

B.Tech (Ag. Engg) - II Year, II Semester 2019-20 ,

Course: Watershed Hydrology.

Topic: Lecture Notes on Drought, Classification, Causes, Impacts & Management strategies.

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## Drought

Drought is a natural calamity. Often some area receives below average rainfall which leads to scarcity of soil moisture, quantity of water in stream, river, ponds & reservoirs. Droughts are one of the most feared natural calamities in India impacting food production, the economy as well as the morale of millions of farmers in a country where agriculture is the livelihood of 60 percent of the population.

### Definition:

Drought is an event of prolonged period of deficient rainfall which leads to scarcity of moisture in soil, shortage of water in storage structures like ponds & less flow of water in rivers.

Drought differs from other natural hazards such as cyclones, floods, earthquakes, volcanic eruptions, and tsunamis in that:

- There is no universally accepted definition that can encapsulate the complexity of this phenomenon adequately;
- It is difficult to determine the beginning and end of a drought episode because of the slow, 'creepy' onset, silent spread and gradual withdrawal. In India, it is generally considered to be coterminous with the monsoons;
- An episode could spill over months or even years with or without any accompanying shift in the geographical arena;
- There is no indicator or index which can precisely forecast the advent and severity of a drought event, nor project its possible impacts;
- Spatial expanse tends to be far greater than in the case of other natural calamities, which when compounded by the difficulties associated with the impact assessment of the disaster, makes effective response highly challenging;

- Impacts are generally non-structural and difficult to quantify e.g. the damage to the ecology, the disruption of socio-economic fabric of communities, the long term effects of mal-nutrition on health and morbidity etc.;
- The impact tends to get magnified in the event of successive droughts.
- About 68% of the cropped area in India is vulnerable to droughts. Of this, over 33% of the area in the country receives less than 750 mm of mean annual rainfall and is classified as “chronically drought-prone”. Another 35% area receives mean annual rainfall of 750-1,125 mm and is classified as “drought-prone”. The drought-prone areas are confined primarily to the arid, semi-arid, and sub-humid regions of peninsular and western India. Some of the major drought years in the country were 1966, 1972, 1979, 1987, 2002, 2009, 2014 and 2015.

### Classification of drought

The National Commission on Agriculture in India classified three types of drought: meteorological, agricultural and hydrological.

**Meteorological drought:** It is defined as a situation when there is significant decrease from normal precipitation over an area (i.e. more than 10 %). It occur when there are long gaps in normal rainfall and are measured based on the degree of dryness and the duration of the dry period. Meteorological drought is further classified based on rainfall deficiency with respect to long term average – 25% or less is normal, 26-50% is moderate and more than 50% is severe.

**Agricultural drought:** Agricultural drought is a situation when soil moisture and rainfall are inadequate to support healthy crop growth. It occurs when there is insufficient soil moisture to meet the needs of a crop at a particular time. Agricultural drought usually follows meteorological drought and occurs before a hydrological drought. Agricultural drought can be measured through indicators such as lack of rainfall, changes in evapotranspiration, soil water deficits, reduced groundwater or reservoir levels etc.

**Hydrological droughts:** Hydrological drought results from prolonged meteorological drought resulting in depletion of surface and sub-surface water resources. These are the result of surface and subsurface water supplies from streams, rivers and lakes becoming scarce due to scanty rainfall. The frequency and severity of hydrological droughts are defined at the watershed or river basin scale and are influenced by factors such as land degradation or land use changes, construction of dams etc.

### **Causes of Drought:**

Droughts are caused due to lack of rains over extended periods of time. A number of factors such as temperature changes between land and water, changes in air circulation and erratic weather patterns can affect rainfall frequency and intensity leading to droughts

Human activities such as land use changes, deforestation, urbanisation, pollution can also have a negative impact on rainfall leading to dry conditions and loss of soil moisture.

Poor rainfall and high temperatures coupled with overuse of surface and groundwater resources and poor water management practices can lead to demand for water exceeding the available water supply. These can trigger droughts.

### **Impacts of Drought:**

Droughts affect people in a several ways. Access to clean drinking water is essential for all life, and sources of water may dwindle during a drought. Without the presence of water, people must bring in enough water from elsewhere to survive. Water is also needed for crops to grow. When not, enough precipitation falls to naturally water crops, they must be watered by irrigation. Irrigation is possible only when there is enough water in nearby rivers, lakes, or streams, or from groundwater. During a drought, these water sources are diminished and may even dry up, preventing crops from being irrigated and causing them to die off.

Drought produces wide-ranging impacts that span across many sectors of the economy. The reverberations are felt by the society and economy much beyond the areas actually experiencing the onslaughts of physical drought because agricultural production and water resources are integral to our ability to produce goods and services. Drought affects the overall economy of the country at macro and micro economic levels, both directly and indirectly. Direct impacts are usually visible in falling agricultural production and heightened food insecurity among poor and vulnerable sections; depleted water levels; higher livestock and wildlife mortality; cattle and animal migration; damage to ecosystem from indiscriminate exploitation; increased fire hazards etc. Indirect impacts of drought can be gauged from the reduction in incomes for farmers and agribusinesses, increased prices for food and fodder, reduction in purchasing capacity and slump in consumption, default on agricultural loans, distress sale of agricultural land & livestock, rural unrest, shrinkage in avenues for agricultural employment etc. These deleterious impulses have huge negative multiplier effects in the economy and society. The impacts of drought are generally categorized as economic, environmental, and social.

**Economic impacts:** It refers to production losses in agriculture and related sectors, especially animal husbandry, dairy, poultry, horticulture and fisheries. It affects livelihoods and quality of life for the majority of farmers, farm labourers, artisans, small rural businesses and rural population in general that is dependent on agriculture. All industries dependent upon the primary sector for raw materials suffer on account of reduced supplies and hardening prices. Drought thus causes a dampening impact on the economy by squeezing profit margins, drying up income and revenue streams and constricting employment avenues through disruption caused to supply chain managements, slowing down flow of credit and tax collections, depressing industrial and consumer demand, increased dependence on imports, and lowering of overall market sentiments.

**Environmental impacts:** It can be gauged from low water levels in ground water and surface reservoirs, lakes and ponds, reduced flows in springs, streams and rivers, loss of forest cover, migration of wildlife and sharpening man-animal conflicts and general stress on biodiversity. Reduced stream flow and loss of wetlands may affect levels of salinity. Increased groundwater depletion rates, and reduced recharge may damage aquifers and adversely affect the quality of water (e.g., salt concentration, acidity, dissolved oxygen, turbidity) which in turn may lead to a permanent loss of biological productivity of soils.

**Social impacts:** Social impacts mainly involve public safety, health, conflicts between water users, and inequities in the distribution of impacts and disaster relief programs. Social impacts are manifest in widespread disruption in rural society on account of migration of the population from drought affected areas, rise in school dropout rates, greater immiseration and indebtedness, alienation of land and livestock assets, malnutrition, starvation and loss of social status among the most vulnerable sections.

**Drought Management Strategies:** These strategies can broadly be classified as:

1. Early warning & forecasting of droughts
2. Short term strategy
3. Medium and Long term strategy

**Early Warning and Forecasting of drought:**

Drought in the Indian region can be monitored from the progress of onset and withdrawal of southwest monsoon. Weather forecasts broadly can be classified into three categories viz., (i) short range forecast (validity for less than 3 days), (ii) medium range forecast (validity from 3-10 days period), and (iii) long range forecast (validity for more than 10 days). These forecasts are issued by the India Meteorological Department through All India Radio, Doordarshan, private channels and various Newspapers. The National Centre for Medium Range Weather Forecast in the department of Science and Technology disseminates weather related information through its network of 82 Agro-met Advisory Service (AAS)

units located mainly in State Agricultural Universities and ICAR institutes. The ICAR funded All India Coordinated Research Project on Agro-meteorology is operative at 22 centres in the country. The main objectives of this project are: characterization of climate, crop-weather relations, crop weather modelling, weather related forewarning of incidence of diseases and pests and agro advisory service to the farmers. Some private companies are also collecting and trading weather information to bankers, insurance and forward trading agencies.

### Short Term Strategy:

In most of the drought situations normal cropping systems and cultivation practices are not possible especially under rainfed conditions. In irrigated areas also, additional efforts are required for efficient utilization of resources with suitable water management strategy and agronomic manipulations in view of higher demand and reduced supplies. Under such a situation, suitable steps are needed for growing alternative crops, their varieties, special cultural practices, plant protection measures and efficient nutrient, soil and water management so as to contain reduction in production to the minimum possible. Following steps may be Undertaken:

- (i) Judicious use of surface and groundwater for drinking and irrigation.
- (ii) Ensuring availability of quality fodder to animals.
- (iii) Livestock management including establishment of fodder / feed depots and cattle camps.
- (iv) Selection of crops, cropping sequences and agronomic practices for drought affected areas.
- (v) Promotion of subsidiary income and employment generating activities.
- (vi) Gainful implementation of schemes like NREGA, RKVY, etc. for employment generation.

### Medium and Long Term Strategy:

Medium and long term strategies should aim at creating resilience or robustness by various mitigative measures productively.

#### 1. Securing Good Quality Water in Drought Prone Areas

Networking of rivers, reservoirs, lakes and other water bodies existing in high rainfall areas which are prone to periodic flooding. Transferred water could be used for ground water recharging and to fill up dried lakes, water storage structures in dry areas whenever such necessity arises.

#### 2. Perennial and Non-conventional Fodder:

Deep rooted bushes, trees, grasses and modified plants of cactus are highly drought tolerant and will be a durable adaptation to climate changes. Perennial component of vegetation may be enhanced in arid and semi-arid regions.

#### 3. Improved Live-stocking, Breeding and Management

Livestock shall continue to be the backbone of livelihood due to ever increasing population and shrinking per capita resources availability. Livestock rearing generates 4-5 times more employment as compared to raising of crops which is essential due to demographic growth. Decrease population of unproductive animals in drought prone areas through castration/controlled breeding.

#### 4. Upgradation and Fine Tuning of Crops, Cropping and Farming Systems

The strategy should include: (i) relooking and upgradation of our knowledge about mixed cropping, intercropping, catch cropping, mixed farming and multi-strata cropping concepts; (ii) promotion of agro-forestry, silvipasture, horti-pasture and sivi-horti-pasture systems etc. through large pilot scale demonstrations in farmer's participatory mode;

#### 5. Exploiting under-exploited and under-utilized plant resources

Large number of trees, bushes, shrubs and grasses are naturally growing as wild plants in one or the other rainfed region of the world. Such plants

are adapted to rainfed situation and have tremendous potential to be exploited as a food, forage, fuel and/or as industrial crop.

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