

## A spatio-temporal analysis of land use pattern and land use changes in Rajasthan.

### Un análisis espacio-temporal del patrón de uso de la tierra y los cambios de uso de la tierra en Rajasthan.

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#### ABSTRACT

Land use planning is a strategic planning exercise to enhance the future potential of the agricultural sector and achieve augmented growth through judicious management of land. The present paper expresses the Spatio-temporal pattern of land-use in Rajasthan during 1960-61 to 2017-18 periods. The objective of the present paper is to find out the land use in different categories and the trend of variations so that the characteristics of land utilization may be analyzed for future planning. The study examines trends of variations in land use patterns in districts of Rajasthan and provides policy implications for future planning. The proportion of net sown area in the state has increased significantly from 38.7 percent in 1960-61 to 52.21 percent in 2017-18. Forest acreage has increased considerably from 2.4 percent in 1960-61 to 8.03 percent of the reporting area in 2017-18 while barren and un-cultivable land declined from 15.2 percent to 6.95 percent over the period of time. Current Fallows and Fallow Land other than Current Fallow have significantly decreased in the same time period.

Keywords: Land use, Net Sown Area, Spatio-temporal, Waste land.

#### RESUMEN

La planificación del uso de la tierra es un ejercicio de planificación estratégica para mejorar el potencial futuro del sector agrícola y lograr un mayor crecimiento a través de una gestión juiciosa de la tierra. El presente documento expresa el patrón espacio-temporal del uso de la tierra en Rajasthan durante los períodos 1960-61 a 2017-18. El objetivo del

presente trabajo es conocer el uso del suelo en diferentes categorías y la tendencia de variaciones para que las características del uso del suelo puedan ser analizadas para la planificación futura. El estudio examina las tendencias de las variaciones en los patrones de uso de la tierra en los distritos de Rajasthan y brinda implicaciones políticas para la planificación futura. La proporción de área sembrada neta en el estado ha aumentado significativamente del 38,7 % en 1960-61 al 52,21 % en 2017-18. La superficie forestal aumentó considerablemente del 2,4 % en 1960-61 al 8,03 % del área de notificación en 2017-18, mientras que la tierra estéril y no cultivable disminuyó del 15,2 % al 6,95 % durante el período de tiempo. Los barbechos actuales y las tierras en barbecho que no sean barbecho actual han disminuido significativamente en el mismo período de tiempo.

Palabras clave: Uso del suelo, Superficie Sembrada Neta, Espacio-temporal, Baldíos.

## INTRODUCTION

Land use refers to the primary use of a geographical area for different purposes and activities. Planning of land development necessitates the collection of available information on land-use and trends of its variation with time. The present paper is an attempt to understand the dimensions of the land-use in state at different points of time and the trends of its variation with time. The objective of the present paper is to find out the different categories of land use and the trend of variations so that the characteristics of land utilization may be analyzed for future planning. Land use is the surface utilization of all developed and vacant land on a specific point of time and space (Mandal, 1982). It is an important meter of agricultural development. Land use and land cover are the two basic indicators which are used to understand human relation with nature (Sala et al., 2000). Land use (human aspect) refers to how land is used by humans. On the other hand, Land Cover (biophysical aspect) refers to the biophysical state of the earth's surface i.e. the vegetation, structures, or other features that cover the land (Duhamel 2003; Brar et al., 2014). To observe the changes on the surface of the earth, both terms are jointly used, because human beings affect land use as well as land cover. The consequences of the land-use variations can be seen in local, regional and global environments, biodiversity, water and sediment flow and soil conditions (Turner et al., 1994). In the state of Rajasthan, because of vast arid tracts, the resources have not yet been fully assessed and whatever information is available has not been rationally utilized to upgrade production. The paper deals with land-use in 2017-18 and also the land-use changes in different districts of the state during 1960-61 to 2017-18.

## SELECTION OF THE STUDY AREA

Rajasthan, the largest state of the country, located in the north-western part of the country, covers an area of 3,42,239 sq km, which is 10.40% of the geographical area of the country. The geographical extent of the State is 23°4'N to 30°11'N latitude and 69°29'E to 78°17' E longitude on the globe. The State has 4 different regions i.e., the Western Desert with Barren Hills(Thar desert), Sandy Plains, the Aravalli Hills, and South-Eastern Plateau. The climate of the State varies from semi-arid to arid and hot. The western part of the State, including Thar Desert (also known as the Great Indian Desert), is relatively dry and infertile whereas, in the south-western part, the land is wetter, hilly, and more fertile. The rainfall is very low, highly indefinite, and variable. The State has 33 districts and has a population of 68.55 million accounting for 5.66 percent of India's population.

## OBJECTIVES OF THE STUDY

The present study is aimed at the following objectives:

1. To study the Spatio-temporal pattern of land use in Rajasthan during 2017-18.
2. To examine a land-use change in Rajasthan during 1960-61 to 2017-18.

## DATABASE AND METHODOLOGY

The study is based on secondary data taken from the Statistical Abstract of Rajasthan, Agriculture Statistics of Rajasthan and District Outlines published annually by the Directorate of Economics and Statistics (DES), Government of Rajasthan, Jaipur. Data are tabulated, analyzed and interpreted by applying suitable statistical and cartographic techniques in the light of the objectives of the study.

## ANALYSIS AND DISCUSSION

### District Wise Analysis of Land Use Pattern in Rajasthan

The area under forest in Rajasthan and districts is very small and also almost stagnant since 1990-91 (shown in table 1). The districts adjoining Aravalli i.e. Alwar, Sawai Madhopur, Karauli, Pratapgarh, Banswara, Baran, Bundi, Kota, Chittorgarh, Sirohi, Dungarpur, Jhalawar, and Udaipur have more concentration of forest area than other districts. In the arid zone districts of Barmer, Bikaner, Churu, Jaisalmer, Jodhpur, Jalore, Hanumangarh, and Nagaur, the forest area are few and almost negligible due to low rainfall and aridity. Rajasthan is the state with the higher concentration of land not available for cultivation due to the extensive rocky barren land and dunes. There is a wide scope of shifting this land under cultivation in Rajasthan.

### Land Utilization in Rajasthan

Table 1: Total Area And Classification of Area (2017-18) in Hactare

(Continued)

DISTRICT	REPORTING AREA FOR LAND UTILISATION STATISTICS AS PER vill. PAPERS	CLASSIFICATION OF REPORTING AREA					
		FOREST	NOT AVAILABLE FOR CULTIVATION			OTHER UNCULTIVATED LAND EXCLUDING FALLOW LAND	
			AREA UNDER NON- AGRI- CULTURAL USES	BARREN AND UN- CULTUR- ABLE LAND	TOTAL	PERMANENT PASTURES AND OTHER GRAZING LANDS	LAND UNDER MISC.TREE CROPS AND GROVES
1	2	3	4	5	6	7	8
1 AJMER	842994	57792	53563	83019	136582	78518	977
2 ALWAR	783281	84941	49375	78416	127791	23828	141
3 BANSWARA	453589	91299	11338	51045	62383	11365	393
4 BARAN	699461	218004	28461	36285	64746	33916	234
5 BARMER	2817424	33392	80429	123417	203846	202986	1537
6 BHARATPUR	506706	33645	30130	21518	51648	7541	111
7 BHILWARA	1050885	75500	68658	143233	211891	120987	62
8 BIKANER	3041753	104280	277384	17391	294775	49941	239
9 BUNDI	581938	142949	41209	46790	87999	23664	161
10 CHITTORGARH	750773	121759	56079	60867	116946	73839	496
11 CHURU	1385905	6523	66742	620	67362	37153	10
12 DAUSA	341428	26393	20065	16989	37054	25567	218
13 DHOLPUR	300913	27175	16908	57855	74763	17820	222
14 DUNGARPUR	385674	64476	23024	67146	90170	34539	925
15 GANGANAGAR	1093290	60526	71618	1919	73537	140	2776
16 HANUMANGARH	970379	18820	57639	493	58132	4621	1
17 JAIPUR	1114058	82814	96301	60637	156938	73681	816
18 JAISALMER	3839154	27424	204071	372709	576780	87635	517
19 JALORE	1056611	23638	44861	78110	122971	47365	20
20 JHALAWAR	632235	127374	29100	33795	62895	46808	9920
21 JHUNJHUNU	591536	40045	22294	15707	38001	39242	26
22 JODHPUR	2256405	8398	79096	143469	222565	124668	18
23 KARALI	504302	173594	23570	48049	71619	30663	192
24 KOTA	518345	127087	33022	29759	62781	13697	595
25 NAGAU	1774938	18737	103987	55057	159044	71094	109
26 PALI	1233079	86797	59426	138772	198198	91312	360
27 PRATAPGARH	411736	120911	10678	27974	38652	22527	94
28 RAJSAMAND	452726	26254	24265	103478	127743	55229	0
29 S.MADHOPUR	497145	82887	31209	32065	63274	26453	2440
30 SIKAR	774244	61094	37170	18481	55651	39894	29
31 SIROHI	517947	155726	25856	74104	99960	33259	23
32 TONK	717958	27754	49939	27385	77324	40518	244
33 UDAIPUR	1388255	397695	155535	316443	471978	82311	507
RAJASTHAN STATE	34287067	2755703	1983002	2382997	4365999	1672781	24413

Table 1: Total Area And Classification of Area (2017-18) in Hactare

DISTRICT	CLASSIFICATION OF REPORTING AREA						TOTAL	AREA
	OTHER UNCULTIVATED LAND		FALLOW LANDS			CROPPED		SOWN
	EXCLUDING FALLOW LANDS					NET	AREA	MORE
	CULTURABLE WASTE LAND	TOTAL	FALLOW LANDS OTHER THAN CURRENT FALLOWS	CURRENT FALLOW	TOTAL	SOWN	ONCE	
1	9	10	11	12	13	14	15	16
1 AJMER	67343	146838	35863	27218	63081	438701	583255	144554
2 ALWAR	8294	32263	32044	19980	52024	486262	847269	361007
3 BANSWARA	24334	36092	32234	3961	36195	227620	341742	114122
4 BARAN	11554	45704	14193	11224	25417	345590	647030	301440
5 BARMER	194276	398799	294094	212914	507008	1674379	1909391	235012
6 BHARATPUR	2506	10158	11354	9036	20390	390865	597146	206281
7 BHILWARA	111670	232719	61714	43065	104779	425996	610934	184938
8 BIKANER	564635	614815	222046	248489	470535	1557348	1967142	409794
9 BUNDI	25755	49580	25004	10006	35010	266400	482464	216064
10 CHITTORGARH	79965	154300	21470	13136	34606	323162	572150	248988
11 CHURU	21303	58466	53040	66706	119746	1133808	1353230	219422
12 DAUSA	5535	31320	11514	13437	24951	221710	346998	125288
13 DHOLPUR	9467	27509	10715	9046	19761	151705	225872	74167
14 DUNGARPUR	21556	57020	33541	6103	39644	134364	196192	61828
15 GANGANAGAR	18902	21818	90775	97701	188476	748933	1219924	470991
16 HANUMANGARH	2362	6984	17479	29164	46643	839800	1262867	423067
17 JAIPUR	43804	118301	65063	61517	126580	629425	901628	272203
18 JAISALMER	2123677	2211829	115140	67939	183079	840042	1120474	280432
19 JALORE	21743	69128	98799	73237	172036	668838	943310	274472
20 JHALAWAR	30498	87226	12854	5560	18414	336326	636402	300076
21 JHUNJHUNU	5907	45175	41920	35531	77451	390864	607547	216683
22 JODHPUR	5078	129764	234731	255721	490452	1405226	1770718	365492
23 KARALI	11397	42252	10666	19530	30196	186641	303686	117045
24 KOTA	22148	36440	15261	8470	23731	268306	507427	239121
25 NAGAU	10322	81525	105440	155585	261025	1254607	1512853	258246
26 PALI	41391	133063	101506	59830	161336	653685	839773	186088
27 PRATAPGARH	35198	57819	8038	2786	10824	183530	306625	123095
28 RAJSAMAND	116606	171835	28185	2546	30731	96163	141621	45458
29 S.MADHOPUR	10582	39475	16095	46378	62473	249036	381623	132587
30 SIKAR	12921	52844	52232	48076	100308	504347	686218	181871
31 SIROHI	8612	41894	27552	22976	50528	169839	226975	57136
32 TONK	40490	81252	27277	40499	67776	463852	671493	207641
33 UDAIPUR	121065	203883	64455	14500	78955	235744	347031	111287
RAJ. STATE	3830896	5528090	1992294	1741867	3734161	17903114	25069010	7165896

Source: Agriculture Statistics of Rajasthan, 2017-18, Directorate of Economics and Statistics, Rajasthan, Jaipur

### Distribution of Land Use

*Reporting Area for Land Utilization:* The reporting area stands for the area for which data on land use classification of the area are available. The total reporting area of Rajasthan state is 34287067 Hect during 2017-18. The reporting area has been classified into nine categories of Land Use.

*Forests:* Forests represent all actually forested areas including all land classified as forests. During 2017-18 the forest area of the State is 27.56 lakh hectares accounting for 8.04 percent of the total reporting area.

*Land put to non-Agricultural Uses:* The lands occupied by buildings, roads, pathways, social forests, bus stands and railways, underwater i.e. rivers, canals, marshy, waterlogged areas and other land put to uses other than agriculture stands for this category. The area under this kind is 19.83 lakh hectares accounting for 5.78 percent of the total reporting area in the state during 2017-18.

*Barren and Un- culturable Land:* It covers all barren and un-culturable land like mountains, deserts and hills, etc. An extent of 23.83 lakh hectare arises under Barren and Uncultivable Land which denotes 6.95 percent of the total reporting area in the State during 2017-18.

*Permanent Pastures and other Grazing Land:* All grazing lands, whether they are permanent pastures or meadows are included under permanent pastures and other grazing land class. An extent of 16.73 lakh hectare which represents 4.88 percent of the total reporting area in the State during 2017-18 is under this category.

*Miscellaneous Tree Crops and Groves not including in the Net Area Sown:* All cultivable land which is not included under the net area sown but is put to some agricultural use is included under this class. An extent under this category was 0.24 lakh hectare which represents 0.07 percent of the total reporting area in the State during 2017-18.

*Culturable Wasteland:* Culturable waste land includes all lands available for cultivation but not cultivated during the current year and the last five years or more in succession for any reason are classified as culturable waste. An extent of 11.17 percent (38.31 lakh hectare) of the total reporting area is in this category during 2017-18.

*Other Fallow lands:* This entails all lands, which were used for cultivation but are temporarily out of cultivation for a period not less than a year and not more than five years. 19.92 lakh hectares of land which are 5.81 percent of the total reporting area is in this category during 2017-18.

*Current Fallow:* This category covers the cropped areas, which are kept fallow during the current year. The area under the current fallow was 17.42 lakh hectares during 2017-18.

*Gross Area Sown:* Gross Area Sown comprises total area cultivated under all food and non-food crops, including the area sown more than once during the agricultural year. The gross area is sown or gross cropped area during 2017-18 is 250.69 lakh hectares which is 73.11 percent of the total reporting area.

*Net Area Sown:* Net Area Sown presents total area sown once with the crops and orchards in an agriculture year. The Net Area Sown during 2017-18 was 179.03 lakh hectares or 52.22 percent of the total reporting area during 2017-18.

*Area Sown More Than Once:* The area on which crops are cultivated more than once falls under this category. An extent of 71.66 lakh hectare or 20.90 percent of the total reporting area during the agricultural year 2017-18, is in this category.

#### Changing Pattern of Land Utilization

Table 2 presents the changing pattern of land utilization for the state of Rajasthan during 1960-61 to 2017-18. The gross cropped area was increased over the decades from 41.4 percent to 73.11 percent during 1960-61 to 2017-18 with the expansion of irrigation facilities in the state. The decline in cultivatable waste and the fallow land area has resulted in an increase in the net area sown. The area under forest increased from 2.4 percent to 8.04 percent during the same period. The area under forest has been almost stagnant ranging between 8.0 to 8.05% and is far less than 33% recommended by National Forest Policy. One alarming feature is the significant increase in the area under non-agricultural use. The area under non-agriculture uses has increased from 3.2% in 1960-61 to 5.78% in 2017-18 which may be due to increasing population vis urbanization. The area under Permanent Pastures & other Grazing Lands also declined from 5.0 percent in 1960-61 to 4.87 percent in 2017-18. Land under misc. tree crops & groves have been almost found to be stable at 0.07 percent of the state reporting area during both time periods. Therefore, suitable policies are needed to prevent fertile agriculture land from being put to non-agricultural use and to properly utilize current fallows. Area sown more than once was increased from 9 lakh hectare in 1960-61 to 71.65 lakh hectare in 2017-18 which shows cropping intensity was increased significantly. The area under cultivable wasteland has declined from 20.2% in 1960-61 to 11.17% in 2017-18. The area under fallow land other than the current fellow has been fluctuating. This is due to the erratic and uncertain behavior of monsoon in the state that farmers here were unable to cultivate their land for several years. Net sown area (NSA) which was 131.12 lakh hectares in 1960-61, constituting 38.7% of the reporting area, increased significantly in course of decades and

reached 179.03 lakh hectares (52.21%) in 2017-18. The possibilities of bringing more areas under cultivation are marginal and a further addition to the cropped area is possible through intensive cultivation. The area under permanent pastures decreased continuously. However, there are remarkable changes in the land use pattern of the net sown area over the time period.

Table 2: Land Utilization Pattern in Rajasthan State

Sr. No.	Items	1960-61		1980-81		2000-01		2012-13		2017-18	
		Area	% share	Area	% share	Area	% share	Area	% share	Area	% share
1	Reporting Area for Land utilization purpose	33841	(100.0)	34227	(100.0)	34265	(100.0)	34267	(100.0)	34287	100
2	Forest	814	(2.4)	2088	(6.1)	2606	(7.6)	2750	(8.02)	2756	8.03
3	Area under non-Ag.uses	1095	(3.2)	1507	(4.4)	1740	(5.1)	1884	(5.5)	1983	5.78
4	Barren uncult. land	5153	(15.2)	2917	(8.5)	2566	(7.5)	2411	(7.0)	2383	6.95
5	Total (3+4)	6248	(18.5)	4424	(12.9)	4306	(12.6)	4275	(12.5)	4366	12.73
6	Permanent pastures & other Grazing land	1684	(5.0)	1834	(5.4)	1707	(5.0)	1694	(4.9)	1672	4.87
7	Land under tree crops& Groves	16	(0.0)	24	(0.1)	14	(0.0)	23	(0.1)	24	0.07
8	Land cultutable waste land	6841	(20.2)	6415	(18.7)	4908	(14.3)	4152	(12.1)	3831	11.17
9	Total (6+7+8)	8541	(25.2)	8273	(24.2)	6629	(19.3)	5870	(17.1)	5528	16.12
10	Other than current Fallow lands	3104	(9.2)	2089	(6.1)	2444	(7.1)	2024	(5.9)	1992	5.81
11	Current fallows	2022	(6.0)	2085	(6.1)	2415	(7.0)	1869	(5.5)	1742	5.08
12	Total (10+11)	5126	(15.1)	4174	(12.2)	4859	(14.2)	3894	(11.4)	3734	10.90
13	Net Area Sown	13112	(38.7)	15268	(44.6)	15865	(46.3)	17479	(51.0)	17903	52.21
14	Total Cropped Area	14013	(41.4)	17350	(50.7)	19230	(56.1)	23954	(69.90)	25069	73.11
15	Area Sown more than once	901	(2.7)	2082	(6.1)	3365	(9.8)	6475	(18.9)	7165	20.90
16	Culturable Land (7+8+10+11+13)	25095	(74.2)	25881	(75.6)	25646	(74.8)	25548	(74.6)	25492	74.34
17	Total Unculturable Land(1-16)	8746	(25.8)	8346	(24.4)	8619	(25.2)	8719	(25.4)	8795	26.65
18	Cultivated Land (11+13)	15134	(44.7)	17353	(50.7)	18280	(53.3)	19348	(56.5)	19665	57.35
19	Total Uncultivated Land (1-18)	18707	(55.3)	16874	(49.3)	15985	(46.7)	14919	(43.5)	14622	42.65

Source: Agriculture Statistics of Rajasthan, Directorate of Economics and Statistics, Rajasthan, Jaipur



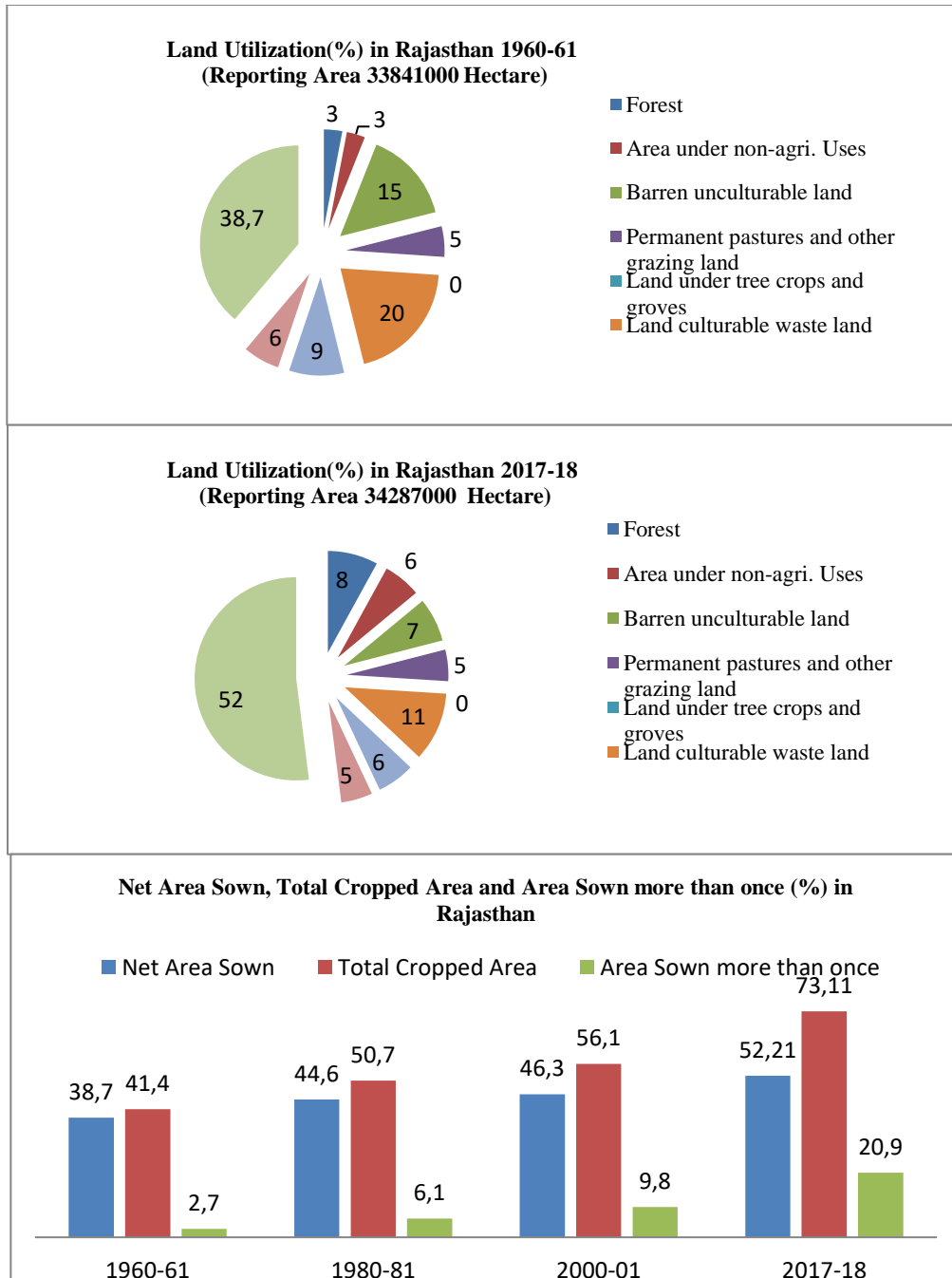


Fig. 1: Land Utilization Changes during 1960-61 to 2017-18

### CONCLUSION

The study concludes that significant changes have occurred in land use patterns over a period of time in Rajasthan. A maximum increase has been seen in terms of the net sown area. The proportion of net sown area in the state has increased significantly from 38.7

percent in 1960-61 to 52.21 percent in 2017-18. Forest land has increased considerably from 2.4 percent in 1960-61 to 8.03 percent of the reporting area in 2017-18 while barren and un-cultivable land declined from 15.2 percent to 6.95 percent over the period. Forest area is far less than 33% recommended by the National Forest Policy. Current Fallows and Fallow Land other than Current Fallow have significantly decreased from 6.0 percent and 9.2 percent respectively to 5.08 percent and 5.81 percent in the same time period. The proportion of area under forest and net sown area increased significantly in the state during this period. Land use planning is a strategic planning exercise to assess the future potential of the agricultural sector and achieve accelerated growth through judicious management of land. There are sharp regional differences in agriculture mainly on account of soil quality and terrain in Rajasthan. In the districts lying east and south of Aravalli hills, the land is more fertile and agriculture is relatively prosperous. On the other hand, in the western desert districts, more than 50 percent of the land is unfit for farming. There is an urgent need for more afforestation programs to prevent the shifting of dunes and extension of the desert area in desert prone districts of Rajasthan.

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