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Agro-Climatic Zones and Economic Development of Rajasthan

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ABSTRACT : *Agriculture occupies a pride place in the country's economy. It is the main source of raw material for India's leading industries, providing employments to a vast number of people in the villages and towns. It also provides a large part of market for industrial goods, particularly the farm inputs like fertilizers, pesticides, implements, machinery pumps etc. It is agriculture which supplies not only food grains, beverages and nutritious food but also sustains a large number of industries. Thus it becomes vital to have knowledge about the agricultural development of the regions. In the ACRP (Agro Climatic Regional Planning) Programme the country was divided into 15 major Agro Climatic regions, later subdivisions were also done according to the homogeneity in agricultural characteristics and feasibility in terms of planning and operationalisation with reference to the geographical area covered. The Rajasthan state has well defined 10 agro-climatic zones. The state is endowed with diverse soil and weather conditions comprising of several agro-climatic situations, warm humid in south-eastern parts to dry cool in western parts of the state. About 65 per cent population (i.e. about 56.5million) of the state is dependent on agriculture and allied activities for their livelihood. Agriculture in Rajasthan is primarily rain fed covering country's 13.27 % of available land. The diversity in climatic conditions of the state creates potentiality to develop certain combinations of crops.The present study based on secondary data is an effort to understand the performance of agriculture in the state of Rajasthan in the recent years and the importance of Agro Climatic zones for the well being of rural people.*

I. INTRODUCTION

In determining agricultural regions factors like rainfall, temperature, altitude, latitude, natural vegetation, soils, crops and livestock are taken into consideration.The agro-climatic classification is nothing but an extension of the climate classification keeping in view the suitability to agriculture. Earlier many methods have been devised for climatic classification but the Koeppen's and Thronhwaite's classifications are the most widely used classifications. National Commission on Agriculture (1971) classified the country into 127 agro-climatic zones.

Rajasthan is the largest state of India constituting 10.4 per cent of total geographical area and 5.67 per cent of total population of India (census, 2011). The state is divided into 7 divisions, 33 districts, which are further subdivided into 244 tehsils, 249 panchayat sammitees and 9,168 gram panchayats. Physio-graphically, the state can be divided into 4 major regions, namely -

[1]. The Western desert with barren hills, rocky plains and sandy plains;
[2]. The Aravalli hills running south-west to north-east starting from Gujarat and ending in Delhi;
[3]. The Eastern plains with rich alluvial soils; and
[4]. The South-Eastern plateau.

Mahi, Chambal and Banas are the three major rivers of the state. The state enjoys a strategic geographical position wherein it is situated between Northern and Western growth hubs in the country and 40 per cent of Delhi Mumbai Industrial Corridor (DMIC) runs through it.

An Overview of Rajasthan according to census 2011

S. No.	Indicators	Rajasthan	Proportion of
1	Area	3,42,000 sq. km.	10.4
2	Population	56.5 million	5.49
3	Rural population	43.2 million	5.8
4	Total forest cover	32,627 sq. km.	4.19
5	Gross cropped area	2,16,99,000 hectare	11.25
6	Net sown area	1,68,36000 hectare	11.87

7	Net irrigated area	62,94,000 hectare	10.46
8	Livestock	49 million	10.13
9	Food grain production	1,14,45,000 tonnes	5.49
10	Oilseed production	59,64,000 tonnes	21.31
11	Rainfall	57.5 cm (annual average)	

Source- Census of India 2011.

Population: As per Census 2011, the population of Rajasthan was 6.86 crore, out of which 75.11 per cent was rural population (GoI, 2011). If we look at the decadal growth rate of the population, it was lower during the decade 2000s (21.44 per cent) as compared to during 1990s (28.41 per cent). The population density in the State has increased by about 22 percent, i.e. from 165 per sq.km in 2001 to 201 in 2011. The overall sex ratio of the population of Rajasthan (number of females per thousand males) was lower (926) than all Indian average (940) in 2011. The literacy rate of Rajasthan was 67.06 per cent, of which the male and female literacy rates were 80.51 per cent and 52.66 per cent respectively.

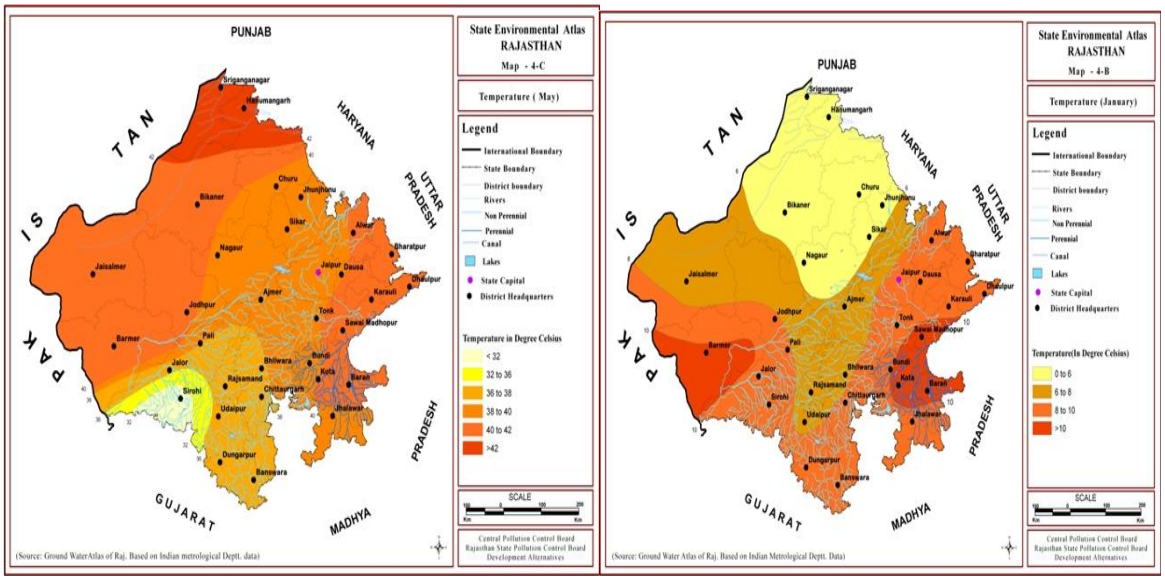
Population Data Table of Rajasthan according to census 2011

S.No	RAJASTHAN	
1	Total Population	6.86 Crore
2	Population Density	201person/sq kms
3	Decadal Population growth	2.41%
4	Sex Ratio	926
5	Literacy Rate	67.06%
6	Female literacy	52.66%
7	Male literacy	80.51%

II. CLIMATE

Temperature : Rajasthan has a wide range of climate varying from extremely arid to humid. The humid zone spans the southeast and east. Except in the hills, the heat during the summer is great everywhere, with temperatures in June—the warmest month—typically rising from the mid-80s F (about 30 °C) to nearly 110 °F (low 40s C) daily. Hot winds and dust storms occur in the summer, especially in the desert tract. In January—the coolest of the winter months—daily maximum temperatures range from the upper 60s to the mid-70s F (low to mid-20s C), while minimum temperatures are generally in the mid-40s F (about 7 °C). The western desert has little rain, averaging about 4 inches (100 mm) annually. In the southeast, however, some areas may receive almost 20 inches (500 mm). South-Eastern Rajasthan benefits from both the Arabian Sea and Bay of Bengal branches of the southwest (summer) monsoon winds, which bring the bulk of the annual rainfall.

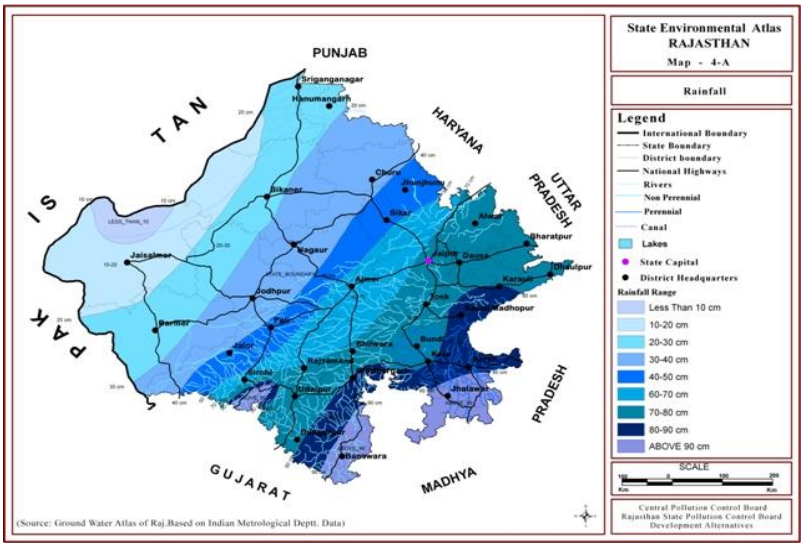
General Temperature Distribution of Rajasthan for the Month of May and January



Source- Ground Water Atlas of Rajasthan based on Indian Metrological Dept. Data.

Rainfall : Rainfall in Rajasthan is characterized by wide variation in rainfall received across the different districts of the state within a year and across years within the same districts. It ranges from a high of 974mm in Banswara to a low of just 91mm in Jaisalmer during 2009-10. Percentage variation as compared to normal rainfall ranged from a high of +168% in Dholpur to a low of -89% in Nagaur in 2009-10. A direct consequence of rainfall variability is drought. The map shows that except a few districts that are part of south and south eastern Rajasthan, the rest of Rajasthan faces the prospects of a drought at least every once in 5 years.

General Rainfall pattern in Rajasthan



Source- Ground Water Atlas of Rajasthan based on Indian Metrological Dept. Data.

Land Use Pattern in Rajasthan : To understand the environmental status of the region, it is essential to understand the land use pattern. It determines the ecological balance in the regions. The present section deals with the land use pattern across the agro-climatic zones as follows.

Forest coverage: Only 8 per cent of the total reporting area is under forest cover. The arid western zone has negligible proportion under forest cover. In other zones, like Hyper-arid partial irrigated, Irrigated North Western Plain and Internal Drainage Dry, it varies between about 2 to 4 per cent of the total reporting area of the respective zones. There are only two zones namely, the Humid Southern and the Humid Southern Eastern Plain that is endowed with substantial proportion under forests, i.e. one-fourth of the total reporting area is under forests. In rest of the zones it varies from 6 to 15 per cent (see Figures below). It is important to mention here that the present forest coverage in the state as well as across the zones is considerably lower as required from the environment point of view i.e. one-third of the total geographical area. However, it must be noted that large parts of the state, especially the western portions are under a desert ecosystem.

Area under non-agriculture uses: This category belongs to the land put to non-agriculture uses such as residential, roads/paths, water bodies etc. The share of such land use is only about 5 per cent of the reporting areas. Across the zones, this proportion varies from 3 per cent to 8 per cent.

Barren and Un-culturable Land: Broadly, this category of land is considered as non-suitable for agriculture operation. At the state level, about 7 per cent of the total reporting is categorized as barren and un- cultural waste land. Across the zones such as semi-arid eastern plain, sub humid southern plain and humid southern, the proportion of the said category varies between about 10 to 20 per cent of reporting area. In irrigated North Western Plain, barren and waste lands are found to be negligible i.e. less than 1 per cent. In other zones it varies from 3 to 6 per cent.

Permanent Pastures and other Grazing Lands: This is one of the most important categories of land use. The availability of permanent pasture and grazing land determines the status of livestock economy in the regions. It constituted about 5 per cent of the reporting area in Rajasthan. In Irrigated North Western Plain, the grazing land

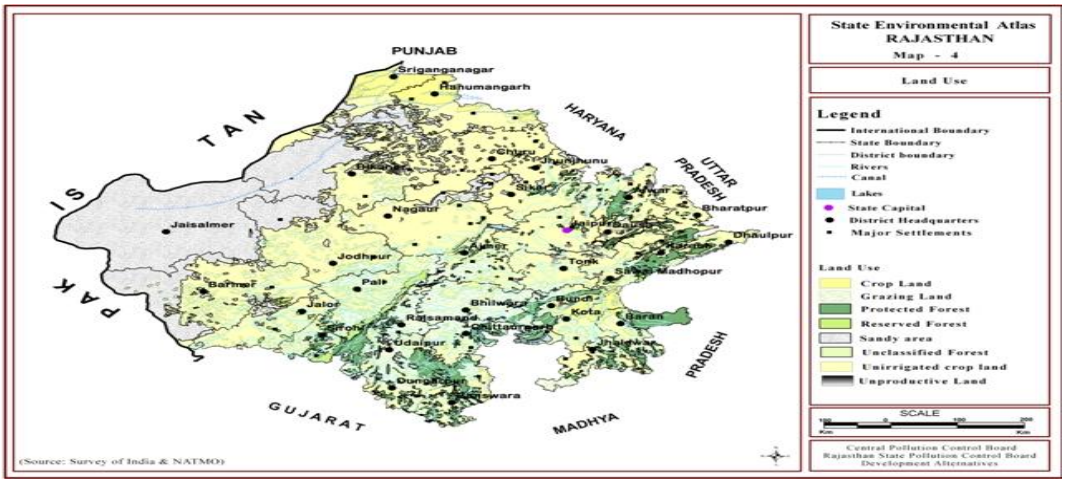
is also found negligible. The Sub humid Southern Plain is endowed with pastures and grazing lands in one-tenth of the reporting area. Largely, it constituted about 4 to 7 per cent across the zones.

Land Under horticulture: Area under fruit crop fall under this category of land use. In Rajasthan, the area under fruit crops is also negligible i.e. less than one per cent. In certain regions, area under fruit crop is absolutely missing. It can be inferred from the fact there is scope for horticulture development in the time ahead.

Culturable Waste Land: This is also one of the major categories of land use. On this land, agriculture operations are possible. It constituted a substantial proportion of the reporting area i.e. about 13 per cent.

Fallow land: There two types of fallow land as current fallow and long fallow. The land is treated as current fallow when the farmer suspended agriculture operation for one to five years. After five suspension of agriculture operation it is treated as long fallow. At the state level estimates, there is no considerable variation in proportionate terms as in case of both types of fallows i.e. 6 and 5 per cent. In irrigated north western plain, there is considerable proportion of land under current fallow. In other zones there slight differences in these categories.

Land Use Map of Rajasthan



Source-Survey of India & NATMO

Net Area Sown: It most important category of land use pattern as considered as agriculture land. About half of the total report area is under agriculture operation. The irrigated northern-western region and internal drainage dry zones leading ahead as compared to other zones in bringing larger proportion of reporting area under agriculture operation that depends upon the availability and access to irrigation facilities, status of aquifer and geophysical features of the regions. The other regions like – Irrigated North Western Plain, Transitional Plain of Luni Basin, Semi-arid Eastern Plain, Flood Prone Eastern Plain regions have half and more than that use the land for agriculture production. There are only three like Hyper-arid partial Irrigated Zone, Sub humid Southern Plain and North Western Plain zones with 15 and 12 per cent respectively. In rest of the zones it varies from 2 to 8 per cent.

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Agro Climatic Zones of Rajasthan : In determining agricultural regions of Rajasthan factors like Rainfall, Temperature, Altitude, Latitude, Natural Vegetation, soils, crops and livestock are taken into consideration.

Source- www.Krishi.Rajasthan.gov.in

Features of Agro Climatic Regions of Rajasthan

Zone	Rainfall	Major Crops	Types of Soil	Districts
IA-Arid Western	200-370	Mostly rainfed crops like bajra, kharif pulses, guar etc. are grown during the kharif season. Rabi crops like wheat, rape-seed and mustard are grown only in areas where irrigation water is available.	Desert Soils and sand dunes aeolian soil, coarse sand texture some places alcareous	Barmer, Jodhpur
IB-Irrigated North Wester	100-350	Amongst the kharif crops cotton, sugarcane and pulses are of importance. In the rabi season, wheat, mustard, gram, vegetables and fruits are produced.	Alluvial deposits calcareous, high soluble	Sriganganagar ,Hanumangar h
IC-Hyper Arid Partial Irrigated Zone	100-350	Mostly rainfed crops like bajra, kharif pulses, guar etc. are own during the kharif season. Rabi crops like wheat, rape-seed and mustard are grown only in areas where irrigation water is available.	Desert Soils and sand dunes aeolian soil loamy coarse in texture & calcareous	Bikaner, Jaisalmer, Churu
IIA-Internal Drainage dry zone	300-500	Bajra, sesamum and kharif pulses are the main crops of the rainy season. Wheat, barley, mustard and gram are grown as irrigated crops or on conserved soil	Sandy loam, shallow depth red soils in	Nagaur, Sikar, Jhunjhunu
IIB-Transitional Plain of Luni Basin	300-500	The area produces bajra, maize, guar, sesamum and pulses in the kharif season. In the rabi season, wheat, barley and mustard are the dominant crops, especially in irrigated areas.	Red desert soils in Jodhpur,Jalore & Pali sierozems in Pali & Sirohi	Jalore, Pali, Sirohi
IIIA-Semi-Arid Eastern Plain	500-700	In the total gross cultivated area of this zone, bajra, sorghum and pulses are grown in the kharif season, and wheat, barley, gram, mustard in the rabi season.	Sierozen, eastern part alluvial, west north west lithosols, foot hills, brown soils	Jaipur, Ajmer, Dausa Tonk

IIIB-Flood Prone Eastern Plain	500-700	The region produces bajra, sorghum, maize, sugarcane, sesamum and a variety of pulses in the kharif season. Wheat, barley, gram and mustard are the dominant crops during rabi season.	Alluvial prone to water logging, nature of recently alluvial	Alwar, Dholpur, Bharatpur, S. Madhopur, Karauli
IVA-Sub humid Southern	500-900	The area produces maize as the chief food crop of the Kharif season but in irrigated areas, paddy is also grown. In the Rabi season, wheat, gram and oil seeds are the main crops. In areas of black soil, cotton and opium	Soils are lithososat in foot hills & alliuvials in plains	Bhilwara, Rajsamand, Chittoregarh
IVB-Humid southern	500-1100	Cotton and sugarcane are the chief cash crops grown in the black soil region. Maize, sorghum and paddy are the chief food crops of the Kharif season. Groundnut, mustard, sesamum and rapeseed are also grown.	Predominantly reddish medium texture, well drained calcareous,	Dungarpur, Udaipur, Banswara, Pratapgarh
V-Humid Southern Eastern Plain	650-1000	Paddy and sorghum are the chief food crops grown in the Kharif season. This area is suitable for soyabeen crop also. Wheat, barley, grain and mustard are grown in winter.	Black of alluvial origin, clay loam, ground water salinity.	Kota, Jhalawar, Bundi, Baran

Source: Directorate of Agriculture, Government of Rajasthan

Compound Growth Rate (%) in Crop Area, Production and Yield in Rajasthan

PLAN PERIOD	AREA	PRODUCTION	YEILD
Annual Plan (1991-92)	-6.64	-20.42	-5.76
8th FY Plan (1992-97)	0.65	4.11	3.44
9th FY Plan (1997-2002)	-1.76	-0.83	0.94
10th FY Plan (2002-07)	12.98	20.43	6.60
11th FY Plan (2007-12)	3.27	12.92	9.34

Source: Computed from GoR (2009).

Food Grains Production in Rajasthan and it's share in India

YEAR	RAJASTHAN	INDIA	Rajasthan's share in India
1990-91	10.9	176.4	6.2
2000-01	10.0	196.8	5.1
2006-07	14.9	217.3	6.9
2007-08	16.1	230.8	7.0
2008-09	16.7	234.4	7.1
2009-10	12.4	218.1	5.7
2010-11	23.6	241.6	9.8

Source- GoI(2012a)

The benefits of such planning is that it overcomes the danger of over- generalization and lack of focus on problems and prospects that are specific to agro- climatic, demographic, economic, ecological and sociological conditions.

Such a decentralization would also make policy formulation and implementation much simpler as the regions would be more or less homogeneous. These zones have been identified with the purpose of developing location specific and problem oriented research and developmental strategies for increasing agricultural production.

Advantages of Agro- Climatic Planning

[1]. The decentralization makes policy formulation and implementation much simpler as the regions are more or less homogeneous.
[2]. Features like watershed development, soil conservation, ground water development can be intimated.
[3]. Both public and private investments are possible for land and water development.
[4]. More balanced growth can be attained by proper utilization of local resources and getting better participation of local people.
[5]. Agro climatic planning can decide the marketing, agro processing and infrastructural support required in the region.

III. CONCLUSION

Agro Climatic Zonal Planning aims at scientific management of regional resources to meet the requirements of food, fibre, fodder and fuelwood without eroding the status of natural resources and environment. The understanding of agro climatic regions can also help to increase the share of agriculture in state's GDP.

Present Share of Agriculture in State's Domestic Product : The economy of Rajasthan is largely agrarian in nature with high level of fluctuation in agricultural production and productivity that has resulted in wide fluctuation in Gross State Domestic Product (GSDP) of the State over the years. Despite of this, the state economy has exhibited a healthy growth path during the recent past. The state's GSDP at current prices has increased by more than double, i.e. from Rs 142236.14 crore in 2005-06 to Rs 368319.52 crore in 2011-12. This has made Rajasthan as one of the fastest growing states of India. The state's NSDP (at constant prices 2004-05) has increased from Rs 120202.28 crore in 2005-06 to Rs 1, 40,471.48 crore in 2007-08 and further to Rs187749.14 crore in 2011-12 . On contrary, the state's NSDP at current prices has grown more steadily from Rs 151427.86 crore in 2005-06 to Rs 172249.65 crore in 2007-08, further to Rs 325265.55 crore in 2011-12.

Agriculture and allied sector plays an important role in State's economy. Though its contribution in NSDP has fallen from about 35 per cent in 1990-91 to around 23 per cent in 2011-12, agriculture yet forms the backbone of state economy. Around two third of its population (56.5 million) is still dependent on agricultural activities for their livelihood. Thus, a higher priority to agriculture will achieve the goals of reducing poverty and malnutrition as well as of inclusive growth. Though agriculture forms the source of livelihood of the majority in the state, it is largely dependent on rainfall. Only 34.5 per cent of the net sown area is irrigated. Since the rainfall amount is very scanty and highly erratic, the expansion of irrigation provisions and efficient water management are major challenging tasks for the policy makers. As highlighted in the Draft State Agriculture Policy (GoR, 2012a), major challenges for agriculture sector in the state are:

[1]. Frequent droughts leading to decline in productivity and reduced performance and even death of animals;
[2]. Climate change and global warming;
[3]. Strengthening of comprehensive technology based on developmental approach to promote dryland/ arid agriculture;
[4]. Deteriorating soil health including imbalanced use of fertilizers, micronutrient deficiency, lack of organic matter content, inadequate soil microbial flora and fauna etc. ;
[5]. Low productivity, unfavorable prices and practically very little value addition, distress sales, rising cost of cultivation;
[6]. Lack of efforts for stabilization of sand dunes and for greening the desert through agro-forestry programs ;
[7]. Lack of integrated farming approach;
[8]. Lack of up-scaling of farm-validated modern technologies and agricultural Innovations;
[9]. Proper institutional mechanisms and organizational and management reforms for overcoming the felt constraints coming in way of the farm prosperity in the state.

The Rural peoples can be benefited alot if they have better understanding of Agro Climatic Regions and knowledge of related programmes. This can diversify and stabilise the earnings of the farmers .There is a need to strengthen the livestock sector mainly milch cows and buffaloes. Sheep, goats, piggery, poultry, fishing and bee

keeping enterprises may suit more to the landless rural households. People involved with agricultural sector should have complete knowledge regarding land, soil types, irrigation facilities, water availability, seeds, amount and distribution of rainfall, human resource, livestock, marketing, credit institutions, input supply system, processing facilities available in the area which can bring better results to the individuals, state and ultimately to the country.

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