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Introduction

A flood is an overflow of water onto land that is normally dry. Floods can happen almost anywhere. They can cover an area with just a few inches of water or they can bring enough water to cover the roof of a house. Floods can be dangerous for communities, lasting days, weeks or sometimes even longer.

The Main types of floods are

1. Flash floods are fast-moving waters that sweep everything in their path. They are caused by heavy rainfall or rapid snow thaw. Floods usually cover a relatively small area and occur with little to no notice, generally less than six hours. The rapid water torrents can move large objects such as cars, rocks, and trees.

2. Coastal floods are caused by strong winds or storms that move towards a coast during high tide. When powerful waves breach the coast's dune or dike, the area is usually flooded. Coastal areas with fewer defences and lower elevation are the most affected. The best time to repair the breach is during low tide.

3. River floods are characterized by gradual riverbank overflows caused by extensive rainfall over an extended period of time. The areas covered by river floods depend on the size of the river and the amount of rainfall. River floods rarely result in loss of lives but can cause immense economic damage.

4. Urban floods occur when the drainage system in a city or town fails to absorb the water from heavy rain. The lack of natural drainage in an urban area can also contribute to flooding. Water flows out into the street, making driving very dangerous. Although water levels can be just a few inches deep, urban floods can cause significant structural damage.

5. Pluvial floods form in flat areas where the terrain can't absorb the rainwater, causing puddles and ponds to appear. Pluvial flooding is similar to urban flooding, but it occurs mostly in rural areas. The

agricultural activities and properties in areas where pluvial floods have occurred can be seriously affected.

Causes of Flooding

Massive Rainfall

Drainage systems and the effective infrastructure design aid during heavy rains. They help the drainage of excess water into reservoirs in an easy way. But in cases of heavy rainfall, the systems stop working. Thus, flood is caused.

Overflowing of the rivers

The people living along the river always have a risk of life from the overflowing of the Rivers. To prevent such a situation, a string of dams is built. However, if these dams are not managed properly, they may cause flooding and huge damage.

Snowmelt

At the time of the high melting of snow due to heavy precipitation and other factors, the situation of flooding arises. Adopting sustainable measures for heavy precipitation can help in dealing with the flooding situation.

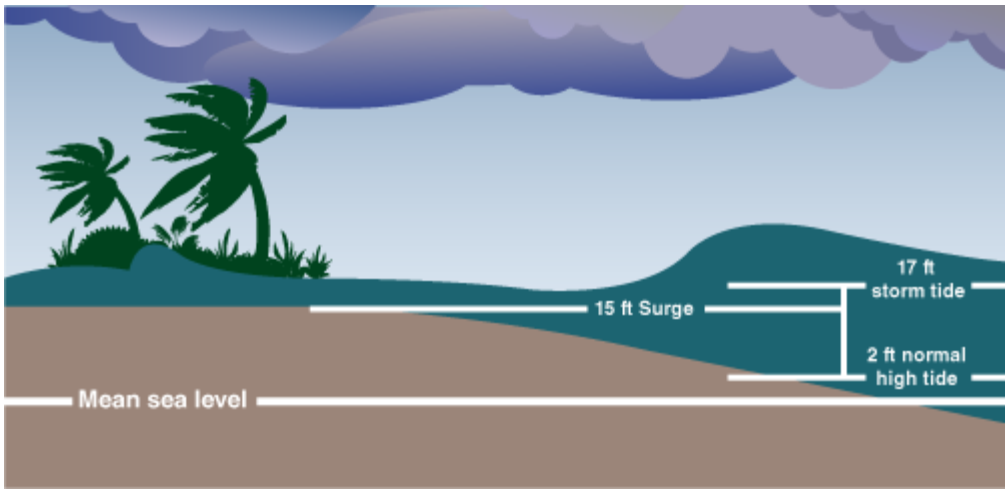
Climate Change

The climatic changes caused due to human practices also add to the risk of flooding. Human beings cut trees in a large number, thus affecting the process of photosynthesis. Thus increased level of carbon-di-oxide in the atmosphere cause changes in climate posing threats of natural disasters like floods etc.

Storm Surges and Tsunamis

Rain is not always the culprit when it comes to flooding. Storm surges related to hurricanes and other storms can lead to significant flooding, as can tsunamis that are sometimes caused by underwater earthquakes

Storm surge is the unusual rise of water that happens during a big tropical storm. When the water rises, dangerous flooding can happen near the coast. Storm surges are not the same as high tides, but when a storm surge happens during a high tide, it can result in even higher water. Sometimes the water can rise as many as 20 feet. And that doesn't mean there is one 20-foot wave that quickly goes away; it means that the water level rises that much, so it can go very far inland if the ground is flat.



Collapsed Dams

In the event of huge rainfall, the dams built begin to collapse. Thus, causing the flood situation to become even critical for the people living around.

Deforestation

The cutting of trees in a reckless manner i.e. deforestation is also a major cause of man-made flooding. Trees prevent soil erosion and also the loss of crops. The vegetation is also enriched as a result of more and more trees. This also blocks the massive flow of rain, thus preventing flooding.

Emission of Greenhouse Gases

The burning of fossil fuels, the industrial influences, the pollution all is depleting the level of the ozone layer and increasing the level of greenhouse gases, becoming a major cause of man-made flooding.

Thus, a flood can be caused both due to natural causes as well as it can be a human-made flood.

Urban Drainage Basins

Many of our cities are made of mostly concrete and other impermeable material. When you have an urban drainage basin that is made of concrete, there is no ground for water to sink into. So, when those drainage basins fill up, it is going to mean flooding for low-lying areas. This is mostly the case in large urban areas. When heavy rains strike, the basins used to drain them cannot always handle the load.

Factors of Flood

VEGETATION COVER

This varies seasonally. The type and amount will affect interception and stemflow/throughfall. Overland flow is reduced. Lag time will be increased.

CLIMATE

The distribution of rainfall over the year and the temperatures will affect the lag times.

SLOPES

Steep slopes will encourage overland flow and gentle slope will slow run off down.

RAINFALL INTENSITY & DURATION

Intense rain will increase overland flow and reduce lag times. Gentle rain over a longer time will allow more infiltration.

LAND USE

Impermeable surfaces created by urbanisation will reduce infiltration and encourage overland flow.

Different types of crops affect interception rates e.g. cereals 7-15%.

SOIL TYPE & DEPTH

Deep soils store more water, pipes in the soil encourage through flow. Soils with small pore spaces will reduce infiltration and increase overland flow.

LAKES & RESERVOIRS

These will store floodwater and thus reduce lag time and control river response to heavy rainfall.

ROCK TYPE

Impermeable rocks prevent groundwater flow and encourage through flow and overland flow. These rocks will decrease lag time. Permeable rock will have the opposite effect

Case Study – Kerala Flood 2018

On 16 August 2018, severe floods affected the south Indian state Kerala, due to unusually high rainfall during the monsoon season. It was the worst flood in Kerala in nearly a century

Kerala State has an average annual precipitation of about 3000 mm. The rainfall in the State is controlled by the South-west and North-east monsoons. About 90% of the rainfall occurs during six monsoon months.

Kerala experienced an abnormally high rainfall from 1 June 2018 to 19 August 2018. This resulted in severe flooding in 13 out of 14 districts in the State. As per IMD data, Kerala received 2346.6 mm of rainfall from 1 June 2018 to 19 August 2018 in contrast to an expected 1649.5 mm of rainfall. This rainfall was about 42% above the normal.

A severe spell of rainfall was experienced at several places on the 8th and 9th of August 2018. The 1- day rainfall of 398 mm, 305 mm, 255 mm, 254 mm, 211 mm and 214 mm were recorded at Nilambur in Malappuram district, Mananthavadi in Wayanad district, Peermade, Munnar KSEB and Myladumparain in Idukki district and Pallakad in Pallakad district respectively on 9 August 2018. This led to further flooding at several places in Mananthavadi and Vythiri in Wayanad district during 8-10, August 2018. Water was released from several dams due to heavy rainfall in

their catchments. The water levels in several reservoirs were almost near their Full Reservoir Level (FRL) due to continuous rainfall from 1st of June. Another severe spell of rainfall started from the 14th of August and continued till the 19th of August, resulting in disastrous flooding in 13 out of 14 districts.

Thirty-five out of the fifty-four dams within the state were opened, for the first time in history. All five overflow gates of the Idukki Dam were opened at the same time, and for the first time in 26 years 5 gates of the Malampuzha dam of Palakkad were opened. Heavy rains in Wayanad and Idukki have caused severe landslides and have left the hilly districts isolated.

- Kerala received heavy monsoon rainfall, on the mid- evening of August 8.
- Almost all dams had been opened since the water level had risen close to overflow level due to heavy rainfall, flooding local low-lying areas.
- Over 483 people died, and 15 are missing
- 33,000 people have been rescued by the forces.
- 65000 people have been rescued by fisherman.
- The Kerala State Disaster Management Authority has placed the state in a red alert as a result of the intense flooding.
- A number of water treatment plants were forced to cease pumping water, resulting in poor access to clean water, especially in northern districts of the state.
- Over 3,274 relief camps have been opened at various locations to accommodate the flood victims. It is estimated that 1,247,49 people have found shelter in such camps.
- The flooding has affected hundreds of villages, destroyed an estimated 10,000 km (6,200 mi) of roads and thousands of homes have been damaged or destroyed.
- The Government cancelled Onam celebrations, whose allocated funds have been reallocated to relief efforts.

- On August 12, Cochin International Airport, India's fourth busiest in terms of international traffic, and the busiest in the state suspended all operations until 29 August, following runway flooding.

Drought

A drought (or drouth, in some regions) is an event of prolonged shortages in the water supply, whether atmospheric (below-average precipitation), surface water or ground water. A drought can last for months or years, or may be declared after as few as 15 days. It can have a substantial impact on the ecosystem and agriculture of the affected region and harm to the local economy. Annual dry seasons in the tropics significantly increase the chances of a drought developing and subsequent bush fires. Periods of heat can significantly worsen drought conditions by hastening evaporation of water vapor.

The various types of droughts are listed below.

- **Meteorological drought**

  Meteorological drought is defined on the basis of the degree of dryness, in comparison to a normal or average amount, and the duration of the dry period. Definitions of meteorological drought must be region-specific, since the atmospheric conditions that result in deficiencies of precipitation are highly region-specific.

  The variety of meteorological definitions in different countries illustrates why it is not possible to apply a definition of drought developed in one part of the world to another. For instance, the following definitions of drought have been reported:

  - United States (1942): Less than 2.5 mm of rainfall in 48 hours.
  - Great Britain (1936): Fifteen consecutive days with daily precipitation less than 0.25 mm.
  - Libya (1964): When annual rainfall is less than 180 mm.
  - Bali (1964): A period of six days without rain.

Data sets required to assess meteorological drought are daily rainfall information, temperature, humidity, wind velocity and pressure, and evaporation.

- **Agricultural drought**

Agricultural drought links various characteristics of meteorological drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil-water deficits, reduced groundwater or reservoir levels, and so on. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil. A good definition of agricultural drought should account for the susceptibility of crops during different stages of crop development. Deficient topsoil moisture at planting may hinder germination, leading to low plant populations per hectare and a reduction of yield.

Data sets required to assess agricultural drought are soil texture, fertility and soil moisture, crop type and area, crop water requirements, pests and climate.

- **Hydrological drought**

Hydrological drought refers to a persistently low discharge and/or volume of water in streams and reservoirs, lasting months or years. Hydrological drought is a natural phenomenon, but it may be exacerbated by human activities. Hydrological droughts are usually related to meteorological droughts, and their recurrence interval varies accordingly. Changes in land use and land degradation can affect the magnitude and frequency of hydrological droughts.

Data sets required to assess hydrological drought are surface-water area and volume, surface runoff, streamflow measurements, infiltration, water-table fluctuations, and aquifer parameters.

Causes of Drought

Natural Causes

Droughts have plagued humankind throughout much of our history, and until recently they were often natural phenomena triggered by cyclical weather patterns, such as the amount of moisture and heat in the air, land, and sea.

Fluctuating ocean and land temperatures

Ocean temperatures largely dictate global weather patterns, including dry and wet conditions on land, and even tiny temperature fluctuations can have huge ripple effects on climate systems. Research shows that dramatic and prolonged temperature changes in the North Pacific and North Atlantic Oceans correspond directly to extreme weather patterns on land, including persistent droughts in North America and the eastern Mediterranean—the latter of which has been described as the region's worst drought in 900 years. Fluctuating ocean temperatures are also behind El Niño and La Niña weather phenomena, with La Niña notorious for drying out the southern United States. Meanwhile, hotter surface temperatures on land lead to greater evaporation of moisture from the ground, which can increase the impact of drought.

Altered weather patterns

The distribution of rainfall around the world is also impacted by how air circulates through the atmosphere. When there is an anomaly in surface temperatures—particularly over the sea—air circulation patterns are altered, changing how and where precipitation falls around the world. The new weather patterns can throw water supply and demand out of sync, as is the case when earlier-than-usual snowmelt reduces the amount of water available for crops in the summer.

Reduced soil moisture

Soil moisture can impact cloud formation, and hence precipitation. When water from wet soil evaporates, it contributes to the formation of rain clouds, which return the water back to the earth. When land is drier than usual, moisture still evaporates into the atmosphere, but not at a volume

adequate to form rain clouds. The land effectively bakes, removing additional moisture and further exacerbating dry conditions.

Manmade Causes

While drought occurs naturally, human activity—from water use to greenhouse gas emissions—is having a growing impact on their likelihood and intensity.

Climate Change

Climate change—and global warming, specifically—impacts drought in two basic ways: Rising temperatures generally make wet regions wetter and dry regions drier. For wetter regions, warm air absorbs more water, leading to larger rain events. But in more arid regions, warmer temperatures mean water evaporates more quickly. In addition, climate change alters large-scale atmospheric circulation patterns, which can shift storm tracks off their typical paths. This, in turn, can magnify weather extremes.

Excess water demand

Drought often reflects an imbalance in water supply and demand. Regional population booms and intensive agricultural water use can put a strain on water resources, even tipping the scale enough to make the threat of drought a reality. Meanwhile, demand for water supplied by upstream lakes and rivers, particularly in the form of irrigation and hydroelectric dams, can lead to the diminishing or drying out of downstream water sources, which may contribute to drought in other regions.

Deforestation and Soil degradation

When trees and plants release moisture into the atmosphere, clouds form and return the moisture to the ground as rain. When forests and vegetation disappear, less water is available to feed the water cycle, making entire regions more vulnerable to drought. Meanwhile, deforestation and other poor land-use practices, such as intensive farming, can diminish soil quality and reduce the land's ability to absorb and retain water. As a result, soil dries out faster (which can induce agricultural drought), and less groundwater is replenished (which can contribute to hydrological drought). Indeed, experts

believe the 1930s Dust Bowl was caused in large part by poor agricultural practices combined with the cooling of the Pacific and the warming of the Atlantic by as little as a few tenths of a degree.

Effects of drought

The effects of drought are widespread and have devastating effects on the environment and the society as a whole. Water use is part and parcel of almost every human activity as well as the life of plants and animals. On this basis, extended deficiency of water can affect the society in various ways both directly and indirectly. The effects can therefore generally be categorized as environmental, economic, and social.

Case Study 2002 Rajasthan Drought

October 2002 - As the south-west monsoon swept across India with less than its usual force, many states face a gloomy harvest and a year of food shortages and drought. Punjab, Haryana, Rajasthan, Uttar Pradesh, Madhya Pradesh, Chattisgarh and Uttarachal in the north and Karnataka, Andhra Pradesh and Tamilnadu are facing major crises. Twelve meteorological districts in the country have been hit by poor monsoon this year. Expected to start around mid-June and continue until September, the monsoon has been intermittent, with heavy rains around the north-east resulting in floods in two States Bihar and Assam, while the north and north-west have been relatively dry causing widespread crop damage and economic loss.

Rajasthan is one of the worst affected states. Drought has loomed in all the 32 districts with a deficit rainfall of 53.4%. There are areas where people have not experienced even one proper shower during the whole monsoon period. This is the fifth continuous drought in the state. Approximately 40 million people and 50 million cattle have been affected this year alone. The water table is going down, wells and handpumps have gone dry. Livestock have started dying of hunger and thirst. People have started abandoning their cattle after praying to god for their lives. Migration to cities and other states is up. Social structures in villages have suffered. Weddings have been postponed indefinitely.

Drinking water

Dry ponds, wells and handpumps are making life miserable for the poor sector of society. About 30% of the handpumps have gone dry. Women have to walk long distances to fetch water. Western Rajasthan is vulnerable in terms of all the scarcities. Water rates have gone up. Tanker tractors are charging extremely high prices. One tanker tractor of 1000 liters costs from Rs.200 to 500 depending on location and distance

PHED has a contingency plan of Rs. 518 crores. Overall, 30,000 works of renovating traditional water harvesting structures have been identified under relief works. 3400 new handpumps and 1205 tube wells will also be bored. 1500 tanker tractors are supplying water in 1100 villages. Of the western state districts, the most severely affected is Pali. Each day, two trains of water must be provided to Pali. No district is in a position to provide water properly, as everywhere the rainfall is deficit. There is simply no way that 1500 tanker tractors could quench the thirst of 40 million people and 50 million livestock.

Fodder and livestock

Most of the reports from District Collectors on the drought situation have prioritized fodder as the main concern. With nearly no agriculture, there is now a situation of fodder deficiency all over the state. Western Rajasthan districts are more affected. Because the drought is regional, neighboring states like Punjab and Haryana, which used to supply fodder in normal years, are themselves facing similar worries this year. The scarcity in other states is not of great intensity as it is their first or second year of drought and they still have some buffer stocks of fodder, but not to supply other states. Due to the non-availability of water and fodder people have started abandoning their unproductive cattle, putting a mark on their foreheads in a last prayer under open skies. There are reports of animals dying of hunger and thirst. Animal carcasses can be found in the countryside's. Many people have started migrating to other states with their animals. In some instances, neighboring states are obstructing this migration. Nearly 50% of the livestock could be lost.