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Drought and There Management in Dryland Agriculture

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Introduction

After the utilization of all the water resources for irrigation, about half of the cultivated area will remain rainfed. The dryland farming is a part of rainfed farming and occurs primarily in arid and semiarid regions where annual precipitation is generally less than 25–50 % of the potential evapotranspiration demands. Because of increased environmental concerns and the threat of recent climatic abnormalities, the challenges are to increase resilience and maintain sustainability of dryland farming. Therefore, dryland farming emphasizes on water conservation, sustainable crop yields, limited inputs, and wind and water conservation restraints.

Depending on the amount of rainfall received, it can be grouped into three categories:

Types of Dryland/Rainfed Agriculture

Sr. No.	Particular	Dry Farming	Dryland Farming	Rainfed farming
1	Rainfall (mm)	< 750	750 – 1150	> 1150
2	Moisture availability	Acute shortage	Shortage	Enough
3	Crop growing season	< 75 days	75 – 120 days	> 120 days
4	Growing region	Arid	Semi-arid	Humid
5	Cropping systems	Single crop	Single crop/ intercropping	Inter/ Multicropping
6	Dry spells	Most common	Less frequent	No occurrence

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7	Crop failure	More frequent	Less frequent Rare	rare
8	Constraints	Wind erosion	Wind erosion/ water erosion	Water erosion
9	Measures	Required Moisture conservation practices	Moisture conservation Practices & drainage for vertisols	Proper drainage required

Source:Rainfed Agriculture and Watershed Management: Mevada K. D., Poonia T. C, SarasPiyush and Deshmukh S.P. Page 2

Drought

Generally drought is defined as prolonged dry period or period without rainfall.**The irrigation commission of India** defines drought as a situation occurring in any area where the annual rainfall is less than 75% of normal rainfall. The Prolonged deficiency of water adversely affects the crop growth and productivity which indicates the incidence of agricultural drought. It is the result of imbalance between soil moisture and evapo-transpiration needs of an area over a fairly long period so as to cause damage to standing crops and to reduce the yields.

Classification of drought

Drought can be classified based on duration, relevance of users, time and using some specific terms.

A. Based on relevance to the users

- **Agricultural drought:** A period when insufficient water is available to support the normal activities of a crop over a fairly normal long period of a fortnight or more.
- **Meteorological Drought**: The intensity of drought is a ratio of actual evapotranspiration (AET) to potential evapotranspiration (PET) during the growing season.
- **Hydrological Drought**:Means low flows in the streams, inadequate storage in reservoirs and lowering of water level in the reservoirs, lakes and aquifers.

B. Based on duration

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- **Permanent drought:** The sparse vegetation growing is adapted to aridity and agriculture is not possible without continuousirrigation during entire crop season.
- **Seasonal drought:** This is occurs in climates with well-defined rainy and dry seasons.
- **Contingent drought:** This involves an abnormal failure of rainfall. It may occur almost anywhere especially in most parts of humid or sub humid climates. It is usually brief, irregular and generally affects only a small area.
- **Invisible drought:** This can occur even when there is frequent rain in an area. When rainfall is inadequate to meet the evapo-transpiration losses, the result is borderline water deficiency in soil resulting in less than optimum yield.
- **Hydrological drought:** Meteorological drought, when prolonged results in hydrological drought with depletion of surface water and consequent drying of reservoirs, tanks etc.

C. Based on time of occurrence

- **Early season drought:** It occurs due to delay in onset of monsoon or due to long dry spells after early sowing
- **Mid-season drought:** Occurs due to long gaps between two successive rains and stored moisture becoming insufficient during the long dry spell.
- **Late season drought:** Occurs due to early cessation of rainfall and crop water stress at maturity stage.

Important causes of agricultural drought

- ✓ Highly variable rainfall
- ✓ Late onset of monsoon
- ✓ Unequal distribution of rainfall
- ✓ Early withdrawal of monsoon
- ✓ High temperature
- ✓ Prolonged intermittent dry spell

Effect of drought

- It affects the absorption and translocation and transpiration of water.
- Photosynthesis and respiration rate of plants.

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- Decrease in size of the cells and inter cellular spaces, thickercellwall, greater development of mechanical tissue. Stomata per unit leaf tend toincrease.
- All most all metabolic reactions are affected due moisture stress.
- Hormonal Relationships
- The fixation, uptake and assimilation of nitrogen are affected. Since drymatter production is considerably reduced because the uptake of NPK is reduced.
- Growth and Development of the plant
- Reduction in yield
- Flowering and physiological maturity of plants
- Reproduction and grain growth:

Management of drought

Drought management is the certain management techniques or skill used to maximize the production and quality of agricultural commodities in arid and semi-arid areas where irrigation water is not available. These are some practiceswhich is involves in management of drought such as soil moisture conservation practices, efficient use of water, antitranspirant, water harvesting, mulching, proper tillage operation, resistant varieties, intercultural operation, cropping system and weed management etc.

1. **Soil moisture conservation practices:** These are the some practices which helps in conserving soil moisture.
   a. **Improve Infiltration rate**
      - ✓ Conserve every drop of rainfall.
      - ✓ Tillage practice- reduces runoff and increases soil moisture storage.
      - ✓ INM improves structure of soil and improves infiltration.
      - ✓ In situ-moisture conservation.

   b. **Reduce of percolation losses**
      - ✓ Water conservation in soil root zone by water retention.
      - ✓ Mitigate the problem of drought.
      - ✓ Soil Compaction decreases percolation losses and drainage pores, whereas increasing water retention.

   c. **Land configuration**
      - ✓ Sowing across the slope.

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- ✓ Dead furrow at optimum distance.
- ✓ Compartment bunding helps in reducing runoff and soil loss.
- ✓ Bund and furrow preparation to conserve soil and water.

d. Selection of crops

- ✓ Short duration crops.
- ✓ Drought resistant.
- ✓ Cover crops.
- ✓ Hairy and small leaves.
- ✓ Water saver plants.

2. **Drought Tolerant genotypes OR varieties:** Some important crop varieties which is suitable in dryland agriculture such as
   - ➢ 1.Groundnut :– Girnar, ICGV-87885, JL-24,TVG-4, SB-11, GG-11, GG-20.
   - ➢ 2.Cotton :- Eknath, Bharati(MCU-6), G. Cot.hy.-8 ,G. cot-13,15, LK- 861,
   - ➢ 3. Sunflower :-Morden, G.Sunflower-1, PKVSH-28.
   - ➢ 4. Chickpea :- GNG-16, ICCC-37, H-208, Chaffa, Vijay, AKG-46, AKG-1.
   - ➢ 5. Soybean:- Gujarat-Soya-1,2,3, JS-81-355, MACS-58.
   - ➢ 6. Pearl millet :- GHB-27, GHB-30, GHB-32, ICMS-7703, ICTP-8203, Mukta, HS-1.
   - ➢ 7. Green gram :- K-851, GM-1,2,3, G-860612, MCH-26.
   - ➢ 8. Black gram :-T-9, TVU-4, APK-1, KBG-512, KB-51.
   - ➢ 9. Sesamum :- Purva-1, Guj-Til-1,2
3. **Cover crops –** Crops are grown primarily to cover the soil and to reduce the loss of moisture due to evaporation. Cover crops also produce more biomass, which can be used for soil fertility management. Examples of cover crops e.g. Groundnut, Cowpea, Green gram, Black gram, Gram, Kidney bean etc.
4. **Mulches**:A practice by which materials such as straw, saw dust, manures, plastic film, vegetative wastes of crop residues are spread upon the surface of the soil. Some commonly used mulches are straw, leaves and green manure crops.

Types of Mulches:-

(a) Synthetic mulch **(b)** Organic mulch **(c)** Sand/dust mulch

Advantages of Mulching –

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- Conservation of moisture.
- Reduction of soil temperature.
- Protection of soil from erosion.
- Reduction in the growth of weeds.
- Protection roots of crops from mechanical injury.
- Surface mulches prevent soil from washed away.
- Reduce evaporation and increases infiltration rate.
- Soil mulching prevents deep cracking of soil.
- Increased soil fertility over the long term.

5. **Cropping System:**Cropping system is most important for mitigate the drought. There are various cropping systems in arid and semi-arid region for escaping the drought such as mixed or intercropping.
6. **Anti transpirant-** Any material applied for reducing water loss from the plant is known as Antitranspirant. Hardly 1 % water is utilized in physiological activities of plant and remaining water lost through transpiration, it may help maintenance of favourable water balance in plant system. There are four types of antitranspirant:-
   - Stomatal Closing type- PMA, Atrazine
   - Film Forming type- Mobileaf, Hexadeconol, Silicone
   - Reflectant type- Kaolin, Calcium bicarbonate.
   - Growth Retardant- Cycoceal.
7. **Rain water management -** Collection and Storage of rain water, either runoff or stream flow for securing and improving water availability for crop growth under drought condition.
8. **Alternate Land Use System** -Diversification of land according to land capability classes which helps to increase the land use efficiency.The alternate land use system reduces soil erosion that improve the soil fertility status and creates congenial and conductive microclimate around the field.
9. **Plant population:** The plant population should be lesser as compared to irrigated conditions and rectangular type of planting pattern followed under dry land conditions.

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10. **Increasing the inter and intra row distance:** The increasing distance between row to row and plant to plant helps inreduction of competition during any part of the growing period of the crop. Hence it is more suitable for limited moisture supply conditions.
11. **Mid-season corrections:** The contingent management practices done in the standing crop to overcome the unfavorable soil moisture conditions due to prolonged dry spells are known as mid-season conditions.
    - **A. Thinning:** This can be done by removing every alternate row or every third row which will save the crop from failure by reducing the competition.
    - **B. Spraying:** In crops like groundnut, castor, red gram, etc., during prolonged dry spells the crop can saved by spraying water at weekly intervals or 2 per cent urea at week to 10 days interval.
    - **C. Ratooning:** In crops like sorghum and bajra, ratooning can practiced as mid-season correction measure after break of dry spell.
    - **D. Mulching:** It is a practice of spreading any covering material on soil surface to reduce evaporation losses. The mulches will prolong the moisture availability in the soil and save the crop during drought conditions.
    - **E. Weed control:** Weeds compete with crop for different growth resources ore seriously under dryland conditions. The water requirement of most of the weeds is more than the crop plants. Hence they compete more for soil moisture. Therefore the weed control especially during early stages of crop growth reduces the impact of dry spell by soil moisture conservation.