

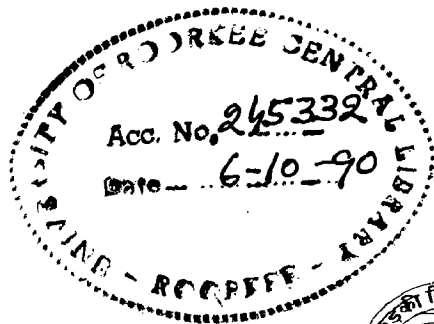
SETTLEMENT PATTERN IN RAJASTHAN DESERT

A DISSERTATION

Submitted in partial fulfilment of the
requirements for the award of the degree
of
MASTER OF URBAN AND RURAL PLANNING

By

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CANDIDATE'S DECLARATION

I hereby certify that the work which is being presented in the dissertation entitled "SETTLEMENT PATTERN IN RAJASTHAN DESERT", in partial fulfilment of the requirement for the award of the Degree of "Master of Urban and Rural Planning", submitted in the Department of Architecture and Planning of the University is an authentic record of my own work carried out during a period of eight months from August, 1989, to March, 1990, under the supervision of Prof. N.K. Tayal, Department of Architecture and Planning, University of Roorkee, Roorkee.

The matter embodied in this dissertation has not been submitted by me for the award of any other degree.

DATED : 31/3/90

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This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

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A C K N O W L E D G E M E N T

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C O N T E N T S

	<u>Page No.</u>
CANDIDATE'S DECLARATION i
ACKNOWLEDGEMENTS ii
CONTENTS iii
LIST OF TABLES	..... vi
LIST OF FIGURES	..... vii
<u>CHAPTER 1.</u> <u>INTRODUCTION</u>	..... 1
1.1 Nature of Rajasthan desert.	..... 1
1.2 Delimitation of the desert in Rajasthan.	..... 2
1.3 Objectives.	..... 5
1.4 Scope & Methods of Research.	..... 5
<u>CHAPTER 2.</u> <u>PHYSICAL & CLIMATIC CHARACTERISTICS OF THE REGION</u>	..... 7
2.1 Geology.	..... 7
2.2 Physiography.	..... 10
2.3 Temperature.	..... 19
2.4 Winds & Dust Storm.	..... 19
2.5 Precipitation.	..... 22
2.6 Ground Water Resource.	..... 30
<u>CHAPTER 3.</u> <u>ECONOMIC LANDSCAPE</u>	..... 33
3.1 Agriculture.	..... 33
3.2 Animal Husbandary.	..... 49
3.3 Mineral Resources.	..... 54
3.4 Industries.	..... 62

<u>CHAPTER 4.</u>	<u>DEMOGRAPHIC CHARACTERISTICS</u>	....	72
4.1	Population Growth & Density.	....	72
4.2	Population Composition.	....	82
4.3	Occupational Structure.	....	85
4.4	Age & Sex Structure.	....	89
4.5	Literacy.	....	93
4.6	Social & Ethnic Composition.	....	95
4.7	Population Movement	....	103
<u>CHAPTER 5.</u>	<u>ANALYSIS OF GROWTH OF SETTLEMENTS</u>	....	105
5.1	Human Settlements In Retrospect.	....	106
5.2	Toponymy.	....	116
5.3	Communications.	....	118
<u>CHAPTER 6.</u>	<u>ANALYSIS OF RURAL SETTLEMENTS</u>	....	121
6.1	Regional Distribution of Rural Settlement.	....	121
6.2	Nucleated-Dispersed Dichotomy.	....	134
6.3	Types of Rural Settlements.	....	138
6.4	Rural House Types.	....	158
<u>CHAPTER 7.</u>	<u>ANALYSIS OF URBAN SETTLEMENTS</u>	....	172
7.1	Growth Trend of Urban Settlement.	....	172
7.2	Types of Urban Settlement.	....	178
7.3	Urban House Types.	....	189
<u>CHAPTER 8.</u>	<u>MACRO LEVEL IMPACT OF INDIRA GANDHI CANAL ON REGION</u>	....	197
8.1	Delineation of I.G. Canal Region.	....	198
8.2	Population Density.	....	203

8.3	Intensive Cultivation.	....	203
8.4	Flora & Fauna.	....	203
8.5	Afforestation.	....	204
8.6	Miscellaneous Impacts.	....	205
<u>CHAPTER 9.</u>	<u>CONCLUSION & RECOMMENDATION</u>	....	206
9.1	Development Policy & Strategy.	....	207
9.2	Problems & Suggestions.	....	211
	BIBLIOGRAPHY		
	APPENDICES		

LIST OF TABLES

	Page No.
1. Area and Population of Region	3
2. Climate types	26
3. Occupational Structure of Population	34
4. Soil and Their Characteristics	36
5. Land Utilization	41
6. Principal Crops	46
7. Distribution of Livestock	50
8. Variation in Population During last 80 years	75
9. Population Density	80
10. Male Female Ratio	90
11. Transportation Network	120
12. Variation in Number of Villages	157
13. Rural House Types	167
14. Number of Urban Centres	180
15. Distribution of Town by Classes	181
16. Classification of Urban Centres	186
17. Urban House Types	193
18. Indira Gandhi Canal Region	201
19. Educational Institution in Region	218

LIST OF FIGURES

	Page No.
1. Physiographic Region	11
2. Rainy Days in Year	23
3. Climate Types	27
4. Depth of Water	31
5. Soil Type	37
6. Minerals	55
7. Industries (Group A)	64
8. Industries (Group B)	65
9. Population Distribution	77
10. Population Density	79
11. Road & Rail Network	119
12. Distribution of Villages	139
13. Selected Villages	140
14. House Types (Rural)	159
15. Town Since 1901	175
16. Types of Urban Centre	184
17. House Types (Urban)	190
18. Canal Command Area	202
19. Water Policy	208

CHAPTER 1

INTRODUCTION :

The settlements of the desert part of Rajasthan are of great interest because they illustrate some of the main themes of geography (a) they show how, in a region that is marginal to man, natural conditions strongly influence if not determine development, yet they are an example of the possibilities human initiative can see in and make out of the natural environment. (b) They express the great importance of the past in the present landscape, but illustrate the swift changes that modern technology can bring about. (c) They reveal the strong effect of the economy on society, but indicate how new social ideals can re-shape the adjustment to the land. (d) They bespeak the powerful force of regionalism, and the need for a regional approach to geography based on the uniqueness of the area, and yet effect enough general trends, found beyond Rajasthan, to invite comparisons with other Indian and with European-American traits. Thus they stimulate a theoretical discussion of how far they obey general laws, i.e., they demand a systematic treatment.

1.1 Nature of Indian Desert :

In India, extreme aridity only covers about 4 %, but semi-arid conditions spread over another 32 %, Thus dryness is a significant aspect of the geography of the sub-continent,

and affects much settlement and many people. The Rajasthan part of the Indian desert covers a total area of 208751 sq. kms., between latitudes of $24^{\circ}40'$ and $30^{\circ}12'$ North and longitude of $69^{\circ}30'$ and $76^{\circ}5'$ East. Here, aridity and sand form the natural setting for 13483022 persons (1981). The sparse population, 64.6 persons per sq. km., and low standard of living are the characteristics of the region where famines and epidemics have left permanent scars on the landscape. Although it comprises of only 6.7 % of the total area of India and 1.95 % of the 1981 Indian population, it has a very strategic location on the Indo-Pakistan border and recently assumed vital importance, politically as well as economically because of increasing drugs trafficking along this route, also due to straining of Indo-Pak relation with the change of both government.

1.2 Delimitation of the Desert in Rajasthan :

The limits of the arid landscape are rather difficult to define, particularly as there is no generally accepted definition of arid lands. Geomorphologically speaking, these lands have forms, dominated by the action of wind. From the ecological point of view, they are characterized by the predominance of physical and chemical factors over biotic ones. Much of the surface is bare. Vegetation and wild life are scanty and both are adapted to drought. Customarily, the extent of xerophytic vegetation is used to mark out arid regions, which extends from Morocco to Indus Valley.

TABLE - 1

Area and Population of the Region At District Level.

Districts	Area in km ²	Total Population	Density per km. ²
Barmer	28387	1118892	39.4
Bikaner	27244	848749	31.2
Churu	16830	1179466	70.1
Ganganagar	20634	2029968	98.4
Jaisalmer	38401	243082	6.3
Jalor	10640	903073	84.9
Jhunjhunu	5928	1211583	204.4
Jodhpur	22850	1667791	73.0
Nagaur	17718	1628669	91.9
Pali	12387	1274504	102.9
Sikar	7732	1377245	178.1
Total for the region	208751	13483022	64.6
Rajasthan State	342239	34102912	100.00
Percent to the total	60.95	39.5	32.36

Based on Statistical Abstract Rajasthan, 1981

Ordinarily, the Aravalli hills are accepted as a rough divide between the semi arid and semi humid regions of the state of Rajasthan. In the North however, i.e. in Shekhawati region or in the districts of Sikar and Jhunjhunu, the Aravallis are not regular but leave long gaps between the isolated hilly outcrops.

Thus for delimitation of the region the Thornthwaite formula, accepted by Indian as well as Rajasthan Government, also it is used all over the world with very good demarcation, has been adopted.

According to Thornthwaite's formula, water need is given by,

$$\frac{P}{E} = 1.6 (10t/I)^a$$

P = Annual Precipitation
 E = Evapotranspiration
 t = temperature^{°C}
 I = Heat Index

Thus, Moisture Index (Im) = (100s - 60d)/n

where, s = annual water surplus

d = annual water deficiency

n = annual water need i.e. $\frac{P}{E}$ index

Except for minor variations, the isopleth of - 40 moisture index gives a reasonable limit. This line runs in a South-West

to North - East direction in the Southern half of the region and passes through the settlements sites of Sanchore, Bhimal, and Ahore in Jalor district; and through Kharchi, Sojat and Raipur in Pali district.

1.3 Objectives :

The present study is essentially a regional account of the mutual connections between environment and settlement. It, therefore deals with the physical bases of the area, and how this affected economic and social development, which in turn influence the growth of settlement. The objectives are thus arranged in the following steps.

- * To understand the nature and appearance of arid landscape.
- * To assess the economic background.
- * To find the origin and growth of rural and urban centres.
- * To study the macro level affect of Indira Gandhi canal on region.
- * To give suitable suggestions to the various problems which is relevant to actual geography of Rajasthan desert.

1.4 Scope & Methods of Investigations :

The approach which is going to be taken is basically functional and tries to show how the settlement has evolved as an adjustment to an arid environment. In so far as

possible, the findings based on observation of landscape is going to be checked by quantitative methods, using census data.

Archaeological remains & historical records attest that settlements of the region had their origin in the ancient past, and the modern period, dominate towns & village patterns. These are analysed in relation to natural, economic & cultural facts, & their inter-relationships and regional associations are indicated.

Field work has been important both to get data and to make initial appraisal of landscape from which ideas about settlement arose. In the absence of adequate published data, unpublished records from the various governmental & local organisations, has been used.

Futuristic effect due to I.G. canal which is not likely to be completed before 2015 A.D. in any case, is not much looked into greater details, since this topic itself has scope of separate dissertation work.

CHAPTER - 2

PHYSICAL & CLIMATIC CHARACTERISTICS OF THE REGION :

The climate is indeed the most influential geographical factor, in that it not only has direct effects through sun & shadow, heat, wind & rain but indirect influences through the relief and drainage, which owe their whole character to the aridity of the region.

2.1 Geology :

The Rajasthan desert presents a rather desolate appearance, since the greater part of it is covered with Pleistocene windblown sand and alluvium. These deposits overlie Mesozoic and Tertiary strata. The solid geology is practically concealed, with the exception of the hilly outcrops which account for only 13,209 sq. kms., i.e., approximately 7 percent of its total area. In the east, the Aravalli hills comprise a remarkable succession of Pre-Gneissic Complex. The lack of rock at the surface and its paucity in minerals have together meant a limited mining industry. However, some formations have local significance.

The Raials series, for example which occupy the intermediate position between Aravallis and Delhi are economically important for their much celebrated Makrana marble. The Delhi system of rocks is associated with isolated and widely separated outcrops of hills. They are mostly argillaceous, soft and easily denuded, and have weathered into bare ridges with sharp

crests and serrate peaks. Quartzites are interbedded in them and have given dark grey or reddish tinge to the exposures.

The Erinpura granite, similar in its chemical composition to the Ajabgarh igneous intrusive formations, is found in patches in the eastern areas of the district of Jalor, i.e., mostly in the tehsil of Ahore. It has given bold touch to the local physiography, with steep rock slopes and deep river valley formation.

The Lower and Upper Vindhyan formations represent the Palaeozoic era. They include granites which stand out as extensive outcrops in the vast sandy tracts of Barmer and Jalor districts. In Jodhpur district, they are made of a thick sandstone (about 61 m). which is highly valued as building stone.

Jurassic formations are represented by the limestone, shales, and soft white feldspathic and ferruginous sandstones in the Jaisalmer and Bikaner areas. The Jaisalmer limestone is highly important as ornamental stone¹.

Cretaceous and Eocene formations are exclusively located in the districts of Barmer, Jaisalmer and Bikaner. They include deposits of lignite, Fuller's earth, limestone and bentonite.

¹During the fieldwork, it has been observed that practically all the houses of the town of Jaisalmer have decorated gates carved out of this stone.

Recent formations extend from the older alluvium of the Pleistocene to the younger alluvium, blown-sand, and salt and gypsum formations. Blown sand has completely engulfed the whole area of the Rajasthan desert except in the immediate neighbourhood of rocky outcrops and rocky Magra region. The older alluvium is mostly found in the river beds of the Ghaggar or Old Saraswati, confined to Ganganagar district.

The calcareous tufa or kamkar, in the form of thick beds, is universally present in the desert sand, especially round the rocky knolls. Here, they form gently sloping 'glacis', a peculiar feature of desert topography. In several low lying areas, beds of impure gypsum are found. Salt is another important deposit with which the desert sand is impregnated.

On the basis of geology the region can be divided into three units, which are :

- (i) The eastern geological complex of the Aravallis, with copper, marble, building stone and limestone as significant minerals.
- (ii) The middle zone having Lower and Upper Vindhyan formations mostly, with building stone and limestone.
- (iii) The western area of Cretaceous-Eocene formations and the Pleistocene blown sand, with lignite, gypsum, salt, Fuller's earth and ceramic minerals.

2.2 Physiography:

The main land forms are more important for the geography of settlement than rock outcrops. These vary considerably throughout the region, but can be grouped according to distinct sub-regions.

(A) Ghaggar Plains :

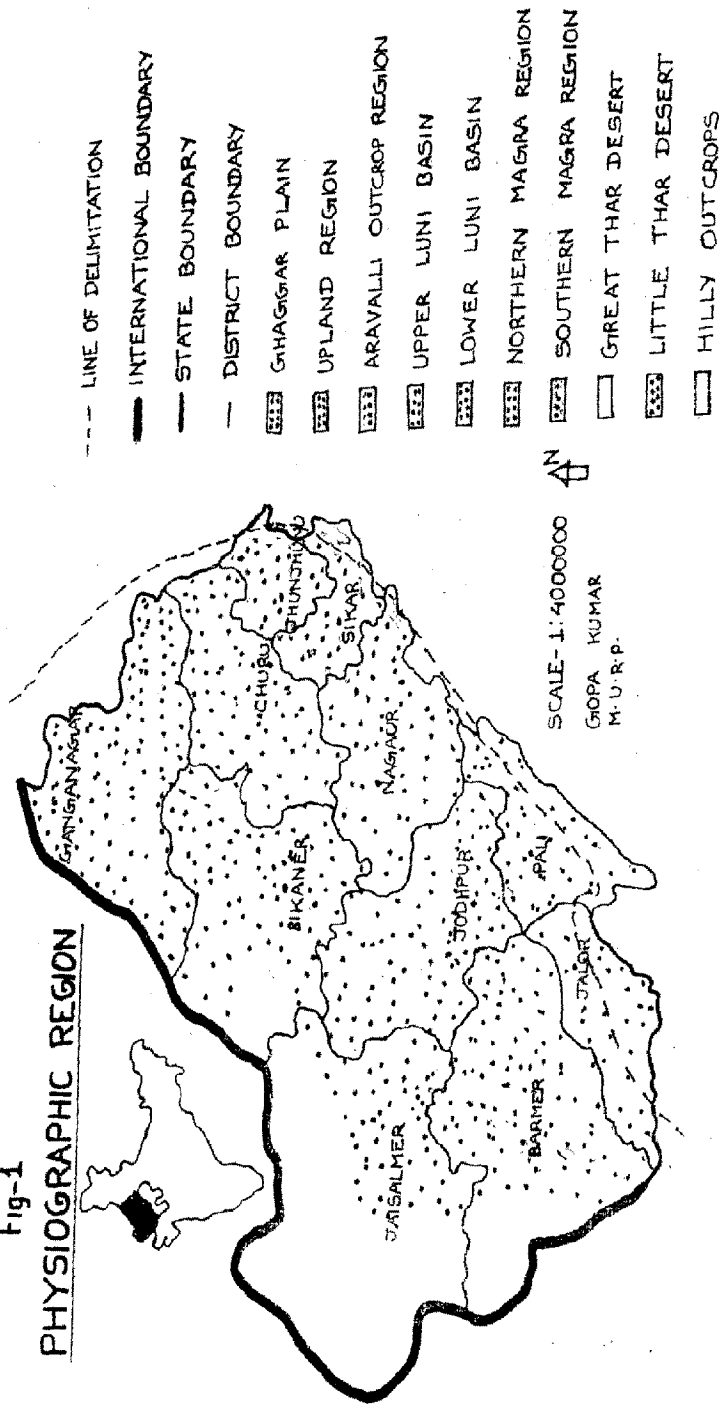
These are confined to the district of Ganganagar. Geologically, they are formed of older alluvium covered with the Pleistocene blown sand, and represent the dry beds of an old gigantic river system of Saraswati²-the Lost River of the Indian desert. Major parts of this old channel are still to be seen, and are important in routeways and the alignment of settlement. In addition there are the beds of tributaries, e.g., Ghaggar, Wah, Sonamwal in the districts of Hissar, Karnal and Ambala of the state of Haryana. These tributary dried up beds are now being utilised for the route of great Rajasthan canal. On the whole, the Ghaggar Plains form a gently sloping area, running from north-east to west and south-west. There are no rivers except when floods, following the heavy monsoon rains in the Sub-Himalayan mountain region, bring these old beds to life. The flow may reach up to the town of Hanumangarh.

(B) North-Eastern Upland Region :

This area, covered with wind blown sand, is an almost level land, It has a general slope from north-east to south and south-west.

²These dry beds of Saraswati came into existence somewhere in the early centuries A.D. or Mahabharata times.

Fig-1
PHYSIOGRAPHIC REGION



Significant rocky projections break the horizon west of the city of Jodhpur and extend several kilometres to the north and west in the form of isolated rocky knolls. Eastward another group of scattered ridges stretches from south of the town of Bilara in a northerly direction. Both groups have influenced the development of internal drainage and consequently the location of wells, villages and routeways.

Longitudinal seif types of dunes are very prominent in the eastern part of the Uplands, parallel to the direction of Aravalli ranges. Here the wind from south-west direction acts in the funnel shaped area between the Aravallis and the Delhis. To the north the gradual decrease in the western parts of Shekhawati region. Both seifs and whalebacks influence settlement. Generally they are hostile to any occupation, but have nursed some hamlets in the hollows between them.

The north-eastern Upland area is comparatively less sandy, covering the tehsils of eastern Jodhpur, Bilara, Jaitaran, Parbatsar, eastern Merta and Degana. Here, on steeper slopes, the constant action of running water washed away sandy deposits to leave more open land, with distinctly more settlements. There is no general drainage pattern but several isolated inland drainage systems exist whose focal points are the shallow depressions where shallow salt lakes are situated. Some of these watered depressions are the sites of villages although the salinity of the water prevents its full use. The Degana salt lake basin is especially important. Its catchment area lies on the western slopes of Aravalli ranges, north-west of the

city of Ajmer and south of the town of Parbatsar. Here rainfed streams spread in the form of Poonlota Sar (low lying area), the site of several villages. In this area, there are ten small locally important nalas associated with little settlements.

(C) Aravalli Outcrops Region :

This region covers the Shekhawati region of Rajasthan and the tehsils of Nawa and eastern Parbatsar of the district of Nagaur. In this area, the Pleistocene desert sand covers the total landscape but the Aravalli outcrops break its monotony, running from south-west to north-east for about 160 kms. They are composed on the Aravalli, Raials and Delhi systems of rocks. A section known as the Khetri hills are significant for their mineral content, e.g., copper, mica and building sandstone and limestone, which have given rise to some mining settlements. Sand-blasted hillocks have been the sites of either forts or temples since the medieval times.

The hilly outcrops are responsible for dividing the general drainage pattern into separate inland drainage areas. The largest of these is centred in the Sambhar Salt Lake, with a total catchment area of about 5,700 sq. kms. It is fed by four streams. With the exception of the dry season, when the lake is a mere puddle, it covers a total area of about 230 sq. kms. in the normal monsoon rainy period. It lies in a closed depression in the Aravalli schists in the northern part of a fault basin. This depression is significant both for routeways and for a number of small trading settlements along them.

The Neem-ka-Thana hilly tract, also a part of the Aravallis, is responsible for the development of a radial drainage pattern, which underlies a marked spray of linear-type settlements. Its main stream, the Kantli, is the longest water course in the Shekhawati region of the Rajasthan desert region. It collects water from 1040 sq. kms. of the area and flows in north, north-west direction for about 112 kms. It dries up near Dhandaria and Khundania villages but occasionally goes beyond this area up to Lamore, Kheri and Khurrh villages near the town of Rajgarh in the Churu district. Throughout the year it is dry outwith the rainy season. In spite of this it is paralleled by villages, spaced widely apart, which strike down to hidden water in wells. Thus, although streams are ephemeral in nature, they play an important role in deciding the local water-table and the location of settlements in the area.

Below the Aravallis proper, there is a sub-mountain area, which slopes gently down and is a completely sandy tract. Isolated hilly outcrops show that the gneissic plane continues below the Pleistocene sand. They brake the monotony of the sandy landscape. A comparatively high water-table makes it a possible area for cultivation.

(D) Godawar Region :

The Godawar region in the south-east of the Rajasthan desert is drained by the river Luni and its numerous tributaries. It may also be termed the Luni River Basin.

In area it is approximately 35,200 sq. kms., comprised mainly Lower and Upper Vindhyan rocks, with Jalor and Sitwana granitic formations domes in the south and central parts. Except for these hilly outcrops, however, the whole region is covered with the Pleistocene sand.

The upper part of the basin is an area of numerous tributaries flowing down the western slopes of Aravalli ranges. The undulating topography is criss-crossed by rain-fed streams, which are the sites of villages, especially at fords. Throughout its course the Luni is most erratic and capricious. Below the village of Samdari, there are no tributaries, except the river Jawai which joins it in its last sojourn in the sandy tracts of the tehsil of Sanchore of Jalor district. After running for about 800 kms., Luni mixes with the water of Rann of Kutch.

The landscape of the lower Luni consists of sandy tracts and dunes. The latter are mostly longitudinal, running in southwest to north-east direction parallel to the general direction of wind. The hilly outcrops in the tehsils of Jalor and Ahore give rise to complex types of sand dunes with a mixture of longitudinal and transverse types, but it is the hills themselves which are noteworthy. The Earana hills attain a height of about 840 m. above sea level and Chhapan-ka-Pahar hills have a maximum height of 975 m.

Only the Upper basin is usable. Here the river has so many tributary streams that it forms the basis of the agricultural

economy of the Godawar region. Walter (1879) wrote that half of the cereal production and successful agricultural economy depended upon the river Luni. This still holds good as these streams have been harnessed to provide irrigation to the sandy and thirsty land of Marwar. Long string like villages are typical.

(E) Magra Region :

This area forms a rock-floored plain, scored by wind-blown sand. Though comparatively free from dunes, it is more dreary and desolate than the Thar region. Magra is elongated in shape stretching from the southern boundary of Chohtan tehsil of Barmer district to the southern portions of Bikaner tehsil. The rock formations range from Palaeozoic to Eocene and the present landscape is the result of mechanical weathering and the action of wind on the relic features. A characteristic feature is reg plains similar to those found in the deserts of south-west Algeria or the gravel plains (serir) of the Libyan desert.

In the southern parts volcanic activity has resulted in hills of a massive and hold appearance amidst the vast sandy tracts. There is no trace of running water action. Large areas are without settlements. In the northern sector, i.e., in the district of Bikaner, Eocene rock formations are well represented and consist of white and buff limestone and shales with nummulitic fossils. Here the lignite coal of Palana is worked, lying south of the city of Bikaner. In the neighbourhood of Jaisalmer town, the Umia and Jurassic beds are exposed

as hilly outcrops. The town of Jaisalmer itself is located on a flat top, 80m. above the surrounding area.

The northern Magra area gives an impression of vast gravel plains with small sandy patches scattered throughout. Shallow salt pans make individual drainage systems, with ephemeral water. This is mostly brackish and useless for human or animal life.

(F) Thar Region :

This, the western most region of the Rajasthan desert, is completely blanketed by sand dunes. It extends from south to north along the border between India and Pakistan. The solid geology is concealed by sand except in the neighbourhood of Jaisalmer town where the Parihar hills and Abur hills stand out. In the neighbourhood of Sawal and Amir villages large patches of pebbles derived from conglomerate, support the fact that the region was a marine littoral even upto the sub-recent times. The pebble beds have springs at their edges, sponsoring wetpoint settlements.

The main part of the Thar is known as the Great Desert, covered by vast and thick sand deposits and a complex pattern of ridges. Between the sand ridges, there are low lying areas which act as ephemeral drainage basins during the sudden down-pours in rainy periods. These intermediate depressions, known as Marho, have alluvium deposits which becomes cultivable when sufficient water is available. Here highly nucleated

villages occur. Areas in the western parts of Sam, Ramgarh and Nachna tehsils have no drainage and form an absolute dreary sea of thick sand dunes.

The northern parts of the Thar are called the Little Desert. The name refers not to an area but to the nature and magnitude of dunes. Here, the dunes are mostly transverse in form and are smaller than their counterparts in the Great desert. A whole mesh of intermingling transverse dunes is closely knitted together. Between the dunes, there are minor depressions (gassis) which during the time of sufficient rains become shallow water basins. These are very important for villages, most of which have the suffi-sar, meaning pond. The villages tend to gather round their ponds in compact circular groups of huts.

It has been observed that both the geological and relief features of Rajasthan have greatly affected settlement. The hilly tracts have been especially significant, as with rather more rain and vegetation and with perennial streams they have attracted agricultural villages. The sand deserts around the lower slopes of the hills are sufficiently watered by even ephemeral streams to have some villages: these are often aligned along stream channels, even if water no longer flows. In the flatter sandy areas settlement becomes sparse and sporadic. Isolated villages spring up round ponds that gather the water in depressions between the bigger dunes. The rock desert is the least occupied of all the areas, often with no more than nomadic camps. The gradation from sub-humid to ultra-arid conditions is the gradient controlling settlement.

2.3 Temperature;

The Rajasthan desert is the hottest area in India. Extremes of temperature are due to location, low relative humidity of atmosphere, the sandy nature of soil, lack of vegetation cover and dry wind. The mean annual temperature varies from 26.1 to 26.8°C in the south and from 24.5 to 24.1°C in the north. Diurnal, as well as seasonal extremes of temperature are experienced. The temperature starts rising by the middle of March & the hot season prevails during the period April to June. May is generally the hottest month of the year, with mean maximum temperature ranges from 40°C to 44°C throughout the region.

One of the major tasks of man is to protect himself from heat, and this is reflected in housetypes and village forms, as will be seen later. In general, houses are made with small if any windows, with overhanging eaves, and of hard-baked mud, in order to keep out the heat. Many are built among shade trees to get out of the direct rays of the sun, while houses must be designed to reduce heat, they must also keep out cold, because the "Cold" weather season, from December to February, is marked by low temperatures. Cold waves, associated with disturbances from the west, frequently bring temperature below freezing point.

2.4 Winds & Dust-storm :

Winds are of great significance for houses, roads, and for settlements, since the wind itself frequently subjects buildings to bombardment and, armed with sand, can cover or

scour objects, sometimes coating building with dust, and heaping sand over the roads. Dust storms have been known to block the railway.

In the cold weather, the Asiatic 'high', with its sub-centre in the plains of Punjab, where pressure exceeds 30.05 inches, brings the north wind sweeping across the northern half of the region. The beginning of March witness a transition to the high temperature conditions in the months of April and May. Low pressure conditions then build up which may produce violent convection whirls, on a local basis. During this time, wind speeds of up to 60 m.p.h may occur, though only during those days when excessive heating causes local disturbances. Winds are sand laden and are associated with high temperature. The worst affected areas by these hot and dusty wind-Loo³ are in the districts of Barmer, Jodhpur, Nagaur, Bikaner and Jaisalmer. They are more violent during the afternoons but they continue even up to mid night. These hot dusty winds are so strong that one cannot sleep in the open space or on the roof of the houses which is the normal practice of the people here, because of sand and the scorching effects and noise associated with them. The bed becomes full of sand and dust, while hair and face are thoroughly powdered with sand. Sometimes, these winds are so powerful

³'Loo' is a local name for a hot and excessives dry and dusty violent wind which can be compared with. 'Khamsin' in Egypt: 'Simon' of Arabian desert: 'Sharmal' in Mesopotamia; and 'Brick-fielder' of Australia. Loo is very trying and dreadful during the afternoons and even during the early part of night very scorching.

that cotton blankets are blown away. Since these have no particular direction it is difficult to protect house or road from them. Wells are usually with high platforms to avoid effects of sand. Stones are put on roof-tops to help keep them down. Houses have high boundary wall on the street so that blowing sand does not creep in the courtyard.

Dust-storms are part of the desert environment. They are caused by excessive heating during the day giving rise to local disturbances. In the Rajasthan desert region Adhiyain (dust-storms) are very common during summer season. Regional and seasonal trends may be noted in the occurrence of dust-storms, but, taking the year as a whole, the regional trends do not alter. These dust-storms mostly come during evenings.

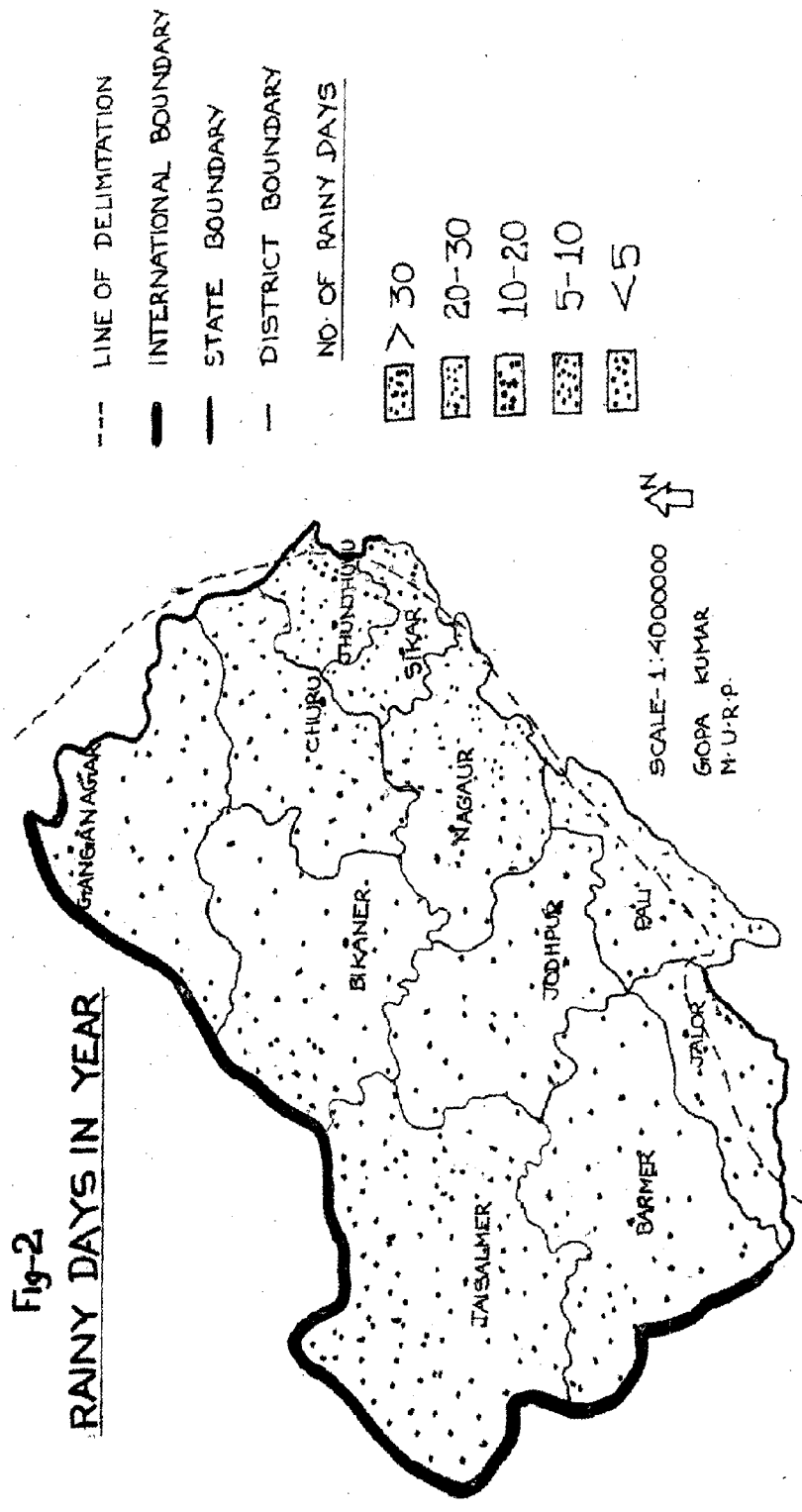
Regional observations show that they are more common in the northern parts of the region and their frequency diminishes from north-west to south-east. During May and June in the north-western areas, the average number of days with dust-storms are 8 to 15, in the central parts 5 to 8, and in the south and south-east 1 to 4. In summer months, Ganganagar district has the maximum number of dust-storm days, viz. 15 to 20. The least affected areas are in the south and southern parts of Pali and Jalor, and eastern parts of Jodhpur, Nagaur, Sikar and Jhunjhunu districts. Taking the year as a whole, the district of Ganganagar in the north has 27 days of dust-storms, and in the south, the district of Pali has 3 to 4 days.

The influence of the monsoon from the Arabian sea as well as Bay of Bengal, spreads over the whole region from June to September. The onset of the monsoon is often violent: this and the quite heavy showers of rain thereafter, is one reason for the strength of roofs and, in better houses, for roof gutters and run-off pipes. In the latter half of September, the pressure conditions gradually change, the general wind system weakens, and there is a curving back of the monsoon.

2.5 Precipitation :

Although there is not much rain, yet rainfall is the most important climatic elements in the region, and its absence or presence largely determines the density and character of settlement. The range of rainfall is on an average between 250 mm. and 300 mm., most of which falls in the season of general monsoon rains.

The seasonal distribution is very marked, since July, August and September have more than 88 per cent of total annual rainfall. The monthly distribution of rainfall shows the maximum amount of rainfall in the month of August, except in the north-eastern districts of Churu, Jhunjhunu and Sikar, August rainfall accounts for 32.5 to 44.8 per cent of the total in the areas of Luni basin, western Uplands, Magra region and Great desert region. In Ghaggar plains and the Aravalli outcrop



region, August rainfall contributes 25.0 to 33.5 % of the total. The season of general rains, with the highest percentages in the Magra region, Great desert and the Luni Basin, where between 85 to 98 per cent of the total falls.

In the other seasons, there is no precipitation except the winter rain associated with the western disturbances. These are negligible in amount but significant in impact. The general regional trend of winter rain shows a decrease in amount from north-north-east to south-south-west.

The manner in which the rain falls is significant. Sharp rainfall discontinuities are clear before and after the general season of rainfall. In the north and north-east, the monsoon rain begins with graded discontinuities: maximum rains occur in the month of July to August; and winters are markedly rainy. For the central parts of the region, the major discontinuity is in the month of July and the maximum amount of rain is not clearly marked in July and August. In the south-east, the major discontinuity is in July with the maximum in July, and winter rains are less frequent and almost absent. For the west and south-west, the major discontinuity is in July but August is the period of maximum. The effect of all this on settlement is noticed in several ways. The streets, roads as well as the whole rural landscape become pleasing after the rains, especially more so in the western parts of the region.

The region is divided into following climate sub divisions :

(A) Extreme Arid Region :

This occupies the westernmost parts of the Rajasthan desert region and, in its climatic characteristics, it can be compared with the core of Sahara of the Libyan deserts. The mean temperature for the coldest month is well below 20°C and for the hottest month it ranges between 32° and 35°C . The diurnal as well as seasonal range of temperature is marked. Considering the amount of variability of rainfall, together with the indices of aridity and moisture, it is the least important for settlements and economy.

(B) Very Arid Region :

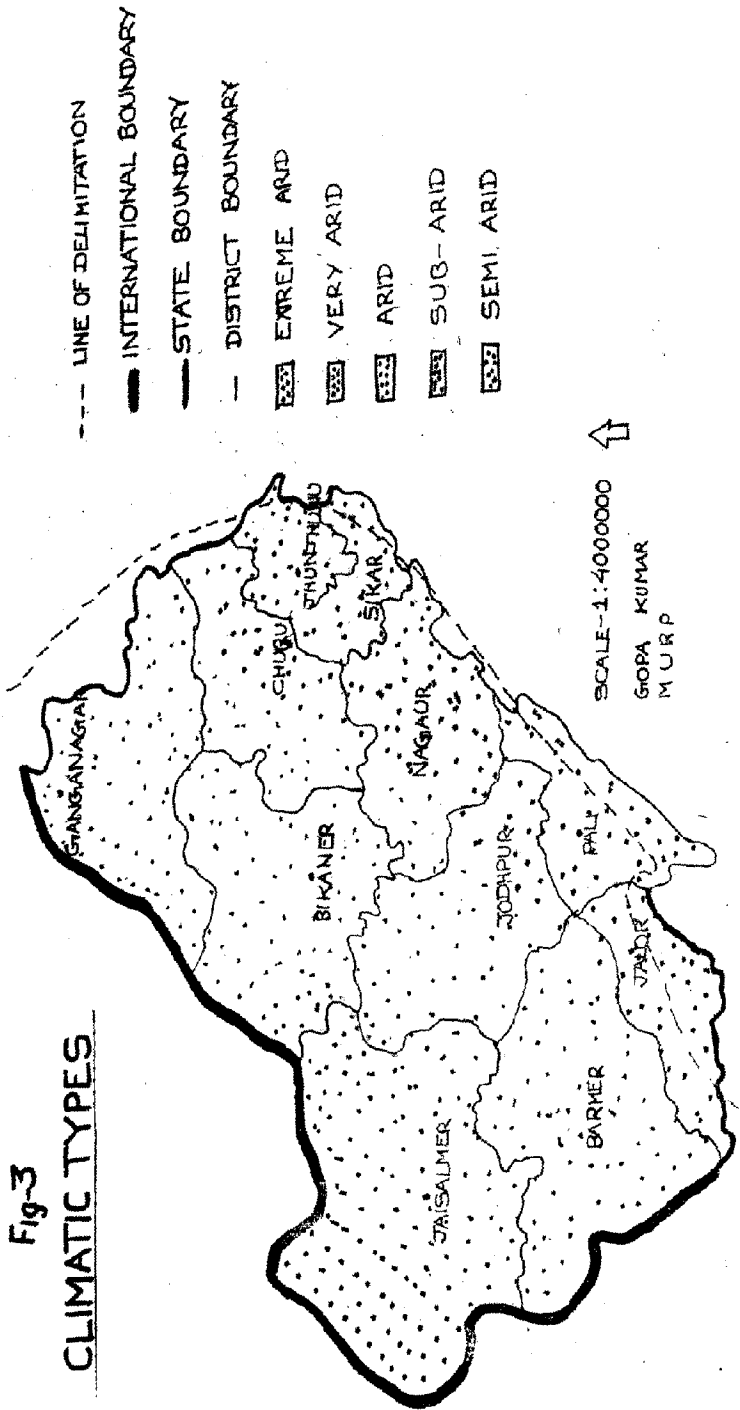
The region has similar climatic characteristics, to southern Sonoran desert with mean temperature below 20°C for the coldest month and between 32° and $34,5^{\circ}\text{C}$ for the hot season. The diurnal as well as seasonal range of temperature is again marked. The rainfall is highly erratic and uncertain. There is no surplus of water but a large amount of water deficiency in every month. This region is almost as dreary and desolate as the extreme arid region, but has a few settlements in hollows between major dunes, or along its few perennial streams.

TABLE 2.

Climatic Types

Type	Areas	Rainfall mm and Rainy Days	Annual P/E Indices	Variability of rain fall %	Indices of Aridity	Indices of Moisture	Vegetation Type
A. Extreme Arid Region	West Ramgarh and Sam tehs. of Jaisalmer district.	Less than 125 and 5	Less than 10	Above 60	92	-56	Mostly shrubs: Grewia capparidifolia, Grewia populifolia, Barbrua acanthoides, Eleonurus, hirsutus. Pacium turgidum.
B. Very Arid Region	E. Jaisalmer and N. Barmer	125-200 and 5-10	10-13	60-55	85-92	52-56 (-ve)	Same as above plus shrub trees: Acacia arabica, Acacia senegal, Prosopis spicigera.
C. Arid Region	S. Barmer W. Jalore, Jodhpur Nagaur, Churu & whole of Bikaner & Ganganagar.	200-325 & 10-20	13-14	45-55	78-88	47-52 (-ve)	Shrubs: Acacia Jaquemontii Capparis aphylla, C. Spinosa Tamarix gallica & dioica. Trees: Same as in (B) & Prosopis juliflora, Boswellia serrata, Zizyphus jujuba, Salvadora Persica Cordia rothi.
D. Sub-Arid Region	E. Jalore, Nagaur, Churu: W. Sikar, Jhunjhunu & Central Pali.	325-400 & 20-30	13-14	30-45	70-78	43-47 (-ve)	Same as (C).
E. Semi-Arid Region	E. Jhunjhunu, Sikar & SE Pali & Jalore, Above 30	Above 300 & Above 30	Above 14	Below 30	Below 70	Below -43	Same as in (C) plus Anogeissus pendula, Acacia catechu.

Source : Central Arid Zone Research Institute, Jodhpur.



(C) Arid Region :

From south to north, it covers the major portion of the region, i.e., Lower Luni basin, western Uplands, Marga region. Little desert and Ghaggar plains. The mean temperature for the coldest month varies from 11.6° to 17.4°C from north to south, and during hot season, it varies from 32.9° to 35.5°C . There is a high diurnal and seasonal range of temperature. The main season of rain accounts for the major portion of rainfall but winter rain is markedly distinct. Winter rain is characterised by an abrupt decrease from north to south, e.g., Ganganagar gets 0.57 per cent of the total rains, Bikaner 0.17 per cent and in south, this %age ranges between 0.17 per cent in south, this percentage ranges between 0.17 and 0.05.

Comparatively, more rains, lesser degree of variability aridity and minus indices for moisture make this climatic sub-division safe for an agro-livestock economy and settlements. The canal irrigation in Ganganagar led to very high population density and dense network of rural settlements. The vegetation cover has improved from its scrubby and stunted nature to more leafy plants and trees.

(D) Sub-Arid Region :

This is another south-west elongated zone covering the eastern section of the region. It may be regarded as a steppe

type. The mean temperature for the coldest month ranges between 15.1° to 16.3°C and for the hot season between 33.3° and 36.0°C . The northern parts of this type get winter rain to the extent of 0.2 and 0.3 per cent of the total.

Due to high temperature and P/E, however, the water deficiency graphs for Jaitaran and Nawa show a significant amount of water deficiency. Nevertheless, climatic conditions are somewhat improved over the preceding sub-divisions. The vegetation cover is far from scrubby and comprises trees and continuous grassland. The agricultural-cum-pastoral economy is more stable and the settlements are more closely spaced and bigger in size.

(E) Semi-Arid to Sub-humid Region :

This confined to the Aravalli foothills and outcrops region. Temperatures are similar to the Sub-Arid region but the rainfall is hardly erratic as attested by the low coefficient of variability of rainfall. The climographs for Neemka-Thana and Sri Madhopur and Bali have elongated shapes and extended well into the sub humid sections. Bali with high amount of rainfall (564 mm.) has elongated climograph, extending as far as humid section. The water deficiency graphs shows a lesser magnitude. The graph for Bali is distinct, as it is the only station which has a small water surplus.

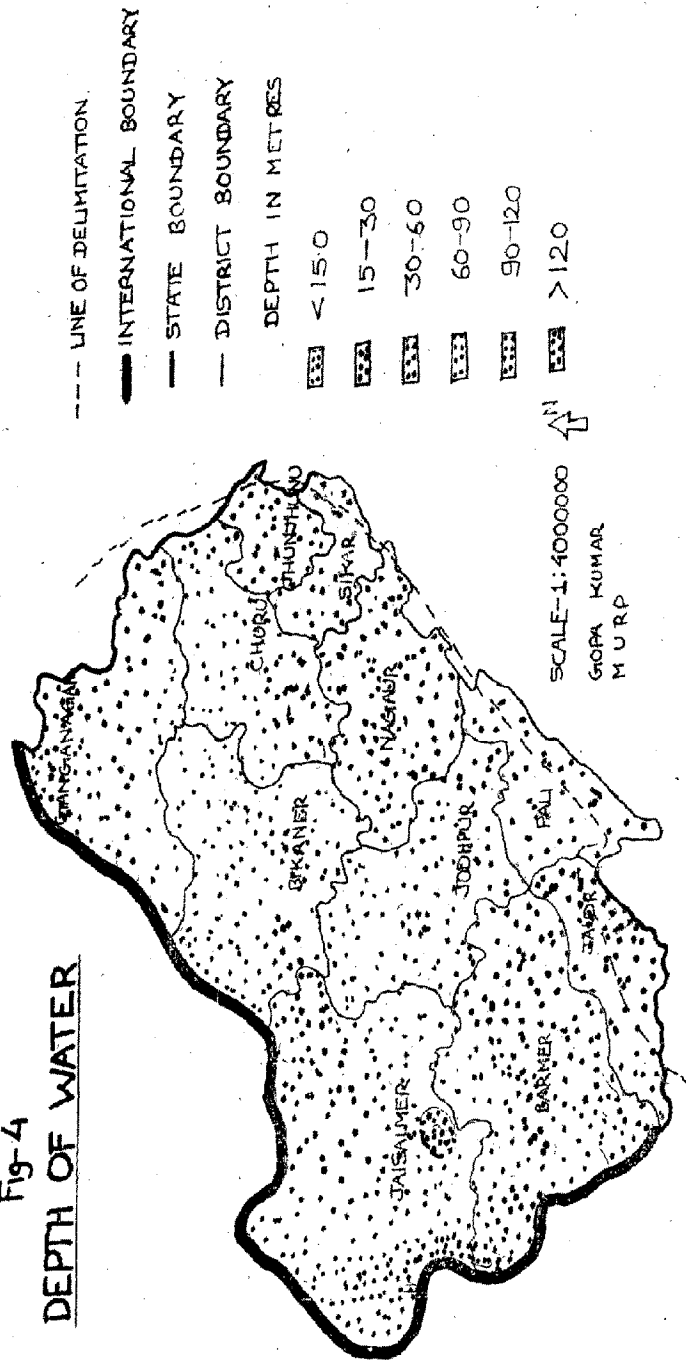
The climatic conditions are suitable for a limited agriculture economy and settlements, but the hilly nature of terrain does not permit a dense settlement network. The vegetation is thick with better trees and plants.

2.6 Ground Water Resource :

The region seriously suffers from varied problems associated with the scarce supply of water. The severity of the problem obviously increases with increasing aridity and is at its peak in the districts of Bikaner and Jaisalmer. Under such severe conditions water is a very dear thing. During old days human settlements clustered around a well or a tank which used to provide drinking water to the inhabitants. This explains, why the name of the most of villages in the region ends with 'Sar', meaning presence of a tank or a well.

The underground water table in the region is very deep and discharge is small. The fig. shows the depth of water table in the study area, the depth varies from 20M to 120M. For qualitative analysis of the under ground water, Central Arid Zone Research Institute has tested water samples of 162 wells which shows total soluble solid varies upto 180 ppm in 2.5% samples, 180-1500 ppm in 32.1% samples, 1500-3200 ppm in 30.8% samples, 3200-5000 ppm in 22.2% samples and 5000-7000 ppm in 10.5% samples.

Fig-4
DEPTH OF WATER



According to W.H.O. permissible total soluble solids in drinking water is 500 ppm but water containing total soluble solids more than 1500 ppm can not be used for drinking purpose. Therefore, only 34.6 % of the total water is suitable for drinking purpose. The location of areas having potential sweet water has been shown in figure.

CHAPTER - 3

It has now been seen that Rajasthan desert has a rather limited physical basis on which to develop, with no major geological resources, without much variety of relief to create differences in soil and vegetation, and with low water supplies both in its scanty rainfall and lack of perennial streams. It is not surprising that this limited input of natural factors should have gone with a low economic output and a sparse population.

The Rajasthan desert region is basically agricultural and rural. Out of the total population, about 80 per cent is engaged in agriculture and allied activities, with animal husbandry an important factor. Large-scale industries are practically absent. An inadequate network, combined with a low educational standard, further add to industrial backwardness.

3.1 Agriculture :

As agriculture has always been the most important occupation of the people of this parched, sand-bound and arid region, yet it has never been able to support much in the way of settled, self-sufficient communities. The inhospitable climate, together with political and social insecurity, have deeply affected the life of the people.

TABLE 3

Occupational Structure of Total, Rural and Urban Population, Fig. in %

District	Non-workers %age to total population			Workers	Percentage to the total workers			Trade	lc	In Other	
	T	R	U		In Agri.	In Min.	At HH				In Mf
Barmer	T	48.2		51.8	90.2	0.5	4.0	0.4	2.3	0.5	2.1
	R	46.9		53.1	93.0	0.5	3.4	0.2	1.4	0.4	1.1
	U	68.2		31.8	15.1	1.0	19.3	7.0	24.4	5.8	27.4
Bikaner	T	60.5		39.5	56.6	1.6	13.7	3.2	5.8	4.4	14.7
	R	50.0		50.0	76.1	1.7	16.2	0.5	1.3	0.7	3.5
	U	74.9		25.1	3.7	0.3	7.4	10.6	17.7	14.3	46.1
Churu	T	52.1		47.9	83.2	0.4	4.8	1.4	3.3	1.1	5.8
	R	43.2		56.8	93.8	0.2	3.8	0.1	0.4	0.2	1.5
	U	71.4		28.6	37.0	1.0	9.0	7.5	15.5	4.7	25.3
Ganganagar	T	60.8		31.2	78.5	0.3	2.4	3.1	4.2	1.2	10.3
	R	59.5		40.5	87.0	0.3	2.3	1.4	1.9	0.4	6.7
	U	68.1		31.9	14.6	0.7	3.5	15.6	21.5	7.4	36.7
Jaisalmer	T	51.4		48.6	51.5	12.4	26.7	0.6	2.0	0.5	6.3
	R	49.5		50.5	54.3	13.0	28.0	-	1.0	-	3.7
	U	69.2		30.8	8.8	3.4	7.4	8.2	17.6	6.6	48.0
Jalor	T	54.1		45.9	84.4	1.2	5.9	0.5	3.2	0.2	4.6
	R	53.6		46.4	86.3	1.1	5.6	0.4	2.8	0.1	3.7
	U	63.6		36.4	33.7	3.8	10.2	4.0	14.3	2.1	31.9
Jhunjhunu	T	55.6		44.4	82.6	0.7	4.7	1.6	2.5	0.5	7.4
	R	52.3		47.7	89.4	0.5	4.1	0.4	1.2	0.2	4.2
	U	70.6		29.4	31.0	1.9	8.8	9.6	13.6	2.7	32.4
Jodhpur	T	57.5		43.5	75.6	1.5	3.7	2.4	3.5	3.1	10.2
	R	51.1		48.9	91.6	0.9	3.2	0.4	0.9	0.4	2.6
	U	72.4		27.6	9.1	4.0	6.0	11.0	14.0	14.3	41.6
Nagaur	T	51.0		49.0	85.6	1.1	4.2	1.3	2.3	0.8	4.7
	R	48.0		52.0	91.0	0.9	3.6	0.3	1.3	0.5	2.4
	U	71.2		28.8	19.5	2.4	11.2	12.8	14.7	5.7	33.7
Pali	T	55.2		44.8	70.0	1.4	12.9	2.4	3.6	1.2	8.5
	R	54.2		45.8	73.3	1.5	13.1	1.1	2.8	1.0	7.2
	U	64.2		35.8	29.0	0.8	11.2	18.0	13.6	4.0	23.4
Sikar	T	53.3		46.7	78.4	1.2	7.6	1.8	3.0	0.7	7.3
	R	49.8		50.2	85.3	1.2	6.8	0.5	1.4	0.3	4.5
	U	69.6		30.4	25.2	1.2	13.8	11.6	15.4	3.7	29.1
Total	T	54.9		45.1	78.9	1.2	6.4	1.8	3.2	1.2	7.3
	R	51.4		48.6	86.6	1.2	6.0	0.5	1.5	0.4	3.8
	U	70.8		29.2	20.2	1.7	8.7	11.2	16.1	7.7	34.4

With the increasing reliance of the people on agriculture, water, soils and vegetation grew in importance, first as a basis for pasture and crops, and then, indirectly, as an influence on routes and settlements. Water is especially important in an arid region like Rajasthan. It is the primary need for any agro-economic growth. It is important in the location of settlements of the region, e.g., in the western areas, the wells are significant in deciding the location most of the villages; in southern parts, the tanks, or ponds control the site of villages; and in northern irrigated areas, the canals are responsible for the distribution of villages.

(A) Soils :

Soils are limited in the range of types and in their scope for development. The soils of the region are, in general, Non-lateritic and Pedocal⁴ in nature. Most of them are alkaline⁵ and coarse textured. They have a high percentage of soluble salts and high pH values. They are immature in the main, structureless, very coarse, and highly unproductive. Organic matter, nitrogen, and phosphoric acid are deficient but there are high values for calcium carbonate. They are developed in situ, and the underlying geology has produced variations in consistency, depth and composition. They fall into the following categories.

⁴In the profile of the soils of the region, there is an accumulation of CaCO_3 .

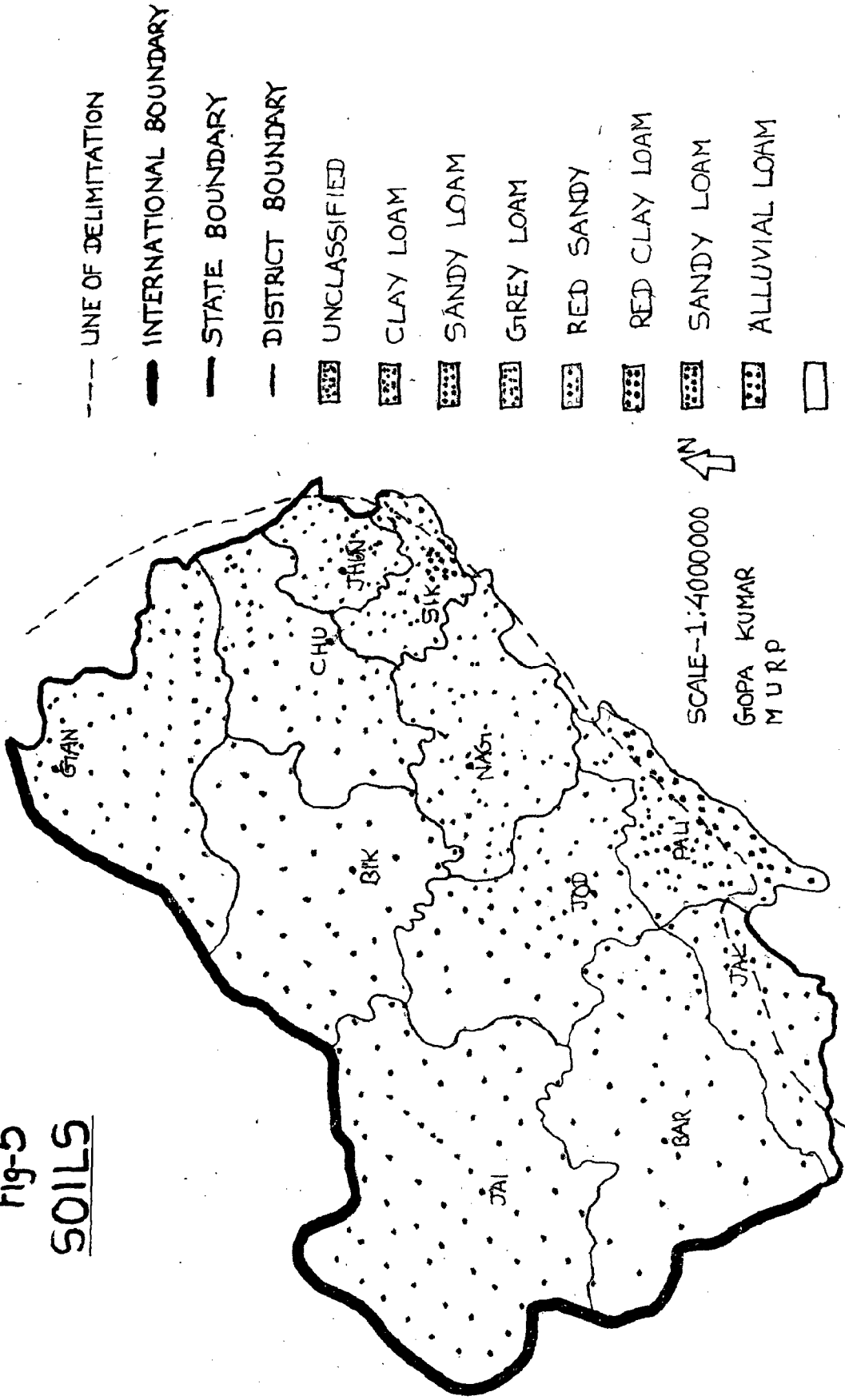
⁵With the exception of south-eastern parts, the soil has pH from 7.5 to 9.0.

TABLE 4
Soils and Their Characteristics

Soils	Colour	Texture %	pH values	Nitrogen Phosphoric Calcium Contents	Organic matter %	Others	Nature
Desert soils	Yellow- Yellowish Brown or Grey-Brown	90-95 sand 5-7 clay	8-9	0.2-0.004	0.2-0.3	Higher % of soluble salts Highly saline and alkaline Incomplete leaching	Unproductive
Clay-Loam (Desert-type)	Greyish Brown	Clay to sandy loam	-ND-	0.03-0.04	0.4-0.6	High % of soluble salts	Moderate to medium in fertility
Sandy-Loam (Desert-type)	Greyish Brown	75 - 85 sand	7.5-8.5	-ND-	-ND-	Moderately saline and alkaline	Moderate in fertility
Grey Brown (Desert-type loam).	Darker in colour	Heavier in texture. Clay 10 to 15 but 40 in subsoil	7.2-9.2	0.02-0.03 0.004-0.008 -ND-	0.3-0.5	Moderately saline and alkaline	Moderate in fertility
Red Sandy Red Clay Loam	Reddish- yellow	Sand 45.0-65	5.5-8.5	0.006-0.016 -ND-	0.06-0.13	Less saline & alkaline	-do-
Sandy Loam	Darker in colour	3.5-8.0 clay	7.0-9.0	0.02-0.03 0.004-0.008 -ND-	0.25-0.45	Highly saline & alkaline	Poor and unproductive
Loam (Alluvial type).	Darker in Colour	15 clay	4.5-7.5	Deficient	-ND-	Less saline & alkaline	Moderate in fertility

Source : Directorate of Agriculture, Rajasthan.

Fig-5
SOILS



Desert Soils occupy the largest area in the region, covering entire Jaisalmer, Barmer, Bikaner, most of Jodhpur, Churu, and the southern parts of Ganganagar, western parts of Sikar, Jhunjhunu and Nagaur districts. In local traditional classification they are designated as Reteli or Magra or Tharra, meaning highly sandy and poor soils. They are highly porous and poor in fertility. The high percentage of soluble salts and high pH values is due to low rainfall, high evaporation and incomplete leaching. They are deficient in organic matter. CaO is only in the unstabilised sandy areas, whereas in the stabilised areas it results in CaCO_3 accumulation or kankar bed formation. The calcium content in the sub-soil is nearly ten times that of the top soil. These soils bear only a scanty thorny vegetation and are associated with nomadic herding. They carry little settlements.

Clay Loam (Desert Type) soils are confined to the district of Ganganagar and the northern strip of the district of Churu and Jhunjhunu. They vary from clay to sandy loam in texture but in texture, they are highly affected with wind blown sand. A typical profile is similar to the sample taken at Gang Colony.

They are heavier in texture but in those areas where irrigation is at present unavailable, the soils are more sandy and resemble the desert soils. Originally they had a high % of soluble salts but the salts have been washed deep down or away from the top-soils due to canal irrigation in this area.

In their natural state they are covered with scanty vegetation cover, which has been used by man for grazing livestock but now due to canal irrigation been replaced for growing crops. The settlement is relatively sparse in the non-irrigated areas, but very dense in the irrigated areas and consists mainly of villages.

Sandy-Loam (Desert Type) varies from sand through gravel sand to sandy loam. It covers the Lower Luni basin in the districts of Jalor, Barmer and Jodhpur and the portion of Nagaur district. The soils are more fertile in the Luni river channel areas due to alluvial character. The vegetation cover is scanty and cultivation is limited to river-beds or close to wells. The settlement is sparse except near the river channels.

Grey-Brown (Desert Type Loam) forms the second most important group of soils covering large areas in the districts of northern Pali, south-east Jodhpur, most of Nagaur, Sikar, Jhunjhunu and eastern Churu. In the east they are more fertile and heavier in texture. The soil fertility is increased due to the presence of nitrogen in the form of nitrates. In many parts the soil has attained an alluvial character in the riverine tracts of Luni and its tributaries in Pali and Jodhpur, and Katli and Sabi in Sikar and Jhunjhunu districts, and has become highly fertile and productive. Here settlement is becoming moderately continuous and dense, and is characterised by large, prosperous and compact type of villages.

The others, i.e., Red Sandy, Clay Loam, Red Sandy Loam, and Loam (Alluvial Types) soils, are limited in their extent and less important for the location of settlements. However, the loam (Alluvial type) is significant of cultivation as for large and prosperous rural settlements in the tehsils of Neem-Ka-Thana and Khetri.

(B) Land Utilization :

Water and soil are basic to agriculture : consequently the scarcity of water and infertility of much of the soil in the region limit crop potential. The net sown area was only 39.5 percent of the total geographical area. The rest was either not available for cultivation or cultivable waste or fallow land or under forests. The forest cover is negligible, covering only 0.63 percent of the total area.

Land utilization⁶ data at district level is illustrated in Table. In the northern and north-eastern districts, and

⁶It is based on standard classification as laid down by the Ministry of Food and Agriculture, Govt. of India. A clarification is necessary of the following terms : Area not Available for Cultivation means all land which is barren or uncultivable covered by buildings, water or roads or otherwise appropriated for non-agricultural purposes. Other Uncultivated Land Excluding Fallow Land shows land available for cultivation but not taken up and includes cultivable waste, permanent pastures and other grazing land and land under miscellaneous tree crops and groves Fallow land includes current fallow, i.e., land which is left fallow during the current year only and other fallow lands which were taken up for cultivation but are temporarily out of cultivation for a period of not less than one year and not more than 5 years. Net Sown Area is not the total cropped area (which includes also areas sown more than once with net sown area). The area sown more than once is only 0.63 percent of the total.

TABLE 5
Land Utilization Fig. in %

District	Forests	Not available for cultivation Land put to Non-Arqi.	Barren & uncultivable	Other pasture etc.	Culturable waste ex. Fallow Land	Fallow other than Curr.	Land Curr. Fallow	Net Sown
Barmer	0.03	2.4	5.3	6.9	11.5	19.0	10.5	43.98
Bikaner	0.3	3.6	0.06	0.07	65.4	8.5	3.8	16.30
Churu	-	5.5	-	1.1	10.0	11.7	8.1	63.38
Ganganagar	-	4.0	-	-	26.6	2.7	9.8	55.70
Jaisalmer	-	1.2	42.1	2.0	43.5	5.6	1.1	4.00
Jalor	0.04	3.1	9.3	4.6	2.5	10.2	11.8	58.04
Jhunjhunu	2.8	1.5	6.9	7.9	1.5	1.0	2.9	75.10
Jodhpur	-	3.4	6.9	5.1	3.3	27.4	10.6	43.40
Nagaur	-	4.2	5.2	3.0	0.8	9.6	16.4	60.70
Pali	4.90	4.0	13.0	6.6	1.6	15.1	12.3	42.33
Sikar	1.00	2.8	8.3	6.6	2.7	2.4	8.1	68.4
Total	0.63	3.1	11.6	3.4	22.5	11.2	8.0	39.55

Based on Statistical Abstract Rajasthan. 1981

amount of net sown area is greater than elsewhere. The minimum occurs in Jaisalmer which is completely dry and sandy. Forest cover is significant only in the sub-montatneous of Pali, Jhunjhunu and Jalor districts. It is significant to note that the extent of cultivable waste and the fallow land is 41.69 % which may be cultivated if water is available.

In the district of Ganganagar, the net sown area is 55.65 % the land which may be put to cultivation amounts to 39.07 % and the rest is not available for cultivation. In the Shekhawati region, the pattern is different mainly due to a decreased water supply and Sikar district is representative. Here 68.38 % of the land is under cultivation, the land which may be put to cultivation is 13.25 % and land not available for cultivation is 12.33 % which is quite high in comparison to Ganganagar.

Futher south in the Luni river basin, the pattern is again different. Out of the total area, roughly 43.0 % is net sown area and the land which may be put to cultivation is about 35.0 % dependant upon an adequate supply of water. The percentage of land not available for cultivation is quite high (15.0 %), while land under pastures is 6.0 %.

In the Great and Little deserts and Magra regions, the net sown area is very less since there is no possibility of water supply. Jaisalmer district has only 3.94 % of net sown area. However, 50.22 % land could be put to cultivation should water supplies become available. The proportion of land not

available for cultivation is 43.3 % which is due to the barren and sandy nature of the tract.

The region has distinct possibilities of increasing the extent of cultivation if adequate water is provided. For example in Ganganagar district before 1927, the land use pattern was similar to that in the districts of Bikaner and Jaisalmer but the supply of water from the Gang Canal system brought about major changes. Similar changes have been envisaged in the area which is to be served by the I.G. Canal system. The possibilities of bringing changes in the central Magra region are very rare, however, as the water supply is deep underground and there is no prospect of getting water from outside the region. The outlook is good for Luni river basin, especially in the Upper basin or along the natural water courses.

(C) Cropping Pattern and Settlement :

How the land is cropped affects settlement? Since the region is subject to frequent famines and droughts, there is a natural tendency to concentrate on growing food crops in order to safeguard against any calamity. There are few industrial crops. Settlement is consequently made up mainly of villages of self-subsistent farmers. Mills are mainly for food or fodder crops and there are few cotton or sugar-cane factories.

The crops are grouped into Kharif and Rabi, related to the two important growing seasons. Further, on the basis of

irrigation, the crops are divided into Barani (non-irrigated) and Non-Barani (irrigated). The system of double cropping is very restricted except in the irrigated areas, and accounts for 0.63 % of the total cropped area. Species of crops are themselves divided into the following major categories: Food crops, Pulses and gram, Oilseeds, and Others (include a wide variety of produces, e.g., cotton, sugar-cane, tobacco, fruits and vegetable, spices and condiments, etc.).

The autumn (Kharif) crops are more important than the spring (Rabi) crops, and can be noted by the insignificant amount of double cropping. The Kharif crops are almost dependent on rainfall during rainy season. Since the rainfall is erratic and uncertain, the Kharif crops are frequently damaged. Most of the rural settlements, except those in northern and north-eastern parts depend for their well-being on Kharif crops. Food crops account for 65.1 % of the total acreage. Of the food crops, Bajra is the most important Kharif crop, both in terms of area and amount of production. It occupies 54.6 % of the total acreage and 41.3 % of the total production. Second in importance is Jowar, which is also a Kharif crop, accounts for 4.4 % of the total acreage and 1.8 % of the total production. Wheat is the third major food crop, but in the Rabi crops it is the principal crop, and accounts for 4.2 % of acreage and 12.1 % of total production.

Pulses and gram form the second group and cover 28.1 % of acreage and account for 26.0 % of production. Most of them are Kharif crops, except gram. Oilseeds 5.0 % of total acreage

and 3.0 % of production, include a wide variety and are grown both as Kharif and Rabi crops. Among others crops, cotton accounts for 1.0 % both in acreage and production, sugar-cane is limited to highly irrigated areas, and the region is quite important for various types of spices and condiments. Fodder crops are limited in acreage and production, as fodder is mainly derived from cereal crops, e.g., bajra, jowar, wheat and barley etc.

The areas which have successful cultivation of both the crops, Kharif and Rabi, e.g., Ganganagar, Pali, Sikar and Jhunjhunu districts have dense settlement pattern with medium to large villages and numerous towns. The case of Ganganagar is important to note. Here the Rabi crops are more important and the commercial crops like cotton, sugar-cane and tobacco occupy significant place in crop production. This cropping pattern based on canal irrigation has resulted in prosperous villages and very active commercial mandi towns.

(a) Major Crops :

The region has a great variety of crops⁷. Food crops, however, are the only crops which have a direct consequence

⁷ Food-crops : Bajra, Jowar, Maize, Wheat, Barley, Small millets, Rice;

Pulses : Gram, Arhar, Moong, Urad, Masur, Peas, Moth, Chanwla,

Oilseeds : Ground-nut, Mustard, Rape-seed, Tori, Rye, Linseed (Alsee), Sesamum Castor-seed, and other;

Spices and Condiments : Zeera, Dhania, Chillies ;

Others : Sugar-cane, Cotton, Tobacco, San hemp, Poppy head;

Fodder crops : Barsim, Rinjka and other like Jowar, Bajra, Maize, etc.

TABLE 6

Principal Crops. A: Area in '000 hectares and P: Production in '000 Tonnes

District	Bajra	Jowar	Maize	Wheat	Others Barley Rice etc.	Pulses and gram	Oilseeds	Others
Barmer	1014.4	4.8	0.017	8.7	0.33	27.6	14.3	0.3 A
	256.9	0.6	0.015	3.4	0.36	12.6	1.3	0.2 P
Bikaner	218.6	0.9	-	0.2	0.04	242.9	20.0	- A
	34.1	0.1	-	0.2	0.02	52.3	1.4	- P
Churu	429.3	1.5	-	0.3	0.08	442.1	4.4	- A
	61.6	0.2	-	0.3	0.04	111.5	0.3	- P
Ganganagar	161.7	25.4	1.4	139.4	41.33	549.0	24.8	110.5 A
	48.4	3.5	1.3	106.2	22.10	222.8	7.2	265.9 P
Jaisalmer	164.9	7.9	-	1.3	0.05	0.1	0.9	0.1 A
	25.5	0.9	-	1.2	0.06	0.02	0.08	0.1 P
Jalore	351.0	4.9	1.0	36.5	7.6	25.2	36.6	2.1 A
	127.5	0.6	0.9	37.8	3.1	4.8	2.7	1.0 P
Jhunjhunu	209.7	0.8	0.03	2.7	7.7	167.5	4.0	1.0 A
	40.2	0.2	0.02	2.9	9.0	24.9	0.8	0.9 P
Jodhpur	609.9	50.7	0.2	24.9	1.9	195.4	43.2	2.9 A
	86.1	5.0	0.2	27.1	1.4	31.3	4.1	1.7 P
Nagaur	522.1	102.2	0.7	31.3	8.5	259.8	90.1	1.3 A
	145.7	15.9	0.7	23.0	13.4	26.2	10.9	1.3 P
Pali	129.9	126.5	25.6	62.8	31.7	26.1	120.4	11.3 A
	31.0	12.5	14.4	55.3	27.3	12.3	14.0	7.7 P
Sikar	261.4	0.4	0.5	8.2	17.4	149.0	12.9	1.1 A
	69.1	0.1	0.4	8.9	31.5	23.7	5.1	3.0 P
Total	4072.8	326.1	29.3	316.4	116.1	2084.9	371.5	130.5 A
	926.1	4.6	17.9	271.3	108.4	5522.4	67.8	283.9 P

Based on Statistical Abstract Rajasthan, 1981

on the regional distribution of population, whereas commercial crops like cotton, sugar-cane, tobacco and oil seeds (which account little both in terms of acreage and production) are principally relevant to the industrial aspects of the region. Among the food crops, Bajra and Wheat are vital. Since these are the principal food crops, their distribution tells about the population distribution in the region.

(b) Bajra (Cumbu Pennisetum Fyphoideum) :

Bajra is an inferior type of cereal, mostly used by poor people and some of it also used as fodder crop. It is the most important crop of the region. An autumn crop (Kharif) it is widely sown with the first rain to the monsoon period, in areas of poor climatic and soil conditions. After 70 to 90 days it is harvested in September/October. Irrigation is not needed but careful tillage and weeding are required and it is usually grown with pulses, e.g., moong, moth. The average yield is 215 Kg. per hectare.

The total acreage under Bajra was 4,073,000 hectares in 1981, and the total production was 926 tonnes. At district level, Barmer is the most important, with 1,014,413 hectares, which is approximately 25 % of the total area under this crop in the region. The distribution of Bajra brings out two facts.

- (i) The areas of great concentration are the south-west parts of Barmer, Jodhpur, eastern parts of Jaisalmer, north-east Nagaur, and south Churu districts. These areas have small to medium types of villaves with smaller farm buildings and less well-developed rural landscape.

(ii) The areas of less concentration are south-east Pali, irrigated parts of Ganganagar, and the western most parts of Jaisalmer and Bikaner. In these areas the other crops like wheat, cotton, sugar-cane and tobacco are more important and due to these villages are more prosperous and large in size.

(c) Wheat (Triticum sativum) :

This is a spring (Rabi) crop sown during October/November and harvested during April May. It accounts for 4.2 % of the total cropped area and 12.1 % of the total production, while the average yield ranges between 900 and 950 Kg. per hectare. It is grown on a wide variety of soils, although the sandy or saline or alkaline soils of the western areas of the region are not good for cultivation. Since rains are scanty and erratic in the region, therefore, the irrigated areas are only suitable for it. The two important areas wheat cultivation are (i) irrigated areas of Ganganagar in north, and (ii) the Upper Luni basin in south-east, where the soils are good, rainfall between 400 and 500 mm. and supplemented by well and tank water. A negative area is confined to Churu, Bikaner, Jaisalmer and southern Barmer.

The wheat cultivation is mostly based on irrigation. The cultivation in wheat areas is intensive and limited to fertile soil. The villages are better equipped with sowing and reaping equipments. The rural landscape is well developed more prosperous than the other crops areas. The villages are medium to large and well connected with neighbouring towns.

The house types in wheat areas gives more prosperous look than of Bajra areas.

3.2 Animal Husbandry :

Animal husbandry is a major economic activity and not an adjunct to agriculture. In this arid and semi-arid region, it is the second biggest sector of the economy, next only to cropping agriculture. It also supplies raw material for small scale industries. The total livestock of the region accounts for about 41 % of the state of Rajasthan, and 4 % of India in 1981. It is the only region where in 1981 the livestock population exceeds human population. The average density is 86 per sq. km., whereas the population density is 65 person per sq. km. Its and then in the farms and villages of the mixed-farming areas.

(A) Composition of Livestock :

The region has a great variety of livestock, including some of the best breed of India. Among the breeds of cattle, Haryana and Sanchoe (Kankrej) are good as milk and draught animals; Tharparkar and Gir are good milk breeds, whereas Nagaur breed is the best draught cattle in India. Nagauri breed is in great demand throughout India and it fetches higher price than any other breed.

There are four breeds of sheep-Magri, Marwari, Jaisalmeri and Chokla which are important for wool. Others are Sonadi, Malpura, Poogal and Nali breeds. Chokla is regarded as the

TABLE 7
Distribution of Livestock

District	Cattle	Buffaloes	Sheep	Goats	Others	Total
Barmer	11.8	2.6	13.5	25.1	16.5	2425123
Bikaner	6.6	4.0	9.9	3.0	7.2	1223740
Churu	6.5	11.8	6.6	6.0	13.2	1383120
Ganganagar	9.0	19.6	6.6	5.5	18.1	1665986
Jaisalmer	6.7	0.1	10.7	5.3	6.9	1299231
Jalor	8.7	8.6	9.3	8.3	4.1	1506057
Jhunjhunu	4.7	9.1	5.0	6.9	8.9	1216462
Jodhpur	12.1	5.8	11.1	9.7	7.9	1769130
Nagaur	13.0	11.4	9.1	9.5	5.8	1854328
Pali	13.5	15.2	11.3	11.0	4.4	2054174
Sikar	7.3	11.3	6.7	6.9	7.1	1508874

Source : Livestock Censuses, Board of Revenue, Govt. of Rajasthan, Jaipur. 1981

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best and is known as Indian Merino. Among goats, the important breeds are Sirohi Marwari and Lohi. The Jaisalmeri and Bikaneri are the two important breeds of camels.

There is remarkable effect of the composition on rural landscape in several ways. For example, the Rathi tract which is confined to the northern half of Jaisalmer and the western half of Bikaner has predominance of sheep, goats, camels, etc. which are mainly bred by nomads. In this tract, many of the settlements are of semi-permanent nature consisting of jhopas (round thatched huts) and dusty lanes and thorny fences. Contrary to this, the Nagaur tract is important for cattle and here the animal husbandry is the primary source of livelihood. The rural landscape comprises better houses and good grazing land. The settlements are of permanent nature. Similar to this, the Great Haryana tract, which is confined to the districts of Sikar, Jhunjhunu Churu and eastern parts of Ganganagar, has predominance of good milk and draught cattle. The rural landscape is rich as well as diversified because of good cultivated land and pastures. Every village has grazing lands and the cultivation is limited to good soil areas close to wells. The settlements are bigger and have better houses.

(B) Regional Density Pattern :

The pattern is the same as that of the human population. Areas of high density of livestock are also the areas of high density of human population. (i) Areas 198 and above livestock

per sq. km. are confined to hilly tract of Aravallis in south-east and north-east parts of the region. This is so evident in the landscape in the many cattle pounds, in the dyres, in the markets for the sale of cattle and there are many villages which are important for annual and semi-annual cattle fairs.

(ii) Areas 148 to 198 per sq. km. are in Jalor and Ahore tehsils of Jalor district, eastern tehsils of Nagaur, whole of Sikar and Jhunjhunu districts, except Sri Madhopur tehsil. In these areas, the high density is due to an adequate supply of water and enough grazing facilities.

(iii) Areas with 59 to 148 livestock density per sq. km. are confined to central tract from south to north.

(iv) Areas with low density between 37 and 59 per sq. km. are confined to western parts, i.e., in Bikaner, western half of Churu, northern half of Nagaur, Phalodi tehsil of Jodhpur, Sheo of Barmer, and Fatehgarh of Jaisalmer.

(v) Areas with a density below 37 are confined to Jaisalmer except Fathgarh and Pokaran tehsils. In these last two regions, although livestock density is low, the countryside is typical livestock land, with much rough grazing, with nomadic camps and thorny fences.

(C) Livestock Products :

Milk and milk products, mutton, wool and hair, bones and bone manure, hides and skins are the main products. These products are processed locally and could not develop creameries, ghee making factories and tanneries. There is no beef production as the slaughter of cows, in accordance with the Hindu religion,

has been completely prohibited in the state of Rajasthan. There is no systematic survey of the livestock products of the region and it is difficult to assess its contribution towards the economy. However, in the major portion of the region, animal husbandry contributes a great deal to the income of the farmers. Further, Animal husbandry is important in influencing the rural landscape and the types of houses. In areas of dense livestock population, the rural landscape consists of sufficient grazing land, typically dusty lanes connecting the village with the grazing areas, thorny fences for keeping cattle in the night and separate covered spaces in the houses for keeping fodder etc. The region is a net exporter of livestock and livestock products like wool, skin and hides, bones, and ghee (purified butter), while there 2078395 working cattle, providing draught power for farming and transport. Of the 1622041 cows and 656374 she-buffaloes giving milk in 1981 the average yield was 321 lbs and 667, respectively, giving a total production of 971 mill. lbs of milk with further additions from she-goats and sheep. Mutton is an important product of the region and in 1981, 304786 goats and sheep were butchered.

One of the principal sources of income is from the sale of wool. The region is one of the principal regions for sheep rearing in India. Especially, in the western parts of the region, sheep rearing has greatly affected the rural landscape by the existence of sheep enclosures made of thorny fences,

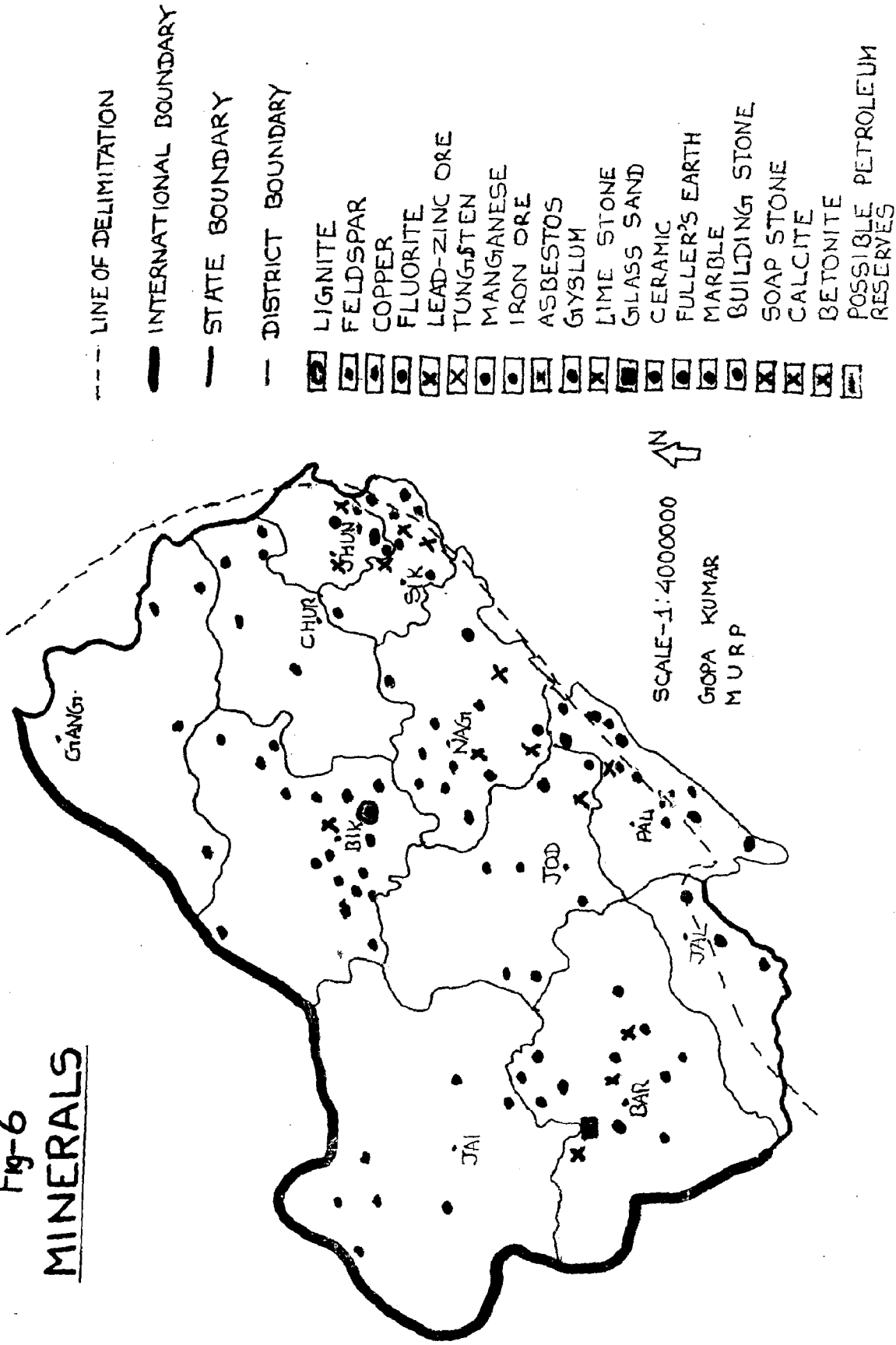
wool sheds, adjacent to living rooms, and dusty lanes leading to grazing areas. In the towns, there are wool depots, small scale wool-bailing processes and wool-selling marts. Sheep of the region are famous for producing the best type of carpet wool. Total production of wool is roughly 25 million lbs. which is 34 per cent of the total production of India. Most of it is meant for export. The total value of the livestock products of the region is roughly 700 million rupees.

Animal husbandry is important, as it decides the nature of pastoral villages, especially in the western areas of the region, therefore, the future development of livestock is essential in order to improve the economic base of rural settlements. The future development of livestock can be achieved by improving the breeds, controlled grazing and reduction of nomadism, developing commercialised dairy industry and industries based on livestock products, and by establishing more up-to-date veterinary hospitals and dispensaries.

3.3 Mineral Resources :

In a dry region like the Rajasthan desert where existing agriculture is precarious, the minerals are bound to be of great importance in its economic development. This region has a limited mineral wealth. However, the range of geological formation from ancient crystalline rocks to recent

Fig-6
MINERALS



alluvium includes some which have a wide range of minerals. Apart from locally important minerals like salt, gypsum, lignite, copper, Fuller's earth and ceramic minerals, and a variety of building stone, there are minor deposits of iron-ore, lead, zinc, tungsten, manganese, clacite, bentonite, asbestos, graphite, glass sand and feldsper. Recent prospecting has indicated a possibility of finding petroleum reserves in the western parts of the region,. Except for salt, gypsum and lignite, the region does not stand comparison with other regions of India.

The mineral industry is not a major means of livelihood. Only 1.17 per cent of the total population is engaged in mining and quarrying. Poor transport facilities, lack of basic data, crude mining methods, and poor planning and administration are some of the factors which are detrimental to its growth. Furthermore, there is no demand within the region as most of the industries are not mineral-based. Most of the minerals are extracted to meet the demand from other parts of India. The minerals of the regions are grouped in three categories, i.e., mineral-fuel, metallic minerals and non-metallic minerals. However, only those minerals have been discussed, which are economically significant.

(A) Mineral-Fuels are deficient:

However, lignite reserves, associated with rock formation of Middle Eocene (Tertiary) period, are estimated at 35 million

tons. Exploration of the lignite started in 1998 at Palana ($27^{\circ}51'$ N and $73^{\circ}19'$ E) situated 23 kms. southwest of Bikaner city. Other occurrences near Bikaner are at Khari, Gangasarowar, Mudh, Channeri and Desnoke. The seams are found at an average depth of 64 m. and vary in thickness between 12 m. and 4.5 m. The average annual production is 3 39460 tons for the period between 1940 and 1981.

The local importance of the lignite resources cannot be over emphasised since it is the only natural fuel available and it is costly to bring coal from the Chota Nagpur region of Bihar. It is used for generating thermal power at Bikaner and Ganganagar. In this area, the lignite mining has enhanced the importance of Palana, which are previously a small village. Now it has developed colony of miners, an established market and a busy railway station. The lignite resources have further affected the small scale industrial development in the city of Bikaner and Ganganagar. The further prospects for lignite are locally important. A committee of Experts headed by Guha was appointed in 1958 to examine prospects. In 1959, it recommended that high priority should be given to surveying the possible large reserve of better grade lignite in the belt running north-west and south-east near Bikaner and assessed the importance of the deposits for developing a briquet plant, under-ground gasification plant, fertilizers plants, high-grade refractory wares, Fuller's earth pulverising plant, perlite and other synthetic products plants,

A sizeable chemical industry on the lignite, gypsum and salt resources is possible.

(B) Metallic Minerals :

There is a large variety of ores in the region, e.g., copper, iron-ore, lead, zinc, tungsten, manganese, beryllium, and wolframite, but, except for copper, these are industrially insignificant. Most are confined to the Delhi system of rocks in the north-eastern part of the region, i.e., in the Khetri-Singhana-Neem-ka-Thana area in the districts of Sikar and Jhunjhunu.

The only important copper producing area (Khetri-Singhana) is located in Khetri tehsil of Jhunjhunu district, where copper mining is very old. It is also found in Pali district, north-west of Sojat town and in southern Churu district, south of Sujangarh town but these are not exploited. Khetri-Singhana copper area has total reserves of about 40 million tons of low grade copper ore with a copper content between 0.8 and 2.5 per cent. It occurs in a belt, about 24 kms. in length running north-south from Singhana to Babai.

(C) Non-Metallic Minerals :

The region is rich in non-metallic mineral deposits and the future is primarily based upon these minerals. Gypsum, salt and Fuller's earth are significant products but there is no complete inventory and they have been worked irregularly. In the absence of local industries, much of the

production of these non-metallic minerals is exported outside the region. Their mining, however, has been responsible for the origin and growth of small settlements.

Gypsum has become growingly important. In 1981 more than 64 per cent of 1,18 million tons of gypsum production in India came from Rajasthan. The deposits, in massive amorphous or in crystalline forms occur in shallow depressions covered with sand, and is locally known as 'Khaddi or Mitha Chuna'. The producing areas are widely scattered in the districts of Bikaner, Nagaur, Churu, Ganganagar, Jaisalmer, Jodhpur, Barmer, Jalor and Pali. In these areas small mining settlements have developed. The estimated reserves are 79 million tons for Bikaner, 38.5 million tons for Jodhpur, 1.5 million tons for Jaisalmer and about 305 million tons for Nagaur areas.

The importance of gypsum lies in its use for fertilisers, cement and other products. Demand will increase within the state with the construction of proposed Hanumangarh Fertiliser Factory and two newly proposed cement factories, but also from other parts of India.

Fuller's earth is found in the Tertiary rocks and is important in textile manufacturing. Annual production is 9000 tons, equivalent to 90 per cent of total production of India, and the reserves are more than 200 million tons.

The main occurrences are in Bikaner district at Palana, Kesardesar and Mudh; in Barmer at Kapurdi and Sheo; at Mandha and Mandai in Jaisalmer ; and minor deposits in northern partsof Nagaur district.

Most of the production is sent to other parts of India. Provided power is available, however, activation plants could be established at Barmer and at Sri Kolayatji in Bikaner.

Clays composed of hydrated aluminium silicates, are widely found in Sikar, Nagaur, Barmer, Jodhpur, Jalor and Bikaner districts, and are the principal Ceramic minerals. A ceramic industry could be developed at many places like, Bikaner, Jodhpur, Barmer and Pali. The clay mining has enlarged the pre-existing villages. However, it has not created new settlements.

Feldspar occurs in the Aravalli and Delhi systems of rocks, in the pegmatite beds, and is used as a flux in ceramic bodies. The main occurrences are confined to Pali district at Chaondiya, Phulad, and near Buchera in Sikar district. Reserves are not fully surveyed but are sufficient for developing a large scale industry.

Among non-metallic minerals, others like Bentonite, Calcite, Soapstone, Asbestos, Fluorite and Glass sand are mined in small amounts and they are important locally. They have increased the importance of many rural settlements, e.g.,

Gunga and Bhadres (Bentonite); Maonda and Paparna (Calcite); and Dariba (Soapstone).

(D) Building Stone, Limestone and Marble :

The region has plenty of building stone of fine quality. Some of the best sandstone is quarried at Khatu, Ladnu and Nagaur (Nagaur district); Jasai in Barmer; Bidasar in Churu; Amarsagar in Jaisalmer; Raghunathgarh, Rewassa, Kali-Doongri and Palsana in Jhunjhunu and Sikar districts; and Fidusar and many other places in Jodhpur district. Fidusar quarries near Jodhpur city are the largest in the region and produce the best quality sandstone. This has been used in many important buildings of India. Similarly, red sandstone from Nagaur district was widely used during the Mughal times for palaces and forts in Delhi and Agra. Yellow limestone quarried near Jaisalmer is a prized stone for ornamental carving. The best examples are in Jain temples and in nicely carved front balconies and arch-ways of houses in Jaisalmer town. The reserves of the widely scattered quarries are sufficient to meet the increasing demand. The major barrier to further development is the lack of approach roads.

Limestone is quarried at hundreds of places, and has been widely used in a limemaking industry. Important occurrences are at Maonda (Sikar), Dabla (Jhunjhunu), Sojat (Pali), Bilara and Gotan (Jodhpur), Mundawa (Nagaur) and Nokha (Bikaner). Marble from the region has been famous for centuries as the

best marble in India. The Taj Mahal and other big buildings like Victoria Memorial (Calcutta) were build of marble from Makrana quarries in Nagaur district. Other occurrences are in Jaisalmer for yellow marble, Rupi in Jalor and Maonda in Sikar.

The Makrana deposits which are the largest, running 20 kms. in north-north east to south-west-south direction, near Makrana railway station. There are about 200 quarries, some of which have been worked to a depth of 30 to 45 m. The individual beds are of varying thickness upto 2 m. High quality white marble is obtained at Chosira, Bhool and Paharkua. Pink marble is also available from Kala Dungri locality. About workers are employed in these quarries but the number varies with the season. There are 20 sawing and grinding factories and 300 'Badas' (small cottages) where workmen earn a living by marble carving and polishing. Makrana town, with its population, depends upon marble.

The region has large Salt resources but as they form the basis of a widespread industry, they are discussed later in the section on industry itself.

3.4 Industries :

Since agriculture occuppies so much of the population and there is as yet little development of fuel and power, and since transport is lacking, the region has not gone in for much manufacturing. Most of the industries are small-scale cottage types. Even the larger scale industries are only

relatively so They are subsidiary to the agriculture and livestock economy and are intimately connected with agro-livestock products. Their growth and decay is primarily controlled by good or bad seasons. Industries based on mineral resources, except the salt industry, do not account for much, and there is no industrial landscape in essence. Nevertheless, industries support about 10.1 % of the population. It is also worth mentioning that although some of the big industrialists of India are natives of this region, they did not try to establish industries here.

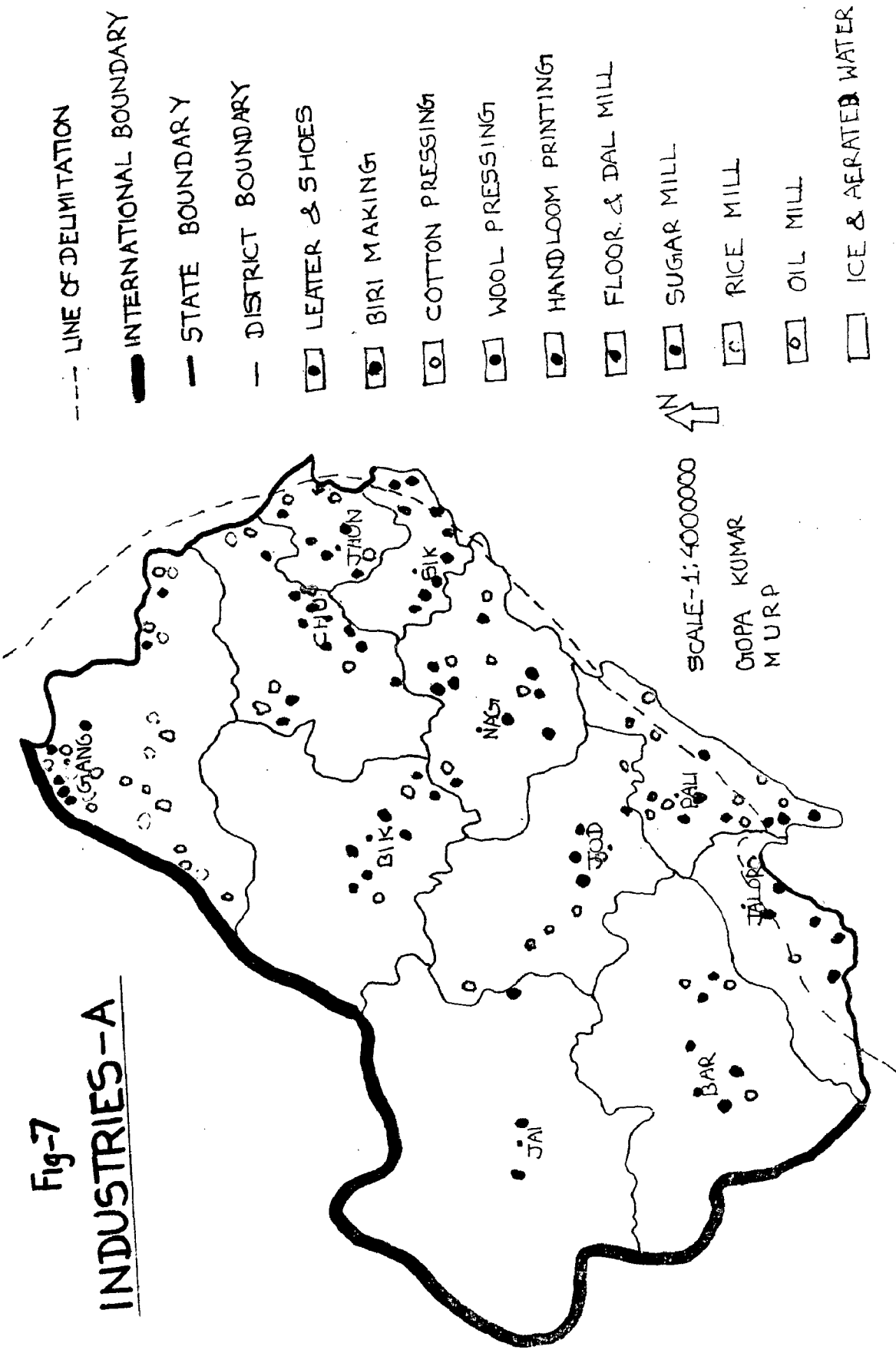
The location of various industries indicates that the south-eastern parts in Pali and Jodhpur and north-eastern parts in Sikar, Jhunjhunu and Churu districts have a concentration. There are isolated nodal centres in the central part of the region, e.g., Ganganagar, Bikaner, Nagaur, Barmer, Bhinmal, Raniwara, and salt producing centres like Pachbhadra, Phalodi and Didwana ; The western part of the region is devoid of industries except village household industries catering for the needs of the local population.

The industries are grouped into the following categories :

Group I Crop-based industries : Cotton textile, Cotton ginning and baling, Handloom and Calico printing, Sugar making, Flour and Dal (pulses) milling, Rice milling, Vegetable-oil making, etc.

Group II Livestock-based industries : Wool baling and pressing, Wool blanket making and wool cleaning, Leather and Hide, and Shoe making, etc.

Fig-7
INDUSTRIES-A



Group III Mineral-based industries : Salt industry, Chemical industry, Soap making, Glass and Pottery, Stone dressing and crushing etc. are included.

Group IV Miscellaneous : Biri Making, Saw mills, Furniture, Match making, Printing presses, Salema and Gotak making, and Small-scale Engineering industries.

(A) Crop-based Industries :

The cotton industry is one of the oldest industries of the region. In the form of small-scale cottages industry, it is wide spread; on a large scale, there are only two important centres, viz, Ganganagar and Pali. Pali district, with its Sumerpur, Bali, Desuri, Sojat centres ; the district of Jodhpur with Jodhpur and Bilara centres; the district of Sikar with its Sikar centre; and Ganganagar district with its Anupgarh, Raisinghnagar, Sri Karanpur, and Ganganagar centres, are cotton producing areas of the region. Most of them are cotton-ginning and baling centres.

Sri Sadul Textiles Mills Ltd. at Ganganagar has 25,300 spindles, 380 looms and 1,353 workers, Sri Umaid Cotton Mills Ltd. at Pali has 20,843 spindles, 442 looms and 2,250 workers. Among the important handloom small units, the city of Jodhpur has 4, Churu 4, Bikaner 3, Pali 2, Sujangarh and the others like Raniwara, Sikar, Ratangarh, Ganganagar, Ladnu and Barmer have one each. The larger mills, especially in Ganganagar and Pali towns, have affected the townscape. These mill are the prominent units of the landscape and occupy the outskirts, marked with smoke chimney and labour colony.

Many centres are also important for printing (Calico-printing) and tie-dyeing of cloth, including Jodhpur, Nagaur, Ladnu, Barmer, Balotra, Sujangarh, Jhunjhunu, and Sikar. Through tie-dye process they bring out beautiful colour printing of cloth and the region is famous. The Handloom Development Board has encouraged the growth of these small units.

Sugar production forms the second crop-based industry, but with little significance on all India level. Most of the sugar making is in crude form, producing Khandsari and gur and located in the sugar cane producing areas.

Oil making is a very old practice, and on a small scale (Ghanis) it is universally attached to towns and big villages in the oil seeds producing areas. A power-driven, big oil making unit is located at Ganganagar with about 200 workers. It occupies the place on out-skirts, and makes an important unit in the industrial landscape of Ganganagar.

(B) Livestock-based Industries :

The large number of livestock supply plentiful raw materials. At local level, small workshops have sprung up everywhere to meet the local demand. The average annual production of hides is 1.63 million of sheep and goats skins, respectively. Processing of hides and skins is done by traditional methods, and on a very small scale. However, there are some centres of regional importance, e.g., Bali,

Sumerpur, Jalor, Bhinmal, Barmer, Jodhpur and Merta in south-east Sikar, Nagaur and Ganganagar in north and north-east; and Pokaran in the western part. The centres at Jodhpur, Pali, Nagaur and Ganganagar have small factories employing 20 to 25 workers and use better techniques. In these towns these tanneries are located in special quarter on the outskirts. The workers form distinct and typical low caste residential areas. Most of the tanned hides and skins are exported to other parts of India, especially to Agra, Kanpur, Calcutta, Delhi and Bombay. However, there is a local demand for the consumption of hides and skins for manufacturing of leather goods at Jodhpur, Bikaner, Sikar, Ganganagar and Pali.

The shoe-making industry produces indigenous footwear and it is essentially of local importance. There are centres well known for embroidered slippers and nagras, e.g., Jodhpuri nagras are well known in India for their fine embroidery, others are at Bikaner, Sikar, Pali and Jalor. Ganganagar is important for Panjabi styled shoes, catering for the local Panjabi farmers of the area. Besides shoe making, there are other types of production e.g., kuppis (leather containers for oil and ghee), Charas (leather bucket for taking out water from the wells) and leather bags and saddles. In big towns and two cities of the region, the shoe-makers form a distinct row or street with low class houses in the urban landscape.

Wool Industry includes wool-cleaning, baling, pressing and wool blanket and carpet making. Blanket and carpet making is minor and indigneous and located at Bikaner, Jaisalmer and Sikar. The total production of wool is 25.2 million lbs., which was 34 % of total production of India in 1981. It is mostly carpetwool and most of it meant for export. Half of the total production is fine and fine-medium grade, which could be used in woollen textiles. Somehow the region has not developed a woollen textile industry, due to the lack of power, skilled labour and interest on the part of industrialists and government.

It must be concluded that the livestock based-industries have high potential; the tanning and wool industries if properly planned, will occupy an important part of the economy and the futrue prosperity of the region depends upon the proper utilization of large livestock wealth.

(C) Mineral based Industries :

The chemical, non-ferrous metal and metal based industries are included in this group. The salt industry is the obly large scale industry which deserves special attention.

The industry is basically localised where salt occurs in natural depressions. Sambhar, Didwana and Pachbhadra lakes are the major units, with minor sites at various places, e.g., Phalodi, Kuchaman, Pokaran, Sujangarh, Rewassa and Lunkaransar.

Sambhar lake accounts for 80 to 90 % of total production of salt from the region which in turn, is responsible for 10 % of total annual salt production of India. Individually, Sambhar Salt deposits are the biggest with more than 55 million tons of common salt reserves.

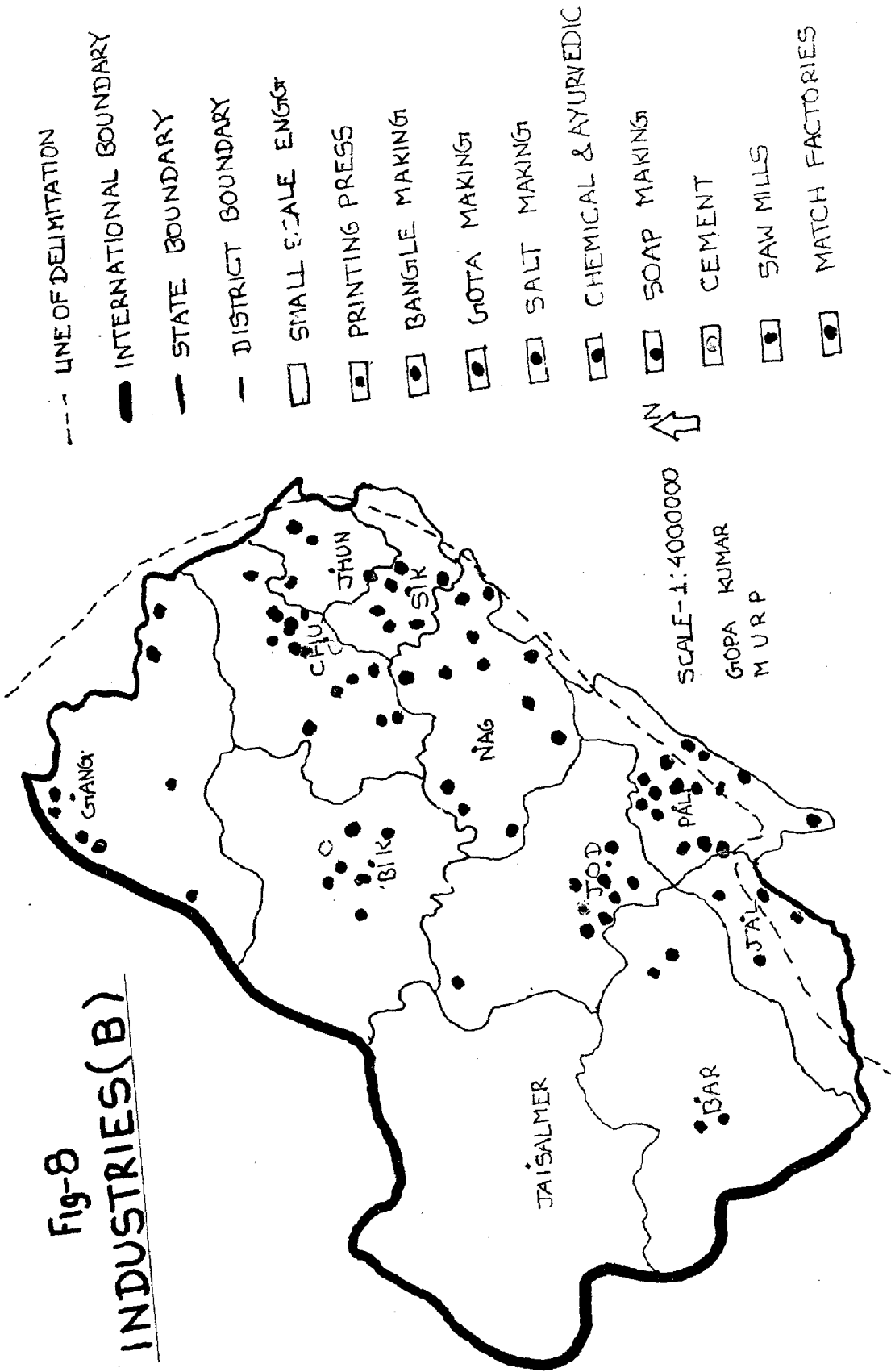
The manufactured salt is collected by bullock-cart and then sent to distant places by railway. Kuchaman and Nawa are developed as important commercial centres, and neighbouring villages are sound in their economy.

Didwan Salt area is an oval shaped depression of 10 sq. kms. located 50 kms. north-west of Sambhar lake. For the last 5050 years or more, salt making has been carried on by 'deswals' community who still make it under private agencies. The town of Didwana is the main collecting and trading centre. These deposits include borates, carbonate and bicarbonates, which increases their value.

Pachbhadra Salt deposits are situated 16 kms. north of Balotra town and 96 kms. south-west of Jodhpur. They are 12 kms. long, 11 kms. broad, and the catchment area is 1,036 sq. kms. The quality of salt is better than the Didwana deposits and the work is carried out by 'Kharwals' community under private agencies. This community has distinct residential area.

Besides common salt, there are good prospects for the production of by products like soda salt, soda ash, magnesium

Fig-8
INDUSTRIES(B)



salt, anhydrous sodium sulphate, borax and carbonates. A moderate size alkali industry could be set up in the Sambhar lake area. Further by-products would be useful in various industries like leather-tanning, electro-chemical and chemical, glass, oil making and agriculture.

Besides the salt industry, mineral based industries are virtually non-existent, although there are several but they can hardly be counted as industries of any significance. On the basis of lignite and the gypsum and Fuller's earth, industries like synthetic nylon and perlon, fertilizers, Fuller's earth pulverising plant, high grade refractory wares cement, ceramic, porcelain, glass, briquetting plant, soda ash, sodium sulphate, and other chemical plants could be located and developed in places like Bikaner, Ganganagar, Sambhar salt lake and Didwana salt lake, Pali, Barmer and Khetri.

For industries based on non-ferrous mineral like copper, lead, zinc, tungsten and asbestos, at present there are none although it would be possible to develop one plant for each mineral, but lack of power is the restricting factor, Khetri-Singhana-Neem-ka-Thana area in north-east has all the prospects for developing non-ferrous mineral based industries, essentially of regional importance, provided enough power is available. In the miscellaneous group, there are several small scale industries for meeting the local demand.

CHAPTER - 4

DEMOGRAPHIC CHARACTERISTICS :

The geographical conditions analysed so far have cumulative effect on the population and settlements of the region. The physiographic features, especially the vast extent of blown-sand explain the regional disparity of the distribution of population and the location of settlements. The arid and semi-arid climatic conditions do not allow the even distribution of population, as the river plains and irrigated parts have a lead over the rest of the region. The region is essentially agricultural-cum pastoral, therefore, the population and settlement distribution is mainly controlled by the regional disparities in agriculture and animal husbandry, e.g., the canal irrigated parts in the Ghaggar plains and better-watered areas of Luni basin and Shekhawati area are thickly populated with a dense network of settlements. Although minerals and industries are limited, yet they have sound impact on the regional location of settlements. The network of roads and railway is skeletal, but has profound influence on the regional distribution of population and settlements.

4.1 Population Growth & Density :

The study of population in retrospect is vital in deciphering the nature and trends of population growth, but the lack of statistical information handicaps any attempt in this direction. Any conjecture about the number of people

living in this region Pre-census period is doubtful although the historical and archaeological records show that the area was part of great Indus Valley civilization during the Proto-historic times (Circa 3,000 B.C. to Circa 500 B.C.). Even the Kautilya's Arthashastra (Shamsastry, 1915) composed in 3rd Century B.C., does not give any idea of number of people but mentions arid conditions and the precarious nature of rain-fed agriculture Sankalia (1952) says that 'Archaeology thus reveals'. The habitation belt, however, was probably once much broader, when the western and northern parts were not so arid as now. (p. 43-45). The two epics (Ramayan and Mahabharata) and Puranas (c. 500-400). have been acknowledged as a rich mine of geographical detail about India but they have no information about population of the region. The Proto-Rajput was an era of great turmoil due to invading Hunas and Gurjars, and living conditions were very difficult in northern and western India. From there people migrated to Rajasthan and settled.

In the late mediaeval or Rajput period (1200 A.D. - 1657 A.D..) the present fabric of population distribution had its beginning. Jodhpur, Bikaner, and Jaisalmer states were established. Later with the establishment of the Mughal Empire, economic and social conditions were improved and the region was divided into administrative units for revenue purpose.

By the year 1818, the region came under British suzerainty but in the first quarter of the Century, the people were in constant trouble due to the plundering activities of Marathas and Pindaris. Living conditions were difficult which resulted either in migration or concentration in bigger villages and towns.

The Census period started in 1881 and this period from 1881 to 1981 may be divided in two sections, 1881 to 1921, and 1921 to 1981, because of the nature of population growth. Up to 1921 the region had experienced decades of marked increase regularly alternating with decades of decrease, whereas, after 1921 there has been a continuous steady growth. The decrease in total population recorded in the 1901 and 1921 censuses were due to the great notorious famine 'Chhapania Akal' during the decade 1891 and 1901 and the great influenza epidemic of 1918-20 during 1911-21 census decade.

The decades 1891-1901 and 1911-1921 showed decreases of -14.5 and -8.17 %, respectively. The reasons for continuous increase after 1921 have been the relative better health the growing prosperity of the masses, socio-politically calm and peaceful times, the improved means of transport and communications, which have helped during scarcity and famine conditions and have led to an increase in cultivation and irrigation. The growth has confirmed and enlarged the main cities, led to an expansion in the transportation and manufacturing towns, and increased both the number and size of villages in the chief

TABLE 8

Variation of Population During Last 80 years (1901-1981)

A = Total Population B = % Variation

District	1901	1911	1921	1931	1941	1951	1961	1971	1981	
Barmer	313102	- 4.34	- 6.04	+ 9.53	+ 27.98	+ 20.98	+ 36.14	+ 31.61	1118892	A
									+ 30.84	B
Bikaner	190457	+ 3.57	- 3.93	+ 18.24	+ 34.29	+ 9.77	+ 29.55	+ 38.16	348749	A
									+ 38.20	B
Churu	260186	+ 15.05	- 0.09	+ 22.26	+ 24.56	+ 14.98	+ 25.95	+ 33.16	1179466	A
									+ 34.47	B
Ganganagar	143442	+ 43.66	- 17.22	+ 102.5	+ 54.58	+ 18.01	+ 64.64	+ 49.16	2029968	A
									+ 31.05	B
Jaipur	75207	+ 15.43	- 20.62	+ 13.60	+ 23.27	+ 13.06	+ 28.62	+ 29.61	243082	A
									+ 33.63	B
Jaisalmer	271363	+ 10.69	- 7.15	+ 15.77	+ 14.08	+ 14.95	+ 29.16	+ 29.18	903073	A
									+ 29.32	B
Jhunjhunu	341572	+ 3.05	- 4.32	+ 14.83	+ 21.08	+ 19.90	+ 22.24	+ 29.05	1211583	A
									+ 30.45	B
Jodhpur	424805	+ 2.47	- 12.05	+ 15.97	+ 25.36	+ 20.37	+ 31.67	+ 35.17	1667791	A
									+ 39.31	B
Nagaur	524217	+ 6.66	- 12.81	+ 16.61	+ 15.47	+ 16.37	+ 22.40	+ 30.27	1628669	A
									+ 33.92	B
Pali	393937	+ 15.94	- 11.67	+ 17.29	+ 17.44	+ 13.95	+ 21.91	+ 25.17	1274504	A
									+ 26.24	B
Sikar	466624	+ 0.60	- 1.46	+ 12.66	+ 17.93	+ 10.04	+ 21.09	+ 28.13	1377245	A
									+ 30.52	B
Total	3404812	+ 3.33	- 3.17	+ 20.00	+ 23.67	+ 16.77	+ 30.24	+ 31.15	13483022	A
									+ 32.17	B

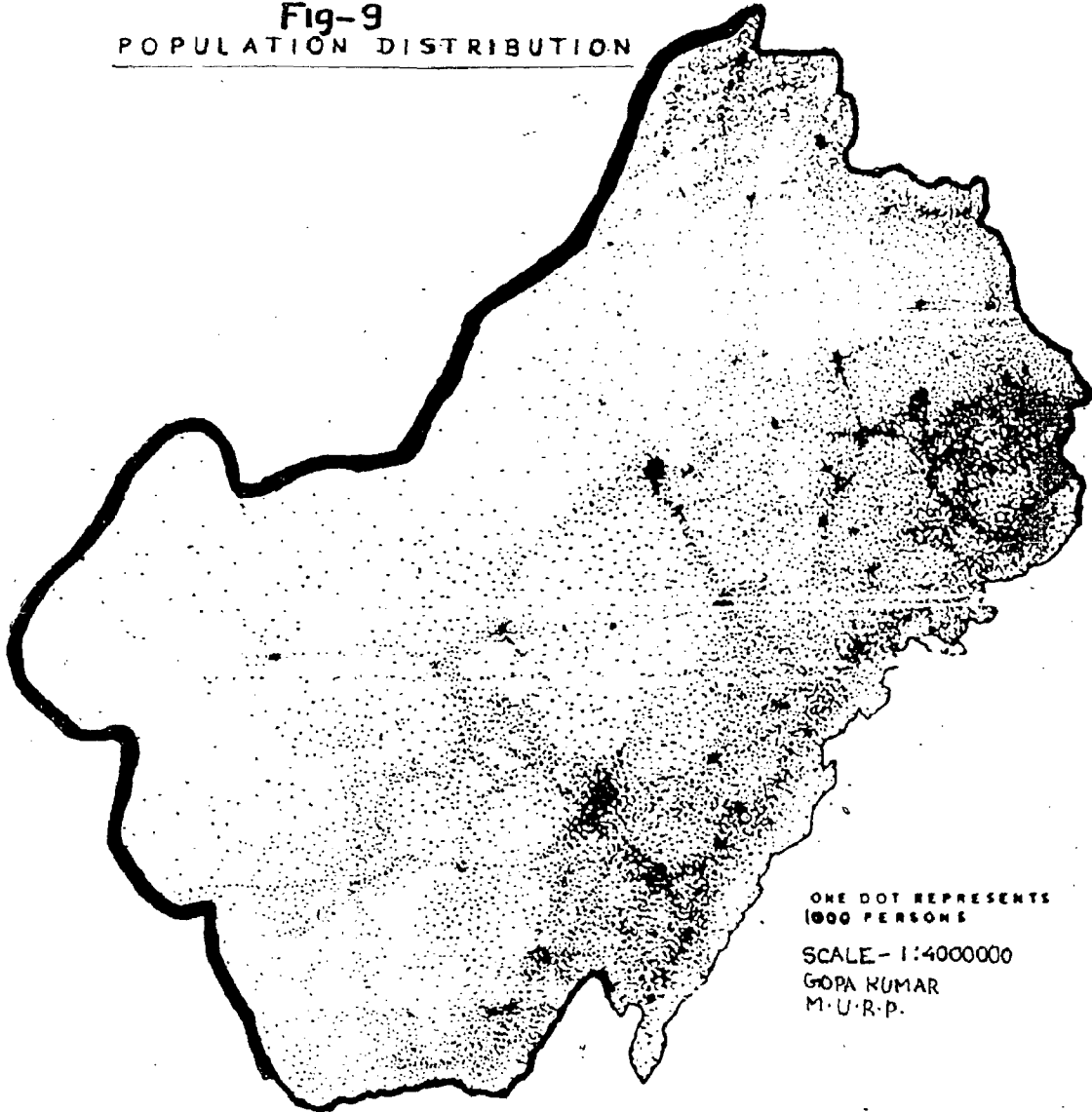
Based on Statistical Abstract Rajasthan, 1981

cropping areas. It has, however, been at the expense of most pastoral areas.

The Regional Distribution of Population clearly shows the influence both of the relatively unaltered and of the drastically changed environment. The map of distribution of population with a dot value of 1000 persons is prepared from various sources. Irrespective of quantitative assessment, this map gives an overall view of population distribution of the region. An imaginary line joining the town of Jalor in south with Jodhpur and Churu in north, demarcates the region of dense population in the east from the sparse and empty region of west with the exception of the northern parts of dense population in Gang canal irrigated parts of Ganganagar district. In the eastern more densely populated parts, there are areas of sparse population, running close and parallel to the eastern boundary. These are due to the hilly sub-region of Aravallis. South of the line joining Anupagrah, Suratgarh, Nohar and Bhadra and west of the line joining Barker, Phalodi, Bikaner, Sardarshahar, Taranagar, is the region of most sparse population. This conforms with the sandy Great the Little deserts and the rocky Magra.

The population distribution closely resembles the combined distribution of two food-crops, i.e., Bajra and wheat. The distribution in the northern isolated, densely populated parts of Ganganagar district is related to extent of canal irrigation.

Fig-9
POPULATION DISTRIBUTION



ONE DOT REPRESENTS
1000 PERSONS
SCALE - 1:4000000
GOPA KUMAR
M.U.R.P.

The isolated, scattered heavily dotted areas indicated the location of urban centres which are most numerous in northeast. The man-land ratio gives a crude density of population, but in order to evaluate the population pressure on resources, it is imperative to assess population in relation to the arable and cultivated area.

(a) Areas of dense population with 179 persons per sq. km. are located in the northern parts in Ganganagar district and in eastern parts of Shekhawati region, i.e., Sikar and Jhunjhunu districts. Ganganagar tehsil has the highest density of 229 persons per sq. km. with a large number of people in medium to large villages. Irrigation has played a major role in northern areas, but it is surprising to note the high density in Shekhawati region without a reasonably adequate supply of irrigation water. The main reason lies in the intensive and better methods of cultivation suited to semi-arid conditions, the greater number of towns with people dependent on trade and commerce and allied activities.

(b) Areas of fairly dense population, 150 to 178 persons per sq. km., are peripheral to the densely populated areas except the tehsil of Jodhpur. Here with 160 persons per sq. km., the impact of the total population of the city of Jodhpur is evident. The factors responsible are the same except that in these areas, the slightly more sandy hilly terrain, and the greater amount of waste land, has reduced the extent of cultivation.

Fig-10
POPULATION DENSITY

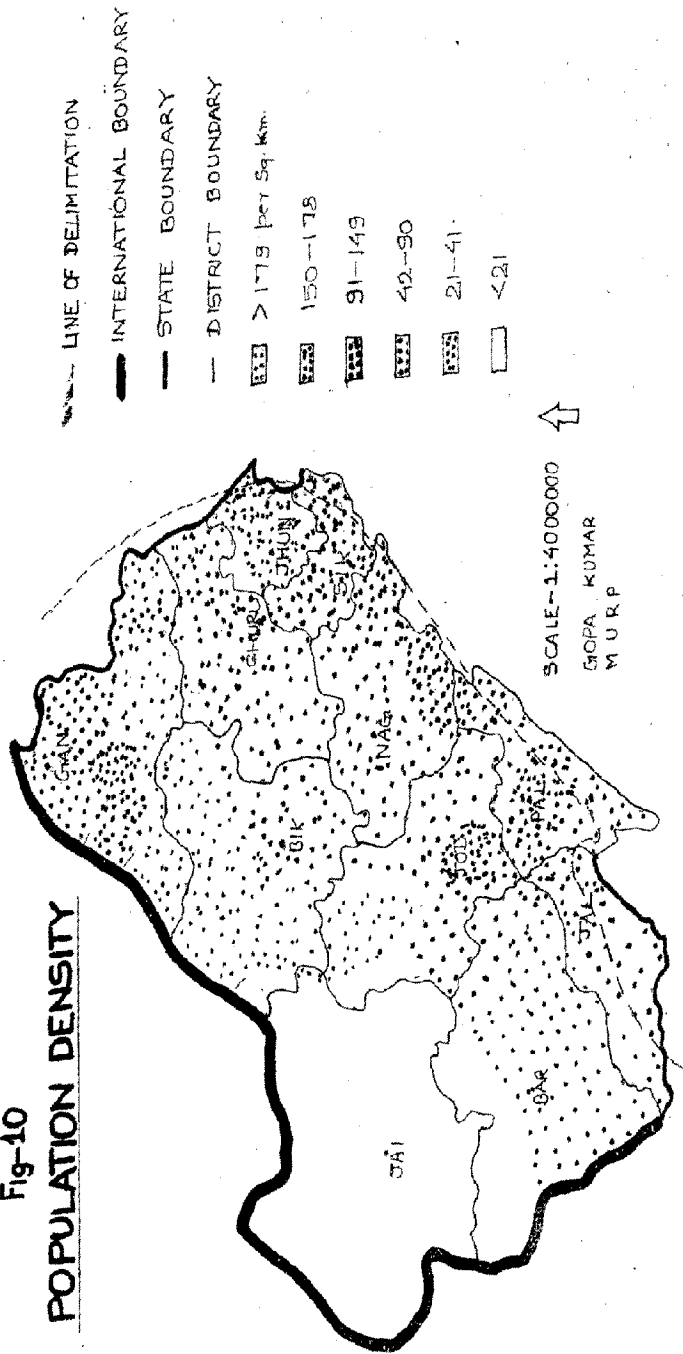


TABLE 9

Population Density Categories With Their Covered Areas and Population

Categories	Area in sq. Km.	%age to the total area	Population	%age to the total population
with 179 and above persons per sq.km.	7927	3.8	1818025	13.8
150 to 178 persons per sq.Km.	8650	4.2	1633572	12.1
91 to 149 -do-	26431	12.6	3405936	25.3
42 to 90 -do-	50883	24.4	3786414	28.1
21 to 41 -do-	55088	26.4	2310092	17.1
Below 21 persons per sq. Km.	59772	28.6	528982	3.9

Based on Statistical Abstract Rajasthan, 1981

(c) Areas of moderate density are confined to the western half of the region and north of the sandy tract in Ganganagar district. They are divided in two sub-categories, i.e., 97 to 149 persons per sq. km. and 42 to 96 persons per sq. km. The first includes the eastern half of Churu, Nagaur, Pali; the western half of Sikar; the tehsil of Jalor, Hanumangarh and Raisinghnagar. In the second, areas of the districts of Jalor, Jodhpur, Nagaur and Churu are included. Here the cultivation depends entirely upon rains. Moreover, there are many sandy tracts, with no perennial streams. There is little crop agriculture, and the livestock economy is the mainstay of the people.

(d) Areas of low and very low population density with below 41 persons per sq. km. make up the western half of the region. The eastern boundary of these areas roughly coincides with the 250 mm. isohyet or line of 45 coefficient of variability of rainfall. These are sandy and rocky desert areas with little surface water, with the deepest water-table, and with practically no cultivation and a poor livestock economy. The whole district of Jaisalmer with Kolayat and Lunkaransar tehsils of Bikaner, and Sheo tehsil of Barmer form the lowest density areas. The lowest density occurs in Ramgarh and Sam tehsils, i.e., 1.9 persons per sq. km. which is the lowest for India. Between very low and moderate density areas are the areas with low density between 21 to 41 per sq. km. These areas have slightly better conditions due to various minerals and livestock based economy.

The pressure of population on cultivated land is equally high in the densely populated parts of the region, i.e., in the districts of Sikar, Jhunjhunu, Pali and Ganganagar where the agricultural density ranges between 107 and 262 person per sq. km.

It has been seen that the pattern of regional distribution of population is greatly influenced by geographical factors, e.g., the sandy and hilly areas, the under-ground water, the amount of precipitation, and types of soils. Among the geographical factors, the most important is precipitation. In the arid and semi-arid regions, it is often assumed that the regional distribution of population is directly linked with the spatial distribution of rainfall.

4.2 Population Composition :

The Rajasthan desert region is essentially rural in its personality. The percentage of rural population is 78.61 and urban 21.39. This is approximately the same as for India, i.e., 76.3 rural and 23.7% urban, but it is slightly different from the state of Rajasthan, i.e., 78.95 rural and 21.05 % urban.

Actually there is no clear cut dichotomy between rural and urban settlements and has changed from census to census, and is not satisfactory; except that it stresses status, size, and density.

(A) Rural Population :

The total rural population is 10599143 confined to 206918 sq. km. of rural area. The average rural density is 51 persons per sq. km. which is lower than the average rural density of 80 for the state of Rajasthan. The rural population is dispersed in 11477 villages.

(a) Growth of Rural Population has witnessed the same trends throughout the census period and has been as sporadic as the total population. The decade between 1901 and 1921 recorded a decrease in rural population throughout the region, with the maximum-19.8 per cent in Ganganagar district and the minimum-0.9 per cent in Sikar district. The total increase between 1901 and 1981 was greatest in the case of Ganganagar district due to the irrigated agriculture and prosperity, and minimal in Sikar due to existing pressure of population on cultivated land and the migration from rural to urban centres.

(b) Regional Distribution of the total population also explain the regional variations in rural density. Jhunjhunu district, 166 persons per sq. km., has the highest density compared with the lowest in Jaisalmer district of 5. At tehsil level, Shri Madhopur (Sikar) has the highest rural density 188 and lowest 1.8 is found in Ramgarh and Sam tehsils (Jaisalmer). These densities relate to the variation in climate, especially in amount of rainfall, noted in Chapter II and also to nature of land use and extent of cultivation, Chapter III.

Rural density decreases from east to west except in the northern irrigated parts, i.e., it is similar to the spatial distribution of the total population. Further, the nature of the rural population distribution can be judged from the percentage distribution of rural population to the total population, and of rural areas to the total area of the region. The rural densities have close association with the size of rural settlements and their nature. Low rural densities of the western areas have predominance of compact but small to medium sized villages. The highest densities areas have medium to large villages, compact to semi-compact in nature, together with growing towns.

(B) Urban Population :

The total urban population represents 40 % of the total urban population of Rajasthan state, and the total urban area is equal to 37.3 per cent of the state. Out of 189 urban centres in Rajasthan state, 91 urban centers are present in the region. The average density of urban population is 1573, whereas for the state of Rajasthan it is 1603, which is far less than the average urban density of India.

The urban population growth has been very rapid by comparison with either rural or total population. The most rapid growth has been recorded in the districts of Ganganagar Bikaner and Churu. It is due to increased agricultural prosperity and consequent growth of trade and commerce,

which attracted migrants, especially from Panjab, to various urban centres of Ganganagar. In the case of Bikaner and Churu districts, the upgrading of over-grown villages as urban centres, and the influx of people to the city of Bikaner as a result of expansion of railway repairing work, shop and increased trade and commerce, are the important factors responsible for urban growth. In the case of Jodhpur, Ganganagar, Nagaur, Churu, and Bikaner there has been a continuous increase since 1931, preceded by ups and downs of previous decades. In the case of Pali, Sikar, Jhunjhunu, Jalor and Jaisalmer, there is either downward trends after 1941-1951 or almost stability, as a result of emigration to various commercial and industrial cities of India, e.g., Calcutta and Bombay.

Areas of highest urban density are found in the northern parts of the region. Others, except the areas of absolute rural population, have low urban densities below 1172, with urban centres small and few in number. Figures further elucidate the urban aspects of population. It is rather difficult to delineate any broad general pattern in the case of urban population distribution, except for the fact that the north and north-east parts and the certain isolated patches in the central and western parts are important.

4.3 Occupational Structure :

In the analysis of occupational structure of the population, the main problem is the complex nature of different categories.

There is no universally accepted scheme for this purpose. This study is based on the Indian Standard Industrial classification for which the census of India, furnishes data.

(A) Workers and Non-Workers :

Out of the total population, the percentage of workers is 45.1 and non-workers 54.9. For the rural population it is slightly higher, i.e., 48.6. workers and 51.4 per cent non-workers but for urban population the dependency ratio is high, as it has only 20.2 per cent workers and 70.8 non-workers. Regional differences in the ratio between workers and non-workers are quite significant.

Of the total population, the percentage of workers is the highest in Barmer (51.8 per cent) and the minimum in the case of Ganganagar (31.2 per cent). It is surprising to note that the driest districts of the region have a higher percentage of workers, whereas the dependency ratio is greatest in agriculturally most important district of Ganganagar. These regional differences may be explained by age and sex structure of the population.

The rural population has the highest percentage of workers in Churu (56.8 %) and the lowest in Ganganagar (40.5%). Of the urban population, the percentage of workers in relation to non-workers is very low for all districts. In consequence the dependency ratio is higher in urban population compared to the rural population.

Of the total number of workers, 79.0 % are engaged in agriculture either as cultivator or labourer and 1.2 % in mining, quarrying and livestock etc. In other words the primary activities account for 80.0 % of the total working population, thus leaving 20.0 % for secondary (8.3 %) and tertiary activities (11.7 %). In the rural population, the primary activities are dominant and account for 87.8 % of the total working population. Urban population presents a different picture, as the dominance of primary activities is greatly reduced (22.0 %) and the secondary (20.0) and tertiary activities (58.0 %) have become overall important.

(B) Regional Variations in Occupational Structure :

The occupational structure for the total population brings out certain facts.

- * agriculturists account for the major portion of workers in all districts except Jaisalmer and Bikaner, where cultivation is very limited due to sandy and barren tracts and precarious rains, and Barmer, Jalor, Churu, Nagaur and Jhunjhunu in contrast show a higher percentage of agriculturists than other districts.
- * in mining, quarrying, livestock, the southern and south-western districts are significant : elsewhere, it is unimportant ;

- * Household industries are significant in the case of all districts, but more so in Jaisalmer, Pali, Bikaner and Sikar. The main reason is that the rural people supplement their income by small scale village industries ;
- * manufacturing as a source of livelihood is only important in those districts where the urban population is great, as in Jodhpur, Pali, Sikar, Jhujhunu, and Ganganagar;
- * the districts of Pali, Jodhpur, Bikaner, Ganganagar are important for a higher percentage of workers in transport and allied services ;
- * workers in trade and commerce form a sizeable portion of the total in all districts, but more so in Pali, Jodhpur, Bikaner, Ganganagar, Churu and Sikar;
- * in other services, except Jaisalmer, Barmer and Jalor, all districts have a sizeable percentage of total workers engaged in construction, public services.

The rural and urban occupational structures vary considerably. There is a great swing of secondary and tertiary groups over the primary in the case of urban population. The rural population has similar occupational structure, except for the fact that there is more dominance of primary activities compared to the total population.

The occupational structure of the region clearly shows that the economy is basically agricultural and under-developed. Further, the small percentage of workers in secondary activities shows the lack of an industrial base, while the greater percentage in tertiary activities indicates the importance of trade and public services, as settlements are getting less isolated. Further the fact that the existing district-headquarters towns have more employment opportunities in 2nd and 3rd sectors, means that they attract more people and thus expand more than others.

4.4 Age and Sex Structure :

The age and sex structure of the population illustrates the dynamics of the population as well as the pressure of population. It also helps to analyse the extent of migration and the resultant concentration and dispersal of population.

The sex-ratio, defined as number of female per 1000 males in the population, is different to that of the state of Rajasthan and India 1981.

There are minor regional variations in the sex-ratios for total, rural and urban population within the various districts. Trend is for the sex-ratios to decrease from east and south-east to west and north-west. The lower ratios in the latter areas may be due to a greater percentage of male migration, as the precarious nature of agriculture and livestock economy compels males to migrate, leaving their families, to other wetter areas.

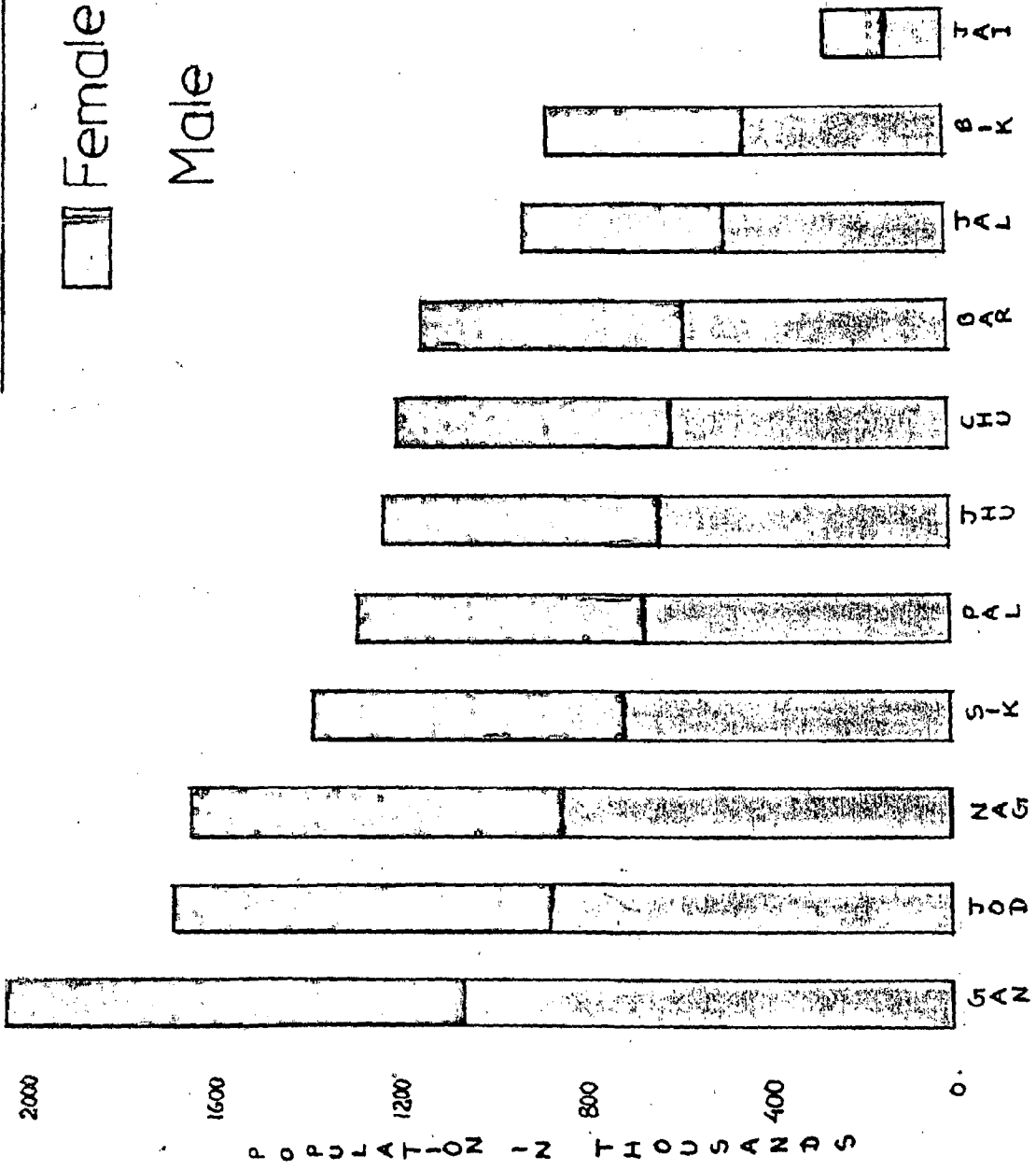
TABLE 10

Percentage of Males and Females according to Age Groups. Fig. in %

District	Children (0-19 years)		Adults (20-64 years)		Old (65 years and over)	
	Males	Females	Males	Females	Males	Females
Barmer	27.69	24.18	24.68	21.13	1.09	1.13
Bikaner	27.82	24.97	23.07	21.27	1.40	1.39
Churu	27.71	25.21	22.24	21.54	1.60	1.58
Ganganagar	28.00	24.98	24.68	19.61	1.45	1.02
Jaisalmer	27.26	21.76	26.97	21.70	1.21	1.08
Jalor	26.42	24.09	24.34	22.45	1.31	1.32
Jhunjhunu	28.34	25.23	21.42	21.72	1.66	1.57
Jodhpur	27.25	24.44	24.48	21.22	1.19	1.29
Nagaur	26.62	24.07	23.47	23.00	1.34	1.50
Pali	26.80	24.18	23.31	22.76	1.30	1.58
Sikar	27.32	24.45	22.01	22.94	1.52	1.61
Total	27.39	24.52	22.48	21.74	1.38	1.39

Source : Census of India , 1981.

SEX COMPOSITION



The age-structure is vital and 'has been called the living record of a nation's biological history'. It is the net result of birth and death rates and of migrations during the past.

The three broad age-groups show the high proportion of children or infants or adolescents (0 to 19 years) in the age structure. It is 52.0 % for the region as a whole and regionally highest in Jhunjhunu 53.6 % and the lowest 49.0 % in Jaisalmer district. The population in north-eastern parts is less reproductive and more dependant, compared, to the western and south-western parts. It is due to more migration of adults from the former areas to seek opportunities in trade and commerce outside the region, and in the case of latter, may be due to lesser number of females and lower fertility.

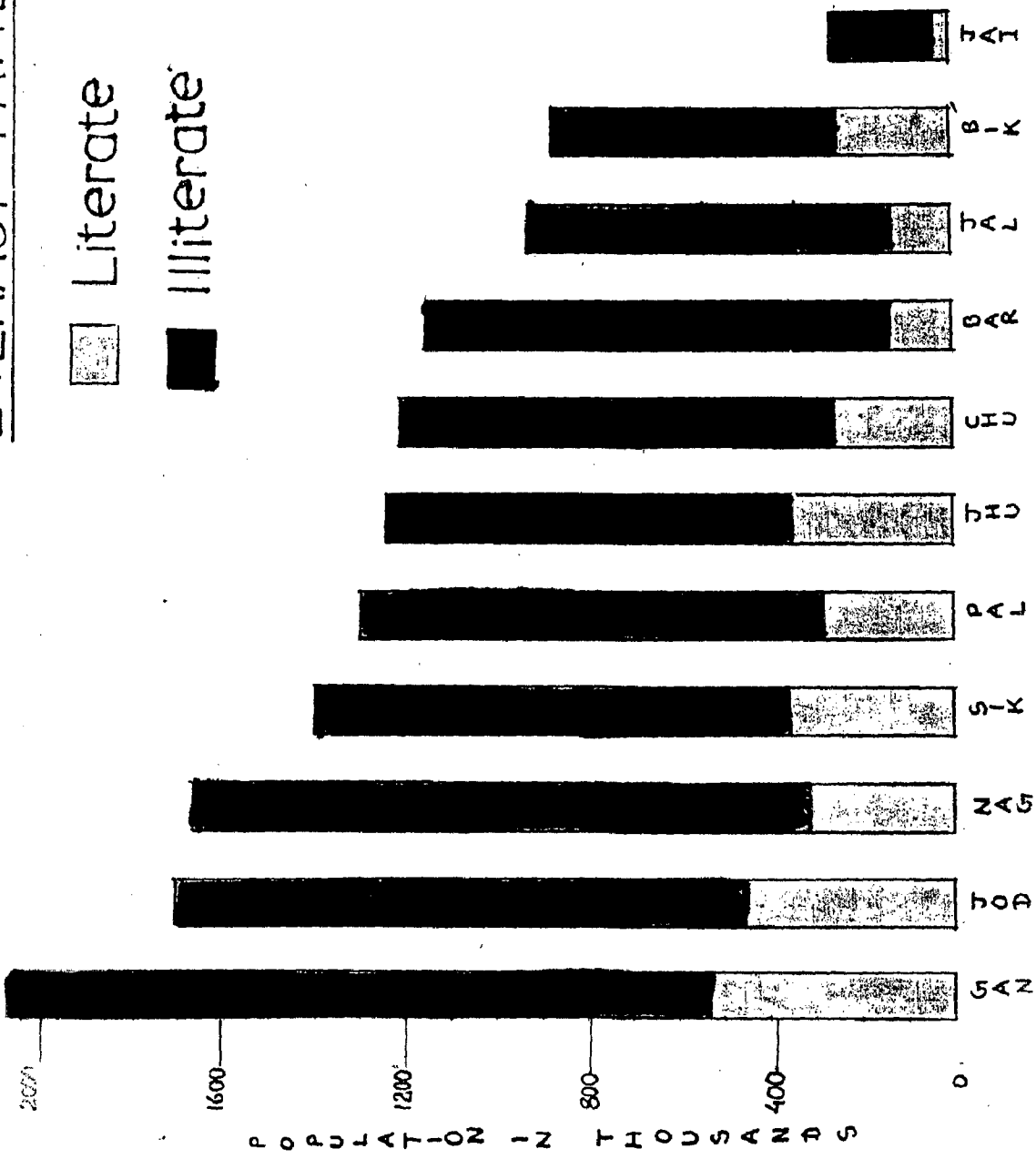
The proportion of adults (20 to 64 years) in the total population is 45.2 % and for the individual districts, Jaisalmer has the highest percentage (48.8 %) and the lowest is in Jhunjhunu (43.1 %). The western districts are more reproductive and productive than the north-eastern districts. Further, the percentage of adults is more in males than females except in the districts of Sikar and Jhunjhunu, from where male adults migrate to industrial and commercial cities of India.

The aged or old group (65 years and over) is only 2.8%. The highest percentage is in the case of north-eastern districts of Jhunjhunu (3.2 %) and Sikar (3.1 %) and the lowest in Barmer (2.2 %). This group is again non-reproductive as well as non-productive.

4.5 Literacy :

The term literacy is a comparative term which differs in its meaning from nation to nation. In this case literacy is defined by the census of India, 1981. The region has a very low percentage of literate persons, with 19.7 % of the total, 12.5 % for the rural and 37 % for the urban population. The greater illiteracy is in Jaisalmer, Barmer, and Jalor compared to other districts. The seasonal migration as a result of failure of rains as well as lack of means of communications and resulting isolation of settlements seem to be the important reasons for higher illiteracy in these desert districts of the region. It is higher in north-east and central districts of Bikaner and Jodhpur than the western districts. The existence of large number of educational institutions, as a result of philanthropic acts of business men who migrated from the north-eastern parts, and impact of the cities of Jodhpur and Bikaner with many educational establishments, seem to be the main reason for higher literacy. The regional trends in the rural population are the same and percentage of literacy varies between 16.0 and 5.6 %. In

LITERACY PATTERN



spite of free primary education, in rural population little headway has been made due to general apathy of the masses. Old people in rural areas give more weight to the fact that their sons and daughters assist them in work and should not waste time in education.

For the urban population, the percentage of literacy is high which is due to more educational facilities and congenial social attitude towards education. The highest is in the case of Jodhpur 43.69 % and Bikaner 41.12 %, as both cities are most important centres for higher education. The level of education is crucial for settlement. Modern manufacturing, transport, and trade all put a premium on higher education. Therefore, these are moving into the larger centres with good schools and technical training programmes. The smaller towns and villages are losing out and are beginning to decline.

4.6 Social and Ethnic Composition :

The social and ethnic composition helps to analyse various influences in the nature and growth of settlements, but data are limited. The focus has been placed on language, religious and caste groups.

(A) Linguistic Structure :

India's cultural pluralism is the outcome of its ethnic linguistic and religious structure, and it has a

most complex mosaic of languages and dailects. According to the Linguistic Survey of India, all the languages and dialects in India belong to the following main groups or families :

- * Austric family,
- * Karen and Man Family,
- * Tibeto-Chinese family,
- * Dravidian family,
- * Indo-European family,
- * Unclassified group.

The linguistic structure of the region is based on Indo-European family, especially on its north-western and mediate or central sub-groups. The mediate or central sub-group accounts for the greater percentage of population.

There are roughly 89 languages and dialects spoken within the region which indicate the extent of immigration of people from other parts of India. Figure. does not give a very clear picture of the linguistic structure of various districts because of the dominance of Marwari language except in in Ganganagar district. Marwari is a dialect of western Hindi, mostly spoken in the former state of Marwar or Jodhpur. Out of the total population, there are 64.38 % who speak this dialect. Second in importance is Rajasthani and Bagri-Rajasthani which accounts for 11.59 % and others are Kharboli (7.18 %), Panjabi (3.94 %), Shekhawati and Dhundhari (3.81 %), Urdu (2.39 %) Sindhi (1.24 %) and Gujarati (0.09 %). The spread

of Sindhi dates back to the partition of India in 1947 and the settlement of people from Sindh area of West Pakistan. Other minor languages which account for 0.30 % of total include Deswali, Hariani, Mewari, Marathi and Bengali. A regional analysis of these major mother tongues brings out certain facts :

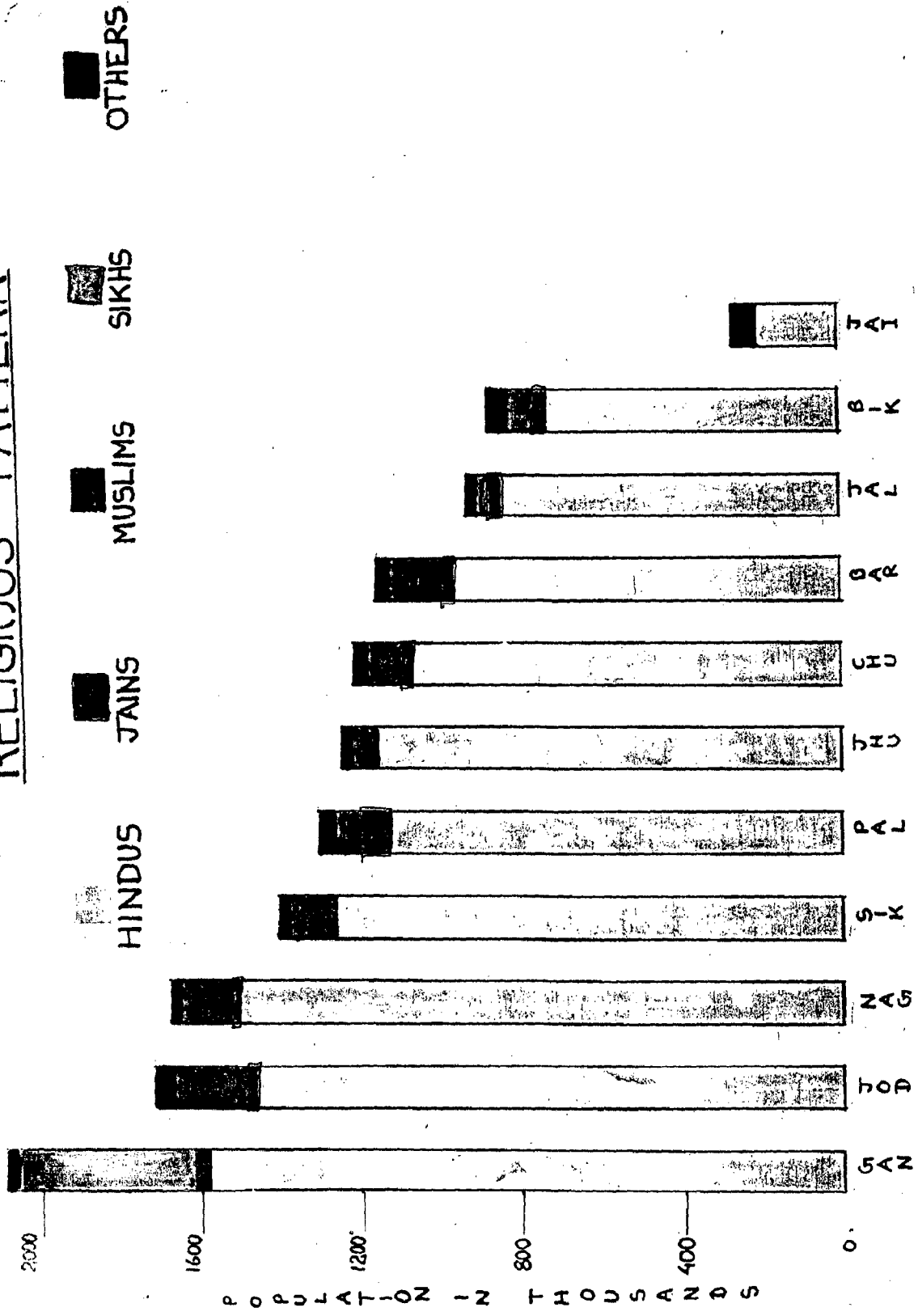
- * Marwari as a spoken language is most important in former states of Marwar, Jaisalmer and Bikaner, i.e., in districts of Jalor, Barmer, Pali, Jodhpur, Jaisalmer and Bikaner;
- * Rajasthani and Bagri-Rajasthani is important in the districts of Ganganagar, Churu, Nagaur where 36.96 to 14.77 % of the population speak this dialect;
- * Shekhawati and Dhundhari are important in Jhunjhunu and Sikar districts, where 5.55 and 30.66 % of population speak these, respectively;
- * Other major language like Panjabi, Hindi, Khariboli, Sindhi and Urdu do not have any marked concentration but they are scattered throughout the region, except for Panjabi which accounts for 27.5 % of population in Ganganagar district.
- * The extent of bilingualism is very limited and it only exists in the form of territorial and socio-economic bilingualism, i.e., in those border areas where the regional languages co-exist as in the case of Ganganagar.

The language do affect the nature of settlements, especially medium to large urban centres, in the form of distinct residential quarters, with the dominance of one particular language-speaking people, e.g., there are separate developed sections of the townscape of large towns and two cities where Sindhi speaking refugees formed separate colonies, the Panjabi speaking people in the irrigated parts of Ganganagar district have separate colonies, which give a prosperous look compared to residential quarters of Marwari speaking people, and the migrated Hindi speaking people from the western districts of Uttar Pradesh have better residential areas than the Marwari speaking people. There are differences of type of houses and the local environment. The villages and small towns are mostly one language settlements. There is a vast difference between a Panjabi speaking village and a Marwari speaking village. The difference is visible in housetypes as well as in rural landscape. However, languages other than Panjabi and Marwari do not form distinct villages.

(B) Religions Structure :

Religious diversity is not as great as linguistic diversity. Religion, as such, is not a major force in controlling the forms or types of settlements because the major portion of population are Hindus, nevertheless it is significant in some cases, on a local scale.

RELIGIOUS PATTERN



The religious composition of population of various districts does not give a clear picture due to the fact that Hinduism dwarfs the position of the other religions. 87.0 % of the region are followers of Hinduism, 7.8 % of Islam, 2.3% of Jainism, 3.0 % of Sikhism, 0.1 % of Christianity and only 71 persons following Buddhism. The region is thus essentially Hindu with its cultural and social connotations.

At district level the north-eastern parts, i.e., Jhunjhunu and Sikar districts have 93.0 and 91.3 % Hindus. Elsewhere the percentage varies between 91.7 and 73.0 %. Muslims account for 26.4, 14.0 and 11.3 % in Jaisalmer, Barmer and Bikaner districts, respectively. These western districts, with a sizable percentage of Muslims are all border areas. The concentration of Jains is greatest in Pali district (5.7 %), and Jalor (5.2 %). Christians vary between 0.10 % of the total population. Sikhs are numerous in Ganganagar, where they account for 20.7 % of the population.

There is no village or town which has the dominance of any other religion than Hinduism. Nevertheless, the impact of minority religious groups is significant in the nature of certain settlements, especially in their morphology. The presence of Muslims is noteworthy, as they form separate living quarters with their mosque, both in villages and towns. In large urban centres, these quarters have Islamic names and have special food and clothing shops and their own schools. The impact of Jains is not marked, as they have almost identical

temples with the Hindus, but they often live in their own streets. The presence of Sikhs has marked effects in the townscape, specially in Ganganagar district in form of typical shopping areas with a greater variety of mobility and larger number of eating places. Their temples, too are distinctive. The impact of Christianity is well marked in the morphology of towns in the form of churches separate christian residential areas and mission schools etc.

(C) Caste Structure :

Although Hinduism as a religion does not create differences in settlement, its many castes do have marked effects on the economy and settlements. Among the different castes present, the important are Brahmins, Rajputs, Jats and Sikh Jats, and people of scheduled castes with their various sub-groups.

It is difficult to present the geographical distribution of various castes in absence of any data. Generally, Brahmins are found in majority everywhere, except in Ganganagar where Sikh Jats are more in number. Among the Brahmins, there are various sub-groups, e.g., Paliwal brahmins are numerous in the south-eastern parts of the region, Pushkarna brahmins in the central and western parts. Scheduled castes form a sizeable proportion of population everywhere.

The caste structure and caste hierarchy has significant influence, both in villages and towns. The rural landscape and morphology show distinct impression of various caste groups. There are caste quarters, i.e., high castes like brahmins and Rajputs have better houses, occupying central positions in the morphology, whereas low castes with their poor huts reside on the out-skirts. In the case of urban centres, the impact of caste groups is well marked in the form of separate living areas, named after the particular caste living in that section, e.g., Churu and Jaisalmer towns are typical examples where most of the mohallas (living quarters) are named after the caste groups.

The house types in their location and quality, both in villages and towns, further show the impact of caste groups. The poor huts on the out-skirts of the villages and towns shelter low caste people, and the better houses in the centre are inhabited by upper castes.

4.7 Population Movement :

Movement of population are not great in this region, due to the prevalence of localised activity, but are of increasing importance in the shift of farm people to villages, and the further migration from villages to towns. The arid and semi-arid nature of the climate with the resultant precarious economy, the poor means of transport and communications, and the attitude of the people explain the restricted nature of movements.

Out of the total population of the region, 70 % may be termed as non-moving population. The rest move either within the district or between districts or states. The population moves between rural and urban areas but there is no record in the censuses. In the western dry and sandy districts with a precarious economy, the percentage of in-moving persons is less than in the irrigated district of Ganganagar or north eastern districts which have only semi-arid conditions and better agricultural economy.

CHAPTER - 5ANALYSIS OF GROWTH OF SETTLEMENTS :

With its present 11477 villages and 91 urban centres, the fabric of human settlements is heavily dotted with non-urban centres, in accordance with rural and village India. Most of the urban centres are not urban, as the majority of them are overgrown villages with the exception of the cities of Jodhpur and Bikaner. But for the people of the region, these urban centres are their main places of commerce, industry and religious festivals. Ever since their inception, they have acted as the foci of trade and commerce and the points of rendezvous for caravans from all parts of the region (Tod, 1877). Small towns like Rajgarh, Churu, Sikar and Pali were significant centres of commercial activity, for internal as well as external trade, as they lay on the great caravan routes of mediaval India. The cities of Jodhpur and Bikaner, founded in 1459 A.D. and 1489 A.D. by Rao Jodha and Rao Bika, respectively, have been the seats of great political authority and grandeur, the centres of commerce and trade and the epitome of well organised urban life.

The human landscape of the region is the legacy of past, especially of medieval India. The truly urban centres are often associated with a fort perched on a hill, a palace of the ruler surrounded with a haphazard collection of houses enclosed by a city wall, and the market occupying a central

position on the roads joining the opposite gates of the city walls. With the exception of new towns, the urban centres reflect through their morphology, the very nature of a region which has suffered waves of invasions since 10th Century A.D. They have never been associated with industrialisation^{but} but they have protected and serviced the needs of the poor agricultural-cum-pastoral society.

5.1 Human Settlements in Retrospect :

The origin and evolution of settlements of the region may be viewed in terms of major cultural periods associated with the area. These are :

- (a) Proto-historic Period (c. 3000-500 B.C.)
- (b) Early Historic Period (500 B.C.-400 A.D.)
- (c) Mediaeval or Proto-Rajput Period (400 A.D.-1200 A.D.)
- (d) Late Mediaeval or Rajput Period (1200 A.D.-1857 A.D.)
- (e) Post-Rajput or British Period (1857 A.D.-1947 A.D.)
- (f) The post-Independence Period (1947 A.D.-Present)

The region was without any settlement in the Pre-historic period, a period upto the late Stone age. In his study of Rgvedic Culture, Das (1925) remarked 'In fact, very few relics of the Stone Age of Civilisation have been discovered in Rajputana, which goes to show that it was not inhabited but completely shunned by the Palaeolithic and Neolithic savages of Southern India'. (p 4).

Even in the Proto-historic Period (c. 3000 B.C.-500 B.C.), there are no traces of settlements in the region except in the northern parts, where 'the Sarasvati, valley had been really a commingling of many rivers, not only geographically, but culturally', (Ghosh, 1952, p. 39). There were numerous settlements during the third and early second millennia B.C. They were outlying representative of the great Harappa and Mohenjodaro Chalcolithy civilisation. Stein (1942) and Ghosh (1952) made extensive archaeological studies of various remains and located their positions in the dried-up beds of Ghaggar in Ganganagar district. Among them the remains of Bhatner, adjacent to Hanumangarh town, Bhadrakali, east of Hanumanagarh, Munda, 16 kms. south-east to the above town, were flourishing settlements. Ghosh (1952) further discovered that these early settlements along the beds of Ghaggar continued to exist until the 7th and 8th Centuries, having been revived by later occupation during the Greyware culture (first millennium B.C.) and the Rangmahal culture (first millennium A.D.). The ancient town of Rangmahal 5 kms. east of Suratgarh town (Ganganagar) was the most significant centre in this region, commanding the neighbouring rural and smaller urban centres. According to Havell (1924), most of the settlements were compact, with well established village corporate life. It was only towards the end of first millennium B.C. that dessication brought in nomadism and a consequent decay of settlement.

In the early Historical Period (c. 500 B.C.-400 A.D.), the region was under the rule of Demetrius and Agnimitra Sunga (204 B.C.-174 B.C.), of Menader (174 B.C.-114 B.C.), of Avanti under Nahapan (114 B.C.-74 B.C.) and a Saka rule (64 B.C.-57 B.C.) and there were important regional centres of commercial significance. Towards the end of this time, Huns (Hiung-nu) came to the scene in northern India and because of their onslaught and of the miserable living conditions that resulted, there was a great influx of people into this region from other parts of northern India. The increase in number resulted in the establishments of many settlements in the northern and eastern part of the region.

It is not until the Proto-Rajput Period (400 A.D.-1200 A.D.) that we come to the history and evolution of most existing settlements. In the early part of this period, Gurjaras, the ancestors of the modern gujars (a people whose mainstay of life is animal husbandary) established themselves in the region, with their kingdom of Gurjardesha and its capital at Bhinnamala (the present urban centre of Bhunmal in Jalor district). Since the early period was one of constant strife between Huns and Gurjaras, most of the settlements were walled and fortified. Contemporary to Gurjardesha, there were two more ancient kingdoms, i.e., the kingdom of Sanvir (the present Sindh in West Pakistan), and the kingdom of Balabhi which ruled some parts of the region in the west and south. Soon after the Gurjaras were thrown out, the Nagas established themselves

in the present area of Jodhpur with their capital at Mandore, 8 kms. north-west of the city of Jodhpur. The northern portion of the region was under a separate rule and was known Janglo desha with its capital at Ahishetrapur—now known as Nagaur. The north-eastern portion of the region, i.e., Shekhawati area of Sikar and Jhunjhunu districts, was under the kingdom of Matsya with its capital at Viratanagara (Bairat in Jaipur district). In the west during the 8th Century A.D., the Bhatias established themselves with their first capital at Tanot (Jaisalmer district) and later on in 10th Century, they shifted their capital to Lodorva, a place 16 kms. north-west of Jaisalmer town. It remained as the capital until Jaisalmer was founded in 1156 A.D., as the third capital of Bhatias. Sankalia (1951) remarked that 'It was in this way that parts of Rajputana which were not probably much populated in earlier times were later inhabited. Towns and cities studded with temples and fed by artificial lakes grew up in desert-like areas.

(a) Historical Towns. The Late Mediaeval or the Rajput Period (1200 A.D.—1857 A.D.) is the living past in the settlement history of the region. Powel (1896) remarked that 'The Rajput settlements now known are almost all the result of later movements of small bodies or clans; and frequently originated in individual adventure and in royal grants to settlers in available waste tracts. The great movements appear to have followed the overthrow of Hindu kingdoms of Delhi,

Ajmer and Kanuj in 12th Century.' Muslim invasions, from the 11th Century onward in the northern plains of India, dispersed and drove out various tribes and clans and they migrated and settled in this region. Although before this period, there were Rajput states controlled by Parihars and Chahamanas (later known as Chauhans) in the southern portion, Bhattis in the western parts and Parmars and Solankis in the north-eastern parts of the region, in essence the Rajput Settlements gained permanency later on with the establishment of Rathors in Jodhpur and Bikaner. In this period, Jalbalipura (the present Jalor) was the capital city for the Chahamanas of Naddula (the present village of Nadol, Pali, district). The overthrow of Jai Chand of Kanuj (1194 A.D.) by the Muslims resulted in migration of Rathors from the northern plains of India, and they settled and established themselves in Marwar (Jodhpur) by 1212 A.D.

By this time, the settlement pattern was established in the eastern and north-eastern parts of the region, making use of growing agricultural potential of river plains and better watered hilly tracts. Most of the important centres were on the main routes from Delhi to south along the Aravallis. In the western parts, settlements were few and isolated, as they were not on main routes from Indus to Ganga Valley. The sandy and dry areas were not settled.

Rao Jodha, son of Rao Chonda, established the new capital at Jodhpur (1459 A.D.). Further north, later on, Rao Bika, the sixth son of Rao Jodha, conquered the areas of Bikaner from Bhattis, Mohils and Johyyas and established the capital city of Bikaner in 1489 A.D. In the north-eastern parts, i.e., in Shekhawati region, the Rajputs of Kachwaha clan established themselves and ruled this area from their capital at Amber (south of Jaipur city). This led to a settled country life and further growth in the number of towns and villages.

During this period, the growth of towns was mostly due to the personal policies of the rulers. However, they were of different types.

(b) Route Towns developed along the main routes, i.e., from north India to south-west India along Aravallis, and Indus to Ganga Valley. Rajgarh, Churu, Ratangarh, Kuchaman and Pali were important halting and trade centres for the caravans on Delhi-Ahmedabad route; Nohar, Hanumangarh and Suratgarh along northern route from Indus to Ganga Valley; and Pali, Bhinmal, Balotra and Barmer on southern route connecting the central India with Lower Indus Valley. The dry and sandy tract between these routes was left untouched by the mediaeval routes. These centres were important for exchange of local products and handicrafts with products of other regions of India.

(c) Agricultural Towns developed as collecting and distributing centres for the agricultural and livestock products of the region. The majority of these towns was confined to wetter eastern areas with fairly established economy. For example, Bilara, Pipar, Merta and Sojat were important agricultural towns in the Luni basin, and Chirawa, Ramgarh and Losal in Shekhawati area in north-east.

(d) Administrative Towns were developed as divisional and sub-divisional headquarters for administration in the states of Jodhpur, Bikaner and Jaipur, e.g., Jodhpur, Pokaran, Nagaur, Barmer and Jalor in Jodhpur state; Bikaner, Sujangarh, Sardarshahar and Sri Dungargarh in Bikaner; Jaisalmer in Jaisalmer state; and Sikar, Khetri and Jhunjhunu in Jaipur state. These were fortified settlements, therefore, important defence centres to protect the people confined in their jurisdiction.

Later on, with the establishment of Moghuls in India, the whole region became subservient to them. Moghuls tried to maintain peace but they made relatively little direct impression on the settlements. Therefore, most of the settlements remained as the product of Hindu culture and society. Throughout the Moghul history, the region was under the Subah (province) of Ajmer with the Sarkars of Jodhpur, Bikaner and Nagaur and Subah of Delhi with the Sarkar of Rewari. In the later stage of Moghuls in India, the region was invaded by

various foreign tribes, Pindaris and Pathans, and later on by Marathas, so that life became miserable and people were compelled to migrate. Villages and towns decayed in this period. The best example of complete annihilation is the ruins of 18th and 19th Centuries of Paliwal brahmin villages in Jaisalmer and Barmer districts.

The Post-Rajput or British Period (1857 A.D.-1947 A.D.) started with British suzerainty by 1818 A.D. With the establishment of peace and economic prosperity, the region experienced a growth in number of villages and towns. Among the factors responsible were :

- * Construction of railways and roads in the later part of 19th Century and early part of 20th Century revived many of the pre-existing towns, e.g., Merta, Pali, Barmer, Jalor, Sojat, Balotra, Makrana, Kuchaman, Nagaur, Suratgarh, Ratangarh, Churu, Sikar and Jhunjhunu; while new settlements were created like Marwar, Raniwara, Merta Road, and Sojat Road. The extension and improvement of roads resulted in increased commercial importance of many pre-existing settlements.
- * The introduction of irrigation, in the later part of 19th Century and onwards in the Luni basin, brought agricultural prosperity and a revival of preexisting and struggling settlement. The best example of great change due to canal irrigation is the northern part of Bikaner state (Ganganagar

district). New towns came in existence, e.g., Sri Karanpur, Padampur, Raisinghnagar, Gajsinghpur; the pre-existing towns like Ganganagar, Hanumangarh, Suratgarh, Nohar and Bhadra grew rapidly and the whole area was studded with new villages (Chaks).

- * Increase in mining activities led to the growth of not a few settlements. Coal mining is responsible for Palana, near Bikaner; Marble quarrying is responsible for settlement of Makrana in Nagaur district; Salt making gave birth to Nawa, Kuchaman (Nagaur) and Pachbhadra and Balotra (Barmer). Gypsum quarrying is responsible for Jamsar (Bikaner); and Copper mining for Khetri and Singhana in Jhunjhunu district.
- * Industries and industrialisation were not basically important in creating or reviving settlements. Nevertheless, small-scale household industries increased the importance of centres like Pali, Ganganagar, Hanumangarh for cotton ginning; Sojat, Jodhpur, Bikaner, Merta and Nagaur for metal and instruments making; and Bilara, Didwana, Sikar, Jhunjhunu, Barmer and Pokaran for food processing and leather and hides.

- * Trade and commerce has been responsible for the growth of many market (mandi) settlements. In the northern part, after 1947, there was a rapid growth in number of (mandi) settlements for marketing of agricultural products. In other parts, most of the towns grew in importance because of trade and commerce, viz., Nagaur, Balotra, Barmer, Merta for products of animal husbandry ; Bilara, Pipar, Merta, Pali, Chirawa, Sikar, Nawalgarh, Fatehpur and Churu for products of agriculture.

Not all the older settlements grew in importance. The commercial centres like Rajgarh, Hhinmal and Kuchaman decayed and the capital city of Jaisalmer declined in its importance. Only those settlements developed, either which became the divisional and sub-divisional head-quarters, e.g., Jodhpur, Bikaner, Nagaur, Churu and Sikar or the centres for small-scale industries, e.g., Pali, Ganganagar and Didwana. The recent rail and road transport development accelerated the growth of many settlements like Hanumangarh, Sojat and Ratangarh.

With the increased economic activity, new trade centres developed, especially in the northern irrigated parts. However, the most important change, especially in urban settlements, has been in their morphology. New planned sections have been added to the pre-existing haphazard quarters Public

utility services became modernised and urban life became more orderly and comfortable. In the Post-Independence period (after 1947) settlements continue to grow and act in similar capacity.

5.2 Toponymy :

A note on place name study is relevant here, as it helps in understanding origins and the impact of culture on settlements. Names often indicate the importance of geographical facts in a region. Ancient place names are not in vogue, because the present day settlements are inherited from medi-aeval times. Hence most of the names of the settlements are either after an individual or a particular clan, in accordance with the heroic history of the region, e.g., Jaisalmer named after Rawal Jaisal (1156 A.D.) and Pali named after the Paliwal brahmin clan.

The study of the toponymy brings out the following facts.

(A) Places based on local features: Places with appellations like mer (rocky nature) and garh (fortified) indicate local relief features and their importance in relation to political instability and need of defence. Barmer and Jaisalmer towns are located on a rocky surface, and the settlements of Raghunathgarh and Sujangurh are fortified settlements.

(B) Places based on availability of water : In this dry and sandy region, the importance of water in the location of settlements is emphasized by appellations like sar, sir, and tala which mean water tank or pond in local language. These appellations are more common in the northern and north-western parts of the region where water is very scarce, e.g., Napasar, Bachasar (Bikaner), Roasars, Sadosar (Churu), Bangasar, Rawatsar (Ganganagar), Malsisar, Jabasir, Bhimsir (Jhun-Jhunu), Birmsir and Dhisar (Jaisalmer), Malsisar-Jaba-sir ka-tala and Buran-ka tala (Barmer).

(C) Places based on ethnic factors. The ethnic composition of the population is well illustrated in many place names. Both rural and urban settlements have names after a particular caste or clan, e.g., Bishani-ki-dhani after Bishnoi brahmins; Jatn-ki-dhani after Jat clan; and Pali after Paliwal brahmins. This shows the importance of clan and caste in the origin and development of settlements of the region.

The places with wali and wala show the impact of Panjabi cultures. They are confined to the northern half of Bikaner and Ganganagar, e.g., Jolalwala, Surawali (Ganganagar) and Narainwala and Jagmalwali (Bikaner). This is due to the geographical proximity of these parts to the southern parts of Panjab.

(D) Places indicating functions. Many place names indicate the status and functions of the settlements. The appellations

ner, shahr and nagar distinguish towns from the villages. In local language ner, shahr and nagar stand for towns, e.g., Bikaner, Sardarshahr, and Ganganagar.

The rural nature of settlements is reflected by appellations like bas or was; kalan or khurd; and dhani. Places with bas or was are widely scattered throughout the region, e.g., (haranwas (Sikar), Jograwas (Pali), Moklawas (Jodhpur), Dhirwas (Ganganagar) and Nawabas (Sikar). The appellations Kalan and khurd indicate the twin nature of rural settlements, and are commonly found in the Luni basin where cultivation is good and settlements are closely spaced, e.g., Raniwara-kalan and Raniwara-khurd. The appellation dhani gives some idea about the nature and size of rural settlements. They are mostly small sized hamlets attached to the parent village, e.g., Hira-ki-dhani, Mahesh-ki-dhani and Kakar-ki-dhani.

Toponymy thus reflects the way in which people have chosen their settlements and gives some idea about the regional location of settlements and the general importance of water points and strategic locations.

5.3 Communications :

As a desert region Rajasthan has comparatively few routes because of difficulty of making railway lines and roads due to sandy nature of terrain as well as the poor economy and the sparse settlement pattern make routes uneconomic. The region has a poor transport system.

Fig-11
RAIL & ROAD NETWORK

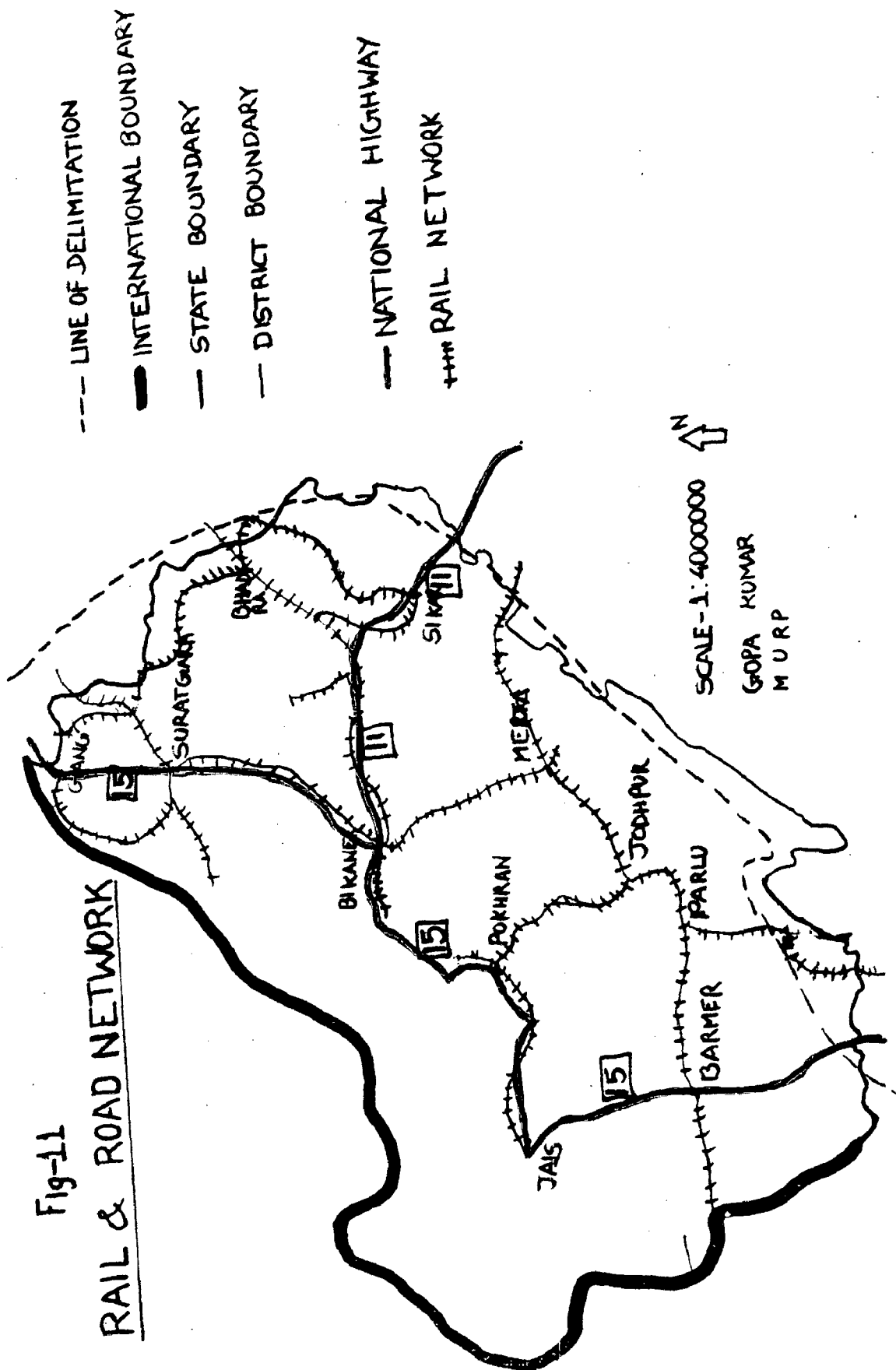


TABLE 11

Transportation Network in Study Area (Fig. in Kms.)

District	N.H.	Tarred Painted	Metalled Road	Gravel Road	Fair Weather Road	Total Length	Road per 100Sq.Km.	Rail Length	Rail per 100 Sq. Km.
Barmer	189	1444	237	846	-	2716	9.57	395	1.3
Bikanar	251	1031	51	105	-	1438	5.28	491	1.8
Churu	113	905	67	213	97	1395	8.29	540	3.2
Ganganagar	124	2003	6	25	-	2158	10.45	824	4.0
Jaisalmer	196	935	61	678	106	1976	5.1	105	0.27
Jalor	41	507	107	485	122	1262	11.86	192	1.15
Jhunjhunu	-	647	51	-	61	759	12.80	94	1.58
Jodhpur	110	2004	282	1609	-	4005	17.52	620	2.71
Nagaur	-	988	75	1064	18	2145	12.11	634	3.57
Pali	-	392	400	573	53	1918	15.48	497	4.0
Sikar	129	676	59	67	85	1016	13.14	320	4.10
Total	1153	12032	1396	5665	542	20788	9.96	4712	2.25

Based on Statistical Abstract Rajasthan, 1981

CHAPTER - 6

ANALYSIS OF RURAL SETTLEMENTS :

Rural settlement is a complex entity as a result of the varying arrangement of dwelling and parcels of land. One of the words which stands for village, namely 'mauza' means parcels of ground with definite boundaries, as well as dwellings. The village is thus more than the built-up local unit, and includes its surrounds. The rural settlement pattern is governed by the effectiveness of the water supply, the nature of the soil, the effects of relief, agricultural-cum-pastoral economy, ethnic characteristics and political history. This is a region of tiny villages, which are medieval in their origin. In form they are mostly compact to semi-compact. The typical features of the villages in this region is the thick high thorn fence which surrounds it. Rural morphology bears witness to the impact of castes and castes and caste-segregation.

6.1 Regional Distribution of Rural Settlement :

The regional or spatial distribution of rural settlements is the outcome of various factors. These factors have been described individually, and some indication has been factors. These factors have been described individually, and some indication has been given of their effects. Here attention is concentrated on the settlement patterns that have grown up out of the environment and its use.

(A) Physiographic Factors. The physiographic divisions of the region already discussed, indicate that the major part of the region is covered with sand and sand dunes and the rest either by the outcrops of Aravalli system in the east or by Luni basin in the south-east. In the sandy waste of the Great and Little deserts, the location of rural settlements is controlled by the sand dunes. They are mostly situated on the leeward side of dunes and in the depression made by the surrounding ridges of dunes. The depressions are sand free areas which are often used for meagre cultivation depending upon the rains.

In the Luni basin in south-east and Katli and Sabi in north-east, the rural settlements are located on the nearest levee which is safe during the occasional floods of the rainy season. Both sides of the river-beds are studded with settlements. This is an advantageous location as the water-table is high near the river beds and the soil is fertile because of annual sedimentation during the floods. Compared with other parts of the region, except the irrigated northern parts, these river basins are heavily dotted with well-nucleated settlements. In medieval times, many settlements were located at the confluence of tributaries for strategic reasons. Most of them are fortified and examples are numerous in the Luni basin.

In the areas of Aravalli outcrops, the tops of hills were a favourable site for the location of fortified settlements. The remains of these medieval fortified settlements

are scattered all over the Aravalli tract from south to north. With the establishment of peace under British suzerainty the pre-existing settlements descended from the top of the hills to the foot hills along the river valleys, in order to get enough free space for expansion and for easy contact with the neighbouring settlements. These villages are highly fragmented in the hilly tracts of the region because of the broken topography.

(B) Climatic Factors. Precipitation is the most important factor in the regional distribution of settlements. The number of settlements is greater in the areas of reasonable rainfall and less in the areas of sparse rainfall. With the decreasing amount of rainfall from east to west, the intervening distance between the rural settlements increases. The above conclusions are valid only if there is no other agency or force to counteract the effects of rainfall, and irrigation and adaptation on the part of man, play their parts in the relationship. The correlation coefficient (r) is +0.3, The value of two regression lines are $a = 0.14b + 91.4$ and $b = 0.63a + 252.4$, when 'a' stands for rainfall and 'b' for number of villages. Thus there is a positive relationship between rainfall and the distribution of rural settlements but the lower value of (r) indicates the limited relationship due to the impact of other factors and adaptation on the part of man.

It is not out of place to consider the influence of water table on the regional pattern. Ali (1942) in his study of Ghaggar Plain, remarked that population and settlement pattern is a hydrographic pattern in nature. The water-table is high in the east and it become deeper towards the west. It is deepest in the south-western parts and in the central Magra region. The number and size of rural settlements decrease from east to west and there is an apparent correlation with the increasing depth of the water table. Statistically, there is a correlation coefficient of $r = 0.44$ in the distribution of water-table and the number of villages. The value of r is greater than in the case of rainfall, indicating that the water-table is more important as a factor in the location of villages.

(C) Nature of Soil. The importance of soil in a agricultural-cum-pastoral economy is undisputed. Nitya Nand (1966), in his study of the east Rajasthan, remarked on the importance of soil in the location of rural settlements that 'The low-lying areas with a calcareous substratum are the best sites for human settlements. Reteli or Magra or tharra soil which is highly sandy and poor does not support large or many settlements, as in the major parts of western areas. Wherever there are patches of clayey-loam, mostly confined to depressions surrounded by ridges of sand dunes, they are used as favourable sites for settlements. The loamy soil (alluvial type)

in Luni basin and in the river basins of Shekhawati, give rise to the large settlements with short intervening distances. Kaul (1952) remarked that 'All the same, the Bandi river gives rise to Chahi holdings, which grow wheat and gujji (mixture of Barley and Gram) as rabi crops and jowar and Karang as zaid (Kharif) crops. The wells are pucca (cemented) and their water invariably sweet, are the good sites for settlements', Hukkoo (1954) remarked that 'It (the river Luni) is thus responsible for valuable Chahi holdings on its banks in the villages of Jasol, Paila, Sara, Gura Bhakarpura and Gadevi.

In the eastern areas of rocky outcrops, settlements are located where small rivers make alluvial fans which provide good sites for cultivation as well as for ease of contact with other settlements. In the irrigated parts of Ganganagar, the soils is fertile and highly retentive of moisture and a large number of settlements are found here, than in the other parts.

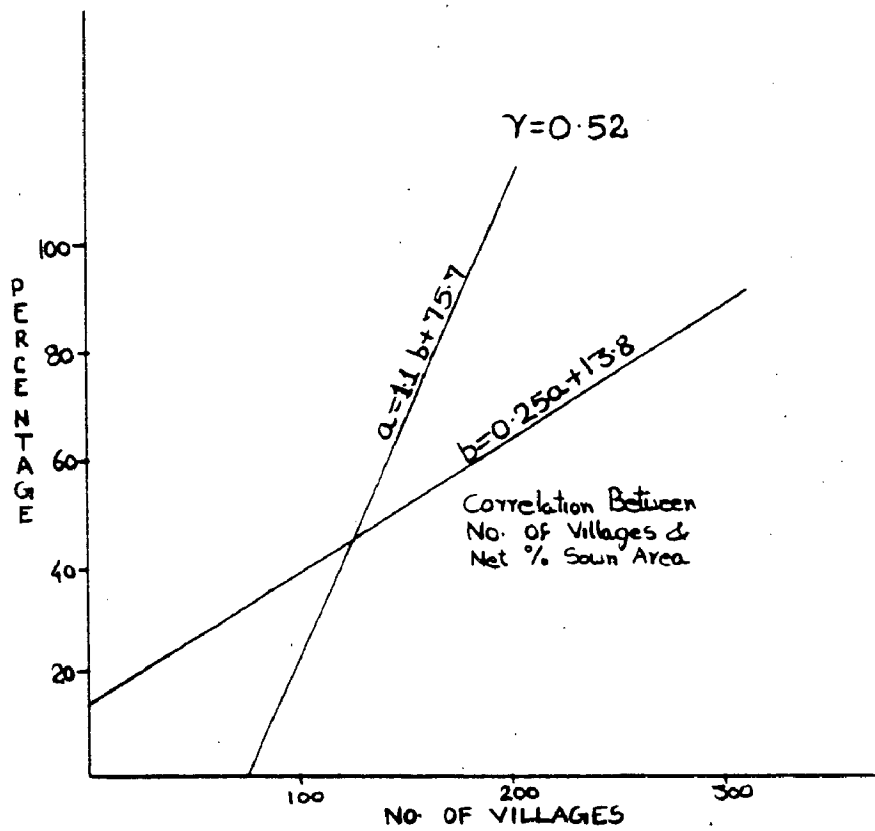
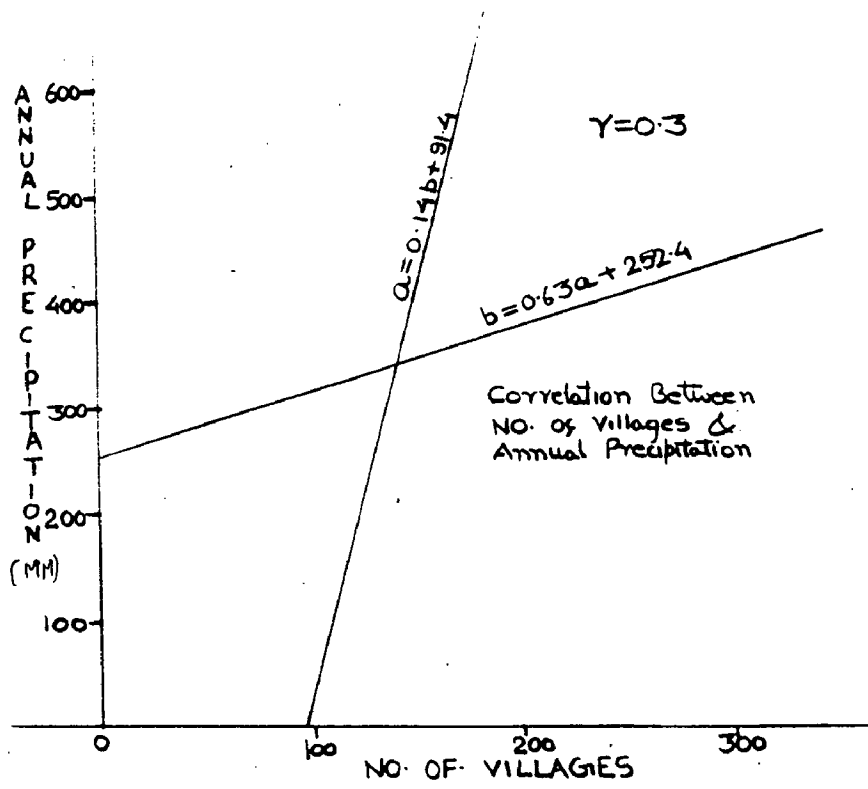
Although the natural vegetation is generally not important, the vegetational cover in favoured areas of eastern parts has acted as a locational factor for settlements. The reason seems to be that these patches provide fodder for livestock which is wealth to the people.

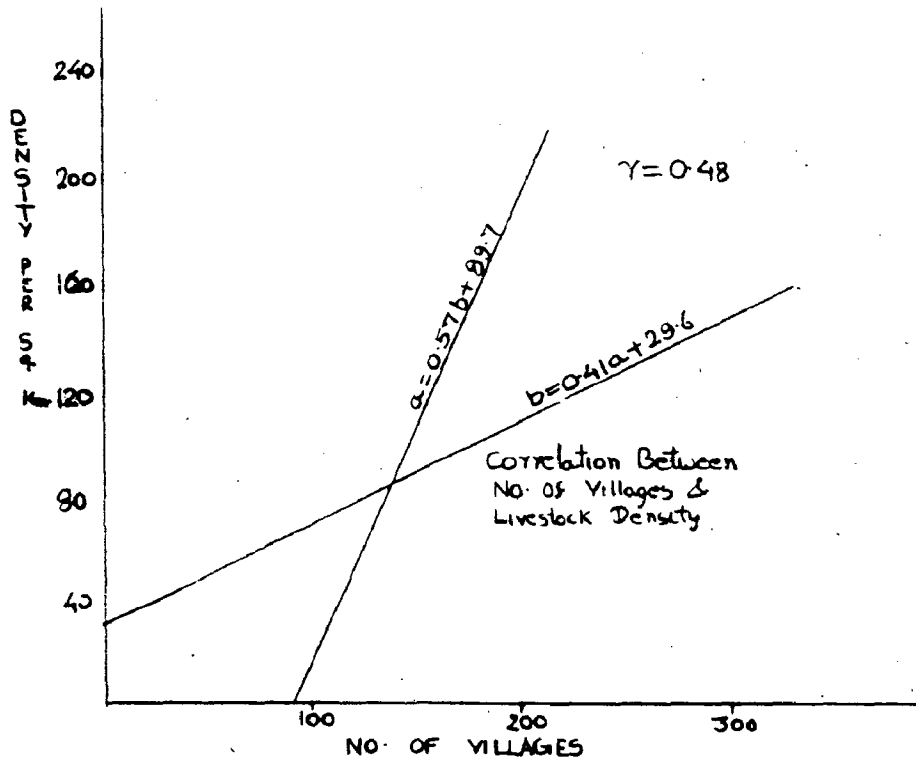
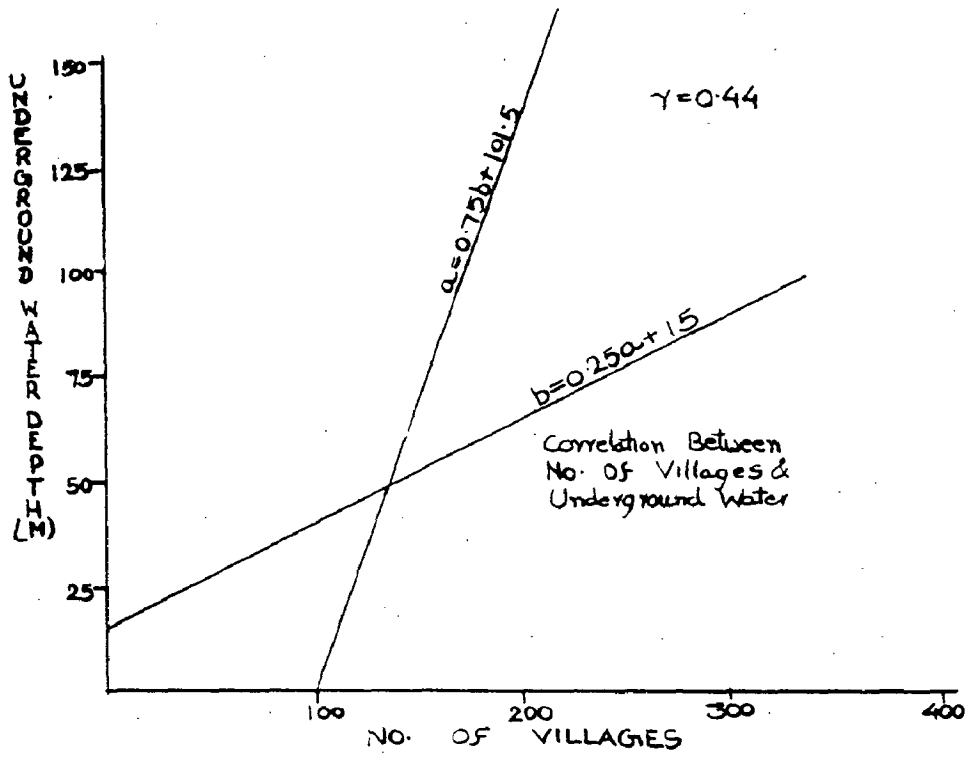
(D) Economic Factors ~~are important~~ are important to explain the regional distribution of settlements.

Agriculture is the mainstay of the people and it is logical that the regional distribution or location pattern of rural settlements is based on the spatial aspect of the agricultural economy. The cultivated tracts are most favourable areas for settlements. The extent of the net sown area decreases from east to west. Similarly, the number and size of rural settlements decreases from east to west, but there are marked local variations in this general pattern due to concentrations of net sown area and the quality of the agriculture. For example the river beds in the Luni basin and in Shekhawati region have more and large rural settlements than the areas away from the river beds. The best example is afforded by the tehsils of Siwana, Pachbhadra (Barmer district), Sanchore (Jalor district), Pali, Sojat (Pali district), Chirawa and Jhunjhun (Jhunjhunu district).

Statistically, the correlation coefficient r is $+ 0.52$ for the number of villages and the extent of net sown area at tehsil level. The two regression lines do not fit and the values are $a = 1.1b + 75.7$ and $b = 0.25a + 13.8$ when 'a' stands for number of villages and 'b' for net sown area. However, it is more significant than the correlation in cases of precipitation and water-table.

Inasmuch as the nature of the region is arid and sub-arid, the importance of means of irrigation is vital. Wells, tanks and canals are the three important methods of irrigation and most of the settlements are located at those points where there are wells and tanks (ponds) which supply water for





drinking as well as for cultivation. Tanks are significant in controlling the location of villages in the southern and south-eastern parts of the region. Wells are of universal importance except in the canal irrigated parts of Ganganagar district.

Livestock is wealth and therefore, animal husbandry, though responsible for nomadism, is also directly responsible for the location of permanent central habitations and for processing the products of a livestock economy. Market places, where seasonal livestock fairs take place, include Tilware (Barmer), Salawas (Jodhpur), Junjala (Nagpur), Padu-Kalan (Nagaur), Ram Deora (Jaisalmer), Ghanerao (Pali), Dadmati Mata (Nagaur), Barkana (Pali), and Parbatsar (Nagaur).

Among other economic activities, i.e., mining, industries, trade and commerce, except mining no one is important as a force in the location of rural settlements. The gypsum deposits in Bikaner district provide a locational factor for villages like Jamsar, Lunkaransar and other adjacent village. Many rural settlements exist in the Aravalli region due to stone quarrying. The salt deposits of Sambhar, Didwana, Pachbhadra and Phalodi are responsible for the location of villages as well as for small sized urban centres. Lignite coal mining, south of the city of Bikaner is responsible for the location of village of Palana.

Lines of transport, i.e., roads and railways are significant in the location of many rural settlements. Railway lines gave birth to many centres as well as being responsible for the enlargement of pre-existing rural habitations. For example, Kharchi was originally a village, but following upon the junction of the main line-Delhi, Jaipur, Ajmer and Ahmadabad-with the Pali-Jodhpur-Merta branch line. Marwar developed and Kharchi grew into a town. Samadhri is another example while the railway track from Bikaner to Suratgarh crossing the sandy waste is dotted with many villages. Further, the railway track is very largely responsible for double-village settlements.

Roads are by far the most important factor, either in locating a new settlement or in increasing the importance and size of pre existing settlements. In many cases recently, with the beginning of regular Bus-transport, roads are acting as a factor for the growth of double-village type settlements. Such examples occur on the main road connecting Jaipur-Ajmer-Pali-Jodhpur ; Jodhpur-Nagaur-Bikaner; and Jodhpur-Pokaran-Jaisalmer in south and south-western parts and Jaipur-Sikar-Jhunjhunu and Sikar-Fatehpur-Churu in north-eastern parts of the region. The result will be the weakening and decay of the original rural settlements and the fast growth of secondary settlements.

The rail and road network has moulded the regional pattern of settlement distribution, particularly in the central and western parts of the region. Lines of closely spaced rural settlements radiate from the various focal points of the rail and road network. For example, Bikaner city a nodal point for rail and roads, appears to be the centre from which lines of rural settlements radiate in all directions.

(E) Ethnic and Cultural Factors. Among the varied factors shaping settlements, the ethnic and cultural forces are important. Religion, clan ties, the caste system, discussed previously, the tenure system, have played a significant role in the location as well as the nature of rural settlements. The concept of 'Dominant Caste' vis-a-vis other subordinates and low castes, has played an important part in the location of villages and their fragmented nature. The migration of a particular caste and its settlement to particular area has influenced the regional pattern of settlements. There are numerous examples of the influence of the caste on the rural settlements, where hamlets or dhanis were established by a particular person belonging to a particular caste become designated for that caste. The caste is further responsible for details of rural morphology.

Clan and clan ties, especially in the Proto-Rajput and Rajput periods, were significant in the case of bigger and compact rural settlements and in the origin of urban centres

(Tod, 1877). Because of the politically disturbed conditions, their impact became dominant. Singh (1968) in proposing the Simulative structural Model brought out the role of clan and clan ties, and Maine (1876) remarked on their importance in the village communities of India. Since the region was inhabited by migrants from time to time throughout its history, the role of clan ties was always dominant in the establishment of rural settlements. Powell (1896) aptly remarked that 'The Rajput settlements now known are almost all the result of later movement of small bodies or clans : and frequently originated in individual adventure and in royal grants to settlers in available waste tracts....' (p. 124). Religion, as a force in location is not very important as it has been a Hindu dominated region throughout its history, but its impact is great in the rural morphology.

The influence of land system and land tenure is often noted by geographers in the regional distribution of rural settlements. From the local point of view villages reflect two main land systems ; (a) The Raiyatwari village; and (b) The Joint village. Most of the villages of the region were of the first type because all lands belonged to the crown of the states of Jodhpur, Bikaner, Jaisalmer and Jaipur. With the disappearance of native states and the abolition of Zamindari system (Land Lordship), all the villages have become of the second type, where land is held together by the cultivators themselves but subject to taxation by the government.

However, the Raiyatwari system was, to some extent, responsible for quicker dispersal of new settlements because of the ease of getting royal grants by certain favoured and faithful individuals, and the joint village system is noted for tendencies towards nucleation due to the fact that the cultivators are attached to their fields.

— It is difficult to conclude which among the various physical, economic, ethnic and cultural, political and historical factors, have been more effective. These factors acted jointly and the locational pattern of rural settlements is the outcome of their intimate relationship in the context of physical landscape of the region.

How villages fit into and express their landscape helps to explain the geography of any region. Settlement is part of landscape. The factors which control the village landscape are : the living needs of the people for shelter against a hot and dusty climate; insecurity in the past; the need of providing shelter to livestock; the importance of religion; caste hierarchy; the distinction between rich and poor; the impact of means of irrigation and transport and communication, and above all the living habits of the masses. These are important parameters which have dictated the village landscape of the region.

6.2 Nucleated-Dispersed Dichotomy

The processes of nucleation or agglomeration and dispersion are often employed in classifying types of rural settlements. Nucleation and dispersal are two relative terms or conditions, resulting from the varying arrangements of houses and streets. Nucleation means a concentration or compactness of inhabited settlements in a limited space, dependent upon the size of population. Dispersal is contrary to nucleation. Therefore, factors responsible or congenial for one are against or detrimental to another.

Factors which contribute to the agglomeration or nucleation

Nature of Arable Land Soil Fertility: Where the soils are fertile and arable land is continuous, the clustered village is the characteristic feature. The river plains in Luni basin and Shekhawati area have fertile land which is continuous in its important for the location and development of nucleated settlement. The sandy waste of the western parts and the hilly outcrops of the east do not encourage large and compact villages, because of limited and patchy nature of cultivation and poor agricultural economy.

Scarcity of Water is a vital fact in the nucleation of rural settlements at those points where water is available. Irrespective of the size of settlement, the location of a well or a tank, with an adequate quantity of water is an attractive

force. Water is the cementing force which exerts enough centripetal pull for the close location of houses, around the source. The scarcity of water, and its accidental availability in the western parts, has led to the formation of compact and nucleated settlements there. When the water supply is sufficient and the land is fertile, then it will result in compact and hamletted types.

The Need of Co-operation in Agriculture has led to agglomeration. Indian castes and their classes, based on a division of labour and consequent inter-dependence, created a congenial social atmosphere for the cohesion and state of compact dwellings. Communal cultivation and the collective management of land led directly to nucleation in the rural landscape. This factor is important in the areas of Luni basin, the irrigated parts of Ganganagar and Shekhawati area, where cultivation is important. It holds good for other parts also, irrespective of the fact that agricultural economy is in a precarious condition due to the paucity of water.

Open-Field System and Fragmentation of Holdings exerts great force for agglomeration. Fragmented holdings, scattered in several parts, do not favour the formation of scattered farmsteads but compel people to live in one central habitation.

Religion has acted as a great force for nucleation. With religious beliefs there are many superstitions which forbid villagers to construct separate dwellings away from the main site beyond the village boundaries. It is commonly held that within the village boundary, life is protected against diseases and calamities by the particular village god. Further, the ancestral site of the dwelling is sacred and remains unchanged from generation to generation.

State of In-Security in the past and Clan Solidarity were important factors, which compel villagers to live together at a common site. In as much as the region had a pronounced political instability and the villages, started with the setting of various clans, they originated and developed in compact form. Most of them were founded as fortified settlements, where clan ties were of paramount importance due to the need of common defence.

Factors which have contributed to Dispersion

Dispersion means the scattering of individual farmstead or farmhouse where individual farmer lives to cultivate the land. In India, the village means a mauza, and therefore, for administrative purposes, the scattered farmsteads confined to the village boundary are collectively referred to a particular village, although in reality they are not grouped together

but stand out on their own. The factors responsible for dispersion of farmsteads are:

Uneven and Dissected Topography leads to the division of arable land into small parcels and the dispersal of suitable patches for the construction of dwellings. Specific examples can be quoted in large number from the eastern Aravalli tract, where dwellings are scattered to find suitable land for cultivation. Altitude and innumerable small rivers led to the establishment of farmsteads at separate sites, as in Raipur, Desuri, and Bali tehsils in south-east; and Neem-ka-Thana, Danta Ramgarh, and Khetri in north-east.

Abundance of Surface Water and a Shallow Water-Table are dispersive factors with consequent fragmentation of settlements. Particularly, in arid and semi-arid climatic conditions, a shallow water-table gives freedom to individuals to scatter their dwellings. This is the main factor in the creation of hamletted settlements as well as the semi-dispersed settlements of the Uplands, Upper Luni basin, and Shekhawati areas. A state of complete dissemination is usually attained in those parts where the soils are very fertile.

Influence of Land Tenures: Prior to the Land Reforms Act and Zamindari Abolition Act in early 1950's absentee landlordism acted against collectivism and communal agricultural

practices because the lands were cultivated by different groups of tenants who were not obliged to live together. They had the freedom of living in separate dwellings.

Separatist Tendencies developed as result of rapid change in the social attitude of villagers and paved the way for the dissemination of rural settlements. They were further activated as a result of peaceful times and no need of common defence. The development of road and railways, and increased mobility in the rural life, has also led to dispesive tendencies.

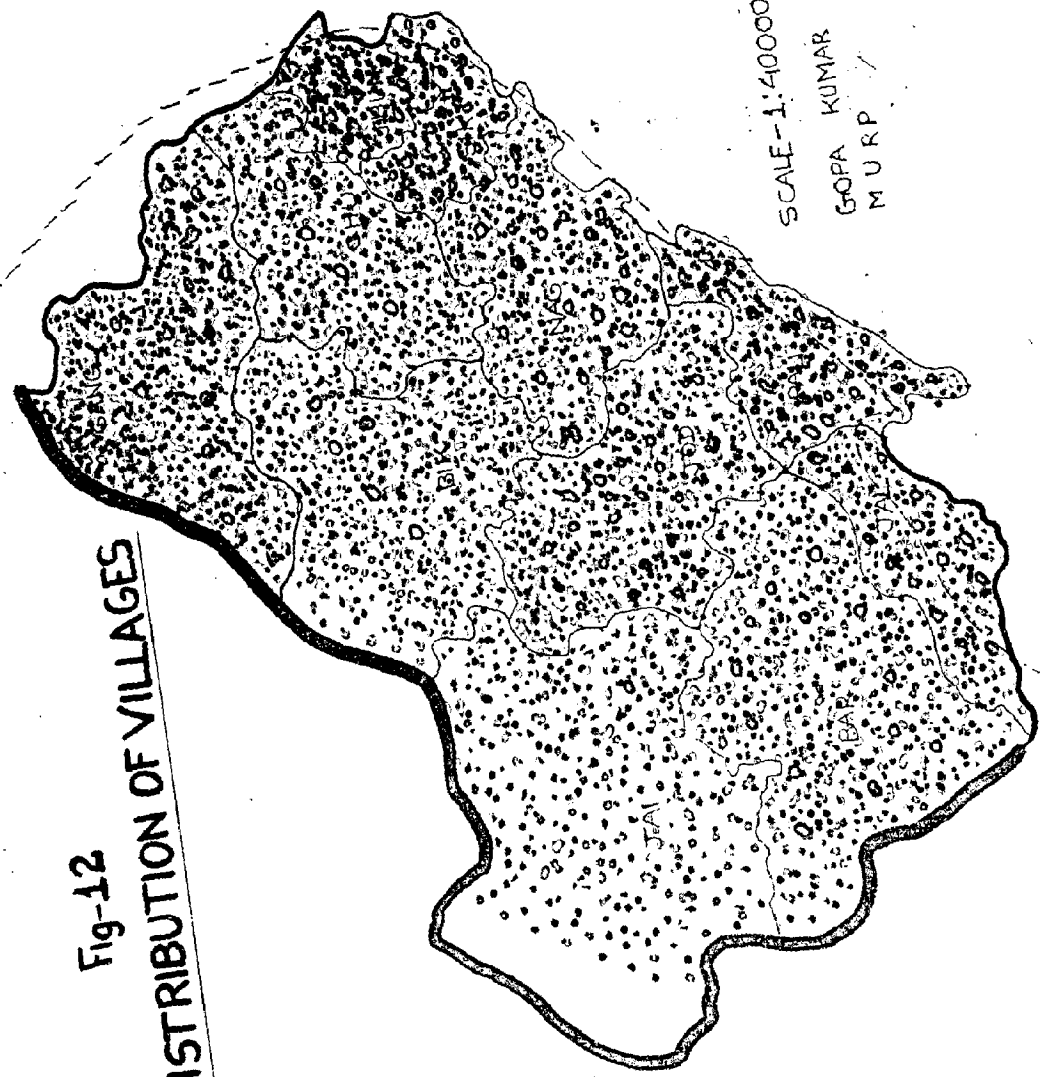
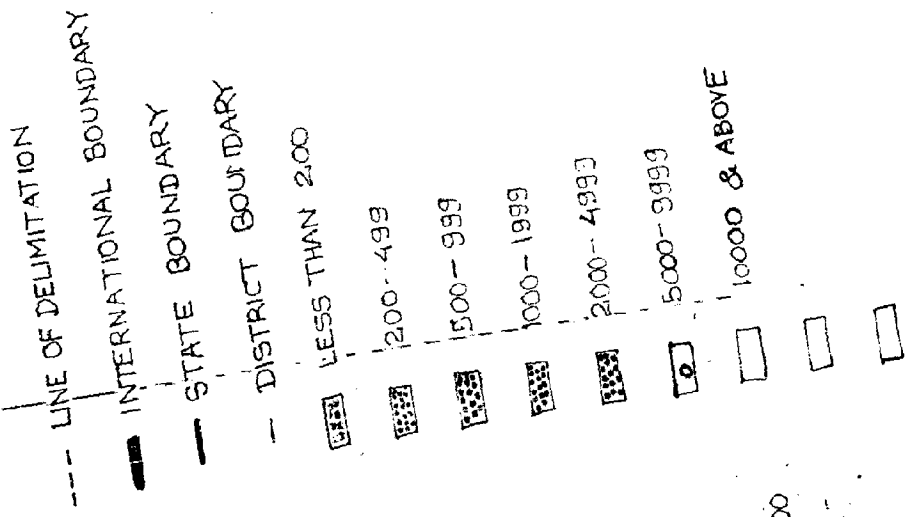
6.3 Types of Rural Settlements :

The various types of rural settlements are defined and the limits are by no means precise.

(A) Nucleated Dispersion Basis :

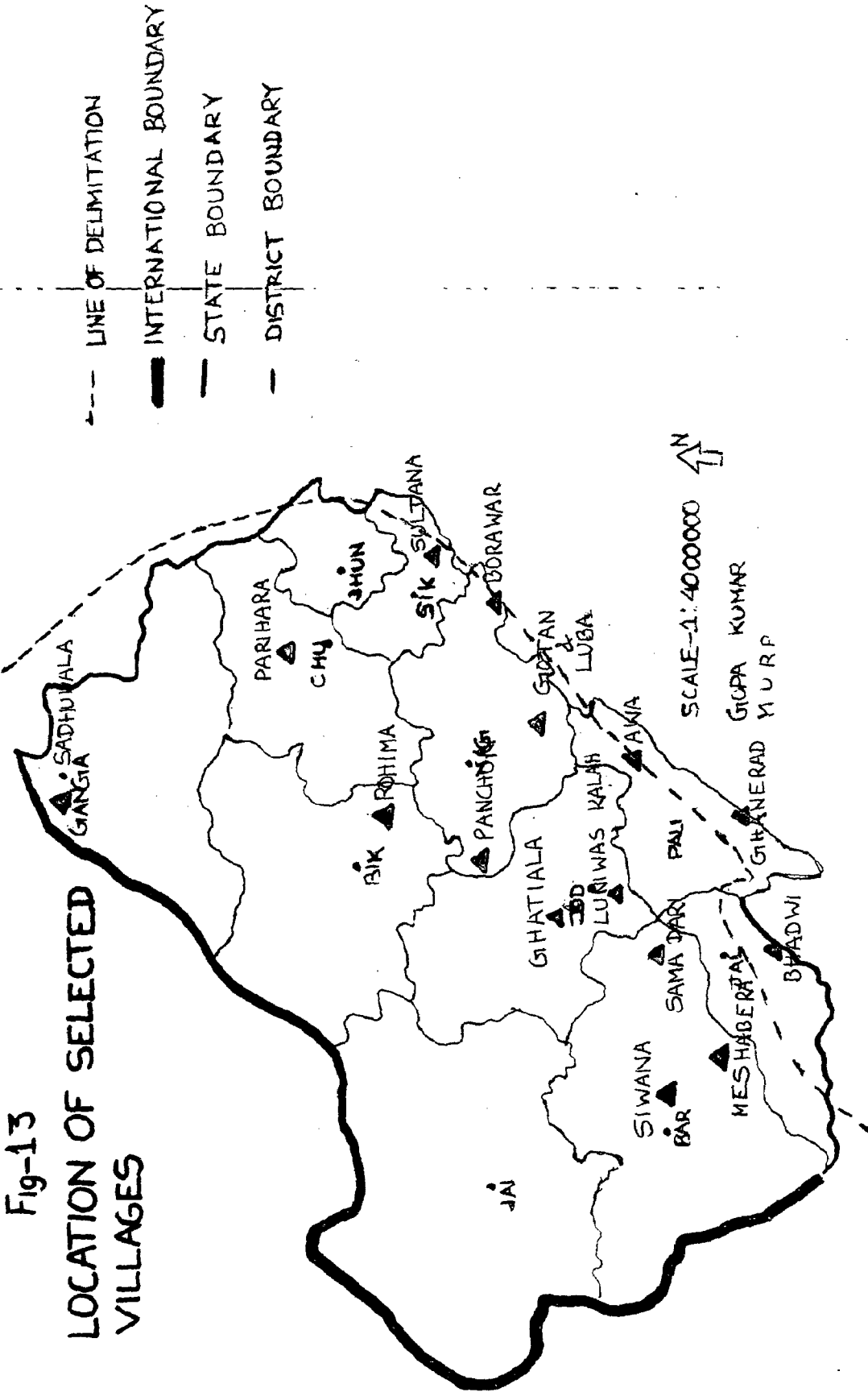
The above analysis of various factors and their regional effects permits a classification of village types based on nucleated-dispersed dichotomy and their regional distribution. The conclusions on the regional delimitation of a particular type of settlement are based on a study of topographical sheets as well as personal observations and decisions during field work.

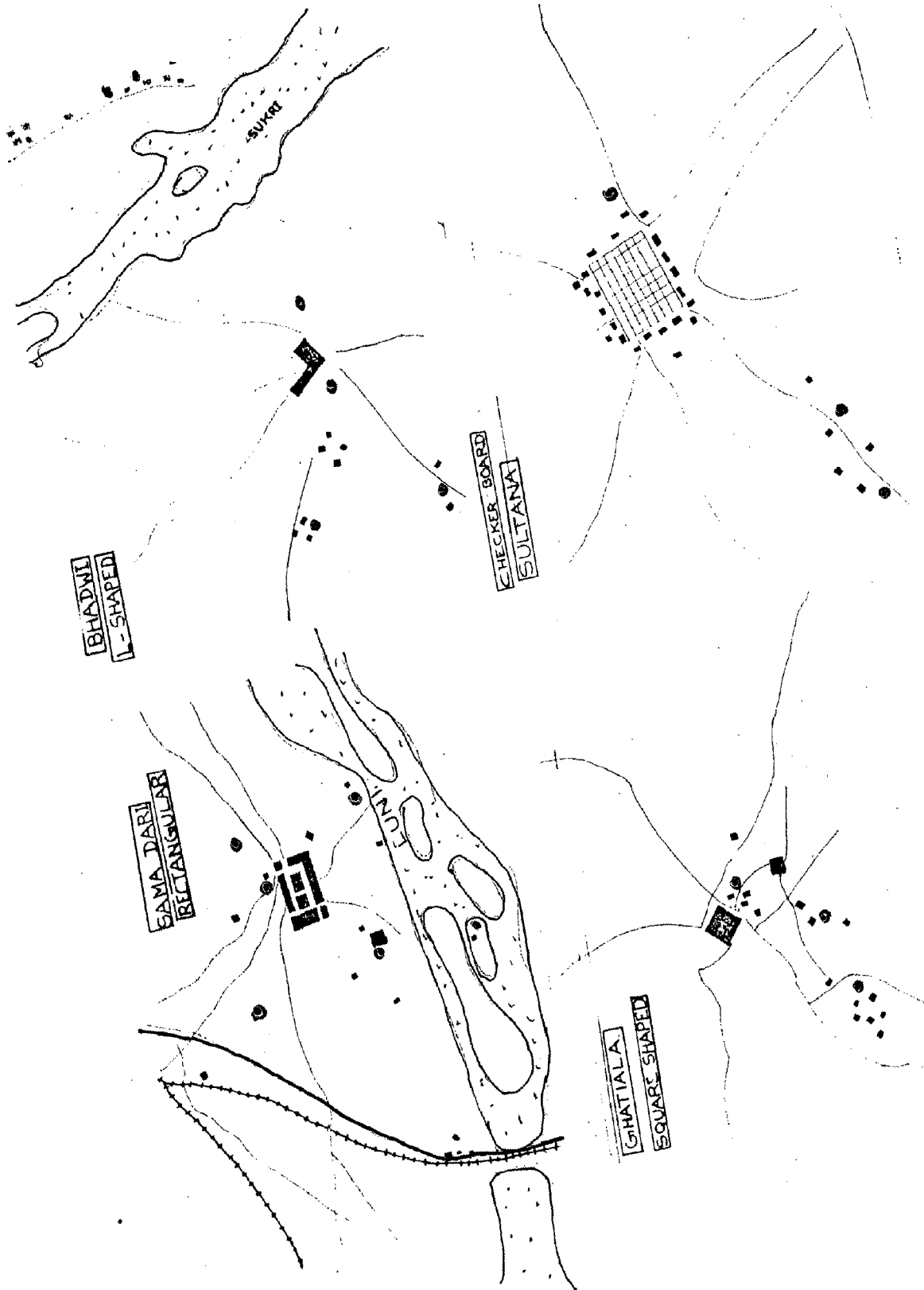
The Compact type covers the maximum area in the Great and Little deserts and Uplands. It stands for those villages

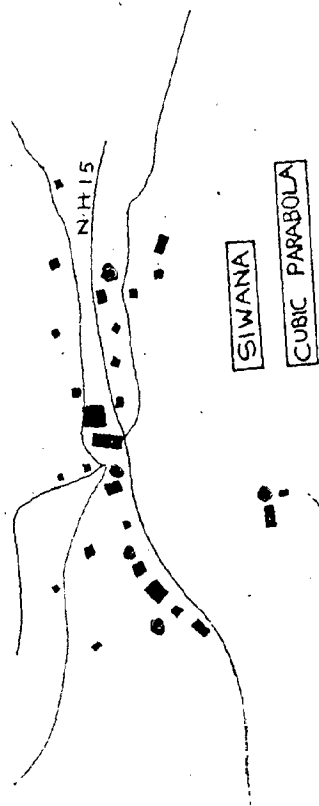
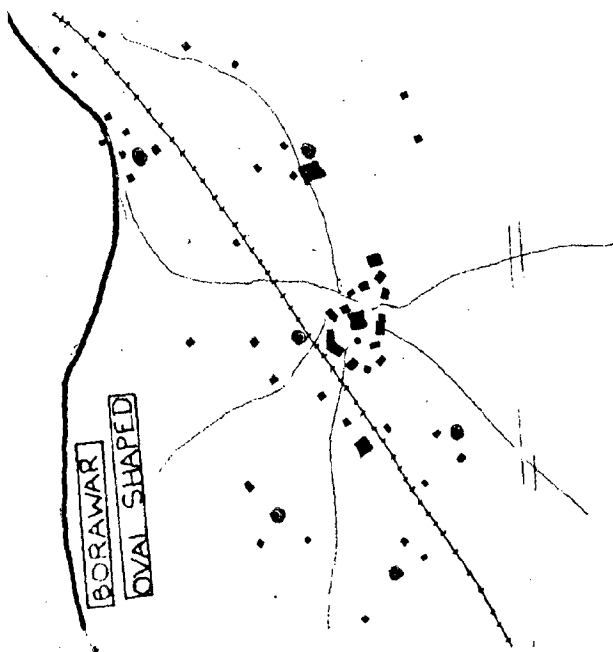
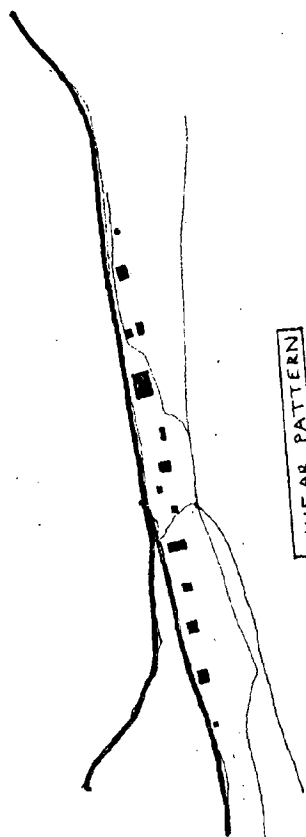
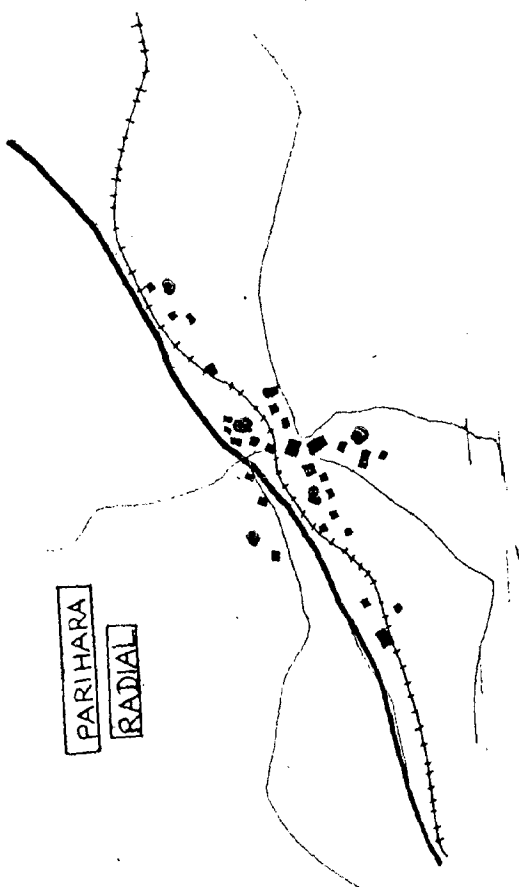


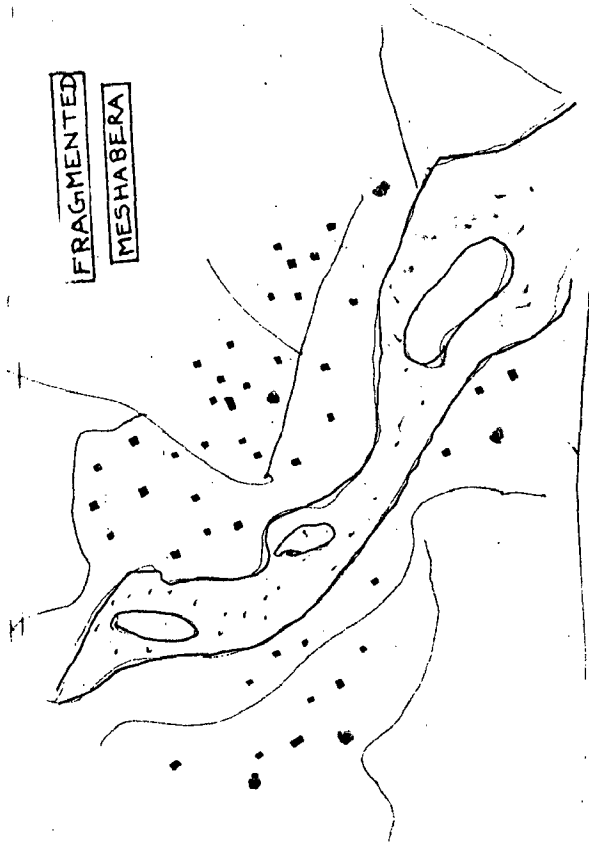
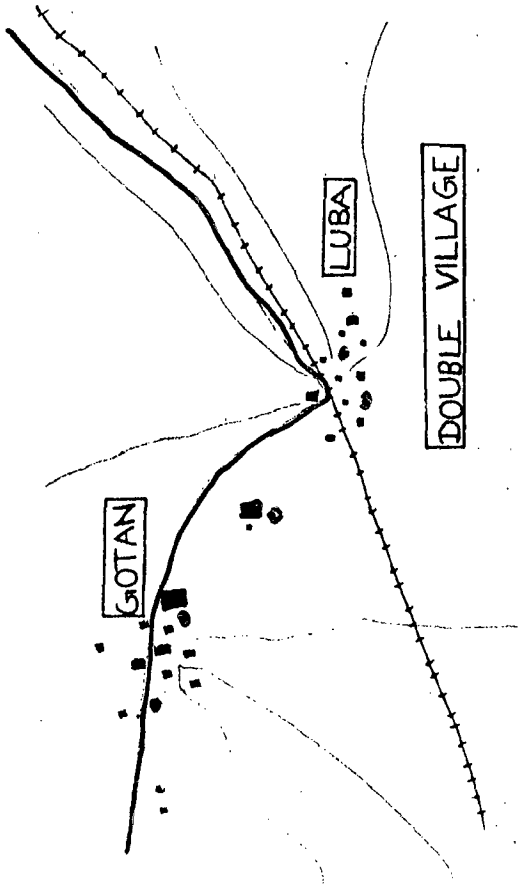
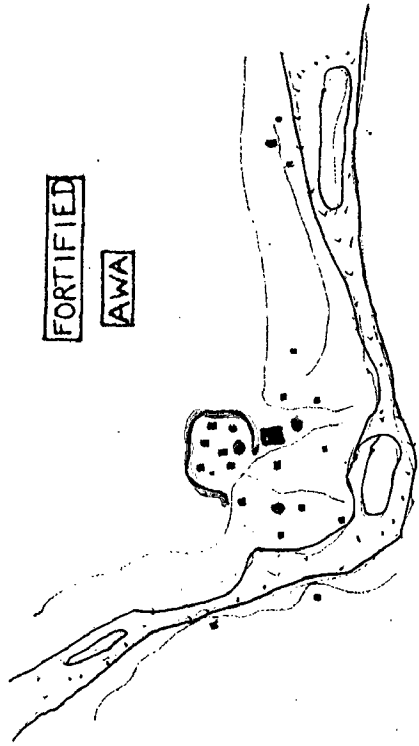
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




Fig-12
DISTRIBUTION OF VILLAGES









<p>SETTLEMENTS</p> 	<p>PATH</p> 	<p>PUCA ROADS</p> 	<p>RIVER</p> 	<p>TEMPLE</p> 	<p>WELL</p> 	<p>FORT</p> 	<p>CANAL</p> 
<p>LAYOUT & FORM OF VILLAGES IN REGION</p>							<p>DERIVED FROM "VILLAGES OF RAJASTHAN" GOVT. OF RAJASTHAN PUBLICATION</p>

which have all the dwellings of a mauza concentrated in one central site. Figure. shows the nature of the concentration of dwellings in the villages of Salampur, Malupura, Kerpura, Maroth and other in the neighbourhood of Katli river in Shekhawati area. Size varies from a small to a large village, i.e., with a population between 500 and 2,000. Most of them are water point and strong point villages, and are either circular or rectangular in layout. They have a closely knit community in which everyone is known to each other. Practically every villager is tied up with the common threshing floor, well, temple and meeting place.

A variant of the Compact type is made up of those villages where the main site is compact and surrounded by several hamlets, which are closely attached to the parent village. This hamletted compact type is confined to the Upper Luni basin except Aravalli hills areas, northern half of Shekhawati area and irrigated parts of Ganganagar. In size it is bigger than the Compact type, with a population between 2,000 and 5,000. The establishment of hamlets is either due to the increasing pressure of population on the main site or due to later expansion of village; or may result from caste hierarchy and individual adventure. Footpaths and cart tracks are the main arteries of regular and constant contact between the hamlets and the main site. Figure shows a typical locality where the hamletted compact type of settlements exist : villages of Korna, Mingola, Agolai, and Jaliali have their

hamlets (dhanis) like Jaton-ki-dhani, Babaji Ki-dhani and Gula-ki-dhani, etc. These dhanis show the impact of caste as well as individuals. There is a lack of very strong bond of cultural cohesion and unity, nevertheless the dominance of the main site over the secondary sites in the economic and cultural life of the villagers is clear.

A Semi-Compact type is confined to the lower Luni basin and eastern parts of Northern Uplands. It is again a modification of the compact type in the sense that the dwellings are not very closely knit and piled together at one common site. In other words, the area covered by the inhabited parts (abadi) in this case is greater than the compact type. Points of water supply in the form of wells, exert a loosening influence on the village morphology. Further, caste hierarchy, and the consequent separate blocks of residence is responsible for this form.

A Semi-Dispersed Type is found in the Shekhawati region as well as in the eastern tehsils of Nagaur district. The entire mauza is covered with small hamlets. The main site at the centre has a feeble influence over the surrounding sites. Indeed, the main site may or may not be distinguishable. In number, the hamlets may vary from 5 to 20 or more. A street pattern is generally lacking and abadis (inhabited sites) are separated by cultivated fields or open spaces. Family ties are more important than caste or

clan ties and a sense of cohesion and unity does not exist. It Shows the nature of the dispersal of dwellings in the villages of Raipura, Karar, Kankra, Manipura, Char, Mairajanpura and Ramjipura. The extent of dispersal is due to the many wells and good fertile soil of the locality. In size they vary greatly, i.e., between 100 and 1,999 inhabitants. The details rural morphology are lost in this process of dissemination.

A Dispersed Type is very limited in its extent, and confined to the rocky outcrops of Aravallis in east. Dwellings are not usually grouped into blocks and they generally stand apart. This type is the result of complete diffusion of farmsteads over the entire mauza. The diffusion or breaking away is not voluntary, but is highly circumstantial because of the effects of dissected and uneven topography. Tiny fields and isolated houses dot the landscape. The sense of neighbourhood and communal inter-dependence is of little importance. Shows the completely fragmented and dispersed farmsteads in the Aravalli hilly tract in the district of Pali. The impact of relief and small rivers (malas) is clear in the dispersal of dwellings.

(B) Functional Basis :

A village does function differently from town, even when it is a big village. It is essentially a community based on primary production with rudimentary third order service directed to a localised area, having few if any

decision making institutions of significance beyond its own borders. Of course, villages perform centralised services, but these services are centralised for a limited area, and offer a limited range of services. On the basis of functions the rural settlements of the region are grouped as follows :

- (a) **Agricultural Villages:** Their primary function is agricultural production. Most of them are small to medium in size. Many consists of groups of hamlets known as dhanis where primary production is the mainstay of the people. These hamlets are, economically and socially, firmly ~~attached~~ attached to the parent villages. For Example, with the village of Agolai (Jodhpur) there are several hamlets, e.g., Jatun-ki-dhani, Dugar and Rabaria.

The agricultural villages may be further divided by the nature of cultivation, i.e., (a) Dry farming villages, and (b) Irrigation villages. These sub types differ considerably. The dry farming villages have a seasonal rhythm and, in the major portion of the year, they remain almost inert, as the adult population goes out for employment to towns or neighboring big villages. The irrigation villages are full of life throughout the year, and they are bigger in size because of a sounder economy.

- (b) Pastoral Villages have animal husbandary as the mainstay of the people. They vary from small to to medium in size, and are mostly circular in layout. These villages are commonly found in the western and central drier parts of the region. The villages of Nosar, Datina, and Palusar and Uparla are typical examples of pastoral type.
- (c) Seasonal Fair Villages are associated with many livestock fairs of the region. These villages are primarily Pastoral in nature, but differ from the ordinary Pastoral sites in that they assume greater importance during the fair season. Some of them are of regional importance, e.g., Sri Kolayat ji, whereas others are of local significance only, e.g., Swadi.
- (d) Mining and Quarrying Villages : Initially most of them originated as agricultural or pastoral villages but became mining and quarrying settlements because of recent mining activities. Purely mining villages are not many because of limited mining activities. Jamsar and Palana are two important mining villages based on gypsum and lignite coal mining, respectively, and Amarsagar and Fidusar are good examples of building-stone quarrying sites.

- (e) **Transport Villages** : Those villages, which are located on main bus routes or railway routes, act as transport centres for the neighbouring villages. Because of their location, they act as collecting and distributing centres. Osian village (Jodhpur) is a good example. It is situated on Jodhpur-Jaisalmer railway and bus routes and it acts as collecting centre for the agricultural and livestock products of the locality and distributing centres for goods acquired from the city of Jodhpur. Most of the transport villages are medium to large in size.
- (f) **Urbanised Villages** are few in number and large to very large in size. They perform centralised services for the limited number of neighbouring villages. Recently, they have become more important as Community Block centres and centres for Panchayat administration. They have established market places and they act as collecting and distributing centres. Bisau, Losal and Bagra are good examples of this type.
- (g) **Holy Place Villages** : They are many and scattered in different parts of the region. They have sacred temples or shrines or mosques. They assume greater significance when annual religious fair takes place, e.g., Ram Deora (Jaisalmer) is an

important religious fair palce due to the shrine of Baba Ram Deora ji. In nature they vary according to the economy of the area in which they are located.

- (h) Fortified Villages : are numerous and found all over the region. They are old historical villages developed as defence centres on strategic locations. Most of them are medium to large in size. Important examples are Nadol Ghanerao and Raghunathgarh.

The classification rural settlements on the basis of form is meaningless unless it shows the relevance to the geographical facts of location functions and size. Villages in ancient India were developed according to the size of population and their spacing was controlled, e.g., sangrahana, a large village (with atleast one hundred families), located in the midst of ten small villages (with atleast one hundred families). These distinctions were obviously functional with the larger centre having service facilities nor found in the smaller. They tend to result in different forms, which are thus a reflection of function and size.

The following categorization of rural settlements is proposed to show the relation of functions and geographical location with the various forms.

The rural settlement functional types discussed in the preceding pages tend to have various forms and they are:

Agricultural Villages are very often rectangular in their layout. The shape of the cultivated fields is very often the controlling factor. The cultivated fields are divided in rectangular parcels of bigha (a measurement which is equal to 2530 sq. m.) and these rectangular boundaries a decisive influence on the boundaries of the inhabited site (basti), because the tendency is not to disturb the ploughable shape of the fertile fields adjacent to dwellings. Hall (1931) and Ahmad (1949) also remark on the importance of the system of measurement in the rectangular layout of the rural settlements. The variations in the rectangular form depend on the location of important land marks of the village morphology, e.g., temples, mosques, wells and the villages meeting place (Chawk), around which dwelling' developed leaving a hollow space in the centre.

Rectangular villages are often medium to large in size and compact in nature. They are common in those areas where cultivation is based on irrigation. Dry farming villages lack this form because of lack of cohesion of layout with irregular fields.

Pastoral-Villages tend to be circular in their form for example the layout of Panchori and Parwar villages.

Two facts explain this from first, the circular circumvallation of thorny bushes for protection against wild animals is an important element of the rural landscape and the second is the need of defence against the constant invasion from all quarters of the compass. The location of a central well or a temple surrounded by an open space brings out variant types, i.e., the hollow circular village. Circular Villages are more common in the western and central parts.

Mining and Quarrying villages, if they are located on the foothill, tend to be either semi-circular or horse-shoe shaped following upon the contours of the locality (siwana village). If they are away from the mining locality, then they may be linear, as having grown up along the road to the mine.

Transport villages are very often linear, (Run village) or steller, Parihara village, in their layout, depending upon whether they are developed along the length of the main road or at the meeting place of cross-roads.

Fortified Villages in most instances are associated with polygonal layout. Awa village, The sides of the polygon vary according to the sides of the fort. Recent growth of these settlements outside the fortified site has resulted in distortion of this shape with fungus-like accretions.

Other functional types vary in layout considerably, depending upon the size of settlements, the lines of communication, and cultural land marks of the village morphology.

(C) Silt Factor Basis :

In order to explain the layout and form of the rural settlements, the site factor is important, as all the differing forms of settlements cannot be explained on the basis of functional types. According to site factor, villages tend to develop certain forms. They are :

- (a) River-Bank Villages : The rivers are few, and for that reason all the more important in controlling the site of villages. Some villages are dry-point villages along the river bluffs and they occupy higher levees, safe from the seasonal flooding, Examples are numerous in Luni basin, i.e., villages of Saila, Othawala, Gol on the northern high levee, and Birana and Alasan on the southern levee of the river Luni. These villages are very often elongated in shape, running along the levee; and further, they are controlled in their shape by roads which run parallel to levees.

Villages, which are located on the points where river can be crossed easily, tend to have radial layout, as the lines of communication converge on these points, and pull out settlement along their direction. For example, Luni village is good example of river-fort village and has radial layout.

- (b) Water point villages are all but ubiquitous in the region. Their site is controlled by a well, a tank or by canal or river. According to local conditions, the layout of these water-point villages varies, viz., a village developed along canal tends to be elongated, but where the siting factor is a well or a tank, the village layout may be semi-circular to rectangular.
- (c) Villages at gaps in hills tend to be either elongated or radial, depending upon their location in relation to gap. They are radial where routes converge at the mouth of the gap from many directions, and dwellings grow along those routes. They are elongated if they are in the gap itself and only one route passes through them. Such villages are found in the Aravalli outcrops region, e.g., Dadkan is an elongated village and Ranpur is a radial pattern village.

- (d) Villages on alluvial fans are mostly fan-shaped in layout because of converging routes which merge in one main road or street towards the apex of the alluvial fan on which the settlement is located. Jhilo affords a good example.
- (e) Villages in the natural basins encircled by sand ridges are commonly found in the Little desert region. Foot paths converge at the centre of the basin where the village is located, and they bring about a radial layout of these villages.

(D) Population Size Basis :

Finally, on the basis of population size, villages may be grouped into :

- (a) Small villages with less than 500 population which are either agricultural or pastoral in nature. In layout and form, they tend to be circular and semi-compact to compact. Very often they are closely linked to a larger parent village for essential services.
- (b) Medium villages with 500 to 2,000 population are essentially agricultural but with subsidiary means of livelihood in pastoral and mining activities. They tend to be fairly compact.

TABLE 1A

Variation in Number of Villages and Their Population

District	Total No. of Villages	Persons	Less than 200	200-499	500-999	1000-1999	2000-4999	5000-9999	10000 & above
Barmer	853	1020663	129	161	210	199	139	13	2
Bikaner	571	513664	127	143	128	111	56	5	1
Churu	855	834807	67	195	269	253	66	5	-
Ganganagar	3886	1611669	2147	888	427	267	142	15	-
Jaisalmer	462	210155	195	145	73	39	8	1	1
Jalor	602	830283	38	75	163	204	108	14	-
Jhunjhunu	689	960316	17	143	185	215	107	19	3
Jodhpur	813	1098309	50	133	252	200	148	23	3
Nagaur	1223	1391592	112	240	390	326	132	20	3
Pali	318	1039739	62	175	234	212	107	28	-
Sikar	705	1087946	55	115	161	242	108	26	2
Total	1477	10599143	2999	2413	2492	2268	1121	169	15

Based on Statistical Abstract Rajasthan, 1981

(c) Large villages with population 2,000 to 5,000 have a variety of sources of livelihood in agriculture, animal husbandry and small scale village industries. Most of them are rectangular but with irregular accretions due to recent growth.

(d) Very Large villages with population over 5,000 are essentially agricultural but nevertheless perform centralised transport and trade through their established market places, periodical fairs, educational institutions, and small scale village industries, They vary in form, depending on various factors.

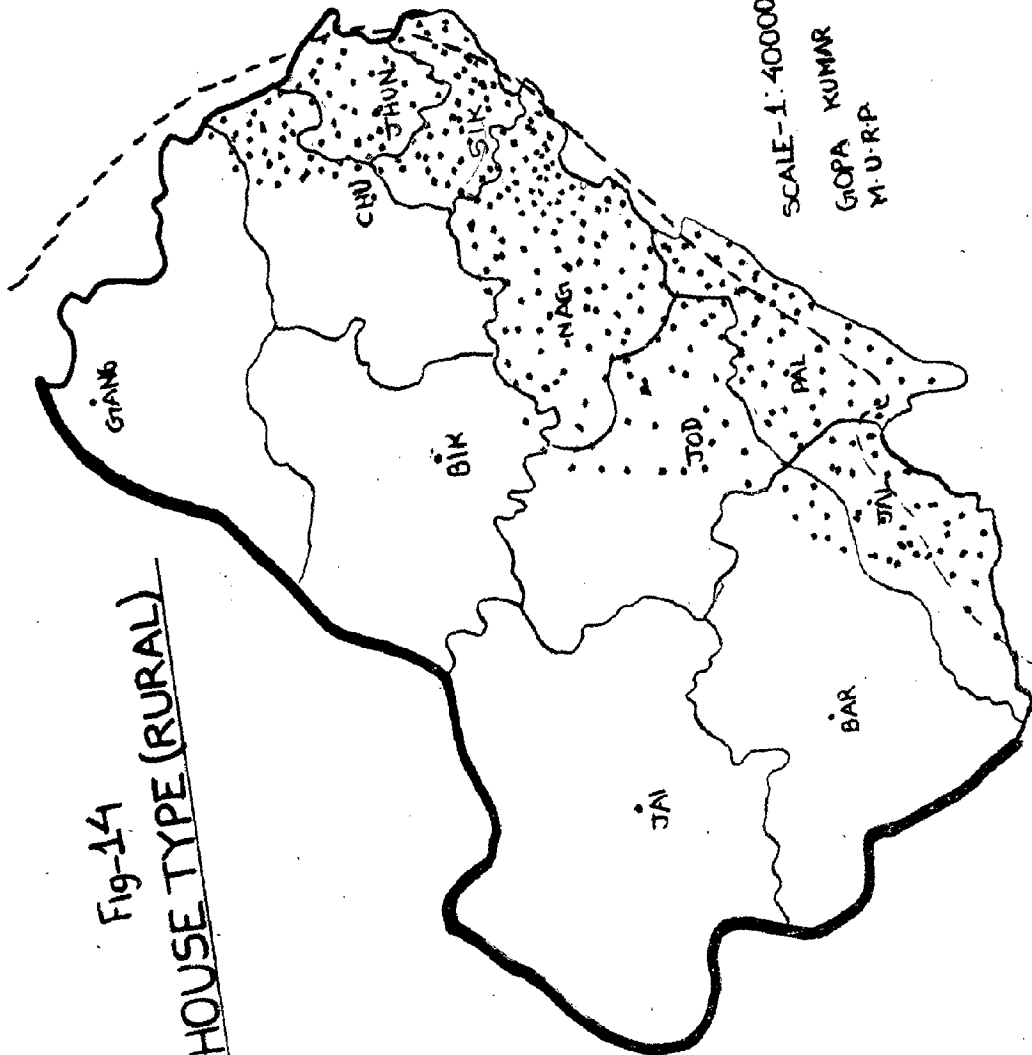
6.4 Rural House Types :

The rural house shows the greater dependence on geographical conditions. It is the result of the adaptation to local physical conditions. It shows the effect of physiography and geology in the availability of building materials; of climate in the form, layout and orientation of walls and roof; vegetation in the characteristic roofings; and of houses.

(A) Factors Affecting the Rural House Types :

Brief reference is necessary to the previous sections on geology, natural and economic features in order to evaluate their role in dictating the rural house types.

- LINE OF DELIMITATION
- INTERNATIONAL BOUNDARY
- STATE BOUNDARY
- DISTRICT BOUNDARY
- THATCHED
- ▤ TILED
- ▥ PUCCA
- ▧ STONE
- ▨ CORRUGATED IRON



SCALE-1:4000000

GIOPA KUMAR
M. U. R. P.

Fig-14
HOUSE TYPE (RURAL)

(a) Building Materials :

Rural house types bear the regional stamp of the type of building materials available in its form and structural layout.

i) Grass, Leaves, Reed or Bamboo : The following saying depicts the importance of these materials :

Akra-ka jhompra aur phogar ri war
Dekhi ho Raja Thari Marwar.

which means that in the kingdom of Marwar (Jodhpur), the huts of Akra (*Anogeissus pendula*) plant is ubiquitous, Karbi stalks of jawar (*Sorghum vulgare*), bajra (*Pennisetum typhodeum*), maize (*Zea Mays*) and Arhar (*Cajanus indicus*) provide materials for thatched roofing in addition to local grasses. Timber for beams and poles is acquired from the following common trees :

Babul (*Acacia arabica*), Khejri (*Prosopis spicigera* Linn), Neem (*Dal bergiasiss*) and Beri (*zizyphus Jujuba*), Stockades, in the form of thorny circumvallation, are made out of plants like Thour (*Euphorbia royaleana* Boiss) and Jhari (*Prosopis Juliflora* and *zizyphus rotundifolia*).

Grass, leaves, reed, and bamboo are more important for roofing than for walls, and are used in 67 per cent of the rural houses. They are more important in Bammer, Ganganagar, Bikaner, Churu and Jaisalmer districts where they cover

80 to 98.4 % of rural houses. Tehsil Ramgarh (Jaisalmer) has the maximum number of houses with roofs of these materials because of non-availability of other materials for roof. The tehsils of Sujangarh (16.2 %), Dungargarh (11.5 %) and Nagaur (8.8 %) are significant in using these materials for walls as compared to other material. They are economical.

The use of these materials dictates the particular shape of the rural houses. Huts (jhempas or zupas) with walls and roofs of these materials are circular and conical in form and very distinctive in appearance. They are especially typical of the western parts of the region. Where walls are of other materials, though the roofs are of vegetation then houses are rectangular in form with single or doubled gabled roofs. These materials are used by poor agriculturists and persons of lower classes.

ii) Stones : This is important as building material for walls and roofs. Out of the total; 14 % of houses have stone slab roofs and 20 % have stone walls. The region is well endowed with a great variety of building stone. The cretaceous sand stone of Barmer and Jodhpur areas; Jurassic limestone and stone of Jaisalmer area; Upper and Lower Vindhyan limestone and stone of Jalor, Jodhpur and Nagaur ; limestone and marble of Rajalo series of Delhi system; and stone and roofing slates of Aravalli system are important sources of building stone. Nagaur (46.0 %), Bilara (42.6 %), Ladnu (42.3%), and Neem-ka-Thana (40.5%) tehsils have a higher percentage of stone roofing

than others, as there is abundance of stone slabs in the quarries in the Aravalli outcrops. Rai-singhnagar, Ramgarh and Sanchore tehsils have the least (less than 1 %) stone ~~roofing~~ ^{as material for thatched roofing} roofing is economical as well as non-availability of stone slabs. Walls of stones are predominant in tehsils of Neem-kathana (69.6%), Raipur (64.8%) and Bilara (61.0%) because of abundance of good building stone, in rocky outcrops, whereas Hanumangarh, Sanchore and Chohtan have the least, below 1 % of the total number of houses, due to difficulty of getting building stone.

Stone, as a building material, give a solid and massive appearance to rural houses with rectangular layout and flat roofs. In areas without local stone resources, the stone rural house indicates the economic prosperity of the owner and his class superiority.

iii) Mud : This is a very important building material, especially for walls. Out of the total houses, 34.0% have mud walls, but it is very rarely used for roofing. Barmer district has the maximum percentage of mud walled houses (73.2%), as villages, along Luni river, have ease of getting mud. The western areas have predominance of mud walls. Kucha bricks (unburnt bricks - sundried) are also important for making walls in the canal irrigated areas of north, in eastern tehsils of Pali district, Jalor, eastern Jodhpur confined

to Luni Basin and northern Churu and Jhunjhunu districts. Nachna, Ramgarh, Pokaran Sheo tehsils have the least number of houses with walls of unburnt brick.

iv) Burnt Brick and Tiles : These form another important building material. The region has 7.5% of burnt brick walled houses and 13.0 % of tiled houses. Brick and lime as roofing material account for 2.9 % of houses. These are important in eastern and north-eastern parts due to availability of getting lime from Vindhyan rocks as well as better economy and living standard. Tehsils of Lachmangarh (32.7%) and Rajgarh (32.0%) are important for burnt brick walls; Kharchi (86.2%) Desuri (83.5%), Sojat (79.0%) and Ahore (80.0%) for pucca (burnt) tiled roofs; and the tehsils of Taranagar (16.0%), Udaipurwati (16.0%) and Chirawa (15.4%) for roofs of burnt brick and lime.

These building materials give durability to houses which have rectangular walls, with flat to gabled roofs. These houses are indicative of more prosperity in the rural landscape and are generally occupied by people of upper classes.

v) Other building materials: Among others, timber and corrugated iron and metal sheets are used for walls and roofs together with asbestos sheets. Timber is important in Phalodi (21.7%), Bikaner (11.0 %), Kolayat (24.6%), Nokha (15.0%) and Sam (18.0%) as material for walls, due to absence of other

types of building material, timber is easier to reach here from ~~Parab~~. On the whole, however, it is not a very important material in the region, as forests are non-existent due to dry climate and ease of getting other materials. Corrugated metal sheets and asbestos sheets are more common in those villages which are near to urban centres and show the influence of urban life in the rural landscape. These materials are only important for roofing. The tehsils of Degana (15.4%) and Parbatsar (14.6%) are prominent in having roofs of corrugated metal sheets.

(b) Climate :

The axiom that houses are made to live in suggests that dwellings are primarily as shelter against the inclemencies of weather. Insolation, direction of winds and orientation of houses and their walls and roofs. The nature of the roof is an especially important index of climatic conditions of any region.

In this region of scorching heat and high insolation, thick mud walls act ~~aga~~ against these conditions and give a cooling effect. Thatched roofing and walls of unburnt bricks provide further thermal insulation. The adaptation to high temperature conditions is also achieved by the use of interior unpaved courtyards and open spaces. High roofing over 3 to 3.5 m. high walls further reduces the effect of high temperature.

The direction of hot winds as well as dust-storms, control the orientation of houses and the angle of slope of the roofs. The circular huts (Zupas), in the western parts where south-westerly hot winds are very strong, have their entrance on the north and north-eastern side thus avoiding the direct impact of hot winds. In the north-eastern parts, houses have high walls with one small gate on the unpaved streets and lanes. These high walls act as a barrier to blowing sand and hot winds. The velocity of strong winds is reduced by the steep angle of thatched conical roofs of zupas.

Rainfall is significant in deciding the angle of slope of roofs. The tiled houses in the vicinity of the Aravallis in the east, where rainfall is above 500 mm, have comparatively steeper slopes (25° to 35°) than houses of the western areas (with less than 250 mm.) where they are either flat roofed or with 10° to 15° slope. Flat roofed houses also assist man in collecting drinking water. Rain water is drained from pre-washed and cleaned roofs by a pipe leading to tanks; (water storage cemented tank) situated on the ground floor. These are very common in Churu, Jhunjhunu and Nagaur districts.

(c) Social-Economic Factors :

These are effective in controlling the use of building materials and the layout of houses. In fact the layout is

dictated by a strict social order and by the form of the economic activities of the community. The poverty and simple ways of the rural society do not permit better building materials or elaborate layouts, and the materials used are an index of the economic status of the owner. Poverty compels the rural folks to be content with single roomed houses. Zupas fenced with thorns are essentially the poor man's single roomed house. The social order is further responsible for the location of houses. Low castes have poor houses located on periphery of the settlements whereas upper classes have well built houses occupying central positions.

French and German scholars distinguished two types of houses on the basis of house plan, i.e., single compact (maison block or einheithaus) and multiple dwelling (maison cour or gehoft), the former having common accommodation for human and animal, while the later provides separate accommodation. These contrasts are found in the Rajasthan desert region. Single compact and multiple dwelling types of houses are the outcome of economic as well as social factors. Rich upper class agriculturists have multiple dwellings and poor low class single compact huts.

(B) Classification of Houses :

House types can be visualised in several ways, e.g., on the basis house plan, external form of the houses, and

TABLE 13

Rural House Types, Area and Population They Cover

Rural House Types	Sub-Types	%age Area	%age Pop.
1. Thatched House	(a) Grass, Reed etc. walls	6.9	5.6
	(b) Unburnt Brick walls	9.9	14.0
	(c) Mud walls	31.8	17.0
	(d) Timber walls	14.0	2.8
	(e) Stone walls	5.8	0.6
	Total	68.4	40.0
2. Tiled House	(a) Unburnt Brick walls	6.5	10.6
	(b) Mud walls	1.5	2.5
	(c) Burnt Brick walls	1.9	4.6
	(d) Stone walls	0.5	1.3
	Total	10.4	19.0
3. Pucca House		4.2	10.0
4. Stone House		15.0	27.0
5. Corrugated metal sheet house		2.0	4.0

Derived on the basis of data, Census of India, 1981

building materials used. The poor rural society have no elaborate house plans, therefore, this parameter is not very fruitful. The external form of the house also provides a weak base for classification of rural houses, but the great variety of building materials used in the construction of rural houses affords a reasonable base within the region.

In using building materials as a basis for classification, the main types are distinguished on the basis of building materials used for roofs and sub-types on material, used for walls. Roofing is the most important element of the house because it gives the main characteristics to the form, plan and layout.

Broad regional pattern of rural house types as follows :

(a) Thatched House :

This is ubiquitous in the western aird parts, and it covers 68.4 % of the rural area and houses 40.0 % of the population. There are two forms: circular and ractangular. The circular type, with a concial roof, if peculiar to the western parts of the region due to the non-availability of wall material other than vegetation.

Generally, the zupa is 2.7 to 3.6 m. in daimeter with 1.5 to 2m. high mud walls. The central pole 2 to 3m. high supports the vertex of the conical roof which is made out of karbi (dried stalks of millet plant).

local grasses, and twigs of Aak plant. The layout of household stalks goods within the circular hut is indicated. Generally, one family has two to three circular huts surrounded by either thorns or mud walls. One is reserved for receiving guests and for work, and the rest for living quarters. There is no provision of bath or toilet because there is plenty of open space for these purposes.

In general, the thatched house is simple in layout and form and its main function is shelter for man and livestock. The thorny enclosure associated with it, is multi-purpose, as it keeps out stray animals, provides a sleeping place during summer nights, space for livestock, and as storage for fodder.

(b) Tiled Roof House :

This has either mud walls or unburnt brick walls or burnt brick or stone walls with a roof made of ill-baked tiles from the local clay. The structure of walls decides the nature of roof—either sloping on two sides or only one side with a shade. Tile houses with shed roof are known as ekdhalia and with gabled roof as dudhalia. The framework over which tiles are arranged is made out of wooden beam of babul, khejri, neem trees.

In these houses there is no provision of bath or toilets. Village wells are the favourite places for a bath and open field spaces for toilet.

Tiled houses provide better living conditions than the thatched houses. They are a typical product of Luni basin, with its better agriculture and economy.

(c) Stone House :

This is dominant in the southern half of the region except for western areas. The eastern half of Shekhawati is another important area for this type. It covers 15.0 % of area and 27.0 % of population. Its existence and regional distribution is intimately connected with the physical topography. The structure layout is generally rectangular; and in appearance and form, it is massive. Stone houses of the upper class are elaborate in their layout. Adjacent to the gate there is a covered place for guests, an open courtyard to allow enough circulation of air, a covered rear verandah as a sitting place for ladies, two or three living rooms, covered store, kitchen. In front there is a raised platform (chabutri). There is no provision of bath or toilets.

(d) Other House Types :

Among others, the Pucca (burnt brick walls and burnt brick and lime roof) and the mud houses are important. Pucca houses are similar to stone house in form, layout and function. They predominate in tehsils of Lachmangarh, Fatehpur, Churu, Taranagar, Rajgarh and Jhunjhunu, because of availability of building materials as well as better standard of living due to good agriculture. The mud house, with plastered high and

flat roof supported with wooden beams, is characteristic of the rich agricultural background of Northern India, i.e., Punjab, Harayana and Uttar Pradesh. The canal irrigated northern parts have an abundance of mud houses. Corrugated iron and zinc metal sheets' house, limited to small part of the region, can be regarded as a variant of the tiled house type.

CHAPTER - 7

ANALYSIS OF URBAN SETTLEMENTS

Although the Rajasthan desert region is predominantly rural, with a rather limited basis for industry, nevertheless it has always sponsored urban development, partly in order to serve the local community, and partly to link up with routes and trading centres to other parts of India. Towns are important in giving focus to the rural landscape. There are 91 urban centres with a total population of 2883878. These centres are essentially small in size and basically most of them are over-grown willages with the exception of cities of Jodhpur and Bikaner and the large urban centres of Ganganagar, Sikar, Churu and Pali.

Urban settlements are widely scattered, and most of them originated as strategic politico-social centres. The word-garh (castle) as a suffix to the name of various towns gives evidence of their origin. Urban morphology imbibes the effects of the chequered growth of urban settlements.

7.1 Growth Trend of Urban Settlement :

Growth trends have been almost identical to those of the total population. Here the emphasis is distinctively urban developments rather than the city as part of population of settlement as a whole.

(A) Trends in Relation to Physiographic Regions :

In the Great and Little deserts and Magra regions there are 13 towns and the city of Bikaner. With the exception of Barmer (48.4 %) and Pokaran (26.5 %), the urban centres do not show significant indices of variation. Fluctuations are few. Decade after decade pass with-out much change indicative of the power of local factors in a comparatively unattractive area.

In the Luni basin there are 13 towns and the city of Jodhpur. Fluctuations during 1901 to 1981 have been large. Every urban centre recorded a negative percentage change during the decade 1911 to 1921, due to the influenza epidemic of 1918 to 1920. The towns of the Upper Luni recorded higher negative change than the lower Luni basin, because they were small in size, and less equipped with medical facilities. Consequently., contagion spread rapidly and there were more deaths than in the Lower Luni basin. The period of maximum increase for all the towns took place either in 1941 to 1951 or 1951 to 1961, because of the introduction of irrigation and improvement in agriculture. At the same time development in road transport enlarged their area of activities. Further, the settling of displaced persons from Sind (Pakistan) also helped to swell their population in these decades. The highest index of variation occurs in the case of Pali (60.7 % followed by Jodhpur (35.4 %).

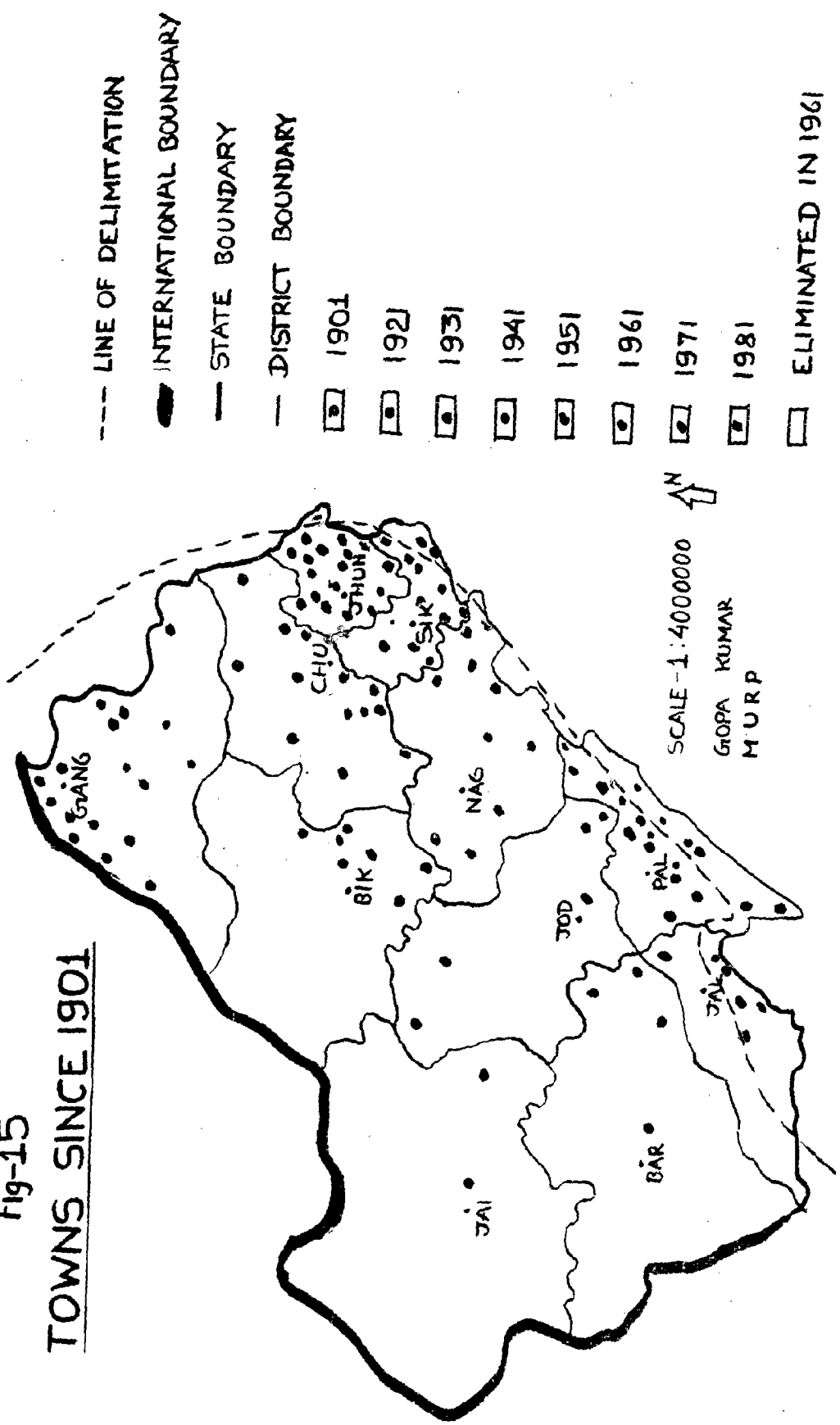
In Uplands region there are 20 towns, which fluctuated widely in population between 1901 and 1981. Merta has shown the highest index of variation (66.6 %), due to factors analysed previously. The great famine during 1891-1901, the influenza epidemic of 1918-20, the poor economy and resultant movement of population explain the population fluctuations of urban centres of uplands.

In Ghaggar beds there are 14 urban centres. None has recorded a negative change because of the security of agriculture following upon canal irrigation. Growth over the total period is, however, large, attesting to sustained prosperity.

In the Shekhawati region there are 27 urban centres. All of them have suffered negative change, with a wide range conditions from decade to decade. This has been a most sensitive region, as the slightest change for the worse in the economy has led to outward migration to the big industrial and commercial cities of India. Index of variation ranges between 5.4 and 32.5%.

Among the physiographic regions, the Luni basin is significant showing large scale fluctuations while the Ghaggar beds are noteworthy as they show rapid increase in the size of urban centres. The Great and Little deserts have decaying towns with the exception of the city of Bikaner.

Fig-15
TOWNS SINCE 1901



(B) Trends in relation to Administrative Units :

Ganganagar district has the most vigorous urban centres which have grown very rapidly within the short period between 1927 and 1981. Ganganagar and Hanumangarh are unique. The factors responsible for the phenomenal increase are centred in irrigation and its multiplied effects. In contrast to this, Jaisalmer and Jalor districts have decaying towns which have seen large downward fluctuations, because of their location in dry and desolate area, where agriculture is almost nil and the livestock economy is precarious. Consequently they have no economic base to attract people. On the contrary, there is constant migration from these towns to other better places of the region or even outside.

Jodhpur district has urban centres with marked fluctuations. Phalodi is a decaying town, as a result of constant decrease in salt production from the Phalodi salt lake. Pipar and Bilara are towns of continuous increase, because of the growing agricultural economy of the area based on the success of dry farming. Jodhpur city itself, as has been seen, is a vigorous urban centres. Bikaner district, except Bikaner city, has urban centres of very recent origin, and has witnessed a rapid increase in urban population. It has benefitted from recent increase in trade and commerce as a result of the growing agricultural-cum-pastoral economy, and also trade in minerals like gypsum, Fuller's earth and lignite. The districts

of Nagaur, Sikar and Jhunjhunu have urban centres with marked decade to decade fluctuations.

Pali district has urban centres which had initial set backs upto 1921. But afterwards witnessed a continuous increase. Pali town had a maximum increase (95.0%) during the 1941-51 decade due to the establishment of a large cotton ginning factory. Churu district has urban centres which have flourished, as they are nodal points for communications and growing trade. Barmer district has two towns. The town of Barmer represents the case of continuous increase, because it has been the administrative centre throughout the census period as well as having acquired small scale industries. The growth of Balotra was much slower because of limited trade, and the migration of people to big towns like Jodhpur, Pali and Barmer.

At district level, Jodhpur and Bikaner are unique in the sense that the cities of Jodhpur and Bikaner account for 84.7 and 80.1 % of their urban population. Jaisalmer and Jalor are essentially districts with small and medium and small urban centres. This is in accordance with the poor agricultural-cum-pastoral economy, skeletal nature of the rail and road network and the absence of Industries.

Thus towns which have benefitted by improvement in agriculture in their hinterlands or have become nodal points for modern transportation and trade, or have developed enough new

industries or institutions have grown continuously. Decay has occurred in those which, even if they had once flourishing trade, have later been overshadowed by new market towns.

In summary, certain generalisations can be made :

- (i) From north-east to south and south-west the number of urban centres decreases. This trend is similar to the general population trends, and relates basically to climate and soil.
- (ii) Uplands and Shekhawati areas are the most urbanised parts of the region. Least urbanised are the Great desert and Magra regions.
- (iii) The regional distribution of urban centres has been strengthened and entrenched by the rail-road network of the region.
- (iv) The distribution of urban centres is very irregular, the spacing between them varying from region to region. However, distances between the urban centres increase from north-east to south and south-west. Distances are less in the Shekhawati area and in the northern part of Uplands. They are greatest in the western parts, i.e., in Great and Little desert regions.

7.2 Types of Urban Settlements :

With a few exceptions, all the urban centres are medieval in origin, and urban and rural functions overlap. In most of them the fort, the palace, the city walls, and the haphazard collection of houses dominate the morphology.

The problem of classifying urban centres is a complex one and may be approached according to location, origin, nature, size, morphology, age and functions. In the present-day quantitative age, systems of classification based on site, origin, and age or stage are less acceptable,

Population size and function provide sound criteria for the classification of urban centres. The former is universally employed in official reports, although the population limits for various types of urban centres vary from country to country. By the size of population, the urban centres are grouped into six classes :

- (1) Class I with a population of 100,000 and above. These are officially designated Cities, and are better equipped with centralised services and perform a wide range of functions through their high-level decision-making institutions. They have higher percentage of tertiary sector, considerable percentage of secondary sector, and negligible percentage of primary sector. For administration, business and culture, they are regional centres.

TABLE 14
Numbers of Urban Centres, since 1901

Year	Class I over 100,000	Class II between 50000 & 100000	Class III between 20000 & 49999	Class IV between 10000 & 19999	Class V between 5000 & 9999	Class VI less than 5000	Total
1901	-	2	1	12	25	9	49
1911	-	2	1	14	26	8	51
1921	-	2	1	13	27	11	54
1931	-	2	2	13	32	7	56
1941	2	-	7	15	32	6	62
1951	2	-	12	17	43	15	89
1961	2	2	11	28	20	5	68
1971	2	3	19	28	18	4	74
1981	4	7	30	41	9	-	91

Based on Statistical Abstract Rajasthan, 1981

TABLE 15

Distribution of Towns by Classes & % proportion of Urban population
 A = Number of Towns B = % of Urban Population

District	I	II	III	IV	V	VI	Total
Barmer	-	1 61.7	1 23.1	1 15.2	-	-	3 98229
Bikaner	1 75.6	-	2 13.5	3 10.9	-	-	6 335085
Churu	-	3 50.3	3 29.8	4 17.5	1 2.4	-	11 344659
Ganganagar	1 28.2	1 12.1	6 35.5	6 20.3	2 3.9	-	16 418299
Jaisalmer	-	-	1 66.9	1 33.1	-	-	2 32927
Jalor	-	-	2 66.5	2 33.5	-	-	4 72790
Jhunjhunu	-	-	4 52.8	8 43.5	2 4.7	-	14 251267
Jodhpur	1 87.3	-	3 12.7	-	-	-	4 579845
Nagaur	-	-	6 83.0	2 9.8	2 7.2	-	10 237077
Pali	-	1 39.0	1 10.3	8 44.3	2 6.4	-	12 234765
Sikar	1 36.9	1 18.3	1 10.5	6 34.3	-	-	9 278936

Based on Census of India. 1981

- (ii) Class II with a population between 50,000 and 99,999. They are called Very Large Towns, they differ from above in not having so many high-level and decision-making institutions.
- (iii) Class III with a population between 20,000 and 49,999. They are called Large Towns, and perform centralised functions to a limited area. The segregation of different townscapes is not well-developed, and they lack many of the public utility services.
- (iv) Class IV with a population between 10,000 and 19,999. They are called Medium Towns with limited or restricted functions. The tertiary and secondary sectors are weak. The townscape is immature and the public utility services are generally absent.
- (v) Class V with a population between 5,000 and 9,999. They are called Small Towns, and have only a local importance because of limited centralised service and functions they perform. Their morphology is immature with marked incursions of rural landscape within the town. Public utility services do not exist.
- (vi) Class VI with a population less than 5,000. They are called Very Small Towns with relatively low percentage of tertiary and secondary sectors. In

the absence of urban functions, many of them may be termed as over-grown villages.

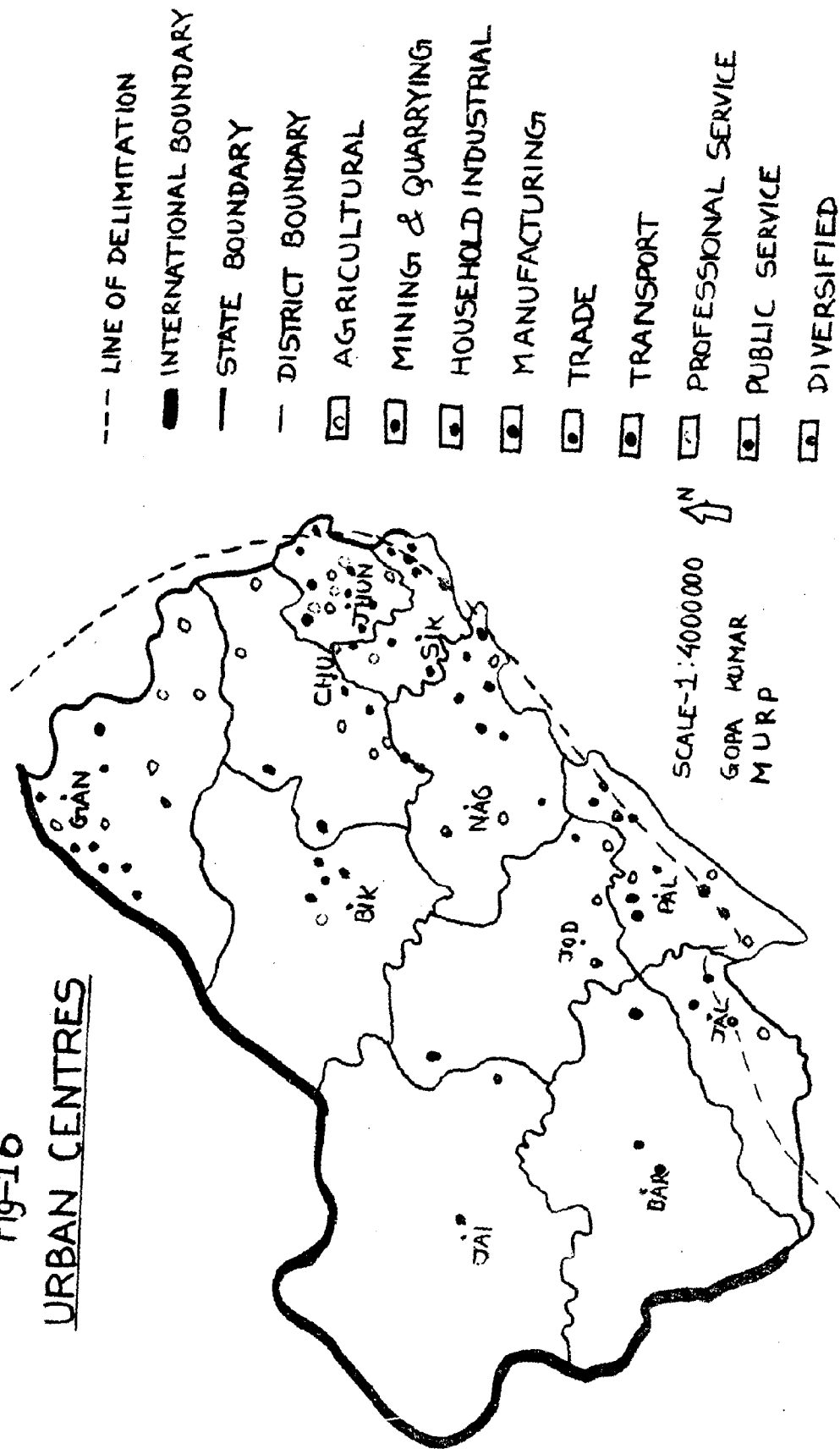
The above designation of the various classes is arbitrary but it will be seen later how they differ in urban activities.

Nelson stated that 'if an activity is concentrated in a city in a certain amount, this activity dominates the city's economic life and becomes its major function. With this basic assumption and using the procedure described, the urban centres are classified and designated as follows :

* Agricultural Centres	...	A
* Mining Centres	...	Mi
* Household Industrial Centres	...	HH
* Manufacturing Centres	...	Mf
* Trade and Commercial Centres	...	TC
* Transportation and Communication Centres	...	T
* Professional Service Centres	...	Pf
* Public Administration Centres	...	PA
* Diversified Centres	...	D

Figure shows the urban types and their regional distribution. Certain conclusions are drawn here with regard to the regional distribution of various types. The diversified and trade centres dominate the Great and Little deserts and Magra regions, with the exception of Napasar as a household industrial centre and Bhinasar as a professional service centre. The Luni basin has agricultural towns with only Pali as manufacturing

Fig-16
URBAN CENTRES



centre, Jalor as mining centre, Bhinmal and Bali as diversified centres and Sojat Road as a transport centre. The Ghaggar plains have mainly trade and commercial centres, but with Nohar and Bhadra as agricultural centres, Anupgarh as manufacturing centre, and Raisingh Nagar as public administration centre.

In Uplands, the agricultural and diversified centres dominate but exceptions are: Didwana as a mining centre, Sujangarh as a household-industrial centre, Dungargarh as a trade and commercial centre, and Merta as a transport centre. In Shekhawati and the Aravalli-outcrop region, agricultural and household-industrial centres dominate but Fatehpur, Jhunjhunu and Mukundgarh are professional centres; Makrana and Khetri, mining centres; Khandela, a Mukundgarh are professional centres; Makrana and Khetri, mining centres; Khandela, a manufacturing centre; and Pilani a public administration centres;

The dominance of agricultural centres in the east, i.e., in Luni basin, Shekhawati area, and northern Uplands, is to be expected, since these are the better watered parts with more fertile soils. The trade and commercial centres of the western parts are due to services on through routes, and the handling of local wool, hides, and salt. The trade and commercial centres of Ghaggar beds in north result from their planned location as marketing centres in the canal irrigated areas, while Ganganagar is a manufacturing centre for processing the agricultural produce of the region.

TABLE 16

Classification of Urban Centres (Activity Based)

I	Agricultural Centres (23)	1. Rajgarh. : Sojat : Sadri : Pipar : Rajaldesar : Taranagar : Bhadra Mandawa : Chhapar : Bagar : Parbatsar : Ratan Nagar : Udaipurwati Bidasar : Bilara : Sumerpur : Ringas : Karanpur : Padampur : Vijaynagar Sanchoe : Mundava
II	Mining Centres (4)	Makrana : Didwana : Jalor : Khetri
III	Household Industrial Centres (12)	Sikar: Sujangarh : Nawalgarh : Kuchaman : Ramgarh : Balotra : Sri Madhopur : Surajgarh : Napasar : Neemaj : Raipur : Peelibanga.
IV	Manufacturing Centres (4)	Ganganagar : Pali : Khandela : Anupgarh
V	Trade and commercial Centres (10)	Dungargarh : Phalodi : Sri Karanpur : Gangashahr : Sangaria : Nokha Mandi : Deshnoke : Gajsinghpura : Sivana Ranikhurj
VI	Transportation and Communication Centres (3)	Hanumangarh : Merta : Sojat Road
VII	Professional Service Centres (6)	Fatehpur : Mukandgarh : Jhunjhunu : Bhinasar : Ravatsar : Gothada
VIII	Public Service (5)	Vidya Vihar : Nawa : Raisingh Nagar : Pilani : Takhtagarh
IX	Diversified (24)	Jodhpur : Bikaner : Churu : Sardarshahar : Barmer : Ratangarh : Nagaur : Ladnu : Lachmangarh : Chirawa : Bhinmal : Neem-ka-Thana : Bali : Jaisalmer : Suratgarh : Pokaran : Losal : Bissau : Keshrisingh : Ahore : Mandala : Jaitaran : Khudala : Kuchena .

Based on Geography of Rajasthan by V.C. Mishra.

(a) Agricultural Centres (A) : Many of these may be termed large villages. There are 23 agricultural towns. They are confined to the eastern half of the region, and have grown from village status. Most of them are small collecting centres for agricultural and livestock products. They have experienced many ups and downs in their population throughout the census period.

(b) Mining Centres (M) : There are only 4 mining towns, located in the eastern half of the region. Stricily speaking, they should not be designated as mining, since all, except Khetri, are building stone and marble. Makrana has been the most important marble quarrying centre in whole of north India since the Moghul times. Khetri once had most flourishing copper mines but now they have declined in importance. Didwana is a salt collecting and manufacturing centre. Jalor is a mere stone quarrying centre.

(c) Household-Industrial Centres (HH) : These are 12 in number, mostly confined to the Shekhawati and Aravalli-outcrop regions with the exception of Balotra in Lower Luni basin, and Napasar in Little desert region. Most of them are centres for food processing, leather and hide processing, oil making and allied industries. Its main industries are khadi cloth making, tie and dye printing, gota making (strips of silver and gold threads for decoration of ladies clothes), confectionary (Indian sweets), soap-making, shoe-making and small scale cotton-gining.

(d) Manufacturing Centres (Mf): These account for only 4 urban centres. Ganganagar is important for cotton-gining and pressing, oil making and sugar industries and Pali for cotton-gining and cotton pressing industry. Both are district headquarters and are well connected by rail and road. Khandela (Sikar district) and Anupgarh (Ganganagar district) are unique because of their small size. They are important for agricultural implements, manufacturing and food-processing industries.

(e) Trading Centres (TC): These form 10 centres and are confined to the western half of the region. Most of them are collecting and distributing centres for agricultural and livestock goods; all of them are located on the railway-Retail trade is more important than wholesale trade.

(f) Transport and Communication Centres (T): There are 3 urban centres in this group, all of which are railway centres. Sojat Road, situated on Delhi-Ajmer-Ahmedabad line has a population of railway workers. Hanumangarh is a railway junction with a medium size rail repairing workshop, and Merta is both a railway and an important bus centre.

(g) Professional Service Centres (Pf): Out of 6 centres, Five are in Shekhawati area and one in the Little desert region. Fatehpur and Jhunjhunu are the only major centres. The other are Mukandgarh Bhinasar, Ravatsar and Gothada.

(h) Public Administration Centres (PA): All Five of these are small sized urban centres. Raisingh Nagar and Nawa.

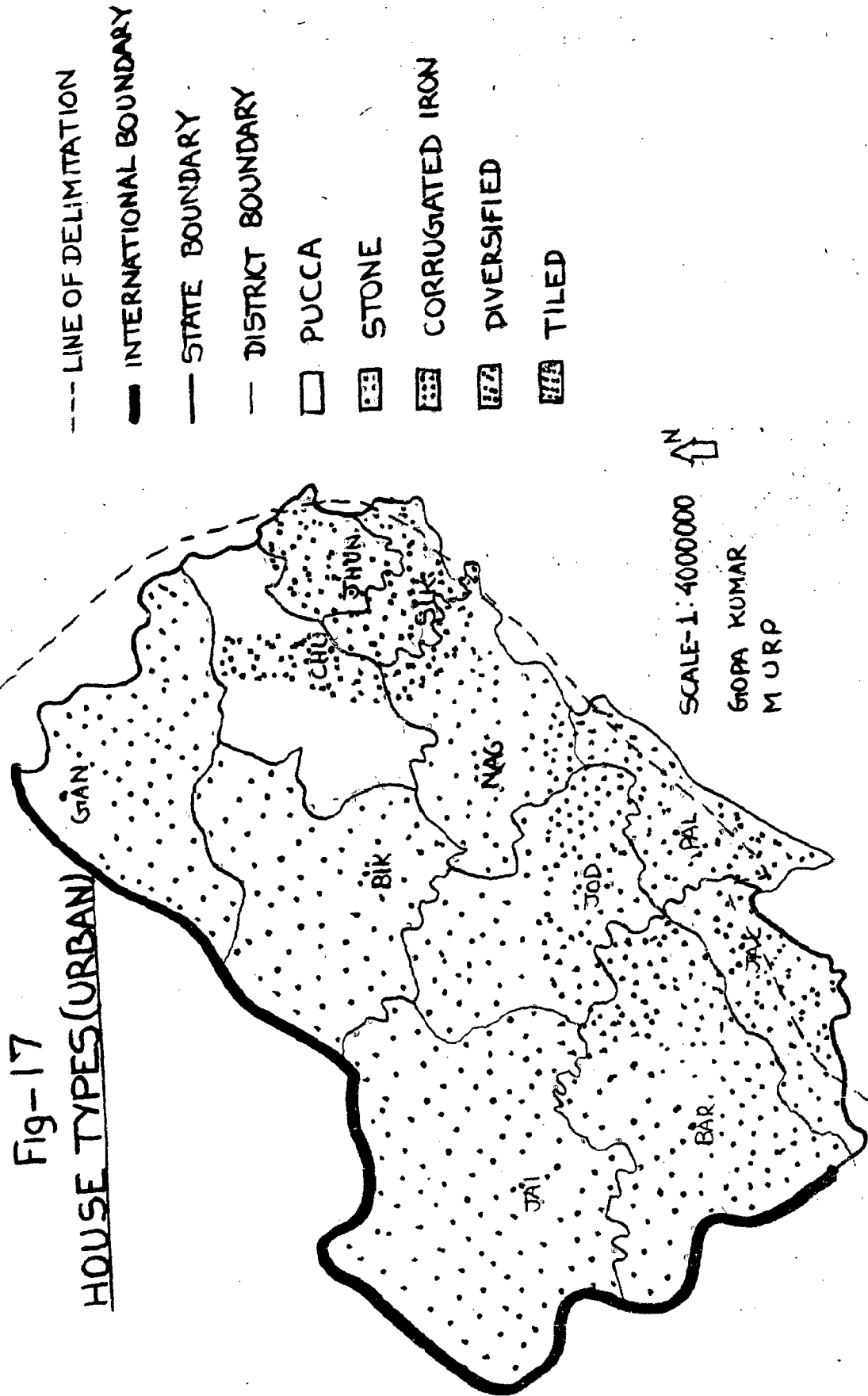
being tehsil head-quarters, have their major population in public services; Pilani and Vidya Vihar have their population mostly engaged in education and administration.

(i) Diversified Centres (D) : These are 24 in number, located all over the region, Many of them are district head-quarters, e.g., Jodhpur, Bikaner, Barmer, Jaisalmer, Nagaur and Churu. In size they range through all the population-size classes except class VI. Jodhpur is the largest centre and the smallest is Pokaran.

Jodhpur and Bikaner are of special interest because of their size. Jodhpur is the largest urban centre of the region and is the head-quarters for the district, having the Rajasthan High Court, Jodhpur University and other regional offices, e.g., of Northern Railway. It has many small-scale industries. It is also a very big collecting and distributing centre for agricultural and livestock products, and is the biggest retail and wholesale trade centre of the region. Bikaner is the second largest centre of the region. It is the head-quarters of its district with many regional offices, e.g., Northern Railway, Railway workshop. It has large retail and wholesale market and acts as a collecting and distributing centre. The association of all these economic activities make both towns into well-diversified centres.

7.3 Urban House Type :

Urban house types though also a product of the local environment, are mainly a reflection of socio-economic conditions.



There are palaces and public buildings as well as poor huts. The main concern is with the common man's house which portrays the local natural conditions and socio-economic characteristics of the urban society.

(A) Factors Controlling Urban House Types :

The impact of the natural environment, so forceful in the case of all rural house types, varies with the size of urban centres. Medium to small urban centres are as profoundly affected by natural factors as are rural communities. Very large urban centres like Jodhpur, Bikaner, Ganganagar and Sikar show less influence from the local environment but more of caste hierarchy and economic standards. Poor men of low castes have poor houses which resemble the rural house types.

Among the various building materials, grass, leaves, reed and bamboo is important for making walls in Nawa tehsil (7.7%) and Sujangarh (6.8%); and as material for roofing it covers up to 86.3% of the urban houses in Anupgarh tehsil as vegetation is the only available material for roof, but not in the tehsil of Bali due to the ease of making tiles as well as convenience of making slope roofs with tiles. Unburnt brick and burnt brick for walls cover 19.0 and 28.6% of the urban houses of the region, more so in Bali tehsil (85.4%). Stone, as material for walls, is most important for urban houses, accounting for 40.5%. It is used more in Ladnu (99.0). Jaisalmer (99.0), Phalodi (97.5), Jodhpur (96.2) and Nagaur (93.7%), as building

stone of good quality is found in abundance in the Vindhyan outcrops. Stone for roofing covers 47.8% of the urban houses. Tiled roof houses account for 70.4 and 56.2% urban houses in Desuri and Padampur tehsils, respectively. Chirawa (23.8) and Fatehpur (22.8%) have urban houses with corrugated metal sheets. Brick and lime roofed houses are more common in Raisinghnagar (54.0%) and Sardarshahar (51.0%).

(B) Classification of Houses :

They may be classified either on the basis of building materials of wall and roofs or on the basis of caste or class hierarchy. In defining urban house types, the building material is taken as a base. The various urban house types are similar to rural house types, but in their regional distribution show marked variations, compared to rural house types.

Stone house type covers a major area in the western and central and north-eastern parts. It accounts for 49.5% of the urban areas and 52.8% of the urban population of the region. Its variant type, i.e., with burnt brick walls, is important in Bikaner, Nokha, Sujangarh, and Nawa tehsils. Stone for these houses is acquired from the rocky outcrops of Vindhyan system of rocks and from the Aravallis.

Next in importance is the tiled house type which covers 15.7% of the urban areas and 5.7% of the urban population. It is used extensively in the tehsils of Jaswantpura, Jalor, Bali, Desuri, Bilara and Padampur. Here tiles are easy to make as well as suitable for making slopy roofs for rain water. Thatched type is limited to the eastern and southern parts of

TABLE 17
Urban House Types, Their Area and Population

Main Types	Sub-Types	%age area	%age Pop.
1. Thatched House	(a) Unburnt Brick walls	5.5	3.9
	(b) Mud walls	1.7	0.6
	(c) Burnt Brick walls	1.2	0.7
	Total	8.4	5.2
2. Tiled House	(a) Unburnt Brick walls	3.7	0.9
	(b) Mud walls 3	8.0	2.8
	(c) Burnt Brick walls	4.0	2.0
	Total	15.7	5.7
3. Pucca House		3.4	9.1
4. Stone House	(a) Burnt Brick walls	13.7	19.1
	(b) Stone walls	35.8	33.7
	Total	49.5	52.8
5. Corrugated Iron and Zinc metal sheets		10.0	12.0
6. Diversified Type		13.0	15.2

Derived on the basis of data, Census of India, 1981

Ganganagar district and it covers 8.4% of the urban area and 5.2% of the urban population, as towns are agricultural in their types and have deeper impact of natural environment. Other types are limited in their extent, e.g., Pucca house type is confined to Sardarshahar, Rajgarh, Ganganagar and Rainsingnagar tehsils because of availability of bricks, lime and stone as well as better economic conditions; and corrugated metal sheet roofed houses are limited to the tehsils of Taranagar, Churu, Ratangarh, Lachmangarh and Sikar, due to difficulty of getting other types of roofing material. These metal sheets are procured from outside the region.

In form, layout and function, the thatched house and the tiled house are similar to the rural type except that one part of it is used for work as well as for dairy animals. It is the pucca house and the stone house which have distinctive features and are analysed here. The layout of these houses varies with the economic or social class of the household.

(a) Low and Middle Class Urban Houses : These houses are generally one to two storeyed with walls of unplastered stone or burnt brick. There is usually a platform (chabutri) between the street and the house. In front there are two to three rooms with separate doors opening onto the street. The central room is known as ('pol') used as 'darikhana' (guest room) and the other front rooms are known as 'ovras' which are very often used as bedrooms for elderly persons of the household. Pol leads to the inner court yard (Chauk) which has in one

corner stairs leading to the upper storey or to the roof, a place for cooking and a place for storing water. At the rear, there are two to three rooms which are also known as 'ovras' and used for living and storing goods. The upper storey has one big front room, known as 'malia or mahal or medi' (parlour), and it is used for guests.

(b) Upper Middle Class Houses : In their layout and function, these are similar to the lower middle class houses, except that they have more rooms, proper drainage and bath and toilet. They are mostly two to three storeyed, with many separate families living as tenants.

Most of the rooms in these houses are dark and ill-ventilated. Inner court yards are always dingy and dirty. Very often the toilet opens onto the street for convenience of cleaning by mahtars (scavengers), and they are the most dirty spots. Side lanes and front drainage are dirty because of their use as toilets by children.

(c) Upper Class Houses : These are known as mahals or havelis but their modern counterparts are known as kothis or bungalows. They have a separate modernised lounge with modern furniture, one or two guest rooms with attached bath and toilet. The covered varandah in front is very spacious and used to receive strangers. The covered portico is used for keeping the car by day but this is locked in a garage at night. Inner varandahas are used for sitting and gossiping. At the rear,

there are modernised bath and toilet. There are separate rooms for kitchen, dining, stores and living. The inner court yard is well cemented or covered with stone slabs. It may have a front garden as well as kitchen garden, the former usually used for sitting during evening.

Besides these houses, in many town new colonies of modern houses for the working class developed by railways, regional offices and municipalities. Railway colonies are important. They consist of small flats with two to three rooms, and in most cases the roof is made of corrugated asbestos sheets.

CHAPTER - 8MACRO LEVEL IMPACT OF INDIRA GANDHI CANAL ON REGION :

This desert is potentially fertile but this vast tract of the land is lying barren and waste only due to scarcity of water. Since water is a major limiting factor for development. Of the area, it is natural to presume that such area would cease to be a problem if water could be brought in to it for irrigation and domestic use. The construction of Indira Gandhi Canal is an attempt to develop hitherto neglected region. It is really a sight to see the life giving water being lifted at pumping stations and flowing through such inhospitable desert, whose inhabitants, for generations have accepted scarcity and famine as their mode of living.

The Indira Gandhi Canal Project, earlier known as Rajasthan Canal Project has its Origin in Indus Water Treaty of 1947, which established the division of the Indus Water between India and Pakistan. Subsequently division of Indian share between participating states in 1955 allocated 9,900 million cubic meters of water annually to Rajasthan. Survey was first conducted by central water commission in 1951; followed by a detailed survey by Rajasthan Govt. The formal inauguration of the project was done on March the 31st, 1958 by Late Govind Ballabh Pant, the then home minister of India.

The Canal takes off from the Harrike Barrage constructed at the confluence of river Bease and Sutlej in Punjab state. It is trapezoidal in shape with top & bottom as 134 feet & 218 feet with depth of water as 21 feet. The total length of the Canal is 649 Kms. first 204 Km. is called the feeder canal and water is not drawn from this portion of the canal. The remaining 445 Km. length is called main canal. The main canal project is divided into two stages. Stage I includes 189 Km, long main canal with its distribution system of 3075 Km. Stage II consists of main canal from 256 Km. to its end with 5112 Km. of branches and distributaries. The cultivable area in stage I and stage II is 5.25 lakh ha. and 10.12 lakh ha. respectively. The construction of the main canal was completed on 31st Dec., 1986. The distribution system on stage I has already been completed and that on stage II is under the way. The 1958 estimate of the project was of the tune of Rs. 664.6 million but due to increased scope of the project and price escalation, the cost of the project is going on increasing. Till the end of 1989 the total investments on project was Rs. 6617 million, and Rs. 30000 million more is needed to complete the work. When it is going to be completed is anybody's guess, but it is certainly not going to finish before 2015 A.D.

8.1 Delineation of Indira Gandhi Canal Region :

The region has already been delineated by the Rajasthan State Town Planning Dept. The region delineated

for the exercise of planning function must have sufficient geographic, economic and social units to permit effective common foresight and policy in handling the important problems of the region. Such an area must have a diversified and complementary resource base to facilitate integrated development.

The canal command area has its distinctiveness due to canal irrigation and the associated crop economy. If the planning is confined to the irrigated area only, then the development will take place in linear fashion which is not economical and good from planning point of view. Moreover, the canal tract is free from minerals and other natural resources, which can contribute to diversified economic base. Important minerals like gypsum, lignite lime stone, fuller's earth etc. occur on periphery of canal tracts. Other factors influencing the delineation of the region are:-

- (1) Entire Western Rajasthan is a desert, of which canal tract covers only 1/13th part. Therefore some part of this desert to which the benefits of the canal could be extended conveniently are taken in the region so that the maximum possible area of the desert is reclaimed and put to productive use.

- (ii) The areas where the geographic conditions are same have common problems of development. Thus, the areas where climate and other natural conditions are found as same have been included in the region.
- (iii) While delineating the region it has been taken care of that two widely different groups are not brought together. Homogeneity in them would make the development more convenient.
- (iv) Areas influenced by the central force like Delhi, Jaipur, Narbada Valley etc. are excluded from the region.
- (v) While demarcating the region it also has been seen that how best the existing administrative system is used without bringing much changes in it. Thus, the international border with Pakistan and border with Punjab and Haryana become firm western and northern boundaries of the region. The eastern and southern boundaries of the region are formed by district and tehsil boundaries.

On the basis of the criterion mentioned above, the region has been delineated and includes four complete districts namely Ganganagar, Bikaner, Churu and Jaisalmer, and parts of Jodhpur and Nagaur districts.

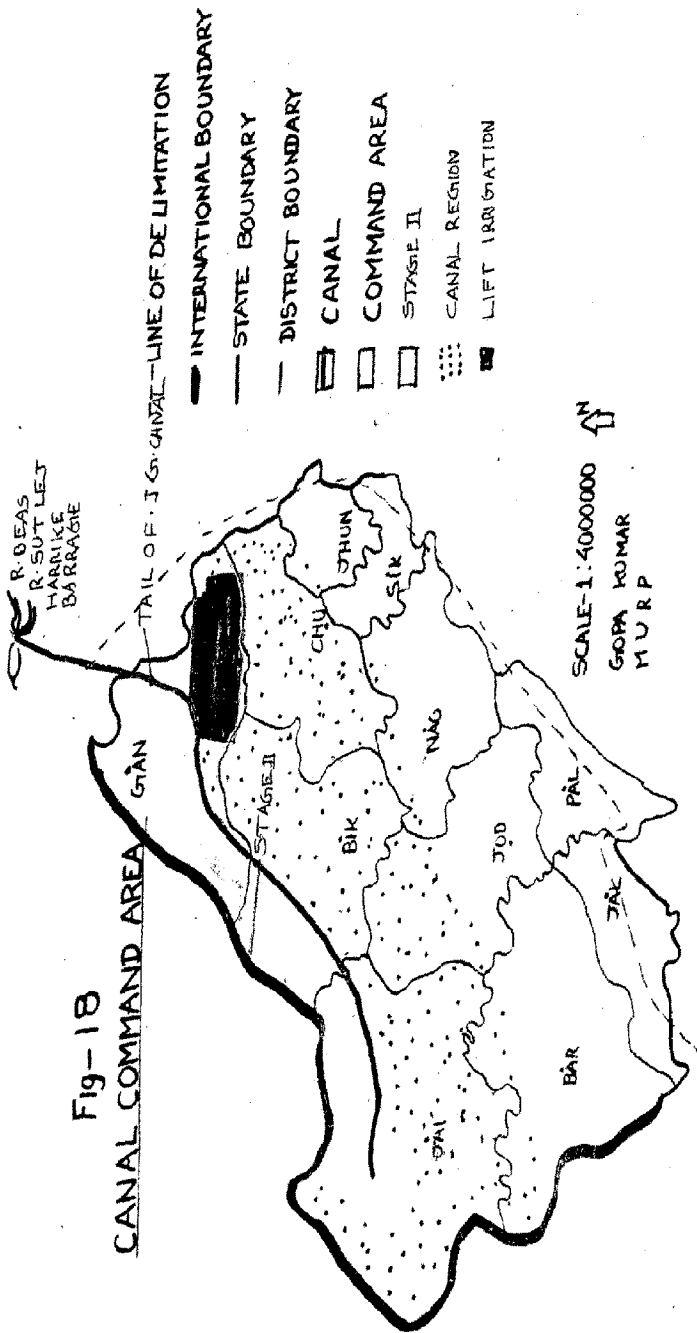
TABLE No. 18
INDIRA GANDHI CANAL REGION

Administrative Unit	Population (1981)	Area (Sq.Km.)
Distt. Ganganagar	20,29,968	20,634
Distt. Bikaner	8,48,749	27,244
Distt. Jaisalmer	2,43,082	38,401
Distt. Churu	11,79,466	16,830
Distt. Nagaur		
(a) Nagaur Tehsil	2,74,281	4,661
(b) Jayal Tehsil	1,21,548	2,056
Distt. Jodhpur		
(a) Phalodi Tehsil	2,55,395	7,524
TOTAL	49,52,489	11,73,350

Source : District Census Handbook (1981) of
District Ganganagar, Bikaner,
Jaisalmer, Churu, Nagaur and Jodhpur.

Fig-18

CANAL COMMAND AREA



SCALE-1:4000000
GOPA KUMAR
MURP

8.2 Population Density:

Ever since the beginning of human civilization, most of the settlements have come up, and flourished along the water bodies. Because at such places food, water and transportation were at hand. Same impact could be seen in Indira Gandhi Canal region. The density of the settlements as well as density of the population is higher in the irrigated area of the region as compared to unirrigated area.

8.3 Intensive Cultivation :

The main crops in the region are wheat, gram, mustard in Rabi season, and paddy, cotton, jawar in kharif season. Cropping pattern has also been tremendously changed some new crops like ground nut, which was nonexistent before 1978, now the production is 25,503 tonnes and it is expected that it will increase in the coming years. The intensive cultivation is bringing prosperity in the region.

8.4 Flora and Fauna :

The flora of the region has tremendously changed after the introduction of the canal. There is a thick line of trees along main water channels and a large area is under double cropping pattern. At a regional landscape scale, the earth surface appears to be fully covered with green and colourful flora in the form of crops during the Rabi and Kharif season, particularly in the stage I area. It does not appear to be a desert area at all as it was in the past.

The fauna system of the region has also changed tremendously with the incoming of water in abundance. These days the fauna of the area includes wild life in the form of Chittal, Blue Bill, Jackal, Fox, Rabbit and birds of various types.

The changed flora at large in the region has helped in reduction in soil erosion by winds, reduction of the severness of the dust storm, improvement in the climate and enhancement of the aesthetics. The changed fauna has affected the region both in positive and negative sense. While they help in pollination and control of pests etc. on the other hand damage to crops is caused directly and through introduction of new disease.

8.5 Afforestation ;

It is feared that the 'Thar Desert' is marching in to fertile land of Uttar Pradesh, Delhi, South Punjab and Haryana. Recent topographic surveys show that the great Indian desert of Rajasthan has been spreading outwards in a great convex arc through Ferozpur, Patiala and Agra towards Aligarh and Kashganj at the rate of 1/2 mile per year. The green belt that the Indira Gandhi Canal will raise in its command area will be an effective check to this process.

Shifting sand dunes are biggest menace for the inhabitants. Stabilisation of sand dunes could be possible to some extent with the canal water. This has helped in protecting

fertile fields, human habitation and lines of communication from drifting sand.

8.6 Miscellaneous Impacts :

The availability of water, both static and flowing provides opportunity for fishery. Water can be diverted from the canal and fish farming can be integrated with irrigated agriculture. This may give a new direction to the economy of the irrigated area. In 1988-89 the total fish production was 2.95 lac Kg. and total money received from fishing tenders worth Rs. 29.75 lac.

The 1965 war with Pakistan has proved that the 'Thar desert' which had been taken as a natural barrier can be easily crossed over with the help of modern technology and machines. The vast stretch of unoccupied land all along the border thus becomes a danger of foreign invasion. The Indira Gandhi canal project which will inhabitate the 45 Km. wide stretch of the land all along the border will help in defending our western frontier.

At many places, particularly in stage I area where clay content of the soil is a bit higher, the land gets water logged. For agricultural purpose, land is called water logged when its productivity and fertility is affected by high water table. The major cause of water logging is seepage from canal system and over irrigation of fields.

CONCLUSION

The Indian Desert, covering 11 districts of the state of Rajasthan and 6.7 per cent of the total area of India, forms a stringent environment. As we have seen a large part, in the west and south, is made up of wind-heaped sand-dunes, where there is little opportunity for settlement. The water-table is deep down and the water, when reached, is brackish. The sands have buried possible outcrops of fuel or metal leaving rocks, and so there are no mineral resources. The zone of elongated seifs is practically uninhabited. The area of barkhans has small villages of pastoral people in depressions behind the larger sand ridges where some water and vegetation may be found. The rock desert of the area is bleak and empty in the extreme, except for a few semi-nomadic herdsmen. Towns are small and few and far between ; most of them are on old caravan routes, throwing on the local area but on what passes through it. Further east the land rises to a broad upland and then to the Aravlli hills. With this rise it loses its sandy nature, shows outcrops of rocks, gives the possibility of mining or quarrying, and at the same time becomes wetter, has more and more regular streams and a closer cover of vegetation. All these factors have helped to produce a denser population with settlements based on mining, on mixed crop and stock agricultare, and on active transport and trade.

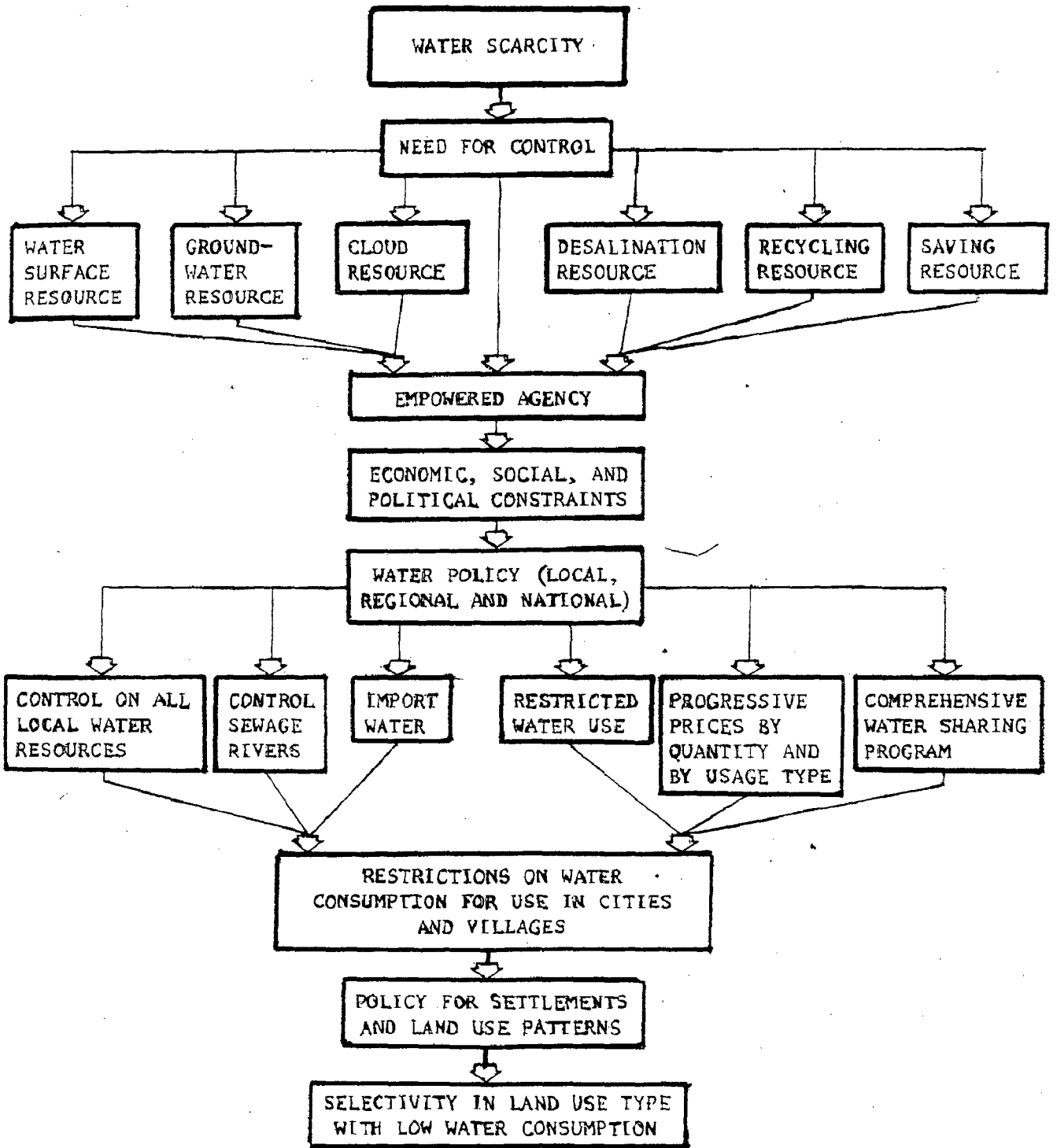
9.1 DEVELOPMENT POLICY AND STRATEGY :

We proudly says that the amount of earthwork in I.G. canal construction is of such magnitude that by this soil, a strip of 1.2 m. height and 6m. width can be constructed and the amount of tiles are such that 4m. width strip can be made, both around the circumference of the earth. So we can afford to make around 40212km. of tile road and 1 lakh km. of earth road, though in the region only 20788 km. of road is there with 2500 km. of metalled road including the N.H.

By above analysis, does not mean that by just constructing the road, I am trying to solve the problem, but since in last there decade we have spent 662 Crore ruppees and more than 2900 Crore still needed to complete it and looking at the fact that this year also for 1989-90 the allocation of money is 121.4 Crore (67.27 Crore from state and other from Centre), so it's completion is still a long drawn process.

So what I suggest is that a fraction of amount of canal development should be envisaged for the, area which in not in the commond area of canal.

Thus the area which can be irrigated through the canal should be developed as the agricultural zone, obtaining self sufficiency for the state but to the magnitude.



of export level to the other states. Also cash crops should also be produced in sufficient amount to obtain hard currency.

Other areas should be developed as industrial area, recreational area for tourists, health centre for asthmatics etc; the policy for which should be made for proper evaluation of resources potential and their usage and water policy, i.e. not allowing the industries which consumes too much of water unless they are economically viable. For electronic goods this place is ideal because of fresh environment.

Thus strong effort through positive and negative planning should be made to discourage the development other than agriculture in canal vicinity and encourage away other activities taking various town as satellite towns, with better linkages to villages, positive and negative planning make explicit that various subsidises should be given for setting up industries in desert. Also the visit to metropolis etc. for desert people should be subsidised. School etc. should be there in sufficient numbers and for higher education well integrated approach with subsidise for attaining higher education outside. There can be many areas like this which should be well studied.

The Rajasthan desert which has more livestock population than human, can depend very much on the biogas plant for some household energy needs. Also based on concept of "Patna Organization-Sulabh Shauchalaya" which maintains pay toilets and the gas produced from sewage is used for

generating electricity, which is sold to the city grid. The economic benefits of such energy use are matched by its environmental gains. Also the solar energy which is technologically and economically feasible can be used for house heating and cooling and even cooking. This all can be done through appropriate technology by putting a fraction of amount as already said of canal for research etc. Since the arid land with very low density (64 compared to 210 at National level) can be very much used for future development; since any development at the cost of forest etc; will result in ecological disaster.

Though my work on the desert can be taken as guideline, but still it requires a lot of research for drawing a development programme which should be taken as national policy.

Problems and Suggestions

Out of such a situation certain problems have arisen. These are not merely academic problems, but problems of the real world. Any academic study should become aware of this. Increasingly the study of geography must be made relevant to the actual geography which is being made in any region.

In desert of Rajasthan the geography now developing is centred in the following problems :

- (1) The economic base of human settlements is precarious, as a result of harsh natural conditions and consequent poor crop-livestock economy. Famines and droughts are constant and compel the people to migrate from one place to another, within the region as well as outside. Rural settlements are especially subject to many vicissitudes from time to time. Their fate hangs on the limited water supply.
- (2) Industrial backwardness of the region has aggravated poverty. It has failed as yet to lift the people from excessive dependence on primary production. Therefore, they are liable to be succumb easily to the vagaries of nature.
- (3) The skeletal nature of the route network causes isolation which is also responsible for retarded rural-urban relationships and inter-dependence.

- (4) Rural settlements are a mere medley of streets and houses. They have no definite morphological pattern. Public utility services hardly exist. Electricity has not reached the villages. A more efficient layout, saving time and effort, and conducive to health, is needed.
- (5) Rural houses are poor and hardly provide sufficient shelter and comfort.
- (6) The majority of villages have no access to centralised services which are important for a happy and healthy life.
- (7) Urban centres have a sharp dichotomy between traditional and modern conditions. Old centres lack hygienic sanitary conditions. Streets and lanes are tortuous, dusty and dirty, and houses are poor and worn-out. Public utility services are far from being satisfactory. The old urban land-scape presents a depressing and gloomy sight. The contrast with the new landscape is too great. The problem of bringing the old up to the new, through urban renewal, is tremendous.
- (8) Urban centres have very weak ties with the rural side. Their spheres of influence are limited and the greater part of the region has no urban influence.
- (9) Central places, so vital in providing centralised services to the country-side, are limited in number and poor in providing access to various services.

The problems stated above put a heavy responsibility on the people and the government for their solution. It is a stupendous task to provide remedies. Public finances are limited, therefore, larger scale immediate steps are difficult to take. A planned economic development was started under the Five Year Plans. Significant development has taken place in agriculture, irrigation, animal husbandry, road transport, and social services. State Government has established urban development and rural reconstruction boards. It has started rural and urban housing schemes. The government aims to achieve balanced regional development.

The development programmes cannot succeed in bringing marked improvements to the pre-existing conditions of rural and urban centres. The reasons mainly and important are : the government machinery has simply not been adequate to handle the development programmes; and the democratic ways were heavily biased due to regional and local interests and traditions.

Suggestions to solve the above-mentioned problems are :

- (1) The economic base of the settlements can be improved by improving the breed of stock, growing more fodder, extending irrigation, and stressing cash crops. Industrial development should be given more capital investment, and helped by training programmes. There are enough natural resources for developing industries based on products of agriculture and livestock and minerals, but capital, skills, fuel and power are needed.

- (2) The region needs more railways and roads. More all-weather roads must be constructed, especially in the western area of the region. Roads and railways will bring integration of natural resources as well as a closer relationship between town and country. With the development of lines of transport, trade and commerce will increase which will bring vitality to the staggering rural and urban centres.
- (3) Self help and government reconstruction programmes are badly needed to improve the living conditions of the rural settlements. Better houses, with properly processed local building materials, can be constructed
- (4) With regional planning, either new towns or improved villages equipped with required centralised services should be planned to augment the older towns which are so difficult and costly to renew.
- (5) Government aided public utility services are required improve the living conditions of the urban centres. Urban housing schemes, especially for lower and middle classes, should be initiated to improve the housing conditions.
- (6) Literacy as well as strict civil rules can bring better living conditions in rural and urban life. Literacy will bring a definite psychological change in the attitude of the people of the region and this will bring significant changes in the rural and urban landscape.

For any development and improvement programmes related to settlements of the region, a correct appraisal of their origin, nature and inter dependence is required. Regional planning for development needs sound and full analysis of the human landscape. It is hoped that the present study could be one step forward providing that base. There is need of more geographical work of intensive nature on Indian Desert settlements both to understand how they have evolved and also to plan their future improvement.

B I B L I O G R A P H Y

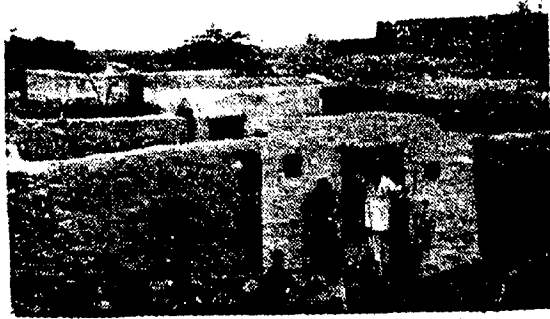
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TABLE 19

Educational Institution in Region

District	University	Degree College	Prof. College	Hgh. Sec. School	Middle School	Primary School	Prof. or Special School	Total
Barmer	-	1	1	46	138	781	-	967
Bikaner	-	5	9	64	134	547	3	762
Churu	-	5	5	90	184	710	2	996
Ganganagar	-	12,	8	141	299	1190	1	1651
Jaisalmer	-	1	1	18	51	299	1	371
Jalor	-	2	-	37	120	543	-	702
Jhujhunu	1	8	4	134	188	710	1	1046
Jodhpur	1	3	11	112	233	868	1	1229
Nagaur	-	3	5	100	214	984	3	1309
Pali	-	3	3	87	161	717	-	971
Sikar	-	7	6	119	216	833	9	1190

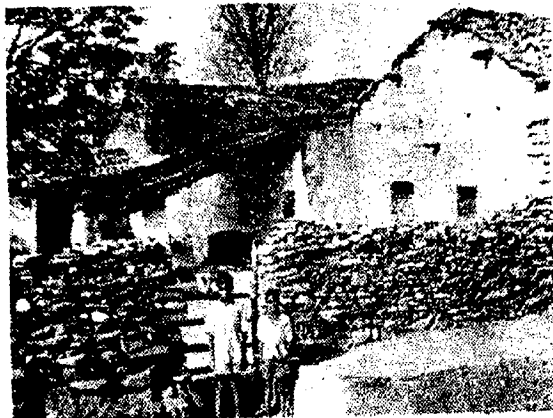
Based on Statistical Abstract Rajasthan, 1981



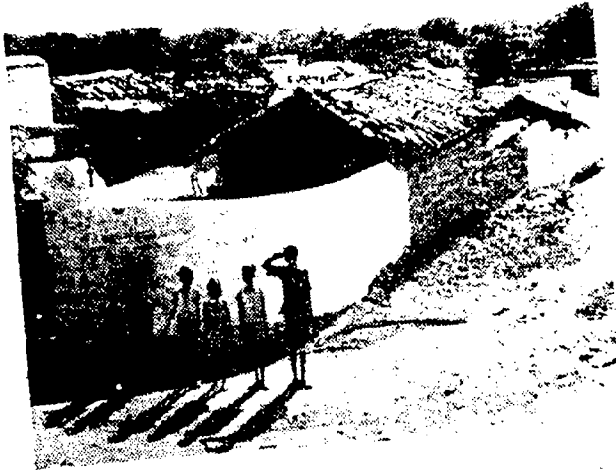
STONE HOUSES
NAGRAUR
- Flat Roofs



MUD HOUSES
SURATGARH TEHSIL
GANGANAGAR
- Unburnt Brick Walls



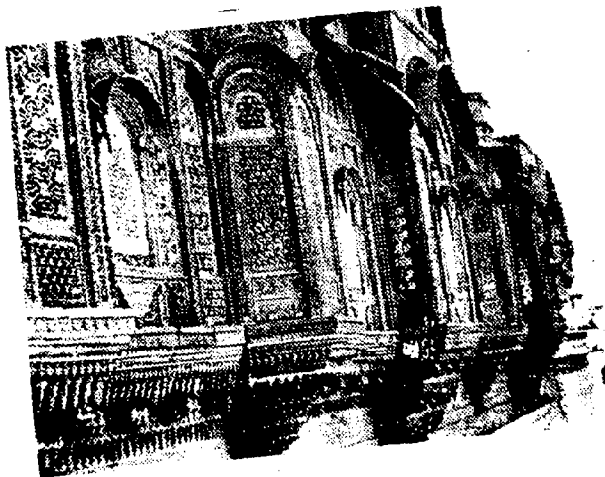
TILED HOUSES
DESURI TEHSIL
PALI DISTRICT
- Burnt Brick Walls
& Stone Pieces



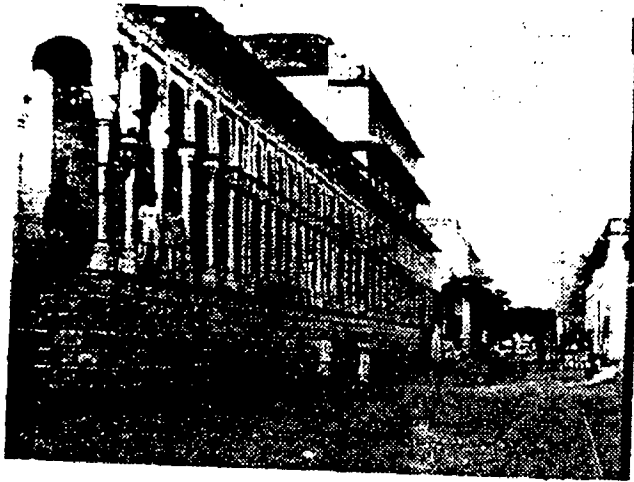
TILED HOUSES
BILARA TEHSIL
JODHPUR
- Stone Walls



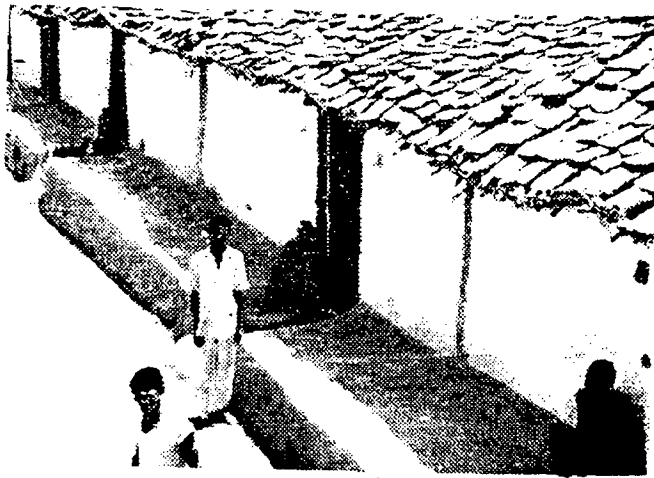
LOWER CLASS
STONE HOUSES
JALOR



OLD PALACES
JODHPUR FORT,
JODHPUR



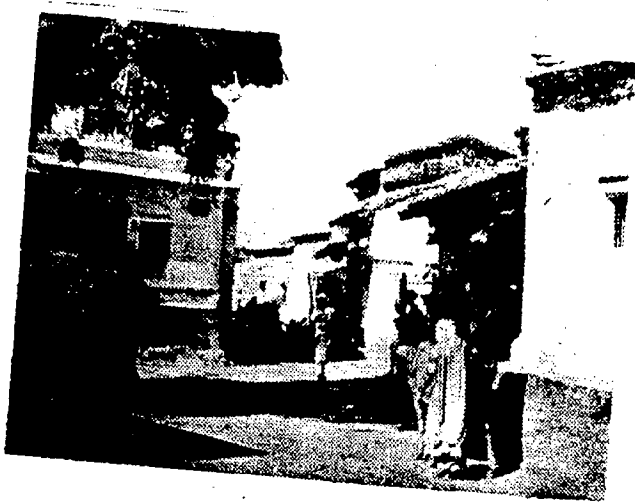
UPPER CLASS HOUSE
CHIRAWA TOWN
JHUNJHUNU



TILED HOUSES
KARACHI TEHSIL
PALI
- Unburnt Brick Walls



THATCHED HOUSE
SARDARSHAHAR
CHURU
- Unburnt Brick Walls



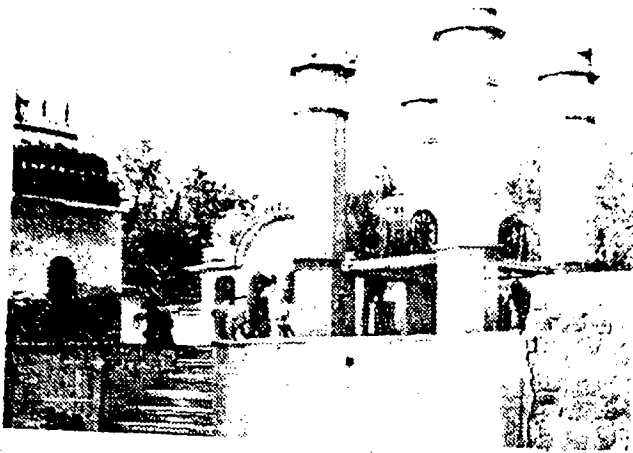
STONE HOUSE
SRI MADHOPUR
SIKAR
- LIME Plastered



MIDDLE CLASS HOUSE
JAISALMER
- Carved & Projected
Balcony



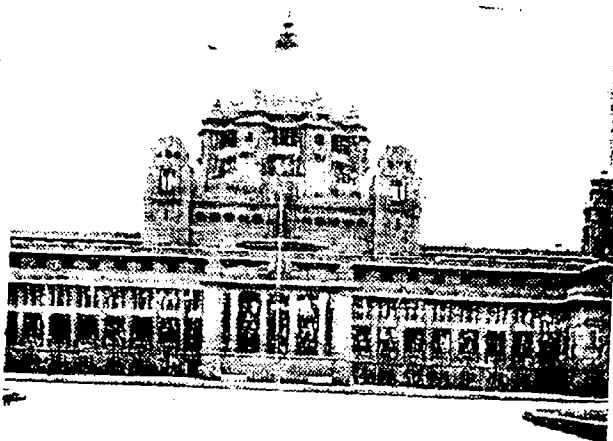
LOWER MIDDLE
JAISALMER
- Carved Projected
Balcony



MASONRY WELL
JHUNJHUNU



THATCHED TYPE
RECTANGULAR HOUSE
CHIRAWA TEHSIL
JHUNJHUNU
- Walls of Mud



CHITTAR PALACE
-JODHPUR

THAR DESERT

Moving Menacingly

Desert advances as the Aravallis suffer denudation

THE forebodings are ominous. Like a menacing leviathan the Great Indian Desert is crawling towards other parts of north India, including Delhi. There have been unmistakable signs of this phenomenon: droughts and famine are becoming more frequent.

In fact, this century's worst famines were recorded in the past two years. Never before have eight droughts occurred in a decade, like from 1978-1988. The Palam observatory in Delhi recorded 153 mm of rain this year, which is 487 mm less than the normal. Increasingly, the capital and nearby regions are being shrouded by dust.

The reason: the once-green 692-km-long Aravalli ranges, stretching from the Delhi ridge to Banaskantha in north Gujarat, have been denuded of their forest cover in a short span of 40 years. Worse, the core of the Thar desert region has shifted from the central to the northern fringe of the Aravallis and is now centred in Delhi. The Aravallis, the last bastion between the encroaching desert and the north-Indian bread basket, is gradually withering away.

Now even the Bhil, Meena and Damor tribes find it difficult to survive in the ranges. The onslaught on forests began after Independence when the nationalisation of forests and

the privatisation of community pastures were completed. The Forest Department went a step further and cut down the forests for commercial purposes. In the process, the Aravalli forest range has shrunk from 40,000 sq km in 1947 to a mere 6,000 sq km now.

Due to the consequent reduction in rainfall in the region, crop yields have slumped. "The number of rainy days have gone down from 101 days in 1973 to 58 in 1989," says Dr S.S. Dhabriya of the Jaipur-based Birla Institute of Scientific Research. And conditions are not even congenial for growing grass.

What is, however, alarming is that such dismal weather might soon be seen in the 'Granary of India' in eastern Rajasthan, south-west Punjab, south-

west Haryana, western Uttar Pradesh, Malwa and Kutch, which lie on the eastern part of the Aravallis. "To check desertification in the west, solutions have to be applied in the east of the Aravalli ranges especially in Rajasthan," explains Anil Agarwal, director of the Centre for Science and Environment in New Delhi.

The Aravallis are the eastern boundary of the Thar desert. "Till it remained densely forested, the Aravalli hills checked the expansion of the sandy desert towards the Indo-Gangetic plain. Now, there is no effective green barrier," asserts Laxmi Narain Modi of the Rajasthan Catalyst Foundation.

Dust storms blow into Delhi through Singhana-Digrota, the longest gap of 22 kms—there are 12 gaps in the ranges totalling 93 kms. The gaps have been recorded by satellite pictures and verified on the ground. Digital processing of the Sambhar Gap and Pushkar Gap by the Computer Compatible Tape and field verification have confirmed that the desert is spreading.

Planning Commission officials, however, assert that efforts are underway to get the Aravallis into the Hill Area Development Programme, at least in the Eighth Plan. But even that is small consolation. "The Government pumps in drought relief, which, for the most part is used to employ people in kutchra road construction and fodder subsidies," explains Kishore Saint, who has been working to green the Aravallis in Udaipur district for the past decade.

Such superficial measures are repeated. The roads are built and rebuilt.

There's large-scale corruption. Warns Saint: "When the future in their own region is bleak, people will go out in search of fresh pastures—inflicting damage on neighbouring regions. It will open the doors for the desertification of the Indian subcontinent."

The Aravallis, the lifeline for not only 14 million people and 24 million cattle in the desert but also the densely populated north, is being ravaged by man and smothered by the desert. And action ought to be urgently taken, for unlike bureaucrats, deserts don't take much time to move.

—SUDHIRENDAR SHARMA

The Thar desert: spreading quickly



BHAWAN SINGH

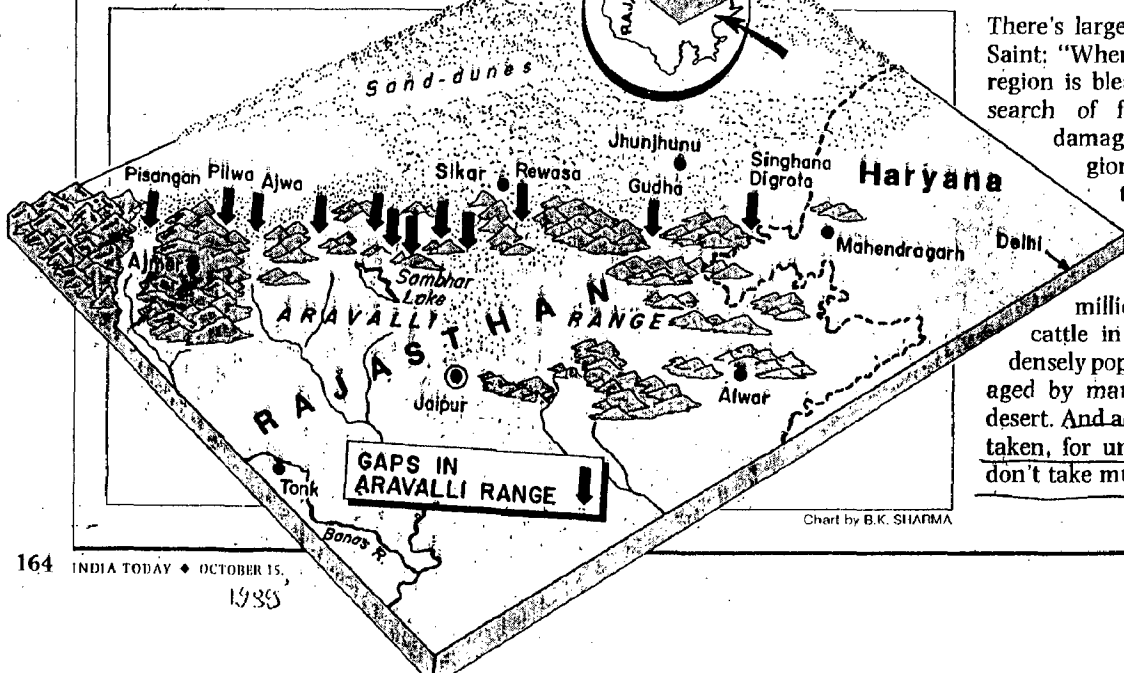


Chart by B.K. SHARMA