

Long-term Strategies and Programmes for Mechanization of Agriculture in Agro Climatic Zone–XIV : Western Dry region

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1. NAME OF AGRO CLIMATIC ZONE : Western Dry region
2. STATES UNDER THIS ZONE : Rajasthan



3. SUB-AGROCLIMATIC ZONE WITH THEIR CHARACTERIZATION

With its geographical area of 34.2 million hectares, which makes over 10% of India's geographical area, Rajasthan is the largest State in the Union of India. Its population in 2001 was 5,64,73,122 making it the seventh most populous State. The Aravalli ranges divide the State of Rajasthan into two distinct regions. The 11 districts which fall on the western and north-western side of the ranges constitute a part of the great Thar desert. The rainfall in this part of the State is 400 mm or less. Two of the 11 districts have overcome the problem of aridity through extensive irrigation. The remaining nine districts, viz. Barmer, Bikaner, Churu, Jaisalmer, Jalor, Jhunjhunun, Jodhpur, Nagaur and Sikar constitute the western dry region of Rajasthan.

The zone has all the characteristics of a hot desert. Rains are scanty and erratic, rate of evaporation is high, there are no perennial rivers, ground water table is very deep and is often brackish. Vegetation is sparse.

The average rainfall is about 400 mm but with very high year to year variations. The average temperature varies from about 45°C in May–June to less than 2°C in December–January. High wind velocity, scorching heat and sand storms are common features during summer months.

The soil is mostly sandy, loamy sand and sandy loam. About 28% of the land is tilled; 11% of the cultivated area is irrigated. Productivity is among the lowest in the country.

4. STATE OF PRODUCTION AGRICULTURE IN WESTERN DRY REGION

- (a) **District-wise area and land utilization:** The district-wise land utilization statistics of the region for the year 1999–2000 is given below:

District	(Area in lakh ha)			Cropping intensity (%)
	Geographical area	Net area sown	Gross cropped area	
Sikar	7.74	2.49	3.30	132.49
Jhunjhunun	5.92	4.27	6.13	143.56
Bikaner	22.28	10.64	11.52	108.27
Churu	16.86	12.11	12.59	103.96
Jodhpur	22.56	10.61	11.28	106.31
Jaisalmer	38.39	3.53	4.01	113.60
Jalor	10.57	5.29	6.53	123.44
Barmer	28.17	13.04	13.94	106.90
Nagaur	17.64	12.00	13.58	113.17

Source: Vital Agriculture Statistics, 2000–2001, Directorate of Agriculture, Rajasthan

There is a wide variation in the percentage of the geographical area utilized for crop production depending primarily on the rainfall and irrigation facilities. The cropping intensity varies primarily according to the extent of the area irrigated.

- (b) **Population:** The population of Western Dry region in 2001 comprised 29,420,011 males and 27,087,177 females. Although the zone account for nearly 50% of the area of Rajasthan, its population forms only a small percentage of the State population.
- (c) **Climate:** The climate of the region ranges from semi arid to arid. The region has harsh climate with great extremes of temperatures, long periods of severe drought, high wind velocities and low humidity. The normal annual rainfall in the Western most district of Jaisalmer is 185.5 mm and it increases to 400 or more as one move towards east. About 85% of the rainfall is received during the period June to September. Jaisalmer and Jodhpur have the highest average wind velocity. Evaporation in the region greatly exceeds the total annual precipitation. The variation in the annual rainfall is very high and in drought years, it is not sufficient to grow even crops like Bajra without some irrigation.
- (d) **Soils:** The region is dominated by desert soils. The fertility status of the soils in respect of nitrogen is low.
- (e) **Economy:** Rajasthan stands at No. 10 in the Country in respect of gross domestic product per capita and at No. 7 in respect of agricultural gross domestic product per capita. This indicates the relative importance of agriculture in Rajasthan economy. The economy of Western Dry region is even more dependent on agriculture.
- (f) **Infrastructure:** The infrastructure in terms of roads, electrification, communication, etc. and accessibility to services like marketing, health centers, development agencies, schools, hospitals, etc. are satisfactory in the eastern part of the region. But low population density and harsh environment in the western part of the western dry region has resulted in inadequate development of infrastructure and services.
- (g) **Area under agriculture:** The net cropped area under agriculture in the region is 7.4 million hectares which comes to about 43% of the geographical area. The temporal variation in cropping intensity is very high. *Kharif* is the main crop season and the extent of sowing in *kharif*

depends almost entirely on rainfall. The *rabi* crops are grown under irrigated conditions and the variation in area sown is less.

- (h) **Land Holdings:** The district-wise information on land holdings in the western dry region is not available.
- (i) **Irrigation:** The district-wise gross area irrigated (by source) in the nine districts in 1999–2000 is given below:

District	(Area in ha)			
	Canal	Tube wells	Other	Total
Sikar	45	2,78,093	0	2,78,138
Jhunjunun	0	2,42,218	10	2,42,228
Bikaner	2,33,850	27,714	212	2,61,776
Churu	0	79,065	0	79,065
Jodhpur	0	1,86,890	0	1,86,890
Jaisalmer	1,05,171	11,970	4	1,17,145
Jalor	0	2,53,011	0	2,53,011
Barmer	0	1,69,198	0	1,69,198
Nagaur	0	3,17,660	0	3,17,660

Source: Pratap Singh and Maliwal, P.L., 2004. Agricultural Development in Rajasthan.

The total irrigated area of 19.05 lakh hectares forms 25.8% of the net cropped areas, out of which canal irrigation accounts for 4.6% and the rest 21.2% is accounted by tubewell irrigation. There is a general lowering of water table in the region indicating over exploitation of ground water resources.

- (j) **Major Crops and their Performance:** The annual rainfall ranging from 100 mm to 500 mm, mostly in the months of July, August and September allows only draught resistant crops to be cultivated without irrigation during *kharif*. The incidence of crop failure has been is high in *kharif* due to below normal or poorly distributed rainfall. Irrigation provides security against crop failure during rains. Crop production in *rabi* is entirely dependent on irrigation. The common cropping patterns are:
 - (i) Jaisalmer and most parts of Barmer, Bikaner, Jodhpur, Nagaur and Churu:
 - Pearl millet-fallow (1 year), pearl millet-fallow-*kharif* pluses-fallow (2 years), sesame/clusterbean-fallow (1 year), wheat/mustard/barley-fallow (1 year), berseem/chillies-fallow-wheat-fallow

(2 years), Crop mixtures, pearl millet + kidneybean/greengram/sesame, sesame + kidneybean.

- (ii) Jalor, Sikar, Jhunjunun, parts of Sirohi, Barmer, Jodhpur, Nagaur and Churu:
 - Pearl millet-fallow (1 year), fallow-wheat/gram/mustard/barley (1 year), sesame-fallow-clusterbean/pearl millet-fallow (2 year), clusterbean-fallow-pearl millet-fallow (2 years), clusterbean-fallow-pearl millet-fellow (2 years), fallow-cumin (1 year), pearl millet-wheat/cumin/barley/mustard (1 year), greengram-wheat (1 year), sorghum (fodder)-gram (1 year), chilli-onion (1 year), cotton-wheat (1 year). Crop mixtures: pearl millet + kidneybean/greengram/sesame, gram + mustard.

The districts in the Western Dry Region find their place among the first five districts in the State of Rajasthan in respect of area and production of crops like bajra, cluster bean, kidney bean, green gram, chickpea and sesame.

- (k) **Energy Sources and their Contribution:** Source-wise farm power availability per hectare of net sown area in the Western Dry Region is given below:

District	Farm power availability per hectare of net sown area (hp)			
	Human work	Animal power	Mechanical sources	Total power
Barmer	0.03 (10.7)	0.10 (35.7)	0.15 (53.6)	0.28 (100)
Bikaner	0.02 (7.4)	0.07 (25.9)	0.18 (66.7)	0.27 (100)
Churu	0.04 (12.5)	0.08 (25.0)	0.20 (62.5)	0.32 (100)
Jaisalmer	0.02 (7.1)	0.14 (50.0)	0.12 (42.9)	0.28 (100)
Jalore	0.07 (6.3)	0.05 (4.5)	0.99 (89.2)	1.11 (100)
Jhunjunun	0.09 (8.2)	0.08 (7.3)	0.93 (84.5)	1.10 (100)
Jodhpur	0.04 (3.6)	0.05 (4.5)	1.03 (91.9)	1.12 (100)
Nagaur	0.05 (3.5)	0.03 (2.1)	1.34 (94.4)	1.42 (100)
Sikar	0.08 (6.7)	0.08 (6.7)	1.03 (86.6)	1.19 (100)
Rajasthan	0.07 (5.2)	0.12 (9.0)	1.15 (85.8)	1.34 (100)

Note: Figures in parentheses indicate percentage

Barmer, Bikaner, Churu and Jaisalmer, all in the western part of the region still rely on animal power to a significant extent.

- (l) **Status of Farm Mechanization:** The number of

Table. SWOT analysis

Component	Strength	Weaknesses	Opportunities	Threat
Human resources	Low density ability to stand harsh condition	Low literacy	Abundant labour supply	Unemployment
Land resources	Average size of holding	Desert soils	Scope to divert for new activities	Desertification salinity development
Water resource	Plans to increase area under irrigation	Limited availability and poor quality	More productive use of water	Over exploitation
Crop activity	Diversified and risks minimization through mixed cropping	Low value crops	Scope for high value crops	High risk
Agro-processing	Supply of varied raw material	Erratic supply	Enhanced employment and income	Poor quality

tractors registered in the nine districts of the western dry region in 2001 was reported to be 1,09,262 which was equal to 30.7% of the total number of tractors in Rajasthan. Considering the area under crops the average availability the mechanization power in the region was lower than in the State. On the other hand more than 50% of the sprinkler sets in the State were installed in these nine districts.

5. SWOT ANALYSIS

It is given in the above Table.

6. STRATEGY

An examination of the strength and weaknesses of the western dry region of Rajasthan invariably leads to the conclusion that unless the risk in crop production is reduced, the scope for development will remain highly restricted. The single most important factor for reducing the risk is soil moisture management. Further expansion of traditional irrigation characterized by low water productivity will not be feasible in the region with its limited surface and ground water resources. Conservation of soil moisture, use of precision irrigation to achieve highest possible water productivity and use of the limited water resource for high value crops are the pre-requisites to open the way for the development of region's agriculture. Assuming that the above requirements would be met through appropriate policy decisions and ground level programmes, following mechanization strategy is suggested for the western dry region in Rajasthan:

6.1 Farm Power

1. The farm power availability in this region stands 0.73 hp/ha. Based on the past experience 1.5 hp/ha will be the minimum requirement to achieve quick tillage and planting in the vast rainfed area during the uncertain monsoons. This additional power supply of 0.77 hp will require about 1.6 lakh tractors equivalent.
2. Implements/tool carrier type tractors of reputed make should be imported, introduced and evaluated for the production of high value crops including vegetables. After making necessary adaptive changes such tractors should be manufactured and popularized for vegetable cultivation in this and all other regions where vegetable production is to be promoted to raise land productivity and returns to the farmers.

6.2 Agricultural Implements and Machinery for Crop Production

3. Coarse cereal, because of their low water requirement and their ability to withstand drought condition, will continue to dominate crop production in the rainfed areas of the region. Equipment and machinery for planting some of the coarse cereals like pearl millet, their harvesting and threshing should be developed and popularized.
4. Deep placement of seeds to make use of the receding soil moisture for proper germination is necessary. Techniques and equipment to achieve deep placement without creating excessive

resistance to seedling emergence are now available. These techniques should be utilized to achieve good establishment of irrigated crops like cotton.

5. Sufficient power and matching equipment should be available to the farmers of the region for quick land preparation and scientific planting of the various coarse cereals and other non-irrigated *kharif* crops under rainfed conditions to make best use of soil moisture for crop establishment, before the top layer of soil gets dry.
6. Since mixed cropping will remain a necessity to reduce the risk of crop failure, equipment for planting, interculture and harvesting of mixed crops should be developed and made available.
7. Equipment for deep tillage to increase moisture intake should be introduced.

6.3 Mechanization of Horticultural Crops

8. Use of micro irrigation and covered cultivation will allow most productive use of the limited water resources of the region. Horticulturists should identify appropriate high value fruits and vegetable crops for the irrigated areas of this region. Specialized equipment including animal drawn and power equipment should be made available for large scale cultivation of the horticultural crops. For this purpose equipment for forming raised beds, planting and transplanting of vegetables and other high value crops, crop care, harvesting, etc. should be provided. Wherever necessary such equipment should be imported, tested, adapted for conditions prevailing in the region, manufactured and made available to the farmers. Equipment for laying plastic mulch should be included. If the tool carrier type tractors are introduced as suggested earlier, specialized equipment to match the tool carriers should be developed, produced and provided.

6.4 Biomass Management

9. Biomass productivity in this region is low due to deficient soil moisture. The farmers take care to conserve all crop residues which can be fed to the cattle. However, with the introduction of combines, collection, of wheat straw from the combined harvested fields presents a problem. Straw combines should be introduced to recover wheat straw and other crop residues for animal feeding.

6.5 Post Harvest Technology

10. Large scale production of vegetables and other high value crops will require facilities for planting, grading, primary processing and cold storage of the produce. Proper equipment for these operations and cool chains should be provided in the production catchments to ensure so that the farmers do not suffer loss of their produce in quantity or quality.
11. Wherever justified on economic grounds, cool/refrigerated transport facility should be provided.

6.6 Infrastructural Improvement

12. A Display Centre of Improved Agricultural Machinery be established in this region with full information and video clippings of the working of different types of equipment, from where the farmers/extension workers/policy makers, etc. can get information about different types of agricultural machinery, their specifications, source of supply and cost. An experienced agricultural engineer should man this center. The center should also have the information on the improved agricultural machinery being used in other advanced countries.
13. Farm machinery exhibitions and demonstrations should be organized at important places in the region every year and groups of farmers should be taken to these exhibitions to see those improved equipment and their working and to identify items which may be of interest to them.
14. Adequate facilities should be created and expanded for training of trainers, farmers, drivers/operators, mechanics, and manufacturers to support the agricultural mechanization programmes. Nationalized banks, fertilizer companies, tractor/power tiller/combine/engine manufacturers should be involved in organizing such training programmes.
15. Training programme should be organized for the entrepreneurs in manufacture/running of custom service centers/Agri-clinics/repair and maintenance of workshops and providing contract services for different farm operations.
16. For creating awareness amongst the farmers and extension workers, regular programmes should be broadcasted/telecasted on radio and TV networks. Video films on the working of different equipment should be prepared and shown to the farmers. Front Line Demonstrations of new

equipment should be conducted in farmer's fields and large number of farmers should be invited to see the demonstration.

17. A proper mechanism should be developed to collect information, annually, about the production and sale of different types of agricultural machinery in the State, on the pattern on which crop production and yield data are being collected. This will help in getting better idea about the present trends and demand of different types of agricultural machinery and will help in better planning for the future agricultural mechanization programmes. Such data should be published annually and should be available on computer/internet.
18. The poor financial condition of the farmers in the region will not permit individual ownership of expensive power source and equipment for deep tillage for water conservation, and specialized equipment for high value crops. Adequate arrangements should be made either through custom operation or through machinery cooperative to provide access for the majority of the farmers to such specialized equipment.
19. As there is a need to convert the farmer of the region into a knowledge worker through training, demonstration and continuing updating of his know-how the scope and objectives of the extension programmes should be refined and these programmes strengthened.

6.7 Institutional Framework

20. A Farm Mechanization Development Council, under the Chairmanship of Minister of Agriculture be setup at the State level to plan, guide, review

and monitor the programmes related to agricultural mechanization in the State. This council should be represented by the officials of the Deptt. of Agriculture, Agricultural Engineering, Animal Husbandry, Horticulture, Fisheries, Irrigation, industries, manufacturers of agricultural machinery, leading banks, Agro industries Corporation, State Planning Commission, ICAR Institute in the region, State Agricultural University and Progressive farmers. This council should meet twice a year.

21. The existing infrastructure and manpower for identification, planning, execution, guidance and monitoring of agricultural mechanization and agro-processing activities in the State is poor and inadequate. There is a strong need for creating a separate Directorate of Agricultural Engineering in the State of Rajasthan to plan, execute, review, and monitor various programmes related to agricultural mechanization and post harvest activities in the State. A Monitoring Cell should also be established in the Directorate of agriculture/Agricultural Engineering for this purpose. This Cell should maintain computerized databases and progress reports of all the programmes.

6.8 Policy Issues

22. Rajasthan should have a well-defined policy to promote agriculture mechanization in this region aimed mainly at the reduction of risk in crop production and at large scale production of vegetables and other high value crops in the irrigated areas.

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