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31.1 Definition of Drought

In simple terms, a drought is a period of unusually dry weather that persists long enough to cause environmental or economic problems, such as crop damage and water supply shortages. But because dry conditions develop gradually and impact different regions differently, there's no agreed upon way to pinpoint when a drought begins or ends, or to objectively assess its severity.

Abnormally low rainfall is, of course, the primary cause of drought. But one can't say in general how little rainfall it takes for a region's Palmer index to sink into drought territory, because the index takes regional averages into account. This regional specificity of the categorizations makes sense in terms of land usage: Wetter regions tend to be filled more densely with people, wildlife and crops, and so more rain is required to maintain normal conditions.

Drought has many definitions, but mostly it originates from a deficiency of precipitation over an extended period of time, usually a season or more. This deficiency results in a water shortage for some activity, group, or environmental sector. Drought should be considered relative to some long term average condition of balance between precipitation and evapotranspiration (i.e., evaporation+transpiration) in a particular area, a condition often perceived as "normal". It is also related to the timing (i.e., principal season of occurrence, delays in the start of the rainy season, occurrence of rains in relation to principal crop growth stages) and the effectiveness (i.e., rainfall intensity, number of rainfall events) of the rains. Other climatic factors such as high temperature, high wind, and low relative humidity are often associated with it in many regions of the world and can significantly aggravate its severity.

31.2 Classification of Drought

The wide variety of disciplines affected by drought, its diverse geographical and temporal distribution, and the many scales drought operates on make it difficult to develop both a definition to describe drought and an index to measure it. Many quantitative measures of drought have been developed in the United States, depending on the discipline affected, the region being considered, and the particular application. Several indices developed by Wayne Palmer, as well as the Standardized Precipitation Index, are useful for describing the many scales of drought. Of the many schemes for classifying droughts, the most widely used is the Palmer Drought Severity Index (PDSI), which combines temperature, precipitation, evaporation, transpiration, soil runoff and soil recharge data for a given region to produce a single negative number representing conditions there. This index serves as an estimate of soil moisture deficiency, which roughly correlates with a drought's severity, and thus, its impacts.

There are four disciplinary definitions of drought, which are as follows:

31.2.1 Meteorological Drought

Meteorological drought is defined usually on the basis of the degree of dryness (in comparison to some "normal" or average amount) and the duration of the dry period. Definitions of meteorological drought must be considered as region specific since theatmospheric conditions that result in deficiencies of precipitation are highly variable fromregion to region. For example, some definitions of meteorological drought identify periods of drought on the basis of the number of days with precipitation less than somespecified threshold.

31.2.2 Agricultural Drought

Agricultural drought links various characteristics of meteorological (or hydrological)drought to agricultural impactsfocusing on precipitation shortage, differencesbetween actual and potential evapotranspiration. Soil water deficits, reduced groundwater or reservoir levels, and so forth. Plant water demand depends on prevailingweather 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 be able to account for the variable susceptibility of crops during differentstages of crop development, from emergence to maturity. Deficient topsoil moisture atplanting may hinder germination, leading to low plant populations per hectare and areduction of final yield. However, if topsoil moisture is sufficient for early growthrequirements, deficiencies in subsoil moisture at this early stage may not affect finalyield if subsoil moisture is replenished as the growing season progresses or if rainfallmeets plant water needs.

31.2.3 Hydrological Drought

Hydrological drought is associated with the effects of periods of precipitation (includingsnowfall) shortfalls on surface or subsurface water supply (i.e., streamflow, reservoir and lake levels, ground water). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with adeficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phasewith or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such assoil moisture, streamflow, and ground water and reservoir levels. As a result, theseimpacts are out of phase with impacts in other economic sectors.

31.2.4 Socioeconomic Drought

Socioeconomic definitions of drought associate the supply and demand of someeconomic good with elements of meteorological, hydrological, and agricultural drought.It differs from the aforementioned types of drought because its occurrence depends onthe time and space processes of supply and demand to identify or classify droughts. Thesupply of many economic goods, such as water, forage, food grains, fish, andhydroelectric power, depends on weather. Because of the natural variability of climate,water supply is ample in some years but unable to meet human and environmentalneeds in other years. Socioeconomic drought occurs when the demand for economicgoods exceeds supply as a result of a weather-related shortfall in water supply.The sequence of impacts associated with meteorological, agricultural, and hydrologicaldrought further emphasizes their differences. When drought begins, the agriculturalsector is usually the first to be affected because of its heavy dependence on stored soilwater. Soil water can be rapidly depleted during extended dry periods. If precipitationdeficiencies continue, then people dependent on other sources of water will begin tofeel the effects of the shortage.

Indices for drought monitoring

1. Percent of normal
2. Standardized Precipitation Index (SPI)
3. Palmer Drought Severity Index (PDSI)
4. Crop Moisture Index (CMI)
5. Surface Water Supply Index (SWSI)
6. Reclamation Drought Index (RDI)
7. Deciles

31.3 Drought Management

Large variability of rainfall both in space and time, semi-arid regions are subjected to the problems of drought. The problems of arid areas wherever one good crop is not possible in normal years is quite different from those of semi-arid areas where one good crop is normally expected but it is frequently lost due to scanty rainfall or due to variability of rainfall. Even normally high rainfall areas face failure of rains and consequent upsetting of human water requirements. Water conservation and water management measures are need of the day to achieve a strong and stable economic base, especially in the arid and drought prone areas of the country. There are no general solutions possible.They will have to be area specific, because of the hydrological peculiarities. It has also to be remembered that development of drought prone areas cannot be modelled on the lines of the development of other favourably placed areas. The pattern of development of the drought-prone areas will have to be quite different from that of the others.

Some of the methods that may be suggested as technical strategies to mitigate the adversities of drought are mentioned below:

31.3.1 Creation of Surface Storage

Conventional approach to water conservation has been to go in for water developmentprojects – creating reservoirs by building dams, big and small, and diversion canals – tosupply water wherever and in whatever amounts desired.

31.3.2 Planning for Less Dependable Yield

For the drought areas, planning ofaverage flows or 50 percent dependability has been recommended by manyCommission and Committees to increase the availability of water mainly for theagricultural purposes.

31.3.3 Prevention of Evaporation Losses from Reservoirs

To savewater in a critically water short region, an application of a layer of chemicals like cetyl,stearyl and fatty alcohol emulsions can effectively retard evaporation and savings in thefield can be around 40 percent of the normal evaporation losses.

31.3.4 Adjustment in Sanctioned Water to a Reservoir or Its Releases

The trend of reservoir filling or the ground water position for a water year gets fairlyknown by the middle of August. Re-adjustment of sanctions and releases has to becarefully carried out at this time keeping a close watch on the behaviour of the monsoon. The modern management techniques using probability analysis may help inassessing the situations of 'supply-variability' in the drought areas.

31.3.5 Reduction in Conveyance Losses

The conveyance system is an important facet of thewater conservation techniques because losses due to seepage are found to vary widelyin an irrigation system ranging from 35 percent to 45 percent of the diverted water.Lining of the canal system could be an appropriate step to conserve this preciseresource in such a situation.

31.3.6 Equitable Distribution

A rotational system of supplyof water if strictly implemented will not only meet the ends of equity but will alsoeconomise use of water.

31.3.7 Maintenance of Irrigation Systems

Over the years, maintenance of irrigation systems has deteriorated mainly due to thefact that water rates charged are not sufficient for carrying out the maintenance forkeeping the system fit and efficient.

31.3.8 Better Irrigation Practice

Simplemeasures like levelling of the fields so that water gets more evenly distributed cangreatly improve the performance. Wastage due to absence of field channels and lack offield levelling are now being eliminated through the Command Area Development (CAD)programmes.

31.3.9 Irrigation Scheduling

It is now well established that water is required more at critical stages of cropgrowth and water stress during other period has negligible impact on yields. Additionwaterings do not add proportionately more to the yield. Greater effort should be made totrain farmers in the use of irrigation scheduling methods appropriate to their mode ofproduction. Agricultural extension programmes could help spread the benefits of thesewater management techniques.

31.3.10 Cropping Pattern

Better water management involves all stages i.e. from pre-project formulation tooperation and maintenance. In the project formulation stage, a suitable cropping patternin conformity with soil and climatic conditions taking into account the farmerspreferences should be evolved. While designing the canal capacities, peak demand ofwater in critical periods by the high yielding varieties of crops should be kept in view.

31.3.11 Conjunctive use of Surface and Ground Water

The concept of conjunctive use of surface and ground water resources is very essentialespecially in drought areas in order to increase the production per unit of water. Themanner of using ground water and surface water varies considerably from region toregion. Where ground water quality is not good, canal water can be mixed in suitableproportion.

31.3.12 Watershed Development

Planning of watershed development involves an integrated approach uponphysiographic and hydrologic characteristics which include construction of soilconservation works on crop lands; Construction of structures, like check dams, Nallabunding, contour bunds, Gully plugging, percolation tanks, development of rainwaterharvesting and construction of wells etc.

31.3.13Creation of Large Storages

While planning various projects particularly in the regions depending on rainfall, it ispreferable to go in for large storages rather than a large number of small storages onthe tributaries, since small tanks are particularly vulnerable to drought. This is alsoessential in view of the fact that about 80 percent of the river flow occurs only during thefour monsoon months and this flow requires being stored for irrigation and powergeneration. The present storage capacity of all the reservoirs including major, mediumand minor schemes is 400 cubic kilometre as against the potential of 690 cubic kilometres which means the water scarcity problem may be solved to a great extent by creation of more storages.

31.3.14 Integrating Small Reservoirs with Major Reservoirs

There are persistent demands to abandon the schemes of large storages as it isfeared that they cause environmental disaster leading to non-sustainable developmentof water resources. Instead, numbers of small reservoirs are being advocated to replacea single large reservoir. However, in many cases, a group of small schemes may notprovide the same benefits as a large project can. It is, therefore, very important thatminor schemes are integrated with the canal systems of major reservoirs.

31.3.15 Transfer of Water from Water Excess Basins to Water-deficit Basins

A permanent long term solution to drought problem may be found in the basic principlesof transfer of water from surplus river basins to areas of deficit. One of the most effective ways to increase the irrigation potential for increasing the food grain production, mitigate floods and droughts and reduce regional imbalance in the availability of water is the Inter Basin Water Transfer (IBWT) from the surplus rivers to deficit areas.