

## MA. Sem IV / Paper IV (Group B)

### Natural Hazards and Disasters Management

## DROUGHT

Lack of rainfall so great and long continued as to affect injuriously the plant and animal life of a place to deplete water supplies both for domestic purpose and for the operation of power plants, especially in those regions where rainfall is normally sufficient for such purpose".

--US weather Bureau

Term drought has different connotations:

- In **Egypt**, any year the river Nile does not flood is a drought year irrespective of rainfall.
- In **Bali**, a period of six days without rain is a drought.
- In parts of **Lybia**, droughts are recognized only after two years without rain.

The definition of drought varies from the use of water and its scarcity. Based on this a few standard varieties of droughts are: Meteorological, Hydrological, Agricultural and Socio-Economic.

### Definition of Drought:

#### Definition based on precipitation

- ❖ **C.G. Bates:** annual precipitation 75 percent or less of normal when monthly precipitation is 60 percent or less of normal.
- ❖ **British Rainfall Organization (1936):**
  - **Absolute drought:** at least 15 consecutive (regular) days with less than 0.01 in. per day.
  - **Partial drought:** at least 29 days when mean rainfall does not exceed 0.01 in.
  - **Dry Spell:** 15 consecutive days with less than 0.04 in. per day.
- ❖ **Hoyt, J.C. (1936):** Any amount of rain less than 85 percent of normal.
- ❖ **Conrad, V.A. (1944):** period of 20 or more consecutive days without 0.25 in. precipitation in 24 hours (during March to September).
- ❖ **Ramdas, D.A. (1950):** When rainfall for a week is half normal or less.
- ❖ **Indian Meteorological Department:** when actual rainfall is less than 75% of normal rainfall.

**Severe Drought:** 50 % actual rainfall of normal rainfall.

**Normal Drought:** 25% - 50% actual rainfall of normal rainfall.

### Aridity and Drought

Aridity is a permanent climatic feature of a region of low rainfall and high temperature, while drought is a temporary feature related to rainfall variability when the rainfall is appreciably below normal.

**Aridity** is both low precipitation and low effective precipitation, where,  
low effective precipitation = precipitation - Evaporation.

Index precipitation effectiveness =  $r/t$

where  $r$  = annual rainfall in mm

$t$  = mean annual temperature °C

If  $\frac{r}{t} < 40$ ; it is arid

If  $\frac{r}{t} > 160$ ; it is per humid

Drought may occur in any rainfall or temperature regime.

It may be confined to a single area (or river basin) or may be widespread invading over many states.

### Drought Assessment:

#### **Assessment through Physio-cultural parameters**

- Drought is a creeping process.
- Its assessment is difficult because it does not involve in any structural damage
- Qualitatively the adverse effects of drought reflect in:

*Human suffering, animal health, groundwater table depletion, surface water sources drying or shrinking abnormally and resulting in shortage of drinking water, for irrigation and power generation, fall in crop and fodder production.*

- Creeping of drought reflects in;

*Migration of agricultural labour seeking employment, steep rise of prices of commodities, increase in thefts, crimes, robberies, abnormal farmers sale of livestock, gold, silver articles at low price, falling trend in daily wages, overall subdued sale in market yards, people movement in buses and trains, fall in gathering of people in festivals etc.*

#### **Assessment through Remote Sensing**

- This is based on vegetation index.
- The pigment in plant leaves, chlorophyll strongly absorbs sunlight in visible spectrum (VIS 0.4-0.7 / $\mu$ m) in the process of photosynthesis.
- The cell structure of the leaves strongly reflects radiation in near infrared spectrum band (NIR 0.7 - 1.1 / $\mu$ m). **Healthy plants with high leaf density absorb more incident visible light and reflect large portion of the NIR.** Plants of improper growth or diseased reflect **more of VIS** and **less of NIR** radiation.
- Vegetation Index defined by NDVI (Normalized Difference Vegetation Index) as  $NDVI = (NIR - VIS) / (NIR + VIS)$

Vegetation index condition classes for drought is given below.

Change in Vegetation Index with respect to normal year	Drought classification
Less than - 50%	Severe
Less than - 10%	Critical
+ or - 10%	No change (normal)
More than +10%	Above normal

### Palmer drought index

Sometimes called the **Palmer drought severity index** and often abbreviated **PDSI**, is a measurement of dryness based on recent **Precipitation** and **Temperature**. It was developed by meteorologist **Wayne Palmer**, who first published his method in the 1965 paper **Meteorological Drought** for the **Office of Climatology of the U.S. Weather Bureau**.

### Drought Parameters

The main parameters of drought are:

- (i) Rainfall, (ii) Temperature (iii) Humidity (iv) Solar Radiation (v) Wind (vi) Soil Moisture (vii) River Flow (viii)

सूखा प्रचण्डता का पामर सूचकांक Palmer Index of Drought Severity			
>	+ 4.0	चरम आर्द्र दशा (exereme moist conditions)	
+ 3.0	+ 3.9	अति आर्द्र दशा (very moist conditions)	
+ 2.0	+ 2.9	अस्वाभाविक आर्द्र दशा (unusual moist conditions)	
+ 1.0	+1.9	आर्द्र दशा (moist conditions)	
+ 0.5	+0.9	आंशिक आर्द्र दशा (incipient moist conditions)	
+ 0.4	(-) 0.4	निकट सामान्य दशा (near normal conditions)	
(-) 0.4	(-) 0.9	आंशिक/प्रारम्भिक सूखे की दशा (incipient drought conditions)	
(-) 1.0	(-) 1.9	सामान्य सूखे की दशा (mild drought conditions)	
(-) 2.0	(-) 2.9	माडरेट सूखे की दशा	
(-) 3.0	(-) 3.9	प्रचण्ड सूखा की दशा (severe drought condition)	
>	(-) 4.0	चरम सूखा की स्थिति	

Vegetation (ix) Crop Condition, (iv) Water Availability for Drinking and Irrigation.

### **Type of Drought:**

#### **On the basis of:**

- Ratio between long period average rainfall and actual rainfall of few successive years.
- Soil moisture and moisture demand for crop growth
- Ratio between surface and ground water storage and Actual water table
- Food problems due to crop failure of some consecutive years.

**(i) Meteorological drought (precipitation based):** This happens when the actual rainfall in an area is significantly less than the climatological mean of that area. The rainfall categories for smaller areas are defined by their deviation from a meteorological area's normal rainfall-

**Excess:** 20 per cent or more above normal

**Normal:** 19 per cent above normal - 19 per cent below normal

**Deficient:** 20 per cent below normal - 59 per cent below normal

**Scanty:** 60 per cent or more below normal

**(ii) Hydrological drought (surface and ground water storage based):** A marked depletion of surface water causing very low stream flow and drying of lakes, rivers and reservoirs.

**(iii) Agricultural drought (Soil Moisture Based):** Inadequate soil moisture resulting in acute crop stress and fall in agricultural productivity, low quality of crops and dust emission.

**(iv) Socio-economic drought:** Socioeconomic definitions of drought associate the supply and demand of some economic good with elements of meteorological, hydrological, and agricultural drought. The supply of many economic goods, such as water, forage, food grains, fish, and hydroelectric power, depends on weather.

### **Drought Management Plan**

Drought prone area program was introduced in 1973-74. The program is funded equally by Central and State Governments. The activities of this program include:

- (i) Soil conservation,
- (ii) Water resources development,
- (iii) Afforestation,
- (iv) Waste land development (fodder, grass land development).

### **Early warning system**

The objective of designing an EWS is to keep track of leading indicators (agro-climatic, market socio-economic indicators and late anthropometric indicators) to get ample lead-time to intervene at the drought onset phase itself. However, most interventions based on late indicators force the governments to adopt a crisis management approach to deal with drought-induced food insecurity stresses. There are many deficiencies in this approach, as it does not reduce vulnerability to drought in the longrun. The effective warning systems should have meteorological/agricultural information, production estimates, price trends of food and feed, availability of drinking water and household vulnerability, so that a variety of indices related to production, exchange and consumption could be addressed.

### **Mitigation**

Drought can be mitigated by two kinds of measures, either by adopting preventive measures or by developing a preparedness plan. Preparedness refers to pre-disaster activities to increase the level of readiness, or improve operational and institutional capabilities for responding to a drought<sup>28</sup>. In order to delineate an implementable drought mitigation strategy, risk areas are identified on the basis of historical records to establish priority zones for comprehensive and integrated development programs aimed at drought proofing and mitigation. Mitigation can be scientifically equated with 'resistance' as a combination of avoidance, tolerance and resilience.

### **Relief measures**

State Governments in India have their relief manuals/ codes with a prescribed role for each Department/officer in the State for managing natural disasters. These are reviewed

and updated periodically based on the experience of managing the disasters and the need of the regions. The policy and the funding mechanism for provision of relief assistance to those affected by natural calamities are clearly laid down. These are reviewed by the Finance Commission appointed by the Government of India every five years. The Finance Commission makes a recommendation regarding the division of tax and nontax revenues between the Central and the State Governments and also regarding the policy for provision of relief assistance and their share of expenditure thereon. A Calamity Relief Fund (CRF) has been set up in each State according to the recommendations of the Eleventh Finance Commission. The size of the CRF has been fixed by the Finance Commission after taking into account the expenditure on relief and rehabilitation over the past 10 years.