PROBLEM AND SOLUTION FOR THE DRYLAND AGRICULTURE IN INDIA

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Dryland agriculture is the practice of crop production entirely with rain-water received during the crop season and on conserved soil moisture in low rainfall areas of arid and semi-arid climates and the crop may face mild to very severe moisture stress during their life cycle. Dry land agriculture is characterized by some points:

1. Rainfall limited (less than 800 mm).
2. Less Crop growing season (less than 200 days)
3. Low availability of moisture Concentration
4. Mono cropping System (intercropping system)
5. High constrains of wind and water erosion.

Soil of dryland areas:

Five types of soils observed in dry land area mostly soils are black, alluvial, red (laterite and lateritic), sierozems and submontane soils. In the north and northwest of the country, alluvial, sierozemic and submontane soils predominate. In central and south India, black and red soils occupy the highest area. In the higher rainfall regions and coastal areas, the laterites and lateritic soils predominate.

Black soils: The black soils are deeper, clay-to-clay loam and characterised by low permeability and high water holding capacity. Low infiltration rate, high plasticity and stickiness, low organic matter content, high CEC, the calcareous nature and slightly alkaline reaction, pose problems of management practices, Vertisoils, when kept fallow during Kharif, are exposed to soil erosion hazards.

Red soils: The red soils are light textured, shallow to medium in depth and usually underlain by compact subsoil, porous and low water holding capacity. Soils are prone to erosion and surface crusting. Because of crust, formation run off Alfisols is more than in Vertisols. Crusting just after seeding results in the poor emergence of seedlings, particularly in the case of small seeded crops such as finger millet and pearl millet.

Alluvial soils: These soils are level, deep, and light to medium in texture with favourable physical characteristics and good permeability. Small showers are useful and there is the utilisation of most of the water held by the soil due to low moisture content at wilting point.

Sierozemic soils: Deep alluvial sandy loams, low soil moisture storage, instability of soil structure, and poor soil fertility are the major problems of soil management in the desert ecosystem. High wind velocity leads to servere wind erosion. Soil drifting leads to

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soil and nutrient losses. Surface crust formation after sowing following light showers limits the desirable crop stand. These soils are observed in Dantiwada, Hisser and Jodhpur.

Submontane soils: Such soils are distributed in the dry sub-humid environment of Hosiarpur in Punjab and Rakh Dhiansar in Jammu and Kashmir and in the humid tract of Dehradun. The lands are sloping, the soils range from loamy sands to sandy loams, silty loams and clay loams with soil moisture storage capacity improving in that order. Soil crusting occurs in soils of dry and sub-humid regions.

Constraints:

Basic Problems related with dryland Agriculture are hereunder:

1. Poor fertility status in marginal lands and low productivity;
2. Irregular topography with high erodability of land;
3. Difficulty in workability particularly in Vertisols;
4. Shallow or very deep in depth with extreme permeability;
5. Low moisture storage and release capacity particularly in Alfisols;
6. Presence of dissolved harmful salts in ground water;
7. Problem soils with respect to soil reaction (pH) and high concentration of soluble salts in the surface soils;
8. Waterlogging in plane lands; flooding and breaking small field bunds resulting in poor conservation of soil and water;
9. Highly movement of sand and soil particles in dry-land area;
10. High surface crusting that leads to poor crop stand and high cracking to a high rate of evaporation and mechanical injury to roots.

Management practices involve in dryland Agriculture: Reduction of moisture loss due to Evaporation and Transpiration. Following measures are taken to reduce the loss of moisture received by the soil.

1. Growing early maturing crop varieties with a deep root system in ramified condition and with a reduced number, size and horizontally orientation of leaves.
2. Maintaining and insure optimum plant population per unit area in field condition.
3. Sowing crops either in dry soil anticipating rainfall suitable for early crop establishment with the first shower, and subsequent growth and development with subsequent rainfall, or in optimum soil moisture but with a minimum expenditure of seasonal moisture for land preparation and sowing.
4. Free far the fields from harmful weeds and increasing the organic matter present in soil.
5. Adoption mixed or intercropping to utilize the slow growth phase of wide spaced crops, to restore soil fertility and to check soil and water loss.
6. Growing cover crops in field condition and using mulches.
7. Using agri-chemicals;e.g. anti-transpirants, plant modifiers or growth retardants, desiccants or defoliants, crop ripeners, anti-evaporants, antiseepage.

Advantages of dryland agriculture:

1. These breakups of the slope.

2. Intercept runoff before its volume and velocity become sufficient to cause serious erosion
3. Gives more time for infiltration
4. water is diverted into the channels down safe gradients of suitable discharge or outlet points which carry away water in such a way as to minimize erosion damage to other land and
5. Finally leading to better conservation of run-off water for agriculture.

1. Use of Cropping systems:

Adaption of dry-land agriculture in different cropping systems, use according to the climate and soil types. The areas with 400 to 750 mm annual rainfall, mono cropping with traditional long duration crops is common. Generally adaptable crops are cereals, oil-seeds and pulses. When the rainfall is between 500 to 700 mm with a distinct period of moisture surplus, the intercropping system can be adopted. Intercropping facilitates the growing of either cereal+legume or legume+legume. e.g. are: sorghum+pigeonpea, pearl millet+pigeonpea, sorghum+green gram, sorghum+soybean, groundnut+pigeonpea and foxtail millet+pigeonpea.

In areas with more than 750 mm annual rainfall with soil storage capacity of 150 mm or more of available moisture sequential cropping is possible. e.g. pulses and oil-seeds, rice followed by chickpea, maize followed by chickpea, sorghum or green gram followed by safflower or sorghum- chick-pea and maize-chickpea.

2. Use of Mechanical Methods in dry-land agriculture:

1. Contour bunding: The bund section is 1.61 m2 in Vertisols and 1.05 m2 in Alfisols. The vertical distance is about 0.9 m. The area occupied is upto 5.0 per cent by the bund and the area lost from cultivation due to stagnation in Vertisols would be 10 to 15 per cent.

2. Graded bunding: Graded bunds are of 0.8 m2 cross section in Vertisols and at vertical internal of 0.7m with a channel on the upstream side. The area lost due to the structure would be no more than 3-5 per cent and there would be no water stagnation and graded bund with grassed waterways and box-type masonry drainage outlets in arable fields.

3. Tie-ridging: The practice of tie-ridging, where adjacent ridges are joined at regular intervals by barriers or ties of the same height, allows the water to infiltrate and prevent run-off except during intense storms. This method is adequate in moderate rainfall areas, except on very steep slopes.

4. Bench terracing: On steeply sloping lands, the slopes where such terraces are found useful vary from 6 to 30 per cent. Bench terraces with 100 m length, longitudinal grades in the range of 0.2 to 0.8 per cent are recommended for Alfisols of high rainfall regions.

5. Ploughing: Ploughing across the slope and growing low value crops in catchment areas, the ploughing of deep soils should be done once in three to four years immediately after rabi crops. The light, shallow and medium soils should be hoed instead of ploughing which help to receive and retain moisture.

3. Reclaiming problem soils in dry-land agriculture: Reclamation of Acidic Alkaline and Saline soils should be done by adding lime, gypsum, sulphur, or pyrites

respectively. Growing high value crops in level run-off concentrated strips and incorporating a liberal quantity of organic matter.

4. Maintenance of soil fertility in dry-land agriculture: Dryland areas have low yields and high yield fluctuations. The maintenance of soil fertility is a problem in such areas as for a considerable period of the year the soil remains un cropped and there is a loss of plant nutrients, loss of the fertile surface due to erosion leads to a decline in soil fertility to build up soil fertility and reduce the fluctuation of crop yield.

1. Combined use of farmyard manure (FYM) and green manure with inorganic fertilizer.
2. Use of the crop residues maintains the soil fertility.
3. Addition of the crop rotation in fodder-legumes/legumes in the cropping system.
4. Use of the bio-fertilisers in crop production increases soil microbial quality and improves soil fertility..
5. Use suitable methods of fertilizers application. and mulching.
6. Checking loss of moisture in surface soil by using soil stabilizer and chemicals e.g. Na_2, Co_2, polythene sheet, mulches and plastic sheets.
7. Develop the small watersheds in agricultural farm for use in collection of runoff water and recycling for life saving irrigation to crops in moisture stress,
8. Allowing a portion of the holding as chemical or legume uncultivated which on cultivation provides a substantial yield during food shortage.
9. Adopting alternate land use planning in conjunction with regular cropping to improve the income of the farming families from fiber, fuel, fruit, furniture-timber, fodder and farm animals along with food.