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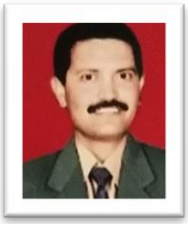
Status of Non-Physical Determinants of Agriculture in 1c-Hyper Arid Partial Irrigated Zone - A Geographical Study



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Abstract

There is increasing appreciation by geographers of the fact that physical and non-physical factors influence overall economic development and those factors contributing to agricultural growth must also be sought in the same perspective. However, one cannot ignore the impact of the vast multiplicity of inter-related physical and non-physical factors on agriculture, notwithstanding the fact that all of them are not equally significant in influencing the regional variations and temporal development of agricultural phenomena in an area.

Adoption of new technology, expansion of irrigatin and credit facilities, population growth, trade, governmental policies etc. determine the landuses of different places and times. The present study examines the status of non-physical determinants of agriculture in the study area.

Keywords: Physical and Non-Physical Factors, Regional Variations, Agricultural Phenomena.

Introduction

In the context of solution of food problem of India, it becomes necessary to undertake suitable strategy to increase the yield per unit area because the expansion of area is very much limited and this country has reached the limit of physical frontiers in cultivation. Moreover, in the context of bringing more of marginal lands under cultivation, it needs heavy investment of land levelling, soil conservation, irrigation etc. which can be justified only on the basis of cost- benefit ratio.

There are numerous socio-cultural, economic, political, technological and infrastructural factors determining the agriculture landuse, cropping patterns and agricultural processes. Of these factors, land tenancy, system of ownership, size of holdings, availability of labour and capital, religion, level of technological development, accessibility of market, irrigation facilities, agricultural research and extension service, price incentives, government plans and international policies have a close impact on agricultural activities.

Study Area

The Hyper Arid Partial Irrigated Zone (Zone IC) lies between the Irrigated North-Western (IB) and IA-Arid Western IIIA-T Plain of inland drainage. In Rajasthan, it spreads from Rajgarh tehsil in Churu district in the North-East to Sam tehsil in Jaisalmer district in the west. It covers the areas of Bikaner, Jaisalmer and Churu districts. The zone lies between $26^0$24' to $29^0$00' North latitudes and $69^0$29' to $75^0$41' East longitude with the altitude ranging from 229 to 292 m above mean sea level. The length of international boarder attached to the zone is 632 km.

Physiographically, the study area can be divided into several distinct terrains. These physiographic terrains have evolved mainly during later tertiary and quaternary periods as degradation land aggradational units. The desert plain is also known as the Thar Desert and covers parts of Bikaner, Jaisalmer and Churu districts.

Objectives of the Study

The present study is aimed to evaluate the status of non-physical determinants of agriculture in the study area.

Hypothesis

Increase in irrigated area and mechanization of agriculture have resulted changes in landuse pattern in the study area.

Methodology

The research work comprises of primary and secondary data. The primary data have been collected from the field work with the help of schedule containing landuse, cropping pattern, irrigaton facilities, use of

machineries and equipments, crop combination, crop rotation, crop diversity, crop ranking etc. of 258 sample villages and 2665 households; whereas the secondary data have been gathered from various census records, journals and government publications. The literature survey on the various aspect of the IC- Hyper Arid Partial Irrigated Zone has been undertaken in the libraries and internet searching. It also includes the study of respective issues from different governmental and non-governmental organization, and various academic and non-academic people have been consulted. After that compilation, calculation and computation of both primary and secondary data; the analysis is done.

Review of Literature

A review of past research helps in identifying the conceptual and methodological issues relevant to the present study. This would enable the researcher to collect the accurate data, information and subject them to sound reasoning and meaningful interpretation. This attempts a brief review of the relevant research literature that has accumulated in the areas related to this study.

Pal and Mruthyunjaya (1990) analyze silvi-pastural system for development of waste lands of and areas in Rajasthan using the time series data of 16 years from 1970-71 to 1986-87. The compound growth rate revealed that the area under forests, grazing land, cultivable wasteland, gross cropped area and area sown more than once registered a significant positive growth during the study period. The growth rate was highest for forest (4.1.0 per cent) followed by sown area more than once (4.10 per cent) the growth rate for barren and uncultivable land was negative significant. They have suggested a landuse plan which envisaged that the proportionate area under crops should decrease from the existing 44.98 per cent to 33 per cent of the total area. The land so released was to be utilized for forests grasslands and fruits.

Singh (1990) examines the landuse pattern in the problematic areas of all the five agro-climatic regions of Uttar Pradesh during the year 1988-89. The study reveals that the Hill Region has the highest area under forests, permanent pastures, grazing land, tree crops and groves, non cultivable wasteland and land under non-agriculture uses. The area sown more than once and the total cropped area as well as the intensity of cropping have been found to be the highest in the Eastern Region and the lowest in the Hill Region. He concludes that the slopes of the hilly area of Uttar Pradesh could be successfully developed for the plantation of temperate fruits.

Goswami and Challa (2004) describe the socio-economic factors affecting landuse in India. According to them, population pressure and prices of essential commodities are the most important factors contributing to change in landuse pattern. The study has indicated that high population pressure on cultivated land induced the rural people to bring more land under cultivation. Similarly in the case of essential commodities whose prices constantly increased, there is a pressure to substitute land from low value output to high value output.

Wani *et al*. (2009) analyze the determination of productive and unproductive land utilization in Jammu and Kashmir. The study has chosen cropping intensity as endogenous variable in productive land utilization and current fallow as variable in unproductive land utilization. The estimates of exponential function for productive landuse reveals that the net irrigated area, literacy level and area not available for cultivation are positive and significant variables of the variation in cropping intensity. Increase in rural population in relation with cultivable area has significantly contributed to the increase of area under current fallow. The area under rise is found to be significant and positive determinant of area under current fallow.

Tinger *et al.* (2008) have made an attempt to study the cropping pattern and crop diversification in Akola district of Vidarbha. The study finds that majority of cereal crops show negative and low growth rates of area during the study period. Soyabeen has not attained important position in the cropping pattern. The trend of crop diversification and cropping intensity has increased significantly.

Meenakshi and Indumathy (2009) have studied the land utilization and cropping pattern in Tamil Nadu. The study has resulted that there is a considerable reduction in the cultivated area and hence output was affected to a great extent. The cropping pattern in the state has a high degree for maladjustment for crops. Roughly 53 per cent of the cultivated area is being used for growing unsuitable crops. Awasthi (2004) analyzed that the landuse changes or modification have important environmental consequences through their impact on soil erosion.

A study conducted by Apte (1964) in the Osmanabad district of Maharashtra state examined various cropping pattern and factors influencing the decision of farmers in selection of crops. He found that the decision on cropping pattern was governed by such factors are desire of the farmers to achieve self sufficiency in cereals, availability of seed for cash crops and incidence of pests and disease. Further, the labour input and product price did not have a significant influence on the decisions indicating the subsistence nature of production.

Outcome of the study

The analysis of the primary and secondary data is described in the following part.

Irrigation Facilities

Irrigation is the basic input of agriculture and it is one of the important components of agricultural technology to boost up agricultural productivity. It is task of geographer to study the spatio temporal aspects of irrigation and its relationship with other attributes. It is obvious fact that irrigation is indispensable for the success of agriculture. It ensures the benefits to farms by reducing the risk of crop failure, increasing the average yields and permitting multiple cropping. The successfully water requirement of various crops canbe met (Gadgil D.R., 1948).

The main sources of irrigation in IC- Hyper Arid Partial Irrigated Zone are wells, tube-wells and IGNP. In 1997-98, the number of wells and tube-wells

in Jaisalmer district are 352 and 211, in Bikaner district 770 and 665 and in Jaisalmer district 8500 and 367 respectively. The number of wells and tube-wells are increasing day by day and it is being exploited underground water. In the year 2014, wells and tube-wells in Jaisalmer district were 1,844 and 5,390, in Bikaner district 8,428 and 26,410 and in Churu district 8,426 and 26410 respectively.

The project is to benefit mainly the western part of Bikaner and Jaisalmer districts. Under the lift irrigation scheme 41 villages of Lunkaransar tehsil with an area of 259 lac acres and 35 villages of Bikaner tehsil with an area of 3.93 lac acres is be benefited. In first phase out of proposed 50,770 ha, 36,709 ha area got the irrigation facility during 1994-95 in Bikaner, Kolayat and Lunkaransar tehsils.

As per data shown in table 1, the total irrigated area was 5.82 lakh ha in the year 1997-98, out of which 3.28 lakh ha was in Bikaner district, 0.80 lakh ha in Churu and 1.74 lakh ha in Jaisalmer which increased up to 11.71 lakh ha as the total irrigated area in the year 2014-15. Out of which Bikaner district leads with 7.09 lakh ha followed by Jaisalmer (3.05 lakh ha) and Churu (1.6 lakh ha). It is important to mention here that area irrigated by canal was highest (59.5 per cent) followed by tube-wells and wells in 1997-98. After that the area under tube-well irrigation increased speedily in Bikaner district while area under canal irrigation increased in Jaisalmer and Churu districts during the period 1997-98 to 2014-15.

Table 1: IC- Hyper Arid Partial Irrigated Zone- Irrigation Facilities

Source	1997-98			2010-11			2014-15		
	Bikaner	Churu	Jaisalmer	Bikaner	Churu	Jaisalmer	Bikaner	Churu	Jaisalmer
Wells	7889	38324	493	3320	35264	427	4307	427	1482
Tube-wells	106082	41334	41630	180076	65911	59247	386485	59247	120169
IGNP	214320	474	131647	159760	230	97561	318079	97561	183785
Total	328291	80132	173770	343156	101405	157235	708859	157235	305436

Source: Agricultural Statistics; Bikaner, Churu and Jaisalmer

The total number of wells and tube-wells was 9552 and 1243 respectively in the year 1997-98 in the study area. Churu district alone had the maximum share of wells (88.98 per cent) while maximum number of tube-wells (53.79 per cent) was in Bikaner district in the same year. Since then their number increased rapidly and have become 17,704 and 38,509 respectively in 2014-15. The highest growth rate (40 times) of tube-wells (26,410) is recorded in Bikaner district followed by Jaisalmer and Churu districts. The maximum growth rate of wells is also recorded in Bikaner district (12 times) followed by Jaisalmer district (5 times) while it has decreased in Churu district during the same period (table 2).

Table 2: IC- Hyper Arid Partial Irrigated Zone- Number of Wells and Tube-Wells

Year	Wells/Tube-wells	Bikaner	Churu	Jaisalmer
1997-98	Wells	700	8500	352
	Tube-wells	665	367	211
2000-01	Wells	2223	7942	540
	Tube-wells	2214	560	538
2005-06	Wells	3794	8865	837
	Tube-wells	3401	1580	1106
2010-11	Wells	5383	6394	1223
	Tube-wells	14162	2995	2346
2011-12	Wells	6795	6594	1423
	Tube-wells	16232	3254	3054
2012-13	Wells	8278	6755	1601
	Tube-wells	20595	5934	3584
2013-14	Wells	8317	6802	1778
	Tube-wells	24607	6359	4862
2014-15	Wells	8428	7432	1844
	Tube-wells	26410	6789	5390

Source: Board of Revenue, Ajmer

Use of Hybrid Seeds, Fertilizers and Pesticides

Agricultural investment is more profitable only after adoption of improved seeds, fertilizers and irrigation technology which helps to multiply the productivity per hectare (Estall R.C. and Buchanan R.O., 1980). Use of improved seeds has changed the traditional cropping pattern to certain extent and marked the beginning of agricultural development. It is supplemented by the expansion of irrigation and use of chemical fertilizers.

Improved Seeds

The quality seeds have always been proved to be important aspect of increasing agriculture production. Agricultural productivity depends to a great extent, upon the use of quality seeds. The increase in the yields are dependent to a large extent in suitable variety of seeds which are capable of producing high yields provided other associated factors are available in the proper combination, improved varieties of seeds are one of the most important component of strategic input in the study region.

Table 3: IC- Hyper Arid Partial Irrigated Zone- Use of Improved Seeds (2015-16)

Crop	Use of HYV seeds (Quintals)	Percentage to the Total Seeds	Percentage to The Total Cereals/Pulses
Bajra	10,549	8.17	19.35
Wheat	40,727	31.55	74.65
Barley	3,275	2.5	6.0
Total Cereals	**54,551**	**42.26**	**100.00**
Moong	3,250	2.51	8.59
Moth	6,250	4.84	16.55
Gram	28,292	21.91	74.86
Total Pulses	**37,792**	**29.27**	**100.00**
Sesamum	43	0.04	0.15
Groundnut	21,930	16.99	80.18
Mustard	4,635	3.59	16.95
Castor Seed	743	0.57	2.72
Oilseeds	**27,351**	**21.15**	**100.00**
Cotton	48	0.04	0.51
Guar	9,335	7.24	99.49
Other Crops	**9,383**	**7.28**	**100.00**
Total Crops	**129,077**	**100.00**	**-**

Source: Agricultural Statistics, Department of Economics & Statistics, GoR, 2014-15

During 2015-16, total quantity of improved seeds of all crops distributed in the IC- Hyper Arid Partial Irrigated Zone is 129,077 quintals. Out of this, 42.26 per cent of high yielding variety seeds are used in cereal crops, 29.27 per cent pulses, 71.54 per cent food crops, 21.15 per cent in oilseeds and 7.28 per cent in guar and cotton crops (table 3).

Nearly 54,551 quintals high yield variety seeds of total cereals are distributed in the study area during 2015-16. Out of these 8.17 per cent high yield variety seeds of bajra, 31.55 per cent high yield variety seeds of wheat only 2.5 per cent high yield variety seeds of barley were used in IC- Hyper Arid Partial Irrigated Zone. Whereas nearly 37,792 quintals high yield variety seeds of total pulses are distributed in the study region in 2015-16. Out of these, 21.91 per cent high yield variety seeds of gram, 4.84 per cent high yield variety seeds of moth and 2.51 per cent high yield variety seeds of moong are used in 2015-16. The main varieties of HYV seeds of various crops widely used in the study area are mentioned in table 4.

Table 4: IC- Hyper Arid Partial Irrigated Zone- Main Varieties of Improved Seeds

Crop	Varieties
Wheat	Raj1482, Raj3765, Raj3077
Barley	RD2552, RD2503, RD2508, RD2035, RD2050
Mung	RGC936, RGC1003, RMG62
Guar	RGC1002, RGC1003, RGC986, RGC471
Groundnut	HNG10, RG141, TBG37, TBG39
Mustard	RN393, RGN13, PRN505, Laxmi T59, Bio902, RGN48
Cotton	RST9, RG8, RG18, Bikaneri Narma
Moth	RMO40, RMO225, FMM96, IPCMO912
Bajra	Bajra, JK26, JK52, Proagro-9444

Source: Field Survey, 2014-17.

Chemical Fertilizers and Pesticides

For boosting agricultural output, the use of chemical fertilizers has an important role. Though, the soils of India are varied and rich but deficient in nitrogen and phosphorus, and other plant nutrients which together with organic manure influence crop return. With the population rising at fast rate, the use of larger doses of chemical fertilizers is the only way to increase to increase crop yield. Excessive use of soils has depleted their nutrients which can be replenished. There is no doubt that fertilizers when used efficiently and in combination with other improved practices can be one of the most effective means of increasing productivity per unit area. In view of deficiency in nutrients in the soils, the supply of fertilizers becomes inevitable particularly in IC- Hyper Arid Partial Irrigated Zone.

In 2007-08, the use of chemical fertilizers was 35,129 metric tonnes which has increased up to 83,583 metric tonnes (2.38 times) in 2014-15 (table 5). Similarly, the crop yield has also doubled during the same period but the quality of soil is degraded in some parts of the study area.

Table 5: IC- Hyper Arid Partial Irrigated Zone- Use of Chemical Fertilizers (2015-16)

District	Quantity (MT)	Percentage
Bikaner	54124	64.75
Churu	13870	16.59
Jaisalmer	15589	18.65
Total	83583	100.00

Source: Agricultural Statistics, DoES, GoR, Jaipur, 2015-16

The district-wise consumption of chemical fertilizers in IC- Hyper Arid Partial Irrigated Zone shows that it is highest in Bikaner district (64.75 per cent) and the lowest in Churu district (16.59 per cent) during the period 2015-16. Urea, DAP, MOP, NPK and SSP are the main varieties of fertilizers used in the area.

Consequently, the consumption of fertilizers is relatively low due to inadequacy of irrigation facilities, poor soils and poor credit facilities have discouraged to use chemical fertilizers. The increasing trend of fertilizer consuption was noticed during the period 1997-98 to 2010-11 and then it is showing a decreasing trend between 2010-11 and 2014-15. The mean maximum consumption of

fertilizers for all crops was 16.08 - 24.75 kg/ha in Bikaner district during 1997-98 to 2010-11; whereas it is recorded maximum in Jaisalmer district (18.58 - 23.44 kg/ha) during 2010-11 to 2014-15 (table 6).

Table 6: IC- Hyper Arid Partial Irrigated Zone- Use of Fertilizers

Year	District	Fertilizer Consumption (kg/ha)		
		Kharif	Rabi	Average of all crops
1997-98	Bikaner	4.52	42.44	16.08
	Churu	2.65	11.64	4.64
	Jaisalmer	8.20	17.27	11.37
2010-11	Bikaner	10.71	84.66	24.75
	Churu	8.13	11.91	5.17
	Jaisalmer	8.47	67.68	23.44
2014-15	Bikaner	4.27	56.10	14.11
	Churu	0.91	5.87	2.06
	Jaisalmer	9.54	45.27	18.58

Source: Agriculture Statistics, 2007-2015

Pesticides are most significant among various agrochemicals in the sense that these act as protective umbrella for other inputs. Even after using other inputs such as HYV seeds, irrigation, fertilizers, machinery etc. The farmers in IC- Hyper Arid Partial Irrigated Zone are aware of importance of input of pesticides in agriculture but they have inadequate knowledge about using them at proper time and in proper quantity. The pesticides are generally used by farmers for many improved varieties ranging from foodgrains to many commercial crops. They can not be afforded by small farmers where income level of farmers is insignificant. There is disparity in use of these pesticides from one part of the zone to another.

The farmers of the study area responded that the yields of foodgrains, pulses and groundnut can be boosted substantially with spraying of insecticides, pesticides and weedicides. The plant protection aspect is being tackled in two ways efforts- to evolve disease resistant seeds and to formulate chemicals and other measures for pest control. Nearly 31.253 lakh litre pesticides and weedicides are used in study region in the year 2013-14.

Use of Machineries and Equipments

The topography, climate, type of soils, along with some socio-economic factors govern the use of agricultural machineries and implements in a region. There are few types of machinery such as tractor, thresher, harvestor etc. and implements as polugh are required to perform agricultural operations in the study area. The land resources being limited, the additional production is to be achieved by increasing the productivity of land.

Tractor

Unlike farm workers and their bullocks or camels, the tractor is not tired. Moreover, the extra power, speed and persistence of the tractor enable the farmer to execute farming operations rapidly and to work round the year to create favourable soil preparation conditions. It has also become a major vehicle of transportation particularly agricultural materials e.g. fertilizers, agriculture implements and produce from market to fields and fields to market. There has been more than three times increase in tractors from 9,566 in 1997 to 38,381 in 2015 in the entire study area. The proportion of tractors out of the total machineries and implements was 3.99, 2.24 and 3.03 per cent respectively in Bikaner, Churu and Jaisalmer districts in 1997 which has gone up to 13.47, 16.62 and 18.7 per cent respectively in the year 2015. In the same way, share of light commerial vehicles, and diesel and electric engines increased while the number of ploughs has decreased tremendously and have become about half during the same period which indicates rise of mechanization in the study area (table 7).

Table 7: IC- Hyper Arid Partial Irrigated Zone- Use of Machineries and Equipments

District	Year	Plough	LCV	Diesel Engine	Electric Pumps	Tractor	Total Implements
Bikaner	1997	77009	38197	270	493	4819	120788
	%	63.75	31.62	0.24	0.40	3.99	100
	2015	45532	68274	3886	7217	19452	144361
	%	31.54	47.3	2.7	4.99	13.47	100
Churu	1997	109136	45651	7	2622	3606	161022
	%	67.77	28.37	0.004	1.62	2.24	100
	2015	40361	22213	842	7861	14211	85488
	%	47.21	26.0	0.98	9.19	16.62	100
Jaisalmer	1997	30937	5308	148	86	1141	37620
	%	82.23	14.10	0.39	0.25	3.03	100
	2015	11104	7908	305	1333	4718	25368
	%	43.77	31.17	1.2	5.25	18.7	100
Total of Zone	1997	217082	39156	425	3201	9566	319430
	%	67.96	27.91	0.14	1.00	2.99	100
	2015	96997	98395	5033	16411	38381	255217
	%	38.0	38.55	1.97	6.43	15.03	100

Source: District outlines, Bikaner, Churu and Jaisalmer

Plough

The agricultural implement are very simple in size, weight and within the capacity of farmers. They use wooden and iron ploughs for ploughing, harrow for crushing the seeds, driller for sowing, hoes for inter-culture, stoneroller for thrushing motes, diesel engine and electric pumps for water lifting, carts for transport and tractors for many agricultural operations. Out of them wooden and iron ploughs,

carts and oil engines, electric pumps and tractors are considered in the present study.

The wooden ploughs are easy to handle to the farmers as well as bullocks or camels and it is also easy to repair in village level and widely used in the entire study region. It is made by the local carpenters using locally available wood. This is mainly due to the socio-economic conditions of the farmers, nature of landforms and low cost of manufacturing they hasve been used for many centuries. Table 4.9 reveals that total number of ploughs used in IC- Hyper Arid Partial Irrigated Zone has decreased from 217,082 (1997) to 96,997 (2015). The highest number of ploughs were used in Churu district (109,136) followed by Bikaner (77,009) and Jaisalmer (30,937) in the year 1997 while their number has decreased to 45,532, 40,361 and 11,104 respectively in Bikaner, Churu and Jaisalmer districts in the year 2015. The percentage of ploughs to total number of implements was 67.96, 63.75 and 87.77 per cent respectively in 1997, have decreased to 31.54, 47.21 and 43.77 per cent respectively in the districts of Bikaner, Churu and Jaisalmer. It indicates the use of traditional implements to the mechanized equipments of cultivation in the study area.

Light Commercial Vehicle (LCV)

It is such a vehicle which not only serves as a means of transportation of goods and agricultural implements, raw material from field to field and place to place in the study region. There are great variations in the percentage of LCV to the total implements in the study area. The data reveals that in the year 1997 total number of carts used in the IC- Hyper Arid Partial Irrigated Zone was 89156. The highest number of them was in Churu district (45,651) followed by Bikaner (38197) and Jaisalmer (5308) districts. The proportion of LCV to the total number of agricultural machineries and equipments increased from 31.62, 28.37 and 14.10 per cent in 1997 to 47.3, 26.0, 31.12 per cent respectively in Bikaner, Churu and Jaisalmer districts in 2015.

Diesel Engines

They are mainly used to lift water from wells of low depth and storage tanks to irrigate the crops. There has been more than six times increase in the total number of diesel engines in IC- Hyper Arid Partial Irrigated Zone from 425 in 1997 to 5033 in the year 2015. The maximum share out of the total number of agricultural machineries and equipments is recorded in Bikaner district (2.7 per cent) followed by Jaisalmer (1.2 per cent) and Churu (0.98 per cent) in the study area in 2015. Due to expansion of electric transmission lines share of diesel pumping sets is reducing day by day.

Electric Pumps

It is an important device to lift the water from the source of water e.g. well, canal, tank etc. to the field. As a result of electrification the oil-engines are mostly replaced by electric pumps. The number of electric pumps used for agricultural purpose is increasing day by day in the study region. There has been more than three times increase in electric pumps from 3201 (1 per cent) in 1997 to 16411 (6.43 per cent) in the year 2015. The data shows that the proportion of electric pumps out of the agricultural implements has increased gradually in the study area.

Land Tenancy

The ownership and the length of time available for planning, development and management of arable land influence the decision making process of the cultivator. Depending on the nature of tenancy rights he decides the extent to which investment on land could be made. If the cultivator is the sole owner of the land, he may install a tubewell in his farm and may go for fencing and masonry irrigation channels. But a tenant farmer or a share cropper will not go for the long term investment in the field as after a short period of occupancy he will have to vacate the land and the real owner may cultivate that piece of land either himself or may lease out to other cultivators.

The system sometimes involves pure share cropping, i.e., there is no fixed rent, but the tenant cultivates the land and gives the owner a share, often 50 per cent of the agricultural produce. In IC- Hyper Arid Partial Irrigated Zone, this system is known as 'Batai'. This tenural system gives the tenant some protection from fluctuations in productions and crop prices and is usually preferable to fixed cash tenancies in which a tenant tends to all progressively deeper into debts, whenever income from his crop falls below the outgoing rent. It is very imortant to mention here that most of the landholdings are owned by farmers themselves and a large proportion of field work is performed by them. Out of the total sample households 45 per cent landholdings are owned by Jats, 22 per cent scheduled castes, 13 per cent Bishnoi, 9 per cent Charan and 8.4 per cent Rajputs in the study area.

Size of Landholdings and Their Fragmentation

The size of landholdings and fragmentation of fields also influence cropping and landuse patterns a unit area. It decides the degree of risk that a farm operator may bear. Larger size of landholdings has greater capacity of the farmer's investment on technoogy and machineries such as sprinkler systm, pumping set, solar light, tractor, plougher, harrows, threshers, harvesters etc. than the small one.

The data shows that Jaisalmer (10.70 ha) and Bikaner (10.16 ha) districts had highest average size of landholdings in 2000-01, while this has declined significantly in 2010-11 with 8.72 and 8.75 ha respectively. On the other hand, Churu district had lowest average landholdings with 8.02 ha in 2001; it has also declined considerably in 2010-11 with 5.85 ha.

The types of landholdings as per their size are given in table 8. The data shows that Jaisalmer and Bikaner districts have dominance of large (<10 ha) and medium (4-10 ha) size of landhondings in the study area. Jaisalmer district ranks first in order of having large landholdings (66.5 & 57.1 per cent), Bikaner ranks second (65.4 & 57.0 per cent) and Churu ranks third (35.3 & 34.3 per cent) in the year 2001 & 2011 respectively. It is important to mention that the study area has the highest size of landholdings in Rajasthan as well as in India.

Table 8: IC Hyper Arid Parial Irrigated Zone- Size of Landholdings

Year	District	Marginal (<1 ha)		Small (1-2 ha)		Semi-medium (2-4 ha)		Medium (4-10 ha)		Large (<10 ha)		Avg. Land holding
		Land holding	Area (%)	Land holding	Area (%)	Land holding	Area (%)	Land holding	Area (%)	Land holding	Area (%)	
2001	Bikaner	1.4	0.1	3.6	0.5	13.9	4.2	46.7	29.8	34.4	65.4	10.16
	Churu	2.1	0.2	6.8	1.3	22.2	8.3	43.0	34.9	25.9	35.3	8.02
	Jaisalmer	3.0	0.2	4.1	0.6	10.2	2.9	50.8	29.8	32.0	66.5	10.70
	Rajasthan	31.8	4.2	20.8	8.2	20.6	16.1	18.9	32.0	7.9	39.5	3.65
2011	Bikaner	1.8	0.1	4.7	0.8	16.5	5.7	49.5	36.4	27.5	57.0	8.75
	Churu	5.6	0.6	12.8	3.3	28.1	14.2	38.6	41.6	15.0	34.3	5.85
	Jaisalmer	2.9	0.2	8.0	1.4	12.6	4.4	52.1	36.9	24.4	57.1	8.72
	Rajasthan	36.5	5.9	21.9	10.2	19.4	17.9	16.4	32.7	5.9	33.3	3.07

Source: Agriculture Census, GOI, 2001, 2011

The highest increase in number and area under operational landholdings of semi-medium (2-4 ha) during 2000-01 (8.3 per cent) and 2010-11 (14.2 per cent) is recorded in Churu district. Churu and Jaisalmer districts have recorded highest and lowest landholdings under semi-medium group of farmers with 22.24 ha & 28.1 ha and 10.2 ha & 12.6 ha in 2001 and 2011 respectively.

According to the law of inheritance in India, the property of the deceased is equally divided among the male heirs. Each son generally insists on having a share from each location and from each piece of land, resulting into further fragmentation of land. The disadvantages of fragmentation of landholdings are well known. It puts a large proportion of land out side the possibility of effective cultivation or economic development. The small fields are difficult to work with modern machinery and tractors etc. In the opinion of agricultural economists, the fragmentation of holding is a great obstacle and one of the major deterrents to economically viable cultivation. It results in wastage of land, labour and material inputs. It is responsible for increased overhead costs, including even the cost of production resulting in low returns from agriculture. The division of holdings may be socially justifiable but economically they are not viable. It is noticed by the analysis of data that the percentage of large landholdings has decreased from 66.5 in Jaisalmer district, 65.4 in Bikaner district and 35.3 in Churu district (2001) to 57.1, 57.0 and 34.3 respectively (2011).

Marketing Facilities

Marketing can be defined as the performance of business activities that directs the flow of goods and services from the producer to the consumer, so that they may reach the consumers at the time and place as per their needs and price. Agriculture produce market committee is main market centre for sale of any farm production. There are 12 Krishi Upaz Mandies (KUM) and sub-market centres in IC- Hyper Arid Partial Irrigated Zone in 2014-15 (table 9). Some of these Krishi Upaz Mandies are of grade A, B, C and D.

Table 9: IC- Hyper Arid Partial Irrigated Zone- Marketing Facilities

District	Krishi Upaz Mandi	Class	Major Crops
Bikaner	Bikaner (FV)	A	Onion, Tomato, Kachari, Potato
	Bikaner (Grain)	SA	Ground Nut, Gram, Guar, Moth, Wheat
	Khajuwala	C	Mustard, Guar, Gram, Wheat
	Lunkaransar	C	Guar, Moth, Groundnut
	Nokha	B	Moth, Gram, Guar, Wheat
	Shri Dungargarh	D	Gram, Groundnut
Churu	Churu	D	Barley, Chole
	Ratangarh	C	Barley, Moth, Guar
	Sadulpur	C	Bajra, Guar, Gram, Moth
	Sardarshahar	D	Moth, Guar, Groundnut
	Sujangarh	C	Gram, Moth, Bajra, Groundnut, Wheat
Jaisalmer	Jaisalmer	C	Groundnut, Gram, Guar, Mustard, Isabgole

Source: Agriculture Statistics at A Glance, 2016

Crop Yield and Its Price

The overall growth in yield and production of major crops has increased bt more than 2.7 times during 1994-95 to 2015-16. The share of oilseeds, pulses and horticulture crops in the study area has increased substantially during the last two and half decades which proves that the process of diversification of agriculture towards high valued crops is in right direction. The rates of foodcrops- wheat, bajra and gram have increased by 1.9 times whereas rates of oilseeds- groundnut and mustard, pulses- moong and moth and commercial crop like guar increased to about three times. It motivates the farmers towards the adoption oilseeds, pulses and commercial crops (table 10).

Table 10: IC- Hyper Arid Partial Irrigated Zone- Rates of Crops (Rs/quintal)

Year	Wheat	Gram	Bajra	Mustard	Groundnut	Moong	Moth	Guar
2006-07	911	2127	664	1633	1772	2787	2307	1621
2007-08	1005	2232	651	2331	2384	2143	1827	1631
2008-09	1062	2116	753	2349	2145	3031	1937	1531
2009-10	1230	2067	968	2297	2563	5061	5021	2138
2010-11	1184	2150	864	2382	2673	3757	2985	2312
2011-12	1138	3171	906	3008	3349	3462	2195	9729
2012-13	1487	3604	1273	3442	4476	4724	4119	9790
2013-14	1527	2697	1246	3081	3318	5913	4226	4814
2014-15	1507	3044	1205	3337	3493	6047	4965	4541
2015-16	1750	3962	1324	3807	3854	6118	5757	3583

Source: Agriculture Statistics at a Glance, 2016

Conclusion

There are many socio-cultural, economic, political, technological and infrastructural factors determining the agriculture landuse, cropping patterns and agricultural processes. Of these factors, irrigation facilities, use of technological development, land tenancy and ownership, size of landholdings, accessibility of market, crop yield, price incentives etc. have a close impact on agricultural activities i.e. production and yield of crops and use of cultivable land with the overall development of the study area.

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