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Research Article

SUSTAINABLE CROP PRODUCTION TECHNIQUES IN BARMER DISTRICT OF RAJASTHAN

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A R T I C L E I N F O

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A B S T R A C T

The India is an agrarian country and more than 60 % of total cultivated area is still depends on rainfall from SE monsoon. There is always an uncertainty of weather in the country especially in dryland areas or hot arid western zone of India mostly comprises of Thar desert of western Rajasthan. The hot arid western zone comprises 208751 km2 with 57% of total geographical area of Rajasthan. Improved agronomical and engineering practices leads to sustainable income from these drought prone areas.

INTRODUCTION

The hot arid zone of western Rajasthan has highest animal and human population density among the deserts of world. The climate of western Rajasthan is very uneven. Due to the uncertain and erratic weather conditions including very high temperature difference (-2^0 to 48^0C), late onset of monsoon, frequent droughts, early cessation of monsoon, low rainfall (<300mm annually), less no. of rainy days (15-20) or hot winds (10-35 km/hour) during summer results in failure or very poor crop production is a common phenomenon. In western Rajasthan where annual mean rainfall ranged 150-300 mm annually and drought appear in every three years. The soils are sandy to sandy loam with poor organic matter and low water holding capacity. The water and soil quality also hinder the crop production. The Barmer districts have highest area under pearlmillet 1.01 mha but the productivity is very low (103 kg/ha) in comparison to state (825 kg/ha) during 2008-2009. In order to bring stability and increase productivity, a certain techniques for such situations is very essential.

Sustainable Agriculture means *"…an integrated system of House, plant and animal production practices…that will* satisfy human food and fiber needs, enhance environmental quality, sustain economic viability, enhance quality of human life."

Sustainability in Agriculture

Economically viable
It Provides - a secure living for small and marginal farm families, a secure living to other workers in the food system and access to good and nutritious food for all

***Socially Sound*:** Food and nutritional security, Supports communities, Involvement of whole family

Eco- friendly : Cropping different variety of plants near to each other to minimize the pest infections, Waste are used for composting to enhance nutrients in the soil, Crops are rotated to preserve the fertility and nutrients of the soil, Un degraded bio-mass and Balanced eco system

The following steps may be of great help in solving the problems to a great extent.

Soil and Moisture Conservation Practices

In situ water harvesting – In the western Rajasthan sorghum is grown as rainfed crop primarily for fodder because the animal population is higher than human population and livelihood of most of farmers depends on livestock only. In area where sorghum is grown farmers are advised to go for ridge and furrow system of planting. This will be helpful in moisture conservation and in some cases avoid water logging conditions in the cropped area. For water harvesting in situ board bed and furrow system is suggested. The furrow may be spaced 12-15 meter along the contours or across the stop. The spacing is selected according to the cropping pattern. This will increase the moisture status of soil profile so that crop can with stand during dry spell as well as early recession of rainfall, which ultimately increase the yield potentials of the crops.

To get better and uniform germination of pearlmillet in desert areas, an recommendation for better contact of seed with soil moisture, the seeded row to be compacted with 4 kg heavy rubber wheel inbuilt on tynes of seed drill. Water harvesting and recycling-run-off is inevitable in the tropical and sub-tropical climates. It varies from 10 to 40 per cent of the total

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rainfall. Of this, at least 30 per cent could be harvested and harvested water could be re-cycled into the donar area during dry-spell period. The concept of run-off re-cycling can be immediately transmitted only in the deep black soil where the seepage losses are very much less.

Re-charging of ground water- Exploitation of ground water for various purposes results in decline water table. The only alternative is to replenish the ground water by artificial re-charging, therefore the construction of percolation tanks, check dams and anicuts across the water crosses are considered quite suitable for artificial re-charging of ground water. Harvest the water in Khadins also.

Contour bunding: In western Rajasthan, sloppy sand dunes are abundant and naked, sowing of crops across the slope or planting grasses on contour helps in reduction of soil erosion and muddy rain water which block the pores on cultivated areas and will reduce crust formation. As pearlmillet is common cereal crop in this area, the seed size is small than other cereals and crust creates problem in germination ultimately reflects poor yield. An idiom is common "No rainfall after sowing of pearlmillet in next nine days".

Land leveling: In western Rajasthan, leveling is very tedious and costly because of big sand dunes however on cultivated area leveling may be practiced for better yield by high infiltration and uniform growth.

***Suitable crops and their Varieties*:** Crops which do well under normal years may not do so under abnormal weather situations. The selection of crop and their varieties must be suited to dry condition and short duration. The varieties must be tolerance to biotic and abiotic stress also. For example, under south Rajasthan condition sorghum perform better than maize (traditional crop) during varied climate in *kharif* and barley found better than wheat (traditional crop) in normal years while taramira, mustard and safflower during drought years in rabi. Growing large areas under improved varieties of cereals, pulses and oilseeds in kharif and rabi. These varieties have been found most suitable for dryland areas:

1. Bajra HHB 67 Improved, RAJ 171, CZP 9802, MPMH 17, MPMH 21
2. Sorghum CSH 6, CSH 9, SPV 245, SPV 346
3. Groundnut JL 24, AK-12-24
4. Greengram GM4, GAM 5, IPM02-3, GM6, RMG 268, RMG 344
5. Castor GCH 7, DCS 9, GCH 8
6. Sesame RT 125, RT 346, RT 127, RT 371
7. Clusterbean RGC 936, RGC 1003, Maru Guar, RGC 1066
8. Moth RMO 40, CAZRI MOTH 2, RMO 435, RMO 257, RMO 225
9. Wheat RAJ 1482, RAJ 3077, KRL 210
10. Barley RD 2055, RD 2052
11. Gram GNG-1488,GNG-1581, GNG-1958, RSG-974, GNG-2171 (Meera)
12. Mustard Giriraj, PM-25, PM-26, PM-27, GM-3, GDM-4, NRCHB-101, Ashirvad
13. Taramira RTM 314

***Crop rotation and Cropping systems*:** As in sandy soils the infection of polyphagous pests and soil borne diseases are common due to low fertility and undecomposed material. Also the choice of crop is limited tremendously increase the infection of insect pest and diseases. In such situation farmers must follow crop rotation with legumes followed by cereals. In dryland conditions intercropping systems showed superiority over sole cropping systems. Intercropping systems increases production and income. It also gave stability and assured successive crop production in addition to other indirect benefits in the soil health. Some important inter cropping systems have been found suitable is as under

i. Paired planting of bajra at 30/75 cm and raising of greengram or cluster bean in the inter space was found most suitable intercropping system.
ii. Growing of two rows of greengram in the inter row space of castor grown at 120 cm row spacing was better than growing sole crops.
iii. Gram + Mustard in 4:1 row ratio at 30 cm spacing was found remunerative.
iv. Inter cropping combination like grass+greengram and sunflower+greengram found better for western Rajasthan.

***Integrated Nutrient management*:** In rainfed areas the crop production is a risky occupation and farming community don't interested for investment. The soil status of western Rajasthan particularly Barmer and Jaiselmer are very low in nitrogen, medium in phosphorus and medium in potash. Also hike in prices of inorganic fertilizers farmers don't afford results in imbalance nutrition. In hot arid zone particularly in Barmer and Jaiselmer district of Rajasthan the fertilizer consumption rate per hectare is only 1.69 and 10.41 kg during Kharif 2009-10 (State average 32.27 kg/ha). To maintain the productivity of soils farmers must follow the integrated approach by using organic, inorganic and bio-fertilizers in balanced ratio for long term sustainability. In organic manures farmers may apply FYM, compost, green manuring, cakes of neem & tumba while *Rhizobium*, PSB, *Azotobactor* etc as bio-fertilizer.

***Alternate Land use*:** The western part of Rajasthan have lot of marginal land not suitable for agricultural production but may be put for cultivation with trees, shrubs, grasses, medicinal plants etc so farmers harvest additional income besides arable farming. The medicinal plants especially shunkhphusphi, aloevira, sonamukhi, mulathi etc found best and gave profitable remunerative. The discriminate use of land lead to severe soil erosion problems, silting-up of reservoirs and consequently the occurrence of flash floods. To achieve greater efficiency in utilizing the resources in dryland and also to combat the "Energy crisis" and deficiency of animal feed, major approaches in this direction should be

Putting the land (class IV & above) under suitable grasses, legumes and fodder crops and integrating with animal productive systems.

Using the same land or a portion of it simultaneously or sequentially for food, fodder and fuel, due attention being given to interaction among various uses aiming to obtaining greater sustained production and securing both immediate benefits and long term environmental concerns.
The various alternate land use systems which may be adopted are as follows

a. Agro-forestry system
b. Silvi-pastrol system
c. Farm forestry system
d. Agro-horticulture system
e. Silvi-horticulture system

f. Alley eropping system

For these systems the probable suitable crops, grasses, legumes and trees are given below. For hot arid areas (<300 mm annual rainfall)

Crops	Grasses and leguems	Trees
Sorghum	*Cenchrus ciliaris*	*Zizyphus numularia*
Pearlmillet	*Cenchrus setigerus*	*Acacia tortilis*
Greengram	*Sehima nervosum*	*Calligonum poly gonoides*
Clusterbean	*Panicum antidotale*	
Moth (Kidney bean)	*Lasiurus sindicus*	*Prosopis juliflora*
Kulthi (Horsegram)	*Heteropogon controtus*	*Capparis Decidua*
Groundnut	*Dichanthium annulatum*	*Prosopis cineraria*
Mustard	*Atylosia scarabaeoides*	*Leucaena leucocephala*
Grain ameranth	*Stylosanthes humilies*	*Tecomella undulata*
Barley	C*litoria ternatea*	*Salvadora persica*
Safflower	*Carchrus biflorus*	*Salvadora Oleoide*s
Gram	*Aristida funiculata*	*Acacia Senegal*
Taramira	*Indigophora Cordifolia*	

In agri-hotriculture system, crops with erect nature and early maturing habit like greengram, moth and cluster bean may be intercropped in orchard of ber, datepalm, pomegranate or during early stage of establishment of orchards of pomegranate, castor may be intercropped to utilize the inter row space and incorporate organic matter and irrigated with drip for water saving.

Other steps

Crop life Saving Practices

a. Life saving irrigation from harvested water
b. Frequent shallow inter culture operation to keep the field free from weeds and create soil mulch or use of surface mulch for prevent water losses
c. Removing lower leaves of the plants
d. Reduced plant population by the way of thinning
e. Use of anti-transpirants etc.

Mid-Season Corrections

In drought years, complete crop failure can be avoided by adopting mid-term corrections i.e.

a. Removing the susceptible component and allowing the resistant component in intercropping system.
b. Removing main component and sowing of rabi crop, if rain received late.
c. Ratooning in case of sorghum and bajra can be done successfully.

Community Nurseries

Transplanting of sorghum and bajra seeding at 20-25 days stage can be done successfully for gap filling and for main crop when rains occur after long drought. This is possible by growing community nurseries.

Other improved agronomical practices

a) Timely sowing at proper spacing
b) Use of balance fertilizers
c) Proper and timely plant protection measures
d) Timely hoeing and weeding operations
e) Sowing improved and healthy seed with proper seed treatment
f) Seed soaking before sowing etc.

Keeping above point in mind a sustainability in dry region may obtain after adopting or manipulating the different agronomical practices as per climate situation.

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