

DROUGHT; INFLUENCE OF DROUGHT IN AGRICULTURE AND MANAGEMENT STRATEGIES FOR DROUGHT-A REVIEW

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Abstract– Drought is one of the major stress factors affecting the growth and development of plants. In this context, drought-related losses of crop plant productivity impede sustainable agriculture all over the world. In general, plants respond to water deficits by multiple physiological and metabolic adaptations at the molecular, cellular, and organism levels. Drought can have a serious impact on health, agriculture, economies, energy and the environment. An estimated 55 million people globally are affected by droughts every year, and they are the most serious hazard to livestock and crops in nearly every part of the world. Drought threatens people's livelihoods, increases the risk of disease and death, and fuels mass migration. Water scarcity impacts 40% of the world's population and as many as 700 million people are at-risk of being displaced as a result of drought by 2030. Rising temperatures caused by climate change are making already dry regions drier and wet regions wetter. In dry regions, this means that when temperatures rises, water evaporates more quickly, and thus increases the risk of drought or prolongs periods of drought. Between 80-90% of all documented disasters from natural hazards during the past 10 years have resulted from floods, droughts, tropical cyclones, heat waves and severe storms.

INTRODUCTION

A drought is a period of time when an area or region experiences below-normal precipitation. The lack of adequate precipitation, either rain or snow, can cause reduced soil moisture or groundwater, diminished stream flow, crop damage, and a general water shortage. Droughts are the second-most costly weather events after hurricanes. Drought is a temporary reduction in water or moisture availability below the normal or expected amount for a specific period.

Types and Causes of Drought

Meteorological Drought: It is a situation where there is a reduction in rainfall for a specific period

below a specific amount, i.e. the actual rainfall in an area is significantly less than the climatologically mean of that area. According to Indian Meteorological Department (IMD), a drought exists when the average annual rainfall is less than 75% of the normal.

Hydrological Drought: It is associated with the **Table.** Moisture Index in Different climatic Zones in India

Moisture Index	Climate Zone	Percent Area
- 66.7	Arid	19.6
-66.7 to -33.3	Semi-arid	37
-33.2 to 0	Dry sub-humid	21.1
0 to +20	Moist sub- humid	10.2
+20.1 to 99.9	Humid	7.8
100	Pre-humid	8.3

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reduction of water levels. There are 2 types of Hydrological Droughts Surface water Drought – It is concerned with the drying up of surface water resources such as rivers, streams, lakes, ponds, tanks, reservoirs, etc. Groundwater Drought – It is associated with the fall in the groundwater level.

Causes of:

Agricultural Drought: It occurs when soil moisture goes below the level needed to sustain plant growth. It is also called as Soil Moisture Drought. The erratic rainfall conditions and inadequate soil moisture results in crop failures.

Socio-Economic Drought: It reflects reduced availability of food and income loss due to crop failure.

Ecological Drought: It occurs when the productivity of the natural ecosystem fails due to a shortage of water and causes environmental damages like the deaths of cattle, wildlife, and trees in the forest.

Impact of drought in Agriculture

Economic losses: It includes a decline in cultivated areas and a fall in agricultural production, which leads to the slowing down of secondary and tertiary activities and a decline in purchasing power.

Environmental Impact: It leads to damages to plant and animal species, wildlife habitat, air and water quality, forest and range fires, degradation of landscape quality, and soil erosion. Soil moisture, surface run-off, and groundwater table get adversely affected.

Impact on society: Migration of people from drought-hit areas to other areas in search of livelihood and food.

Decreased Water Availability for Agriculture: Decreased water availability for agriculture is a huge problem that will increase in magnitude as global temperatures continue to rise. Farmers are already having trouble growing enough to produce due to the dry conditions, and many crops have been decimated by lack of precipitation. With reduced water resources, there is less water for irrigation in agriculture. This can lead to crop failure, increased food prices, and ultimately famine if it's not dealt with appropriately.

Increased Incidences of Pests and Diseases: When combined with rising high temperatures, drought significantly increases cases of pests and diseases that primarily affect forage, crops, and livestock. For

instance, the recent locust swarms in parts of East Africa and the Middle East were mainly attributed to the drought and the associated stress on vegetation. Pest and disease management is highly challenging on drought-stressed plants and animals.

Crop Failure and Pasture Losses: Another effect of drought is crop failure and pasture losses for livestock. Drought can cause poor pollination of crops which leads to crop failure, especially for fruits and vegetables that are generally reliant on insect or animal pollinators.

Reduced Yields of Food Crops: Reduced crop yield is another drought effect on agriculture that greatly impacts food production. In fact, regular droughts reduce crop yields by up to 30%. The lack of water makes the plants' stalks weaker and can cause them to topple over. The fruits or vegetables that do grow may be smaller than usual and have less flavor. Farmers in drought-stricken areas must often choose which crops to grow, and sometimes they are forced to abandon their fields altogether.

Risk for Crop Nutritional Deficiencies: Drought-stricken areas tend to have poor soil, contributing to nutritional deficiencies in crops. A dearth of rainfall means that the water table is lower than normal, resulting in nutrient runoff. Some areas are also deprived of atmospheric moisture due to drought conditions when they need it most. This can lead to an increase in crop stress and a decrease in overall yield.

Some Impacts of drought on agricultural field crops

- Delay or prevention of field preparation and other cultural operation, sowing/planting of field crops and crop establishment.
- Weakening or destruction of established crop. The effects are more pronounced in case of early season drought.
- Pre-disposition and vulnerability of crops to various insects-pests and diseases.
- Alteration of physiological and bio-chemical metabolism in plants.
- Alteration of quality of grain, forage, Fiber and oil etc.
- Drought is responsible for reduction in grain and fodder yield of field crops.

Drought Management

Drought management encompasses three-fold structures and each step needs a holistic approach to

ensure effective end result. The 3 components are-

- Drought intensity assessment and monitoring
- Drought declaration and prioritization of affected areas for management
- Development and implementation of drought management strategies.

Agricultural drought-mitigation strategy

Relief measures are also required for providing livelihood environment to upkeep the cattle wealth during and after drought as natural calamity. It includes fodder availability and transport to the affected areas and monitoring of fodder. Fodder cultivation is to be encouraged in all possible regions/states of the country.

- In drought-prone areas, it becomes necessary to generate additional employment through labour-intensive works for water harvesting etc. at the village level.
- Public health and cattle health care should also be on priority and to monitor for the supply of disinfect drinking water to prevent spread of water-borne diseases and plans to cope-up with likely epidemic. Immunization and surveillance of public and livestock health measures be taken.
- Molasses-treated cattle feed and fodder in the form of pressurized bricks has been developed at IARI, New Delhi, which is now recommended.
- General public should come forward to learn more about various natural calamities including droughts.
- Side by side, they are to be advised to know about available natural resources of a particular region and planning to minimize the risk by diversifying production technology to sustain better livelihood.
- There is a need to give more emphasis on better extension programmes to disseminate the modern technology for crop husbandry in drought-prone areas.
- Due to Global Warming, there are chances of unpredictable weather conditions and drought occurrence frequency even in high rainfall areas of Indian sub-continent. Therefore, there is a need to give serious thought on household strategies and farming system approach to manage drought and to provide alternate income sources to the farmers. For example, horticulture, tree plantation, poultry farming, bee-keeping, mushroom farming etc. are

recommended for certain households. Investments in the processing of farm products generate income and diminish the risk of high dependence on water.

- Life-saving practices/mid-way corrections should come in practice including adoption of agronomic practices, viz. thinning, mulching and use of antitranspirants mainly to reduce the transpiration and evaporation losses during the water-stress periods. For saving the field crops from drought the agronomic measures suggested are as follows:
 - ◆ Reduction in plant population (up to the extent of 15%) so as to minimize the transpiration losses.
 - ◆ Need based intercultural operations in the form of dust mulching to check the evaporation losses and for efficient soil moisture utilization.
 - ◆ Spray of antitranspirants like Kaolin (6%), Cycocel (0.03%) on the standing crops is recommended to check transpiration losses and to give green look to the crop for a longer period.
 - ◆ The standing irrigated crops like rice, maize, pigeonpea [*Cajanus cajan* (L.) Milli sp.], cotton (*Gossypium hirsutum* L.) and sugarcane (*Saccharum officinarum* L.) may be saved by applying life-saving irrigation at saturation point depth. This is just to follow economy in water use, so that larger area may be covered with life-saving irrigation.
 - ◆ Arrangements are to be made for supplying quality seeds of non-traditional crops recommended for cultivation during drought-affected *kharif* season.
 - ◆ A mechanism should be developed to export more wheat (*Triticum aestivum* L. emend. Fiori & Paol.) so that the foreign exchange earned can be of use for the strategic import of edible oil and pulses, if necessary.
 - ◆ Area planning of different *rabi* crops needs to be developed region-wise, along with recommendations related to suitable varieties and agronomic package of practices with the cooperation of State Agricultural Universities and State Departments of Agriculture.
 - ◆ Pre-sowing seed treatment (hydration + fungicide) should be made mandatory and farmers must be educated to follow the simple technology to ensure lower disease infection and spread as well as higher levels of germination.

- ◆ Aqua-fertilizer drill, designed and developed at the IARI, New Delhi, has been proved useful for seedling and placing the fertilizer along with adequate moisture at a proper depth which results in proper germination.
- ◆ Use of organic molasses and dust-mulching are proved very effective from better water use efficiency point of view.
- ◆ Efficient weed control saves the crops from transpiration losses. Yields are drastically reduced if weeds are not removed within 3-4 weeks of emergence
- ◆ After experiencing the drought effects in agricultural fields, it has become essential for the administration to work for efficient drought-management practices that include:
 - Operation of an early warning system mainly to mitigate forthcoming drought of any kind.
 - Recycling of runoff water after rain water harvesting and drainage.
 - Resource management for stabilizing crop production. Implementation of long term strategy of fodder banks. To have a check on evaporation and transpiration losses.
 - Assurance to the affected population of physical and economic access to food and preservation of farmers' assets to enable them to recover quickly after the resumption of the normal monsoon.
 - To promote adoption of drought-tolerant crops for the survival.
 - Institutional mechanism for arrangement of quality seeds, chemical fertilizers and pesticides etc. to stabilize yield (Jakhar, 2002).

Drought Assessment and Monitoring

The Indian Meteorological Department (IMD) gave an early warning system about the possibilities of impending drought. Many states in India have now developed a sophisticated monitoring system to manage drought. The Weather Watch Group in the Ministry of Agriculture, Government of India is working since 1979. The expert meets every week, particularly during rainy season of each year to take stock of the rainfall, its effect on the crops growing in the fields (Gautam, 2014).

Future action plans for managing droughts in India

Creation of databank for scenario of major drought in the past is essential for future drought-mitigation planning. The Central Government now has permanent arrangements for Calamity Relief Fund

for reducing the impact and severity of drought. Some of the sponsored programmes include (i) Rural Works Programme (RWP),

- ◆ Efforts should be made for reliable monsoon predictions as well as proper agrometeorological analysis of climate-soil-crop relationship for efficient crop planning and management.
- ◆ Funds for catchment treatments are meager and they should be increased.
- ◆ Ensure that every new source of water should have re-charge system.
- ◆ Government should think of subsidizing to irrigated marginal farmers for not sowing paddy in future (it will save the irrigation water).
- ◆ Nationwide Watershed Development Programme for rainfed agriculture should be strengthened. To start with, there are ways of storing the run-off from rainy periods for use during the dry spells. These include the tanks, ponds and earth dams used for supplementary irrigation.

CONCLUSION

Drought is a natural disaster. Lack of precipitation for a protracted period of time causes drought. This results in a water shortage which affects the ecosystem. While droughts occur naturally, human activity, such as water use and water management, can exacerbate the dry conditions of the region. In conclusion, drought is a natural disaster whose effects are adverse and cause loss of living non living and agriculture. The management of drought generally involves the water conservation, plantation, storage and expansion of sources of water. The consequences of drought are deleterious and destruct the ecosystem and also loss of biodiversity.

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