

FLOODS

Definition:

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.

Causes of Floods:

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

Indian Hazard Zones:

Floods occur in almost all the river basins of the country. 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:

- With the advancement of technology such as satellite and remote-sensing equipments flood waves can be tracked as the water level rises.
- Heavy precipitation will give sufficient warning of the coming river flood.
- High tides with high winds may indicate flooding in the coastal areas.
- 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. CWC maintains close liaison with the administrative and state engineering agencies, local civil authorities to communicate advance warning for appropriate mitigation and preparedness measures.

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.
- Lack of proper drinking water facilities, contamination of water (well, ground water, piped water supply) leads to outbreak of epidemics, diarrhoea, viral infection, malaria and many other infectious diseases.
- 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.

Possible Risk Reduction Measures:

Mapping of the flood prone areas is a primary step involved in reducing the risk of the region. Historical records give the indication of the flood inundation areas and the period of occurrence and the extent of the coverage. Warning can be issued looking into the earlier marked heights of the water levels in case of potential threat. In the coastal areas the tide levels and the land characteristics will determine the submergence areas. Flood hazard mapping will give the proper indication of water flow during floods.

Land use control will reduce danger of life and property when waters inundate the flood plains and the coastal areas. The number of casualties is related to the population in the area at risk. In areas where people already have built their settlements, measures should be taken to relocate to better sites so as to reduce vulnerability. No major development should be permitted in the areas which are subjected to high flooding. Important facilities like hospitals, schools should be built in safe areas. In urban areas, water holding areas can be created like ponds, lakes or low-lying areas.

Construction of engineered structures in the flood plains and strengthening of structures to withstand flood forces and seepage. The buildings should be constructed on an elevated area. If necessary build on stilts or platform.

Flood Control aims to reduce flood damage. This can be done by decreasing the amount of runoff with the help of reforestation, protection of vegetation, clearing of debris from streams and other water holding areas, conservation of ponds and lakes etc. Flood Diversion include levees, embankments, dams and channel improvement. Dams can store water and can release water at a manageable rate. Flood Proofing reduces the risk of damage. Measures include use of sand bags to keep flood water away, blocking or sealing of doors and windows of houses etc. Houses may be elevated by building on raised land. Buildings should be constructed away from water bodies.

Flood Management In India, systematic planning for flood management commenced with the Five Year Plans, particularly with the launching of National Programme of Flood Management in 1954. Structural measures include, storage reservoirs flood embankments, drainage channels, anti erosion works, channel improvement works, detention basins etc. and non-structural measures include flood forecasting, flood plain zoning, flood proofing, disaster preparedness etc. The flood management measures undertaken so far have provided reasonable degree of protection to an area of 15.81 million hectares throughout the country.

DROUGHTS

Definition:

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.

- 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 is a normal, recurrent feature of climate. Climate is expected to show some aberrations and drought is just a part of it.
- 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 Droughts:

- Deficit rainfall
- Over population
- Over grazing
- Deforestation
- Soil erosion
- Excessive use of ground and surface water for growing crops
- Loss of biodiversity

Types of droughts:

Drought proceeds in sequential manner. Its impacts are spread across different domains as listed below.

Meteorological drought:

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

Hydrological drought:

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

Agricultural drought:

This form of drought occurs when moisture level in soil is insufficient to maintain average crop yields. Initial consequences are in the reduced seasonal output of crops and other related production. 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.

Socio-economic drought:

Socio-economic drought correlates the supply and demand of goods and services with the three above-mentioned types of drought. When the supply of some goods or services such as water and electricity are weather dependant then drought may cause shortages in supply of these economic goods.

Elements at Risk:

In general, all those elements that are primarily dependent on water are most affected.

- It affects the rain fed 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 in India:

- 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.

Typical adverse effects:

- As the meteorological drought turns into hydrological drought, the impacts start appearing first in agriculture which is most dependants on the soil moisture.
- Irrigated areas are affected much later than the rain fed areas.
- However, regions surrounding perennial rivers tend to continue normal life even when drought conditions are prevailing around. The impacts slowly spread into social fabric as the availability of drinking water diminishes, reduction in energy production, ground water depletion, food shortage, health reduction and loss of life, increased poverty, reduced quality of life and social unrest leading to migration.

Possible Risk Reduction Measures:

There are various mitigation strategies to cope up with drought.

Public Awareness and education: If the community is aware of the dos 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. Awareness can be generated by the print, electronic and folk media.

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.

Water supply augmentation and conservation through rainwater harvesting in houses and farmers' fields increases the content of water available. Water harvesting by either allowing the runoff water from all the fields to a common point (e.g. Farm ponds) or allowing it to infiltrate into the soil where it has fallen (in situ) (e.g. contour bunds, contour cultivation, raised bed planting etc) helps increase water availability for sustained agricultural production.

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.

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.

Drought planning: the basic goal of drought planning is to improve the effectiveness of preparedness and response efforts by enhancing monitoring, mitigation and response measures.

- Planning would help in effective coordination among state and national agencies in dealing with the drought. Components of drought plan include establishing drought taskforce which is a team of specialists who can advise the government in taking decision to deal with drought situation, establishing coordination mechanism among various agencies which deal with the droughts, providing crop insurance schemes to the farmers to cope with the drought related crop losses, and public awareness generation.

LANDSLIDES

Definition :

The term 'landslide' includes all varieties of mass movements of hill slopes and can be defined as the downward and outward movement of slope forming materials composed of rocks, soils, artificial fills or combination of all these materials along surfaces of separation by falling, sliding and flowing, either slowly or quickly from one place to another.

Causes of Landslides:

There are several causes of landslide. Some of the major causes are as follows:

- **Geological Weak material:** Weakness in the composition and structure of rock or soil may also cause landslides.
- **Erosion:** Erosion of slope toe due to cutting down of vegetation, construction of roads might increase the vulnerability of the terrain to slide down.
- **Intense rainfall:** Storms that produce intense rainfall for periods as short as several hours or have a more moderate intensity lasting several days have triggered abundant landslides. Heavy melting of snow in the hilly terrains also results in landslide.
- **Human Excavation** of slope and its toe, loading of slope/toe, draw down in reservoir, mining, deforestation, irrigation, vibration/blast, Water leakage from services.
- **Earthquake shaking** has triggered landslides in many different topographic and geologic settings. Rock falls, soil slides and rockslides from steep slopes involving relatively thin or shallow disaggregated soils or rock, or both have been the most abundant types of landslides triggered by historical earthquakes.
- **Volcanic eruption:** Deposition of loose volcanic ash on hillsides commonly is followed by accelerated erosion and frequent mud or debris flows triggered by intense rainfall.

Distribution Pattern in India:

Landslides constitute a major natural hazard in our country, which accounts for considerable loss of life and damage to communication routes, human settlements, agricultural fields and forest lands. The Indian subcontinent, with diverse physiographic, seismic, tectonic and climatological conditions is subjected to varying degree of landslide hazards; the Himalayas including North-eastern mountains ranges being the worst affected, followed by a section of Western Ghats and the Vindhyas. Removal of vegetation and toe erosion has also triggered slides. Torrential rainfall on the deforested slopes is the main factor in the Peninsular India namely in Western Ghats and Nilgiris.

Typical Adverse Effects of Landslides:

- The most common elements at risk are the settlements built on the steep slopes, built at the toe and those built at the mouth of the streams emerging from the mountain valley.
- All those buildings constructed without appropriate foundation for a given soil and in sloppy areas are also at risk.
- Roads, communication lines are vulnerable.

Possible risk reduction measures:

Hazard mapping locates areas prone to slope failures. This will help to avoid building settlements in such areas. These maps will also serve as a tool for mitigation planning.

Land use practices such as:

- Areas covered by degraded natural vegetation in upper slopes are to be afforested with suitable species. Existing patches of natural vegetation (forest and natural grass land) in good condition, should be preserved
- Any developmental activity initiated in the area should be taken up only after a detailed study of the region has been carried out.
- In construction of roads, irrigation canals etc. proper care is to be taken to avoid blockage of natural drainage
- Total avoidance of settlement in the risk zone should be made mandatory.
- Relocate settlements and infrastructure that fall in the possible path of the landslide
- No construction of buildings in areas beyond a certain degree of slope

Retaining Walls can be built to stop land from slipping (these walls are commonly seen along roads in hill stations). These are constructed to prevent smaller sized and secondary landslides that often occur along the toe portion of the larger landslides.

Surface Drainage Control Works: The surface drainage control works are implemented to control the movement of landslides accompanied by infiltration of rain water and spring flows.

Engineered structures with strong foundations can withstand or take the ground movement forces. Underground installations (pipes, cables, etc.) should be made flexible to move in order to withstand forces caused by the landslide

Increasing vegetation cover is the cheapest and most effective way of arresting landslides. This helps to bind the top layer of the soil with layers below, while preventing excessive run-off and soil erosion.

Insurance will assist individuals whose homes are likely to be damaged by landslides or by any other natural hazards.

FOREST FIRES

Definition:

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 twigs, which could burst into flames ignited by the slightest spark. The Himalayan forests, particularly, Garhwali 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 Fires:

- **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 fire can be categorized into two groups:

- (i) Environmental causes(which are beyond control)
- (ii) Human related causes (which are controllable)

Environmental causes: These 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.

Human related causes: These result from human activity as well as methods of forest management. These can be intentional or unintentional, for example:

- graziers and gatherers of various forest products starting small fires to obtain good grazing grass as well as to facilitate gathering of minor forest produce like flowers of *Madhuca indica* and leaves of *Diospyros melanoxylon*
- the use of fires by villagers to ward off wild animals
- fires lit intentionally by people living around forests for recreation
- fires started accidentally by careless visitors to forests who discard cigarette butts.

The causes of forest fire have been increasing rapidly. The problem has been accentuated by the growing human and cattle population. People enter forests even more frequently to graze cattle, collect fuel wood, timber and other minor forest products. It has been estimated that 90% of forest fires in India are man-made.

Adverse Effects of Forest Fires:

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
- Loss of livelihood for tribal people and the rural poor, as approximately 300 million people are directly dependent upon collection of non-timber forest products from forest areas for their livelihood.

The Need of Fire Management:

The incidence of forest fires in the country is on the increase and more area is burned each year. The major cause of this failure is the piecemeal approach to the problem. Both the national focus and the technical resources required for sustaining a systematic forest fire management programs are lacking in the country. Important forest fire management elements like strategic fire centres, coordination among Ministries, funding, human resource development, fire research, fire management, and extension programs are missing. Taking into consideration the serious nature of the problem, it is necessary to make some major improvements in the forest fire management strategy for the country. The Ministry of Environment and Forests, Government of India, has prepared a National Master Plan for Forest Fire Control. This plan proposes to introduce a well-coordinated and integrated fire-management program that includes the following components:

- Prevention of human-caused fires through education and environmental modification. It will include cultural activities, engineering works, people participation, and education and enforcement. It is proposed that more emphasis be given to people participation through Joint Forest Fire Management for fire prevention.
- Prompt detection of fires through a well coordinated network of observation points, efficient ground patrolling, and communication networks. Remote sensing technology is to be given due importance in fire detection. For successful fire management and administration, a National Fire Danger Rating System (NFDRS) and Fire Forecasting System are to be developed in the country.
- Fast initial attack measures.
- Vigorous follow up action.
- Introducing a forest fuel modification system at strategic points.
- Fire fighting resources.

Each of the above components plays an important role in the success of the entire system of fire management. Special emphasis is to be given to research, training, and development.