P: ISSN NO.: 2321-290X RNI : UPBIL/2013/55327 VOL-6* ISSUE-1* (Part-1) September- 2018
E: ISSN NO.: 2349-980X **Shrinkhla Ek Shodhparak Vaicharik Patrika**

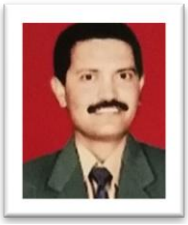
Spatio-Temporal Assessment of Landuse Pattern in 1c-Hyper Arid Partial Irrigated Zone - A Geographical Study

Abstract

The study of landuse is important not only in agriculturally dominated and over populated developing areas, but also because of its relationship with different human phenomena. Its importance has also increased due to population pressure, decrease in man-land ratio, and increasing demand for food and raw materials. The need for optimum utilization of land in an integrated manner has assumed a greater relevance.

Land utilization is a dynamic concept changing with space and time with a view to meet out requirements and is governed largely by the physical, cultural and technological factors. The present study is based on analysis of primary as well as secondary data and its outcome shows variations in the landuse of the study area.

Keywords: Landuse, Optimum Utilization, Variations, Dynamic Concept.



Jai Bharat Singh
Associate Professor
Deptt.of Geography,
Govt. Dungar College
Bikaner,Rajasthan

Archana
Research Scholar,
Deptt.of Geography,
Govt. Dungar College
Bikaner, Rajasthan

Introduction

Landuse is an economic activity of human being associated with a specific piece of land. It reflects land's importance as a fundamental factor of production. The understanding of past changes and projecting future landuse pattern requires understanding the interactions of the basic human forces that motivate production and consumption. It is used to describe the use of an area of land of certain time is put to. Landuse by definition is the use of land usually with emphasis upon its functional role with respect to economic activities.

Landuse refers to man's activities and the various uses which are carried on land (Clawson and Steward, 1965). It is a primary indicator of the extent and degree to which man has modified the land resources (Vink, 1975). Landuse is the surface utilization of all developed and vacant land on a specific point at given time and space (Mandal, 1982). It is mainly related to the optimum use of limited land between the alternative major types of landuse. It is the result of continuous interaction between available resources and human needs acted upon by human efforts. It is necessary for human survival and man has a definite role in managing and transforming his physical environment. As a result scientific knowledge of landuse is essential to solve the number of problems associated with landuse.

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. The characteristics features of this zone are the development of sand dunes that have been classified on the basis of their age of formation and stability, morphology and relation to wind direction. The sand dunes together with the inter-dune plains cover about 50 per cent of the Thar Desert Dune-free plain. It is characterized by rocky-gravely pediment, flat buried pediment, older and younger alluvial plains and riverbeds produced by the fluvial processes within the desert.

The pediment is invariably flat, rocky or slightly veneered surface with sharp interface with the adjoining hill slope.

Objectives of the Study

The present paper is aimed to examine the spatio- temporal changes in landuse pattern in the study area.

Hypothesis

Increase in irrigated area and mechanization of agriculture are responsible for 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. After that compilation and computation of data have been done for final analysis and presentation of the study.

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.

V. Ratna Reddy (1991) describes the trends of under utilization of land in Andhra Pradesh for a period of 33 years from 1955-56 to 1987-88. The study shows that the under-utilized lands included current fallows, other fallows, and cultivable waste, grazing and pasture lands. The analysis suggests that under utilization of landuse associated with irrigation, tractors, commercialization and such other factors. Such under utilization is attributed to the inability of the farmers to adjust to higher demand for resources. He concludes that land utilization largely depends on the availability of resources with the farmers and the nature of investment in relation with the expected returns.

The dynamics of landuse and cropping system in the Tawa Command Area of Hoshangabad district of Madhya Pradesh is examined by Srivastava *et al.* (1991). They have assessed the impact of the Tawa Irrigation Project on cropping pattern and landuse in the area during the pre-project period (1971-72 to 1974-75) and the post project period (1975-76 to 1979-80). They have observed a decline in the forest area as a result of illegal felling of trees for domestic purposes and have also reported that fallow land has increased since the introduction of the project.

Singh and Kaur (1991) have studied the changing pattern of land utilization in Punjab since the inception of new farm technology in the mid-sixties i.e. from 1966-67 to 1987-88. The study reveals that the reported area for land utilization remained constant while they are under forests, area not available for cultivation and net area sown increased during the same period. Due to intensification of agriculture, gross cropped area and cropping intensity increased. They have concluded that Punjab agriculture has recorded drastic structural changes since the beginning of the Green Revolution.

The land utilization pattern in Himachal Pradesh using secondary data for the period from 1966-67 to 1986-87 is analyzed by Vaidya and Sikka (1991). They have observed that there is an increasing trend while that of other categories have shown a declining trend. They have projected the landuse pattern for the year 2000 on the basis of compound growth rates calculated. The projection reveals that the area under all categories except current fallows will increase.

Sharma and Pandey (1992) have studied the dynamic of landuse in different states of India. The study reveals a general declining trend in the area under permanent pastures, grazing land, barren and uncultivable lands. The area under non-agriculture uses, cultivable waste and fallow lands have showed a positive growth in most of the states. With regards to area under forest, negative growth rate are observed in the states of Assam, Bihar, Haryana, Himachal Pradesh, Madhya Pradesh, Maharashtra and Tripura while Jammu & Kashmir and Orissa showed negative growth rates for area put to non-agriculture uses. The annual rate of increase in area under non-agricultural uses is very high in Gujarat, Tamil Nadu, Rajasthan, Uttar Pradesh, Maharashtra, Karnataka and Madhya Pradesh. Increasing trend is observed in the area under permanent pastures and grazing land in Bihar, Maharashtra, Mizoram and Uttar Pradesh, similarly declining trend is observed in the area under miscellaneous tree crops in Andhra Pradesh, Gujarat, Haryana, Kerala, Orissa, Punjab, Tripura and Uttar Pradesh.

A shift in cropping pattern is observed in cropping pattern of Amritsar and Ferozpur districts in Punjab state. The food crops are replaced by non-food crops and inferior crops by superior and commercial crops. This has led to higher agricultural production through large use and increased productivity of variable resources (Shah, 1963).

Jaya Kumar and Valayudhan (2002) have studied the agricultural stagnation in Kerala and reported that though it was stagnant for the last many years, still a major sector of Kerala's economy. They have observed that the area and production of food crops is declining over the year, while the area, production and productivity of cash crops have increased. They conclude that the prevalence of obsolete technology in the state and the relative profitability has influenced the farmer's decision to allocate land under different crops resulting agricultural stagnation.

Krishnakumari and Swaminathan (1992) examine the changes in cropping pattern, crop combination, crop area and diversification of crop

enterprises in Tamil Nadu. The results are that the changes are mainly due to change in agriculture inputs, high yielding varieties, fertilizers, pesticides, irrigation intensity and tractor use. The analysis indicates that in the western and north-western regions modernization is low because of low rainfall, poor soils and poor irrigation facilities.

According to Vyas (1996) the most important factor determining the cropping pattern is the number of regulated markets. The significant changes in cropping pattern are inferred to be explained by change in the relative prices. Apart from agronomic condition in a given region, the most significant technological changes which have remarkable impact on ploughing, irrigation, harvesting, cleaning of crops, transportation and marketing of crops. Farmers have also reported problem like price, number of regulated markets, transport, finance, literacy, irrigation etc. The major problems faced by the farmers are price fluctuation and finance related aspects.

Landuse Analysis

The outcome of the study based on analysis of the primary data is described as below-

Area under Forest

This category includes any land classified as a forest under legal enactment. The area under grazing lands or a crop within the forest is also included in this category. The area under forest has increased from 106,671 ha in 1994 to 128,713 ha in the year 2014 in IC- Hyper Arid Partial Irrigated Zone. The data given in table 1 shows that out of the total area under forest in the study area, Bikaner district shared the highest (71.25 per cent) followed by Jaisalmer district (22.44 per cent) in the year 1994-95 which slightly increased by 2.28 per cent (73.53 per cent) in Bikaner district and decreased in Jaisalmer and Churu Districts in 2014-15. Bikaner ditrict had 2.5 per cent, Jaisalmer 0.62 per cent and Churu 0.48 per cent area under forests to the total geographical area that has become 3.11 per cent, 0.48 per centand 0.71 per cent respectively in 2014-15 due to expansion of irrigation facilities. Out of the total geographical area of IC- Hyper Arid Partial Irrigated Zone, forest land has increased vaguely from 1.29 per cent 1994-95 to 1.55 per cent in 2014-15 (table 1).

Land not Suitable for Cultivation

This category of land is of three types- (a) Permanent pasture and other grazing land (b) Miscellaneous tree crops and groves, and (c) Cultivable waste land. These types of lands play an important role in the economy of villages. Actually they are the catchment areas of traditional water harnessing structures, sources of fodder for animals, also fuel and livelihood source for human population, particularly economically poor households of the village. These types of lands are also the source of biodiversity in the ecosystem. Out of the total geographical area of IC- Hyper Arid Partial Irrigated Zone, area under uncultivated has decreased drastically from 47.38 per cent 1994-95 to 11.35 per cent in 2014-15 showing that the area under cultivation is rising gradually in the study area.

The area under uncultivated category has decreased from 39.15 lakh ha in 1994 and has remained to about one-fourth (9.38 lakh ha) in 2015 due to the irrigation facilities, mechanization in agriculture and use of modern technology. It was found to be maximum in Jaisalmer district (75.73 per cent), followed by Bikaner (31.20 per cent) and Churu (4.4 per cent) out of the total geographical area in 1994-95 that has remained only 14.87 per cent, 9.9 per cent and 4.81 per cent respectively in the year 2014-15. It shows a slight increase in Churu district.

Land not Available for Cultivation

The area not available for cultivation is of two types: one, land put to non-agriculture use and second, barren and uncultivated land. The land not available for cultivation is generally used for industries, buildings, roads, schools, urban housing and other purposes but not used for cultivating agricultural crops. The area under this category has increased from 7.97 lakh ha (1994-95) to 30.31 lakh ha in 2014-15. Out of the total geographical area of IC- Hyper Arid Partial Irrigated Zone, land not available for cultivation has increased rapidly from 9.64 per cent 1994-95 to 36.66 per cent in 2014-15. It indicates the expansion of settlement, industries and infrastructural facilities in the study area.

Table 1: IC- Hyper Arid Partial Irrigated Zone- Landuse Classification (ha**)**

Landuse	District	1994-95	1999-2000	2004-05	2014-15
Forest land	Bikaner	76005 (71.25%)	78266	82463	94650 (73.53%)
	Churu	6726 (6.30%)	8156	6452	663 (5.19%)
	Jaisalmer	23940 (22.44%)	22198	23442	27400 (21.28%)
	Total	**106671 (100%)**	**-**	**-**	**128713 (100%)**
Land not suitable for cultivation	Bikaner	945122 (24.14%)	281407	291155	300299 (32.00%)
	Churu	61109 (1.56%)	74221	64252	66749 (7.11%)
	Jaisalmer	2908487 (74.30%)	473083	494830	571341 (60.89%)
	Total	**3914718 (100%)**	**-**	**-**	**938389 (100%)**

Land not available for cultivation	Bikaner	271340 (34.05%)	834357	789690	692564 (22.85%)
	Churu	73388 (9.21%)	59885	48691	51831 (1.71%)
	Jaisalmer	452128 (56.74%)	2823600	2630993	2286567 (75.44%)
	Total	**796856 (100%)**	**-**	**-**	**3030962 (100%)**
Fallow land	Bikaner	270579 (53.78%)	470571	599335	368110 (49.68%)
	Churu	150666 (29.95%)	332602	117219	110672 (14.94%)
	Jaisalmer	81858 (16.27%)	166739	320007	262185 (35.38%)
	Total	**503103 (100%)**	**-**	**-**	**740967 (100%)**
Net sown area	Bikaner	1173804 (39.91%)	1063628	1275571	1586130 (46.27%)
	Churu	1394305 (47.40%)	1211415	1149284	1149990 (33.55%)
	Jaisalmer	373238 (12.69%)	353534	369882	691661 (20.18%)
	Total	**2941347 (100%)**	**-**	**-**	**3427781 (100%)**
Gross sown area	Bikaner	1243286 (40.76%)	1151798	1364346	1928363 (45.36%)
	Churu	1429673 (46.87%)	1259231	1429402	1452323 (34.16%)
	Jaisalmer	377503 (12.37%)	400505	400257	870760 (20.48%)
	Total	**3050462 (100%)**	**-**	**-**	**4251446 (100%)**
Area sown more than once	Bikaner	69482 (63.68%)	88170	88775	342233 (41.55%)
	Churu	35368 (32.41%)	47816	280118	302333 (36.71%)
	Jaisalmer	4265 (3.91%)	46971	400257	179099 (21.74%)
	Total	**1091151 (100%)**	**-**	**-**	**823665 (100%)**

Source: Agricultural Statistics Rajasthan, DoES, Jaipur

The area under land not available for cultivation in IC- Hyper Arid Partial Irrigated Zone shows the variation during the same period. It was 11.77 per cent in Jaisalmer district, 8.96 per cent in Bikaner and 5.29 per cent in Churu out of the total geographical area of the individual district in 1994-95 that has reached up to 59.54 per cent, 22.86 per cent and 3.74 per cent respectively in Churu district. While out of the total area under land not available for cultivation in maximum in Jaisalmer district (56.74 per cent) followed by Bikaner district (34.05 per cent) and Churu (9.21 per cent) in the year 1994-95; has become 75.44 per cent, 22.85 per cent and 1.7 per cent respectively in 2014-15.

Table 2: IC- Hyper Arid Partial Irrigated Zone- Landuse Pattern

Landuse	**1994-95**		**2014-15**	
	Area (Ha)	**Area (%)**	**Area (Ha)**	**Area (%)**
Forest land	106671	1.29	128713	1.55
Land not suitable for cultivation	3914718	47.38	938389	11.35
Land not available for cultivation	796856	9.64	3028962	36.66
Fallow land	503103	6.09	740967	8.97
Net sown area	2941347	35.60	3425664	41.46
Total	**82,62,695**	**100.00**	**82,62,695**	**100.00**

Source: Agricultural Statistics Rajasthan, DoES, Jaipur

Fallow Land

The fallow land also classified into two types: first, old fallow land; and second, current fallow land. Cultivable land kept unused more than five years is classified as old fallow land while all land which were taken up for cultivation but are temporary out of cultivation for a period of one year to five year is known as current fallow land. Though there may be

many reasons for keeping the land fallow, ranging from poverty of the farmer to non-availability of water and irrigation or from unproductive nature of farming. However, in case of the present study existence of fallow land may also be attributed to the shift of land for non-agriculture uses. The area under fallow land in IC- Hyper Arid Partial Irrigated Zone has slightly increased from 5.03 lakh ha in 1994-95 to 7.41 lakh ha in 2014-15. Out of the total geographical area Churu district had 10.87 per cent, Bikaner 8.93 per cent and Jaisalmer 2.13 per cent in the year 1994-95. In the year 2014-15, it has increased in Bikaner (12.15 per cent) and Jaisalmer districts (6.82 per cent) while it has decreased in Churu district (7.98 per cent). While the area under fallow land out of the total geographical area, has increased moderately between 1994-95 (6.08 per cent) and 2014-15 (8.97 per cent).

Net Sown Area

The change in landuse and cropping patterns is the result of new strategy for agricultural development, use of machineries and equipments, development of irrigation facilities, government efforts, favourable monsoon, and awareness in peoples specially the farmers of that region and many more factors in IC- Hyper Arid Partial Irrigated Zone.

The net area sown is the area under actual cultivation either it is irrigated or unirrigated land. The net area sown has declined mainly due to drought in the study area. It has increased from 29.41 lakh ha in 1994-95 to 34.28 lakh ha in 2014-15. It shared 35.61 per cent out of the total geographical area of the study area in 1994-95, has increased to 41.58 per cent in the year 2014-15 (table 2). Whereas the net sown area out of the total geographical area in IC- Hyper Arid Partial Irrigated Zone; has increased from between 1994-95 (35.6 per cent) and 2014-15 (41.56 per cent) indicating extension of cultivable land during this period.

Table 3: IC- Hyper Arid Partial Irrigated Zone- Net Sown Area

District	Area (%)				Variation (%)		
	1994	1999	2004	2014	1994-99	1999-2004	2004-14
Bikaner	23.02	20.86	25.01	31.11	-2.16	4.15	6.1
Churu	28.42	24.69	23.44	23.44	-3.73	-1.25	0
Jaisalmer	20.87	19.77	20.68	38.68	-1.1	0.91	1.8

Source: Agricultural Statistics Rajasthan, DoES, Jaipur

The data mentioned in table 3 shows the variation of net area sown during 1994-99 is observed negative in all the districts of IC- Hyper Arid Partial Irrigated Zone. Similarly, the variation of net area sown during 1999-2004 is observed positive in whole area except Churu district while it is observed to be positive between 2004 and 2014 in the whole study area. The highest increase in net area sown was observed in Bikaner district (6.1 per cent) followed by Jaisalmer (1.8 per cent) during 1994-2014 in the entire study area. The data analysis indicates that one type of land category transfers to another type naturally. Where this volume of change is greater; then more dynamic conditions exist there. The highest (16.2 per cent) volume of change was observed in Jaisalmer district followed by Bikaner (11.81 per cent), Churu (0.95 per cent).

Landuse Analysis Based on Sample Study

The analysis of the primary data collected from field survey of ten households each from 258 sample villages conduted during 2014-16 is described in the following part of the paper. The outcome of the study is as follows-

Fallow Land

The data shows that the highest fallow land is recorded in Bikaner district (51.30 per cent) followed by Jaisalmer (34.42 per cent), while lowest land under this category is in Churu district (14.28 per cent) that indicates that there is availability of abundant land which can be brought under cultivation (table 4).

Table 4: IC-Hyper Arid Partial Irrigated Zone- District-wise Landuse Pattern

District	Fallow Land	Irrigated Land	Non-Irrigated Land	Area sown more than once
Bikaner	3126 (51.30)	4876 (46.19)	15870 (51.96)	4605 (53.59)
Churu	870 (14.28)	1365 (12.93)	6107 (19.99)	1560 (18.16)
Jaisalmer	2097 (34.42)	4314 (40.88)	8566 (28.05)	2427 (28.25)
Zone Total	6093 (100)	10555 (100)	30543 (100)	8592 (100)

Source: Field survey conducted during 2014-16

When the tehsil-wise data out of the individual district have been analysed, it is concluded that the area under fallow land varies between 22.65 per cent and 13.45 per cent in Kolayat (Bikaner district) and Pokaran (Jaisalmer district) tehsils of containing maximum area under this category in study area followed by 12.48 per cent, Jaisalmer, 8.51 per cent Fatehgarh, 7.87 per cent Bikaner, 5.66 per cent in Nokha tehsils. The lowest area under fallow land is recorded in Rajgarh tehsil (0.82 per cent) followed by Chattargarh (1.3 per cent) and Dungargarh (1.89 per cent) tehsils.

While the tehsil-wise data out of the total study area have been assessed; it is concluded the tehsils those have highest area out of the individual district, also lead in the area out of the total study area under each landuse category (table 5). The area under fallow land is recorded to be maximum in

Kolayat (22.65 per cent) and Pokaran (13.45 per cent), and the minimum in Rajgarh (0.82 per cent) and Taranagar (1.14 per cent).

Irrigated Land

Irrigation is essentially the artificial application of water to crops to overcome scanty rainfall. The data given in table 5 shows that the highest potential of irrigated land is recorded in Bikaner district (46.19 per cent) followed by Jaisalmer (40-88 per cent), Churu (12.93 per cent). The area under this category also differentiates from one tehsil to another in tha study area. The maximum area brought in Jaisalmer tehsil (23.13 per cent) whereas the minimum area isin Churu tehsil (0.30 per cent). The share of other tehsils is Kolayat (9.66 per cent), Bikaner (7.99 per cent), Sardarshahar (5.72 per cent), Fatehgarh (3.27 per cent), Nokha (4.09 per cent), Chhatargarh (2.55 per cent) and Rajgarh (1.22 per cent) as per the data collected during the field survey.

Table 5: IC- Hyper Arid Partial Irrigated Zone- Landuse Pattern

District	Tehsil	Fallow Land	Irrigated Land	Non-Irrigated Land	Area sown more than once
Bikaner	Bikaner	480 (15.35%)	844 (17.31%)	3270 (20.60%)	800 (17.37%)
	Nokha	345 (11.04%)	432 (8.86%)	1572 (9.90%)	415 (9.01%)
	Kolayat	1380 (44.14%)	1020 (20.92%)	4885 (30.78%)	970 (21.06%)
	Dungargarh	115 (3.68%)	590 (12.10%)	1280 (12.72%)	520 (11.29%)
	Lunkaransar	318 (10.17%)	790 (16.20%)	2018 (5.58%)	790 (17.15%)
	Chattargarh	80 (2.56%)	270 (5.54%)	885 (5.58%)	270 (5.86%)
	Pugal	210 (6.72%)	490 (10.04%)	1135 (7.16%)	425 (9.25%)
	Khajuwala	198 (6.34%)	440 (9.03%)	825 (5.79%)	415 (9.01%)
	Total	**3126 (100%)**	**4876 (100%)**	**15870 (100%)**	**4605 (100%)**
Churu	Churu	148 (17.01%)	32 (2.34%)	570 (9.33%)	32 (2.05%)
	Sardarshahar	205 (23.56%)	605 (44.32%)	935 (15.31%)	600 (38.46%)
	Taranagar	70 (8.04%)	-	1320 (21.61%)	-
	Rajgarh	50 (5.74%)	128 (9.38%)	1472 (24.10%)	328 (21.02%)
	Ratangarh	162 (18.62%)	285 (20.88%)	848 (13.88%)	285 (18.28%)
	Sujangarh	235 (27.02%)	315 (23.08%)	962 (15.77%)	315 (20.19%)
	Total	**870 (100%)**	**1365 (100%)**	**6107 (100%)**	**1560 (100%)**
Jaisalmer	Fatehgarh	518 (24.70%)	345 (7.99%)	2842 (33.18%)	270 (11.12%)
	Jaisalmer	759 (36.19%)	2442 (56.62%)	3531 (41.22%)	1200 (49.44%)
	Pokaran	820 (39.11%)	1527 (35.39%)	2193 (25.60%)	957 (39.44%)
	Total	**2097 (100%)**	**4314 (100%)**	**8566 (100%)**	**2427 (100%)**
Zone Total	**6093**	**10555**	**30543**	**8592**	**8592**

Source: Field survey conducted during 2014-16.

The tehsil-wise area under irrigation out of the total IC Hyper Arid Partial Irrigated Zone is recorded to be maximum in Jaisalmer (23.13 per cent) and Pokaran (14.48 per cent), and the minimum in Taranagar, Churu (0.30 per cent) and Rajgarh (1.22 per cent).

Non-Irrigated Land

The data shown in table reveals that the highest non-irrigated land is in Bikaner district 15,870 ha (51.96 per cent) followed by Jaisalmer 8,566 ha (28.05 per cent) and Churu district (19.99 per cent). There is 30,543 ha land under this category in the whole study area. The tehsil-wise highest non-irrigated area is found in Kolayat tehsil (15.99 per

cent), whereas the lowest non-irrigated area is found in Churu tehsil (1.86 per cent). The share of other tehsils is given as Jaisalmer (11.56 per cent), Bikaner (10.71 per cent), Fatehgarh (9.30 per cent), Pokaran (7.18 per cent) and Nokha (5.15 per cent).

The tehsil-wise area unirrigated area out of the total IC-Hyper Arid Partial Irrigated Zone is recorded to be maximum in Kolayat tehsil (15.99 per cent) and Jaisalmer tehsil (11.56 per cent), and the minimum in Churu (1.86 per cent) and Khajuwala (2.70 per cent).

Area Sown More than Once

This represents the areas on which crops are cultivated more than once during the agricultural year. This is obtained by deducting net area sown from gross cropped area. There is 8592 ha area under area sown more than once in IC-Hyper Arid Partial Irrigated Zone. It is found to be maximum in Bikaner district 4605 ha (53.59 per cent) whereas minimum area is in Churu district 1560 ha (18.16 per cent).

The variation in area from tehsil to other is also recorded by the data collected during the field survey. It is found to be highest in Jaisalmer tehsil (49.44 per cent), while the lowest is noticed in Churu tehsil (2.05 per cent) in IC-Hyper Arid Partial Irrigated Zone. When the area is classified into three categories according to the area out of the total surveyed area of the individual district; it is concluded that above 30 per cent area sown more than once is in Pokaran (39.44 per cent) and Sardrshahar (38.46 per cent); on the other hand, Kolayat (21.06 per cent), Rajgarh (21.02 per cent), Sujangarh (20.19 per cent), Ratangarh (18.28 per cent), Bikaner (17.37 per cent) and Lunkaransar (17.15 per cent) fall under 10-20 per cent category; and Pugal (9.25 per cent), Bikaner (9.31 per cent), Lunkaransar (9.19 per cent), Khajuwala and Nokha (9.01 per cent) each, Chhatargarh (5.86 per cent) and Churu (2.05 per cent) fall under 10 per cent category (table 6).

Table 6: IC Hyper Arid Partial Irrigated Zone- Tehsil-wise Landuse Pattern

District	Tehsil	Fallow Land	Irrigated Land	Non-Irrigated Land	Area sown more than once
Bikaner	Bikaner	480 (7.87%)	844 (7.99%)	3270 (10.71%)	800 (9.31%)
	Nokha	345 (5.66%)	432 (4.09%)	1572 (5.15%)	415 (4.83%)
	Kolayat	1380 (22.65%)	1020 (9.66%)	4885 (15.99%)	970 (11.29%)
	Dungargarh	115 (1.89%)	590 (5.59%)	1280 (4.19%)	520 (6.05%)
	Lunkaransar	318 (5.23%)	790 (7.48%)	2018 (6.60%)	790 (9.19%)
	Chattargarh	80 (1.31%)	270 (2.55%)	885 (2.89%)	270 (3.14%)
	Pugal	210 (3.45%)	490 (4.64%)	1135 (3.71%)	425 (4.95%)
	Khajuwala	198 (3.25%)	440 (4.18%)	825 (2.70%)	415 (4.83%)
Churu	Churu	148 (2.42%)	32 (0.30%)	570 (1.86%)	32 (0.37%)
	Sardarshahar	205 (3.06%)	605 (5.72%)	935 (3.06%)	600 (6.98%)
	Taranagar	70 (1.14%)	-	1320 (4.33%)	-
	Rajgarh	50 (0.82%)	128 (1.22%)	1472 (4.83%)	328 (3.82%)
	Ratangarh	162 (2.66%)	285 (2.70%)	848 (2.78%)	285 (3.31%)
	Sujangarh	235 (3.85%)	315 (2.98%)	962 (3.16%)	315 (3.66%)
Jaisalmer	Fatehgarh	518 (8.51%)	345 (3.27%)	2842 (9.30%)	270 (3.14%)
	Jaisalmer	759 (12.48%)	2442 (23.13%)	3531 (11.56%)	1200 (13.98%)
	Pokaran	820 (13.45%)	1527 (14.48%)	2193 (7.18%)	957 (11.16%)
Zone Total		**6093**	**10555**	**30543**	**8592**

Source: Field survey conducted during 2014-16.

While the tehsil-wise data out of the total study area have been examined; it is resulted that the area sown more than once is recorded to be highest in jaisalmer (13.98 per cent) and Kolayat (11.29 per cent) followed Bikaner, Pokaran, Lunkaransar, Dungargarh and the minimum in Churu (0.37 per cent), Fatehgarh (3.14 per cent), Ratangarh and Rajgarh.

Conclusion

Land is becoming a scarce resource due to immense agricultural and demographic pressure. Hence, landuse analysis is essential for the selection, planning and implementation of landuse schemes to meet the increasing demands for basic human needs and welfare. It also assists in monitoring the dynamics of landuse resulting out of changing demands of increasing population and has become a central component in current strategies for managing natural resources and monitoring environmental changes.

Accelerated conversion of forest and fallow lands due to irrigation facilities, technological development, intensive agricultural practices and over-exploitation of resources have resulted in changes in landuse in the study area.

References

1. *Ali, Mohammed (1978). Studies in Agricultural Geography. Research Publication, New Delhi, pp. 1-6.*
2. *GoR (2016). Rajasthan Agricultural Statistics At A Glance for Year 2000-01 to 2015-16, Commissionerate of Agriculture, Govt. of Rajasthan, Jaipur.*
3. *Government of Rajasthan, Directorate of Economics and Statistics, Jaipur (1959-1965). Statistical Abstracts, Table 4.1.*
4. *Jayakumar, G and Velayudhan, K.V. (2002). Agricultural Stagnation in Kerala. Causes and Consquence, Southern Economist.41 (1): 9-12.*
5. *Krishnakumari, A and Swaminathan, E (1992). Changing farming Scene inNellore District. Indian Geographic. J., 65 (2): 123-129.*
6. *Mandal, R.B. Mandal (1982). "Land Utilization", Concept Publishing Company, New Delhi.*
7. *Marion Clawson, Charles L. Stewart (1965). Landuse Information: A Critical Survey of U.S. Statistics Including Possibilities for Greater Uniformity, Resources for the Future Publisher, Committee on Landuse Statistics, Baltimore, MD.*
8. *Noor, Mohammad (1978). "Agriculture Landuse in India", Inter-India Publications, Delhi.*
9. *Ratna Reddy, V. (1991). Under Utilization of Land in AP: Extent and Determinants, Indian J. Agric. Econ., 46(4) : 555-567.*
10. *Shah, S.M. (1963). Cropping Pattern in Relation to Irrigation. Indian J. Agric. Econ., 18(1): 154-160.*
11. *Sharma, U.K. and Pandey, V.K. (1992). Dynamics of Landuse in different States in india, Agric. Econ. Res. Rev., 5(1): 24-33.*
12. *Singh and Kaur, P. (1991). Structural Changes in Punjab Agriculture. Agric. Situ. India, 25(2): 330-335.*
13. *Singh, J. and Dhillon, S.S. (1995). Agricultural Geography, Tata Mc-Graw Hill Publishing Co. Ltd., New Delhi, p. 116*
14. *Socio-Economic Review and Statistical Abstract of Bikaner and Churu Districts, 2000-01.*
15. *Socio-Economic Review and Statistical Abstract of Bikaner, Churu and Jaisalmer Districts, 2010-11.*
16. *Srivastava, S.N., Mishra, B.L., Bhaghel, A.S., Sahu, R.M. and Singh, R.P. (1991). Dynamics of Landuse and Cropping Pattern in Tawa Command Area of Hoshangabad District, MP. Agric. Situ. India, 45(11): 743-748.*
17. *Vaidya, C.S. and Sikka, B.K. (1991). Land Utilization Pattern in Himachal Pradesh. Agric. Situ. India, 46(8): 539- 540.*
18. *Vink, A.P.A. (1975). Landuse in Advancing Agriculture, Springer, Verlag, Berlin Heidelberg, New York.*
19. *Vyas, V.S. (1996). Diversification of Agriculture in India. Indian J. Agric. Econ., 51 (4): 639-640.*