm zone. This is called the “eye” of a cyclone. The eye looks like a black hole or a dot surrounded by thick clouds. The outer circumference of the thick cloud is called the ‘eye wall’.

c) Weakening or decay: A tropical cyclone begins to weaken as soon as its source of warm moist air is abruptly cut off. This is possible when the cyclone hits the land, on the cyclone moves to a higher altitude or when there is the interference of another low pressure.

Depending on their track on the warm tropical sea and proximity to land a cyclone may last for less than 24 hours to more than 3 weeks. On an average the life cycle of a cyclone (a cyclone to complete these three stages mentioned above) takes six days. The longest cyclone is typhoon John which lasted for 31 days (August to September, 1994 in the north east and north west pacific basins).

Indian Cyclones

Cyclones vary in frequency in various parts of the world. The 7516.6 kilometers long Indian coastline is the earth’s most cyclone battered stretch of the world. Around 8 per cent of the total land area in India is prone to cyclones. About two-third of the cyclones that occur in the Indian coastline occur in the Bay of Bengal. The states which are generally affected in the **east coast are West-Bengal, Orissa, Andhra Pradesh; Tamil Nadu and on the west coast Gujarat, Maharashtra, Goa, Karnataka and Kerala.**

Death associate with noteworthy Tropical Cyclones

SI No	Year	Area	Death toll
1	1971	Eastern Coast	9658
2	1972	Andhra Pradesh and Orissa	100
3	1977	Chennai, kerala & Andhra Pradesh	14,204
4	1979	Andhra Pradesh	594
5	1981	Gujarat	470
6	1982	Gujarat & Maharashtra	500
7	1984	Tamil Nadu & Andhra Pradesh	512
8	1985	Andhra Pradesh	5000
9	1990	Andhra Pradesh	957
10	1990	Orissa	250
11	1999	Orissa	8913

Warning:

Low pressure and the development can be detected hours or days before it causes especially those in the sea, port authorities, commercial aviation and the government machinery.

Elements at Risk: Strong winds, torrential rains and flooding cause a huge loss to life and property. The 1999 Super Cyclone of Orissa killed more than 10,000 precious lives with women and children greatly affected. Apart from loss to life there is a huge loss to infrastructures like houses built of mud, older buildings with weak walls, bridges, settlements in low lying areas.

Flood:

- Flood is a state of high water level along a river channel or on the coast that leads to inundation of land, which is not usually submerged.
- Floods may happen gradually and also may take hours or even happen suddenly without any warning due to breach in the embankment, spill over, heavy rains etc.

There are different types of floods namely: flash flood, riverine flood, urban flood, etc.

Flash floods can be defined as floods which occur within six hours of the beginning of heavy rainfall, and are usually associated with cloud bursts, storms and cyclones requiring rapid localized warnings and immediate response to reduce damage.

Wireless network and telephone connections are used to monitor flood conditions. In case of flash floods, warnings for timely evacuation may not always be possible.

Causes:

- There are several causes of floods and differ from region to region.
- The causes may vary from a rural area to an urban area.

Some of the major causes are:

1. *Heavy rainfall*
2. *Heavy siltation of the river bed reduces the water carrying capacity of the rivers/stream.*
3. *Blockage in the drains lead to flooding of the area.*
4. *Landslides blocking the flow of the stream.*
5. *Construction of dams and reservoirs*
6. *In areas prone to cyclone, strong winds accompanied by heavy down pour along with storm surge leads to flooding.*

Typical Adverse Effects:

- The most important consequence of floods is the loss of life and property.
- Structures like houses, bridges; roads etc. get damaged by the gushing water, landslides triggered on account of water getting saturated, boats and fishing nets get damaged.
- There is huge loss to life and livestock caused by drowning.
- Flooding also leads to a large area of agricultural land getting inundated as a result there is a huge crop loss.

- This results in shortage of food, and animal fodder. Floods may also affect the soil characteristics.
- The land may be rendered infertile due to erosion of top layer or may turn saline if sea water floods the area.

Distributional Pattern of floods in India:

- ✚ Floods occur in almost all the river basins of the country.
- ✚ The Vulnerability Atlas of India shows pictorially the areas liable to floods.
- ✚ Around 12 per cent (40 million hectare) of land in India is prone to floods.
- ✚ Most of the flood affected areas lie in the Ganga basin, Brahmaputra basin (comprising of Barak, Tista, Torsa, Subansiri, Sankosh, Dihang and Lohit), the northwestern river basin (comprising Jhelum, Chenab, Ravi, Sutlej, Beas and the Ghagra), peninsular river basin (Tapti, Narmada, Mahanadi, Baitarani, Godavari, Krishna, Pennar and the Kaveri) and the coastal regions of Andhra Pradesh, Tamilnadu, Orissa and Kerala.
- ✚ Assam, Uttar Pradesh, Bihar and Orissa are some of the states who have been severely prone to floods. Our country receives an annual rainfall of 1200 mm, 85% of which is concentrated in 3-4 months i.e June to September.
- ✚ Due to the intense and periodic rain, most of the rivers of the country are fed with huge quantity of water, much beyond their carrying capacity.

Warning:

- a. Flood forecasting and warning has been highly developed in the past two decades. With the advancement of technology such as satellite and remote-sensing equipments flood waves can be tracked as the water level rises.
- b. Except for flash floods there is usually a reasonable warning period. Heavy precipitation will give sufficient warning of the coming river flood. High tides with high winds may indicate flooding in the coastal areas.
- c. Evacuation is possible with suitable monitoring and warning. Warning is issued by the Central Water Commission (CWC), Irrigation & Flood Control Department and Water Resources Department.
- d. CWC maintains close liaison with the administrative and state engineering agencies, local civil authorities to communicate advance warning for appropriate mitigation and preparedness measures.

Drought :

- Drought is either absence or deficiency of rainfall from its normal pattern in a region for an extended period of time leading to general suffering in the society.
- It is interplay between demand that people place on natural supply of water and natural event that provides the water in a given geographical region.
- The more the imbalance in supply the higher is the drought.
- It is a slow on-set disaster and it is difficult to demarcate the time of its onset and the end.
- Any unusual dry period which results in a shortage of useful water.
- Drought can occur by improper distribution of rain in time and space, and not just by its amount.
- Drought is negative balance between precipitation and water use (through evaporation, transpiration by plants, domestic and industrial uses etc) in a geographical region.

Causes of Drought:

Though drought is basically caused by deficit rainfall, which is a meteorological phenomenon, it manifests into different spheres because of various vulnerability factors associated with them (see the box). Some of these factors are human induced. Though drought is a natural disaster, its effects are made worst in developing countries by **over population, over grazing, deforestation, soil erosion, excessive use of ground and surface water for growing crops, loss of biodiversity.**

Types of droughts:

Meteorological drought:

- a. Meteorological drought is simple absence/deficit of rainfall from the normal.
- b. It is the least severe form of drought and is often identified by sunny days and hot weather.

Hydrological drought:

- a. Hydrological drought often leads to reduction of natural stream flows or ground water levels, plus stored water supplies.
- b. The main impact is on water resource systems.

Agricultural drought:

- a. This form of drought occurs when moisture level in soil is insufficient to maintain average crop yields.
- b. Initial consequences are in the reduced seasonal output of crops and other related production.
- c. An extreme agricultural drought can lead to a famine, which is a prolonged shortage of food in a restricted region causing widespread disease and death from starvation.

Measuring Drought Elements at Risk

- In general, all those elements that are primarily dependent on water are most affected. It affects the rainfed crops and then slowly creeps into the irrigated crops.
- People who are dependent on agriculture and areas where the other livelihood opportunities are least developed are greatly affected.
- The herdsman, landless labourer, subsistence farmers, women, children and farm animals are the most vulnerable groups.

Distribution Pattern: Around 68 per cent of India's total area is drought prone to drought. 315 out of a total of 725 Talukas in 99 districts are drought prone. 50 million people are annually affected by drought. *In 2001 more than eight states suffered the impact of severe drought. In 2003 most parts of Rajasthan experienced the fourth consecutive year of drought.*

Possible Risk Reduction Measures:

There are various mitigation strategies:

1. Public Awareness and education: If the community is aware of the do's and don'ts, then half of the problem is solved. This includes awareness on the availability of safe drinking water, water conservation techniques, agricultural drought management strategies like crop contingency plans, construction of rain water harvesting structure.
2. Drought Monitoring: It is continuous observation of the rainfall situation, availability of water in the reservoirs, lakes, rivers etc and comparing with the existing water needs in various sectors of the society.
3. Expansion of irrigation facilities reduces the drought vulnerability. Land use based on its capability helps in optimum use of land and water and can avoid the undue demand created due to their misuse.
4. Livelihood planning identifies those livelihoods which are least affected by the drought. Some of such livelihoods include increased off-farm employment opportunities, collection of non-timber forest produce from the community forests, raising goats, carpentry etc.

Avalanche and Frost:

An avalanche is a very large slide of rapidly moving granular material, most commonly snow, down a mountainside caused by a build up of material.

When a mass of material exceeds the static friction threshold, a cascading effect takes place and accumulates more material as it travels down the mountainside and causes massive, widespread destruction. There are many different types of avalanches including snow, ice, rock and soil.

There are three main factors that contribute to causing an avalanche.

If the steepness of the terrain is between 35 to 45 degrees, is shady, has a convex shape and has a rock or slab base with little vegetation the chance of an avalanche is extremely high.

Weather is another main factor where everything from temperature to wind and rain can loosen the material pack and cause an avalanche.

For a snow avalanche, the snow itself can contribute to the probability of an avalanche. If there is a large amount of new, unbounded snow with little compaction and a large crystal size, the snow can cause an avalanche all by itself.

Contributing factors: Determining critical load which would cause a slope avalanche is a complex task involving evaluation of many factors. Some of them are: **Terrain, Snow and Weather.**

Frost:

Frost is a localised seasonal phenomenon prevalent in the country except in Southern India. Frost damage to crops occurs when moisture within the plant is frozen, gets crystallized and expands. This causes cells to rupture and fluid to leak out, thus the watery appearance of plant tissue or seed after a damaging frost. Different parts of plant, different stages of development of plant, and different types of plants can have varying levels of these 'antifreeze' compounds that result in a range of susceptibility to frost.

- For example, when air temperature reaches zero (0) degree centigrade, crop itself can be 4 or 5 degree cooler, because plants lose heat faster than the surrounding air temperature.
- Frost and cold waves greatly impacts pulse crops.
- During flowering stages, these crops are likely to be adversely affected at temperature of -2 to -3 degree C.
- Those in podding stage are a bit more tolerant but are likely to be damaged at a temperature of -3 to -4 degree C.
- As pulses often mature from bottom of the plant towards the top, frost injury may be much greater on plant tops.

Types of Frost: Hoar frost, advection frost, window frost, white frost and black frost.

Frost-free areas: Frost-free areas are found mainly in the lowland tropics, where they cover almost all land except at altitudes above about 3,000 metres or 9,800 feet near the equator and around 2,000 metres or 6,600 feet in the semiarid areas in tropical regions.

- Some areas on the oceanic margins of the subtropics also are frost-free, as are highly oceanic areas near windward coasts.
- The most poleward frost-free areas are the lower altitudes of the Azores, Île Amsterdam, Île Saint-Paul, and Tristan da Cunha.
- In the United States, southern Florida around Miami Beach and the Florida Keys are the only reliably frost-free areas, as well as the Channel Islands off the coast of California.
- The hardiness zones in these regions are 11a and 11b.

FOREST FIRE

The most common hazard in forests is forest fire. Forest fires are as old as the forests themselves. They pose a threat not only to the forest wealth but also to the entire regime to fauna and flora seriously disturbing the bio-diversity and the ecology and environment of a region.

During summer, when there is no rain for months, the forests become littered with dry senescent leaves and twinges, which could burst into flames ignited by the slightest spark. The Himalayan forests, particularly, Garhwal Himalayas have been burning regularly during the last few summers, with colossal loss of vegetation cover of that region.

Forest fire causes imbalances in nature and endangers biodiversity by reducing faunal and floral wealth. Traditional methods of fire prevention are not proving effective and it is now essential to raise public awareness on the matter, particularly among those people who live close to or in forested areas.

Causes of forest fire:

Forest fires are caused by Natural causes as well as Man made causes

Natural causes: Many forest fires start from natural causes such as lightning which set trees on fire. However, rain extinguishes such fires without causing much damage. High atmospheric temperatures and dryness (low humidity) offer favorable circumstance for a fire to start.

Man made causes: Fire is caused when a source of fire like naked flame, cigarette or bidi, electric spark or any source of ignition comes into contact with inflammable material. Causes of forest fires can be divided into two broad categories: environmental (which are beyond control) and human related (which are controllable).

Environmental causes are largely related to climatic conditions such as temperature, wind speed and direction, level of moisture in soil and atmosphere and duration of dry spells. Other natural causes are the friction of bamboos swaying due to high wind velocity and rolling stones that result in sparks setting off fires in highly inflammable leaf litter on the forest floor.

Classification of Forest Fire:

Forest fire can broadly be classified into three categories;

- ✚ Natural or controlled forest fire.
- ✚ Forest fires caused by heat generated in the litter and other biomes in summer through carelessness of people (human neglect) and
- ✚ Forest fires purposely caused by local inhabitants.

Types of Forest Fire

There are two types of forest fire i) Surface Fire and ii) Crown Fire

Surface Fire

A forest fire may burn primarily as a surface fire, spreading along the ground as the surface litter (senescent leaves and twigs and dry grasses etc) on the forest floor and is engulfed by the spreading flames.

Crown Fire

The other type of forest fire is a crown fire in which the crown of trees and shrubs burn, often sustained by a surface fire. A crown fire is particularly very dangerous in a coniferous forest because resinous material given off burning logs burn furiously. On hill slopes, if the fire starts downhill, it spreads up fast as heated air adjacent to a slope tends to flow up the slope spreading flames along with it. If the fire starts uphill, there is less likelihood of it spreading downwards.

Effect of forest fire

Fires are a major cause of forest degradation and have wide ranging adverse ecological, economic and social impacts, including:

- Loss of valuable timber resources
- Degradation of catchment areas
- Loss of biodiversity and extinction of plants and animals
- Loss of wildlife habitat and depletion of wildlife
- Loss of natural regeneration and reduction in forest cover
- Global warming
- Loss of carbon sink resource and increase in percentage of CO₂ in atmosphere
- Change in the microclimate of the area with unhealthy living conditions
- Soil erosion affecting productivity of soils and production
- Ozone layer depletion
- Health problems leading to diseases

Integrated forest protection:

The main objective of this scheme to control forest fires and strengthen the forest protection in Tamilnadu. The works like fireline clearing, assistance to Joint Forest Management committees, creating water bodies, purchase of vehicles and communication equipments, purchase of fire fighting tools, etc., are being undertaken.

References:

www.imd.ernet.in

www.ndmindia.nic.in

www.cwc.nic.in website of the Central Water Commission of India, (CWC) of India.

www.drought.unl.edu

https://agritech.tnau.ac.in/agriculture/agri_majorareas_disastermgt_forestfire.html