REGIONAL STRUCTURE OF SHEKHAWATI (RAJASTHAN)

Dissertation submitted to the Jawaharlal Nehru University in partial fulfilment of the requirements for the Degree of

MASTER OF PHILOSOPHY

By

BHAJAN LAL

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JAWAHARLAL NEHRU UNIVERSITY

CENTRE FOR THE STUDY OF REGIONAL DEVELOPMENT
SCHOOL OF SOCIAL SCIENCES

Gram-JAYENU
Telephone :
New Mehrauli Road,
NEW DELHI-110067

NOVEMBER 29, 1979

I certify that the dissertation entitled "Regional Structure of Shekhawati (Rajasthan)" submitted by Bhajan Lal in fulfilment of six credits out of the total requirements of twenty four credits for the degree of Master of Philosophy (M.Phil.) of the University is a bonafide work, to the best of my knowledge and belief, and may be placed before the examiners for their consideration.

(M.H. QURESHI)
SUPERVISOR

(MOONIS RAZA) 30.11.79
CHAIRMAN

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Bhajan Lal

BHAJAN LAL

C O N T E N T S

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Chapter 1

1.0 INTRODUCTION

The present study embraces the analysis of the spatial arrangement of physical (structure, relief, drainage, climate, soil, natural vegetation etc.) and socio-economic (population, agricultural activities and settlement etc.) attributes. The main objective of study is to identify the regional pattern of these attributes in Shekhawati and also to examine levels of their development. The study aims at bringing out the geographical personality of the region.

1.1 DELINEATION OF THE STUDY AREA

Shekhawati region, situated in north eastern part of Rajasthan (fig. 1.1), lies between 27° 21' and 28° 50' North Latitude and 74° 44' and 76° 0' East Longitude. Bounded by Haryana, in the north and east, Nagour in the southwest and Churu district in the northwest, Shekhawati covers an area of 13,661 square kilometres.

Shekhawati can easily be differentiated from the surrounding region. The western part of the region is bounded by the arid part of Rajasthan which has quite different characteristics. In Shekhawati itself the climate is arid to semi-arid. The rainfall is scanty and erratic and water table is low. The western part of region is a sandy plain while some hilly outcrops are visible in the eastern part.

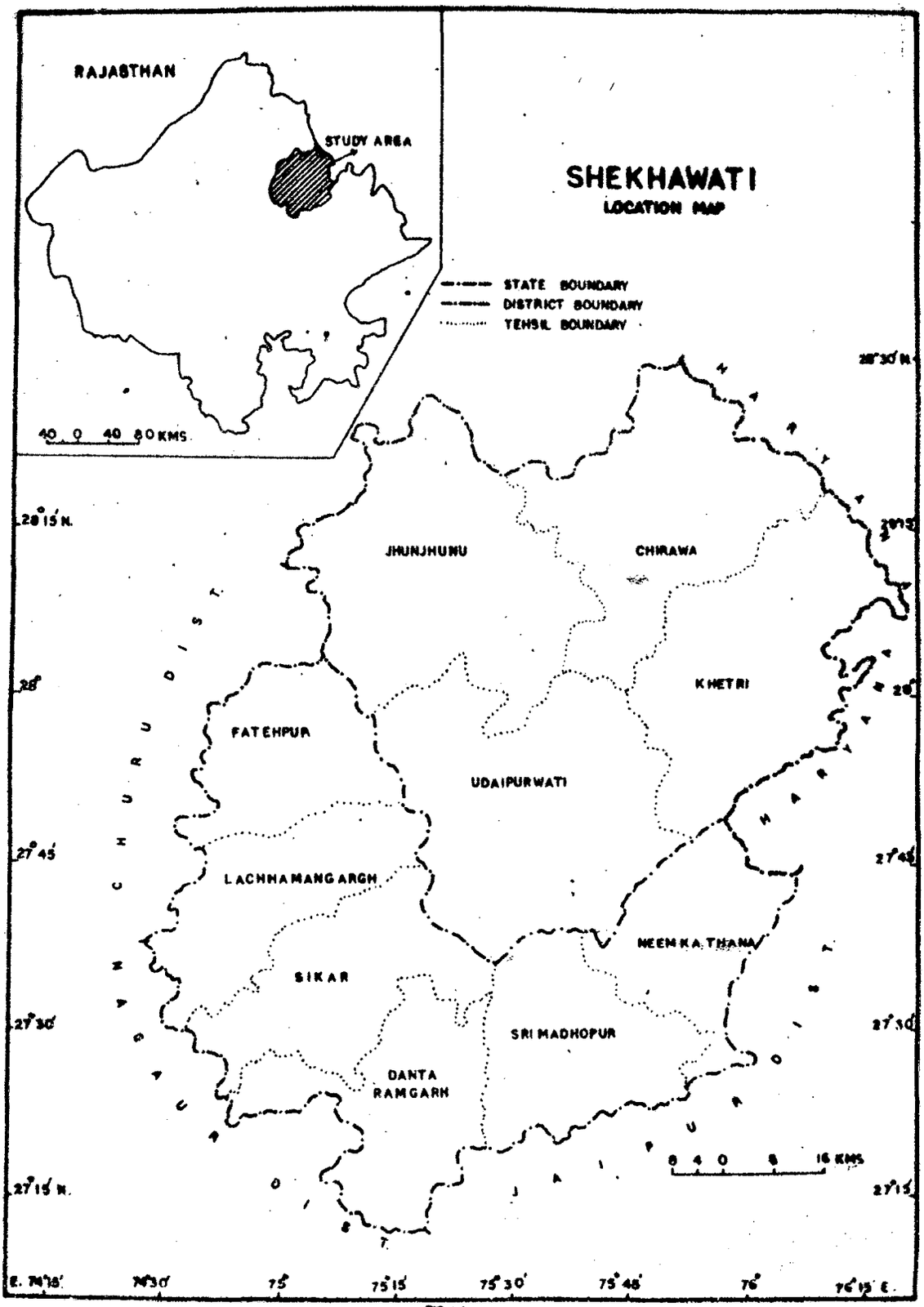
RAJASTHAN
STUDY AREA
40 0 40 80 KMS
SHEKHAWATI
LOCATION MAP
STATE BOUNDARY
DISTRICT BOUNDARY
TEHSIL BOUNDARY
JHUNJHUNU
CHIRAWA
KHETRI
FATEHPUR
UDAIPURWATI
LACHHMANGARGH
NEEMKA THANA
SIKAR
SRI MADHOPUR
DANTA RAMGARH
8 4 0 8 16 KMS
28°30' N.
28°15' N.
28°
27°45'
27°30'
27°15' N.
E. 74°15'
74°30'
75°
75°15'
75°30'
75°45'
76°
76°15' E.

FIG 1-1

1.1.1 Historical Background

Historically Shekhawati is the name given to the area ruled by Shekha, a local ruler who was a descendant of Amer family of Rajputs.[1] On the basis of the available historical material pertaining to the limits of Shekhawati, it can be accepted that the region roughly covers the present districts of Jhunjhunu and Sikar of Rajasthan.[2] The term Shekhawati has been derived from Shekha and wati[3], i.e., the land of Shekha's, descendants of the Shekha, the first ruler who politically organised the area. During the Rajput period this area was ruled by Chauhans and the power was wrested by Kayamkhani Pathans from them who were actually Chauhans converts (1383) to Islam under the leadership of Kayamkhan.[4] Later on Shekha took possession of the area from the Kayamkhanis.[5] The area has high concentration of Shekhawat Rajputs who later on come to be known by this title. The historical facts show that the Shekhawati region remained under the subjugation of the then rulers of Jaipur family.

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1. J.S. Gahlot, Rajputane-ka-Itihas, Vol. 3, Jaipur, Alwar.
2. Ibid., p. 179.
3. Ibid., p. 183.
4. Dasharatha Sharma, 'Early Chauhan Dynasties', Motilal Banarsidas, 1975, p. 11.
5. Ibid., p. 185.
6. James Todd, Annals and Antiquits of Rajasthan, Vol. 3, Motilal Banarsidas, 1971, p. 1384.

Though adequate information is not available on the expansion of the influence of the Shekhawats during medieval times, it may be possible to delineate the territory on the basis of the more definitive information available about surrounding regions, i.e., in the north east there was the territory of Patiala, in the southeast Torawati and Sambhar, in the south territory of Jodhpur, in the west territory of Bikaner and in the north territory of Loharu. The contemporary historical works of Gahlot (1966)[8], Mandava (1970)[9] and Todd (1971)[10] confirm by and large the same view. Mandava while describing the history of Shardool Singh Shekhawat, a local ruler, wrote that the then king ruled the areas of Jhunjhunu, Fatehpur, Khandela and Udaipur. Views of other historians regarding the limits of Shekhawati are similar and as such the region includes the present districts of Jhunjhunu and Sikar.

The boundaries of the region conform to the district boundaries of the districts of Jhunjhunu and Sikar in order

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7. H.C. Batra, The Relations of Jaipur State with East India Company (1803-1858), Map of Jaipur State, S. Chand and Co., Delhi, 1958.

8. J.S. Gahlot, Rajputane Ka Itihas, Vol. III, Jaipur Alwar Estates, Hindi Sahitya Mandir Jodhpur, 1966, p. 179.

9. D.S. Mandava, "Shardool Singh Shekhawat", Shardool Education Trust, Jhunjhunu, 1970, p. 183.

10. James Todd, "Annals and Antiquities of Rajasthan", Vol. III, Motilal Banarsidas, 1971, p. 1384.

to get the relevant data and statistical informations which are collected on the basis of the administrative units. Administratively the region is divided into 10 sub-units, i.e., tehsils which have 1520 villages in them.

1.2 OBJECTIVES

The main objectives of the study are :

(i) To identify the regional structure of Shekhawati region on the basis of physio-economic-cultural attributes, in order to understand the geographical personality of the region;

(ii) To identify the levels of development on the basis of major socio-economic parameters; and

(iii) To delineate the major sub-regions of the study area on the basis of the levels of development.

1.3 HYPOTHESES TO BE TESTED

An attempt has been made to test the following hypotheses :

(i) The agricultural economy is directly influenced by the availability of water and soil conditions;

(ii) The distribution of culturable waste land is inversely related to irrigation and the amount of rainfall;

(iii) The distribution of the fallow land is negatively related with the amount of rainfall and the level of irrigation in the study area;

(iv) Intensity of cropping in Shekhawati has been determined by irrigation intensity;

(v) Increase in irrigation has induced a shift of area to wheat from rape and mustard;

(vi) The distribution and spacing of settlements is controlled by physiography of the region; and

(vii) The levels of development of regions has been influenced by various physio-socio-economic parameters.

1.4 DATA BASE

Almost all the data used in the present study have been collected from secondary sources.

Survey of India Topographical Sheets

The quarter inch topographical sheets nos. 45M, 45I, 54A, 53D, 44L and 44P covering the area of the districts published by the Survey of India, Dehradun were used in the preparation of relief and drainage maps.

Climatological Data

The data of rainfall and temperature has been taken from the climatological table of observatories in India published by IMD. The information pertaining to soil has been taken from the proceedings of the symposium on arid zone held on the occasion of 21st International Geographical Congress, 1968.

Census Publication

Decade-wise general population data for the region as a whole from 1901 to 1971 has been taken from the Census of India, Districts-Handbooks of Jhunjhunu and Sikar.

The tehsil level data on population, occupational structure, literacy, dependency ratio and scheduled caste and scheduled tribes have been taken from the Districts Census Handbooks of the two districts.

The agricultural data pertaining to general land use, irrigation, cropping pattern has been taken from Statistical Handbooks.

The data on the rural and urban settlements was also taken from the District Census Handbooks of Jhunjhunu and Sikar for the year 1971.

1.5 METHODOLOGY

The cartographic techniques like isopleth, choropleth and diagramatic representation have been applied to prepare maps and to understand the spatial arrengement of various attributes of the region.

The water balance equation used by Thornth Waite has been followed for calculating water balances. The agricultural data has been analysed by finding out intensity of cropping and its correlation with intensity of irrigation. The correlation has also been found between rainfall and culturable land, fallow land and net sown area. The crop combination has been found out by applying Weaver's method of least deviation. Nerlovian Model has been tested to find out the shifts of area amongst the crops in the region. For this the stepwise regression has been done with the help of computer.

The spatial distribution of settlements has been analysed with the help of Near Neighbour Distance Technique. The distribution of settlements has been analysed with the help of chi-square test. The hierarchy of the urban centres has been worked out with the help of rank-size rule. To measure the economic base of the urban centres, functional classification of towns has been found out with the help of Nelson's method. The accessibility has been found out cartographically.

1.6 FRAME OF THE STUDY

The study is divided into six chapters. The first chapter deals with introduction, historical background, objectives, hypotheses, data base, methodology and the structure of the present study.

The second chapter deals with regional variations in physical attributes, i.e., structure, relief, drainage, soils and natural vegetation in the region. Various physiographic regions have been identified on the basis of the drainage and relief characteristics.

Third chapter deals with the demographic characteristics of Shekhawati region. An attempt has been made to analyse the growth of population, population densities, sex ratio and literacy. The economic aspects of the population, viz., man-land ratio, dependency ratio and the occupational structure of the working population has also been examined. In order

to have an idea of the social structure of the region the pattern of scheduled caste and scheduled tribes has been analysed.

The fourth chapter deals with the structure of agrarian economy of Shekhawati. In this chapter an attempt has been made to evaluate the land use pattern and its relationship with various factors, e.g., technological factors like irrigation and environmental factors like rainfall. The cropping pattern has been correlated with the availability of water by irrigation and rainfall. The shifts of area between the crops brought about by the technological break-through has been examined by Nerlovian model.

The fifth chapter deals with the settlement structure of Shekhawati which examines the spatial distribution pattern of rural and urban settlement, spatial pattern of the settlement by their size classes, spacing of rural settlement etc., The hierarchy of urban settlements and their functional classification has also been examined. The development of transportation, a crucial parameter in establishing linkages between regions, has been studied by examining the state of accessibility taking both rail and road routes.

Finally, in the sixth chapter an attempt has been made to present the conclusions and generalisations derived from the study of regional structure of Shekhawati. An attempt

has been made to identify the various regions on the basis of their levels of developments taking various environmental, technological and institutional parameters.

Chapter 2

PHYSICAL SETTING

2.1 STRUCTURE

Geologically Shekhawati region is one amongst the oldest structures on the surface of the earth. The bed rock in this region comprises mostly of pre-aravalli granites, gnesses and schists (Banded gneissic complex) Aravalli phyllites slates lime-stones and quartzites. The different rock systems and their varying degree of resistance to weathering and erosion have given rise to a rugged topography. The rock formation found in the study area is as under[1] :

Recent and sub-recent	Alluvium blown sand etc.
Unconformity	
Delhi system (Purana)	Ajabgarh series, Alwar series, with intrusive pegmatites granite and epidiorite

The area under study is dominated by closely folded consolidated rocks of Delhi system which consists of Arkose

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1. D.K. Dutt, et al., 'Ground Water Resources a part of the Kantli River Catchment, Rajasthan', Geological Survey of India (Miscellaneous Publication No. 14), 1963, p. 164.

quartzite, Amphibolic quartzite, schist and marble of the Alwar-series quartzite schist, slates, phyllites, limestone and calc granulites of the Ajabgarh series. One of the most remarkable characteristic in this rock formation is that these are mostly intruded by the epidionite and granite. Besides quartzites, granites are well jointed which decrease and finally die away with the depth. Other systems of rock formation in the area belong to Aravalli and pre-Aravalli systems.

The valley floors consist generally of Schists and in areas, underlain by rocks of Vindhyan System, they consist of calcareous conglomerates, alluvium comprising of clay, silt and gravel, cobbles and boulders, and sediments brought by wind-action. Kankar rich zone area is hard, compact and semi-consolidated. Near the hills considerable amount of talus or scree material forms the valley fill. The thickness of these valley fills varies greatly depending on the configuration of the bed rock and topography. Thickness exceeding 50 metres within a few hundred metres of exposed bed rocks is not uncommon in areas adjoining quartizites of the Delhi system. At Choanara the drilling has proved the depth of alluvium upto 56 metres where the basement is formed with schist. However, in area underlain by the aravalli and pre-aravalli rocks the bed rocks slope more gently and large variation in thickness of the valley fills in short distances are not common.

A generalized sub-surface geological succession in the exploratory bore holes at Chonara and Jodhpur is as under[2] :

Recent	Dune sand	Clay percentage increases towards Chonara
Sub-recent	Sand clay and Kankar with intercalations of gravel bounder-gravel calcareous conglomerate	
	Unconformity	
Delhi System	Upper weathered mantle bed rock (Schists, quartzites calc-granulites)	

Among the lithological units of the area boulder gravel bed is the most persistent. This bed rises very near the land surface towards the course of River Kantli east of Jodhpura. The depth of bed along with alluvium increases in the vicinity of Choanara, i.e., South of River Kantli. The valley fills exhibit a common feature, i.e., the lowest horizon - immediately above the bed rock is generally a boulder - gravel bed succeeded upwards by finer material, which may be entirely clay, sand or intercalation of clay, sand and gravel.

Thus on the basis of spatial geological realities two types of distinctive tracts may be ascertained, i.e., the north eastern undulating tract and southern hilly and sandy tract extending towards east which form the basis of geological

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2. Ibid., p. 164.

structure of the region.

The north east undulating tract is a part which may well be grouped among pleistocene origins and was formed by aeolian accumulation. The tract is contemporary to Indo-Gangetic alluvium though presently there is a great difference between the two, due to different environmental conditions. The tract extends over Jhunjhunu, Chirawa, Fatehpur, Lachhmangarh north, east Sikar, and north west Udaipur wati tehsils of the region. River Kantli flowing through the central part of the region, being a seasonal river, exhibits some valley fills which consist of calcareous conglomerates, silt, sand, gravel, cobbles and boulders. Besides, sediments formed by wind action are visible at some places through out the region.

The southern part of the region is rugged and represents rocks of harder type, i.e., stony and sandy structure form the larger portion of the part. It covers the tehsils of Khetri, Neem-ka-thana, Sri Madhopur, South West Sikar Danta Ramgarh and South east Udaipurwati. The area is characterised by the extension of Aravalli hills which run from south west to north east direction of the region. It is believed by most of the leading geologists that the hill has been almost pene-plained. The first upliftment took place during cambrian period. The second upliftment took place during the tertiary period.[3] The important rocks of the hill area are schist,

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3. V.C. Misra, 'Geography of Rajasthan', National Book Trust of India, New Delhi, 1968, p. 2.

quartzite and limestone. Since the structure belongs to Dharwarian period which is famous for its mineral deposits, there are good reserves of copper and lead in Khetri tehsil and some iron-ore in Udaipurwati tehsil. Exploratory tests have revealed 100 million tons of ore reserve with an average of one per cent copper.[4] Besides, there are different types of attractive building stones. The white coloured stone found in Harsh hills is a notable variety of building stone which is sent to neighbouring places.

2.2 RELIEF

The physiography of a region is closely connected with the geological history and the forces which are always busy in shaping and shifting of surface material. The region (fig. 2.2) has two distinct relief regions, viz., undulating northern tract which is a part of the Thar and southern hilly region which is merely an extension of Aravalli hills in the form of isolated hillocks except some patches of fertile plain.

The northern undulating tract is the area of scanty rainfall having an annual average of less than 25 cms. which makes the region arid type. The large difference between day and night temperature has caused the breaking of rocks which ultimately have resulted into pebbles and sand. Not only this

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4. D.N. Wadia, Geology of India, 3rd edition (revised), 1970, p. 473.

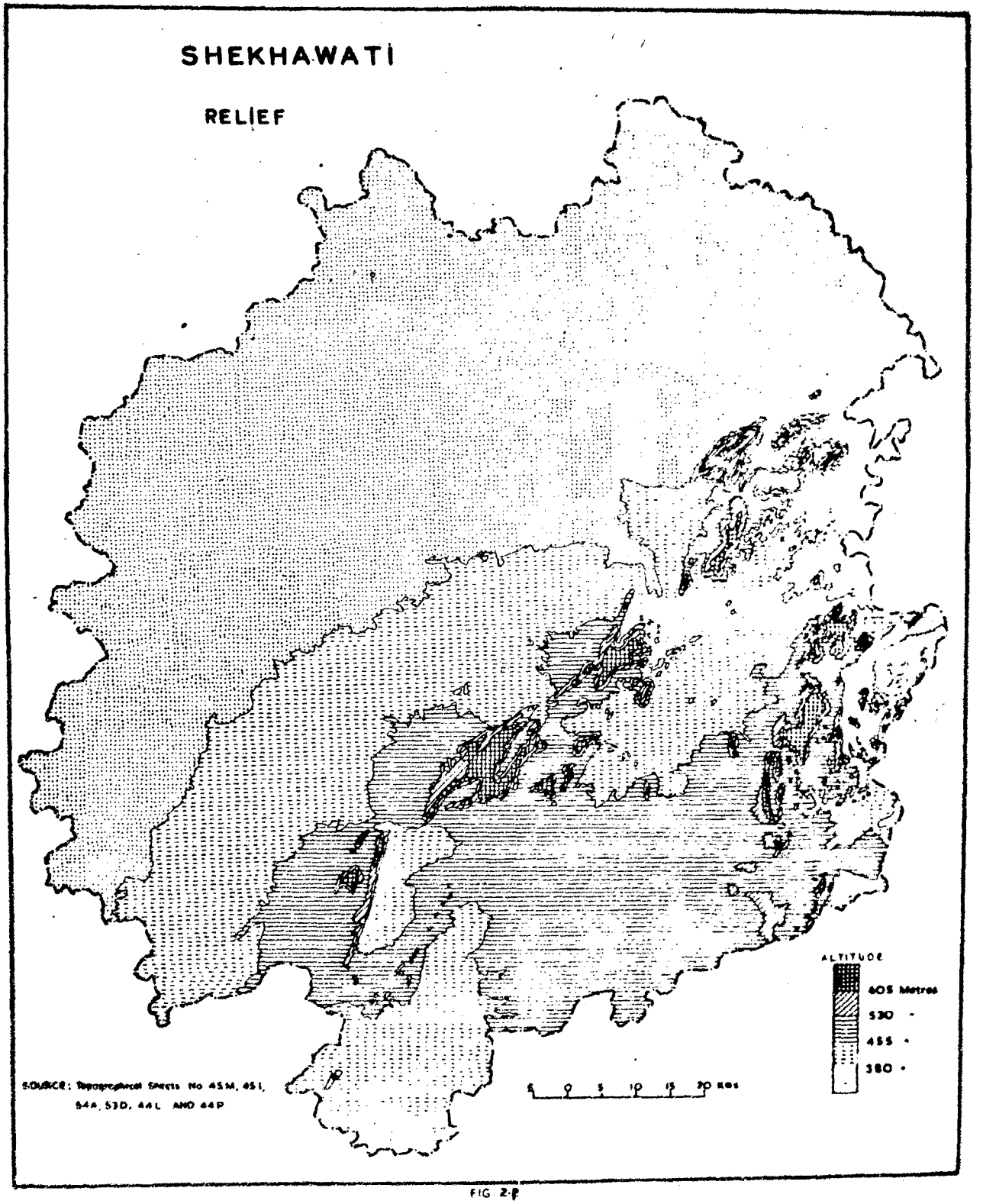
SHEKHAWATI
RELIEF
ALTITUDE
605 Metres
530 "
455 "
380 "
0 5 10 15 20 Kms
SOURCE: Topographical Sheets No 45M, 45I, 54A, 53D, 44L AND 44P

FIG 2-B

but also the patches of good soils in the vicinity of sandy tract lose its original entity becoming a part of it due to contamination and encroachment. The most dominating physical feature of the area are sanddnes which cover over 40 per cent of the surface area. This type of landscape is visible in the vicinity of Thai, Bagega, Berainghwas, Nawabas and between Narainpura and Godla. Kantli the main river of the area which originates from Neem-Ka-thana area flows south to north through the central part of the area along with its tributaries Singhana, Dohan, Krishnawati Sabi and Mandha. These rivers are the seasonal rivulates and nadis which remain dry for the most part of the year except during rainy season. The dry river bed becomes full of barchans which are washed out with the spell of rain. The altitude of the region varies between 150 and 300 metres above mean sea level.

The south Shekhawati region is almost stony with scattered patches of sandy and loamy soil in between the hills. Such soil patches are found in Neem-Ka-thana Sri Madhopur and Danta Ramgarh tehsils.

No part of area is below the height of 300 metres above mean sea level. The highest point of Aravalli in this region is Raghunathgarh in Sikar tehsil which measures 1058.80 metres above sea level. The north-eastern part of this ridge is called Khetri hills which is famous for its copper deposits. This Babai hill range has a maximum height of 780 metres, Malkhet

Tarawati ridge with a height of 846 metres is the prominent range in the central part of the region. Shekhawati Rohi is another range formed of small hillocks with a maximum base height of 350 metres which runs in a south-west and northerly direction of the region.

These isolated hillocks are believed to be the erosional residuals of the same mountain range now disintegrated and disconnected. The rocks are understood to be among the oldest ones on the surface of the earth. The aravalli hill is having rich deposits of mineral in Khetri. In south eastern part of Jhunjhunu district, Udaipurwati tehsil is famous for its quartzite and soap-stone. In the Khetri tehsil sand stone is found near Paporana village while both lead and zinc occur near Singharna. In Sikar district there are deposits of iron ore beryle ore, lead ore, dolomite lime stone, feldspar, mica and soap-stone. There are some of the finest building stones which are mostly used locally because of the heavy weight involving high transportation cost.

2.3 DRAINAGE PATTERN

The drainage pattern is highly influenced by the structure of the area and has adopted to it. Other important factors affecting are the activity of interior forces and slope. An observation of Shekhawati region reveals the impact of stony structure and steep slope in the development of drainage pattern.

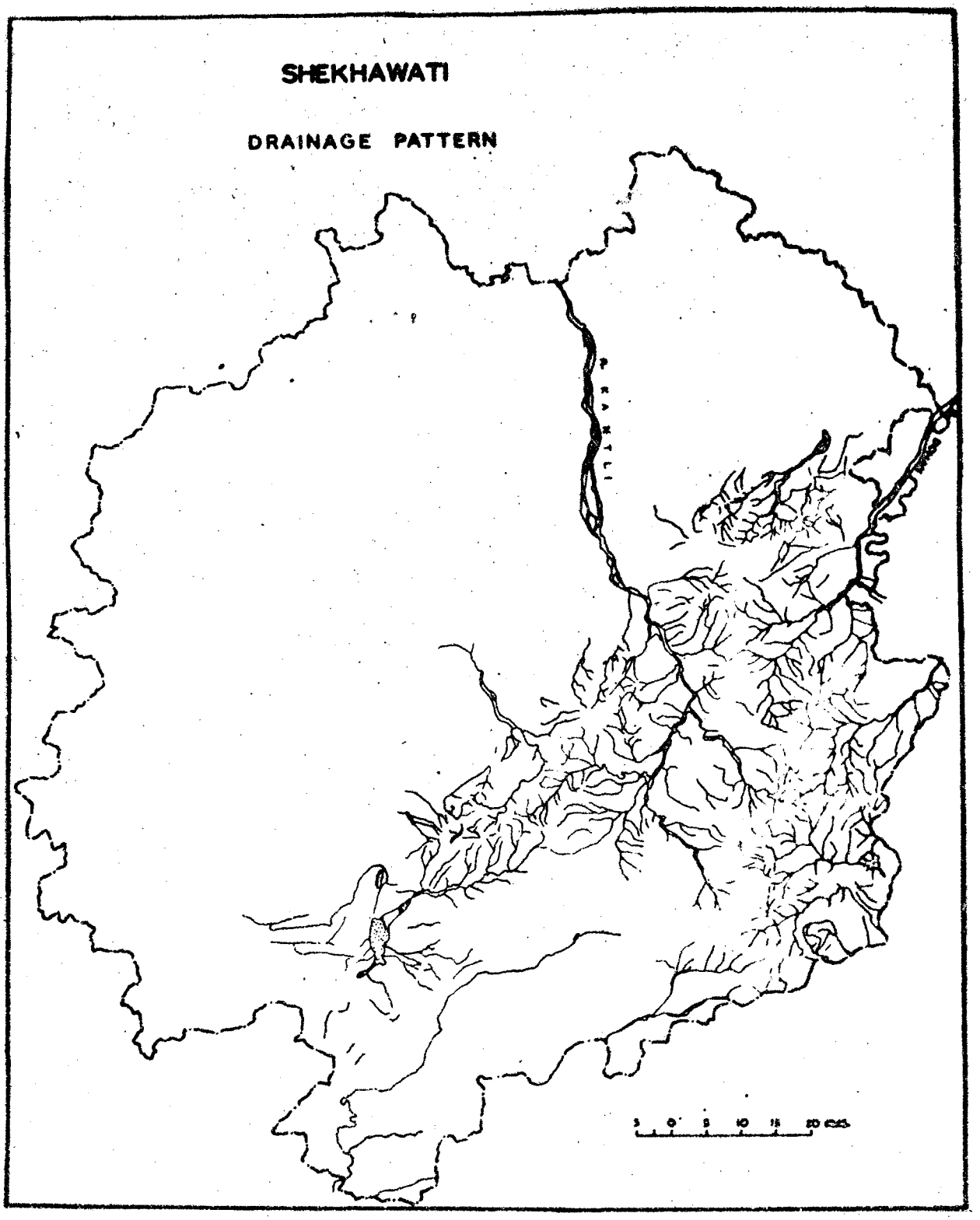

Fig. 2.2

The extension of Aravalli hills has also played significant role in shaping the drainage pattern of the region because of the fact that these hillocks form the point of origin for various rivuluts flowing out in different directions. All the streams are ephemeral and flow only during rainy reason. The drainage is inland.

The main stream of the area is Kantli flowing from (fig. 2.3) south to north. Other rivers are Singhana flowing from central part to north, Dohan flowing from the south west to north east, Sahabi from south west to north east and Mandha river flowing from north east to south west direction. Besides there are several rivulets which join the main stream or disappear in the sand after being choked.

Thus it is noted that all these rivers and rivulets originate from Neem-Ka-thana, Sri Madhopur area and flow in all the directions giving rise to radial drainage pattern. A brief discription of principal rivers follows.

2.3.1 Kantli River

It is the principal stream of the region and originates in Neem-Ka-thana area and is joined by four rivulets from Raghunathgarh, Khendilu, Thoi and Depas. All rivulets join Kantli at Gwala, giving rise to a dendritic drainage pattern.

The length of main stream like Kantli Singhana, Mandha, Sahabi and Sota in the region accounts for 217.6 kilometres.

River Kantli is the largest stream measuring 86.4 kilometres.

The catchment of Kantli river extends over an area of about 1200 sq. kilometres. The ground water occurs in rocks of the Delhi system and its intrusives, alluviums and wind blown sand. The area of saturated rocks in the valley fill is about 350 sq. kilometres. It trends approximately parallel to the present course of the main channel of the Kantli river, but lies tranverse to the tributaries in the upper reaches.

The saturated alluvial aquifer is 12 kilometres at its broadest. Exploratory drilling near Jodhpura and Choanara has indicated a maximum thickness of alluvial and aeolian fill to be 57 metres. The saturated thickness in the central part of the fill varies between 30 and 50 metres the lower half comprising predominantly of coarse sand and gravel with pebbles. The following results were obtained during hydrological tests on 5 pumping wells with 10 observation wells.[5]

(A)	Specific capacities of pumped wells	... 427 to 1490 litres/min/metre
(B)	Coefficient of transmissibility	... 504 to 7406 $M^3/d/M$
(C)	Coefficient of Permeability	... 38 to 361 $M^3/d/M^2$
(D)	Coefficient of storage	... 3.1×10^5 to 6.6×10^4

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5. A.K. Roy and K.R. Varanth, Ground water in the Valley Fills of Eastern Rajasthan, Dr. Wadia Commemorative Volume, p. 844.

2.3.2 Singhana River Catchment

Singhana river flows from the Khetri ranges. The length of the river is 19.2 kilometres with a catchment of about 75 sq. kilometres.[6] The ground water occurs in alluviums. It occurs in the rocks of Delhi System and its intrusives. The saturated alluvial aquifer is about a kilometre in width and lies parallel to the river up to Singhana. The thickness of the alluvium is about 30 metres of which only 20 metres is saturated with water. The floor of the valley comprises of biotite schists and granites.

The result of hydrological tests with three pumping wells and seven observation wells were as follows[7] :

(A)	Specific capacities of pumped wells	...	22 to 261 litres/min/M
(B)	Coefficient of transmissibility	...	759 to 6484 $M^3/d/M$
(C)	Coefficient of permeability	...	53 to 400 $M^3/d/M^2$
(d)	Coefficient storage	...	5.95×10^3 to 1.09×10^2

2.3.3 Dohan River

This river originates from Choani situated in the eastern part of the region. The length of river is 51.2 kilometres in the area. The river flows from south-west to north-east

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6. Ibid., p. 845.

7. Ibid., p. 845.

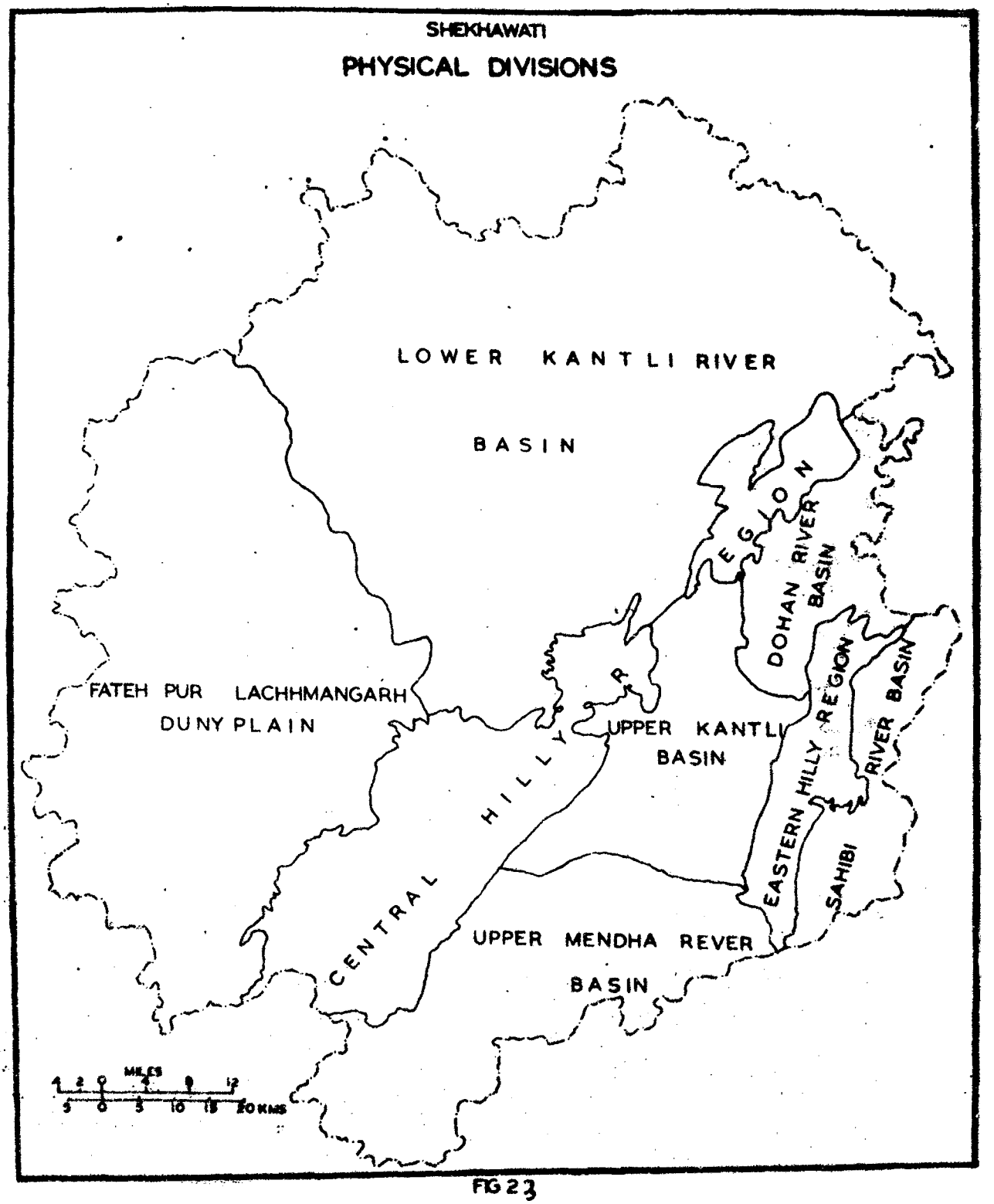
SHEKHAWATI
PHYSICAL DIVISIONS
LOWER KANTLI RIVER
BASIN
DOHAN RIVER BASIN
EASTERN HILLY REGION
SAHIBI RIVER BASIN
FATEH PUR LACHHMANGARH
DUNY PLAIN
CENTRAL HILLY R
UPPER KANTLI
BASIN
UPPER MENDHA REVER
BASIN
MILES
KMS

FIG 23

direction across the region following the course determined by slopes, forming a consequent stream.

Besides these rivers there are a number of seasonal nallahs which are of very little significance. One of them rising from Raghunathgarh area flows in a meandering course from south to north and finally taking east-west direction, disappears at Nawalgarh. Another important nallah flows from Khendela towards south-west in a meandering course and joins the lake near Kuchour.

2.3.4 Physiographic Divisions

On the basis of the relief and the drainage pattern the study area constitutes seven geomorphic units which can be grouped under three major physiographic divisions (fig. 2.1). These three major sub-regions are (i) Dunny Plain, (ii) Riverine Plain and the (iii) Hilly and hummocky areas. The seven geomorphic areal units may further be identified as (i) Fatehpur-Lachhman Garh dunny plain, (ii) upper Kantli basin , (iii) lower Kantli basin, (iv) upper Mendha basin, (v) Dohan and Sahibi basin, (vi) hilly and (vii) hummocky areal units, the detailed account of which has been given in the Chapter 5 of this thesis while describing the spatial structure of settlements of the study area.

2.4 CLIMATE

Climate is the most important environmental factor which

influences the modes of the life and economy of the people, particularly in an arid region. It determines, to a large extent the type of soil and natural vegetation in a given region and hence influences the utilization of the land whether for crop cultivation forest or grazing.[8] It also partially "determines the ability of land to support a population".[9]

Climate effects the choice of a farming system either indirectly through its influence on soil formation or directly through such factors as the length of the growing season the occurrence of frost and the availability of water for crop growth.[10]

The mean values for various elements of climate are generally understood to reflect, average weather and climate but abnormal weather conditions, cannot be over ruled. The variations of climate are closely associated with the controls of weather and climate.

Continentality is more pronounced in the climate of Shekhawati. The extremely high average temperature with very meagre amount of rainfall and high evaporation reduce the precipitation effectiveness. This has resulted in severe arid conditions in the region.

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8. N. Arthur, Physical Geography, Wiley and Sons Inc., New York, 1965, p. 219.

9. Ibid., p. 219.

10. Jasbir Singh, An Agricultural Atlas of India - Geographical analysis, 1977, pp. 10-11.

Table 2.1 Monthly Temperature and Relative Humidity*

Month	Maximum Temp. (in degree c)	Minimum Temp. (in degree c)	Relative Humidity (in per cent)
January	22.0	5.8	62
February	26.2	8.2	56
March	31.5	14.5	49
April	36.4	19.0	43
May	39.7	24.3	43
June	39.1	27.5	51
July	34.7	26.0	66
August	33.1	24.7	75
September	33.7	23.1	71
October	33.1	17.1	58
November	29.1	10.4	58
December	24.8	6.7	63

* Refer to the observations of an exclusive observatory located at Sikar in the region

Source : India Meteorological Department, Climatological Table of Observatories in India (1931-1960).

Rainfall in Shekhawati is most important of all the weather elements and has foremost influence on agricultural activities because of its uncertainity, variability and scarcity.

The region, broadly, experiences three seasons :

(a) Hot weather season

(b) Season of general rains

(c) Cold weather season

2.4.1 Hot Weather Season

This season extends from February to May. The most important characteristic of this region is that during this period the maximum temperature goes as high as 38.8°c and the minimum temperature is recorded to be 20.1°c giving a range of 18.7°centigrade. The humidity (Table 2.1) remains very low. The lowest humidity is recorded in the month of May which is 43 per cent whereas relative humidity is 56 per cent in the month of February. The high temperature leads to high evaporation. The wind velocity has dessicating influence and enhances the rate of evaporation. The rainfall during this period is very meagre and absolutely insufficient for agricultural operation.[11]

Less than 10 per cent of the normal annual rainfall is received during this season. It varies between 5.38 to 9.32 per cent (22.9 to 36.1 mm) in the various parts of the region. In almost all these stations, i.e., Neem-Ka-thana, Sikar, Jhunjhunu, Chirawa, Khetri and Nawalgarh the rainfall recorded

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11. Indian Meteorological Department, Climatological Tables of Observatories in India, 1931-1960.

during this season varies between 7 to 10 per cent of its total rainfall while Danta Ramgarh and Sri Madhopur receive less than 7 per cent of their annual rainfall. On the basis of the year-wise rainfall (1960-61 to 1974-75) it can be conveniently generalized that in the region the amount of rainfall is more in hot weather season than in cold weather season. In Jhunjhunu the highest 14.06 per cent (54.5 mm) to total rainfall is recorded in 1960-61 while lowest 4.05 per cent (14.3 mm) rainfall is found in 1963-64. In Sikar the highest 24.78 per cent (176.1 mm) of rainfall is found in 1969-70, while lowest 0.81 per cent (3.1 mm) is recorded in 1963-64.

On the basis of the observation of mean annual rainfall it can be seen that Sikar receives more rainfall than Jhunjhunu.

2.4.2 Season of General Rains

This season prevails from June to September and during this period the region experiences rains. The monsoon showers bring down the temperature. The maximum temperature recorded is 23.8°centigrade with a diurnal range of 11.1° centigrade. The rainfall received during the rainy season accounts for more than 85 per cent of the total annual rainfall (Table 2.2).

Danta Ramgarh receives 90.26 per cent of the total annual rainfall of 384.5 mm in this season. With the sole exception of Jhunjhunu which receives only 84.59 per cent of its total

Table 2.2 Normal, Annual, Seasonal Rainfall and Percentage of Seasonal Rainfall to Total Annual Rainfall

Stations	Seasons of general rains		Cold Weather Season		Hot Weather Season		Total	
	Amount (mm)	Percent to total rainfall	Amount (mm)	Percent to total rainfall	Amount (mm)	Percent to total rainfall	Total (mm)	Per cent
Jhunjhunu	327.7	84.59	23.6	6.09	36.1	9.32	387.4	100.0
Chirawa	348.4	85.23	24.4	5.97	36.0	8.80	408.9	100.0
Khetri	479.5	85.53	38.1	6.80	43.0	7.67	560.6	100.0
Nawalgarh	369.3	87.76	20.2	4.80	31.3	7.44	420.8	100.0
Sikar	380.8	86.27	24.1	5.46	36.5	8.27	441.4	100.0
Neem-ka-thana	434.8	86.15	32.0	6.34	37.9	7.51	504.7	100.0
Danta Ramgarh	384.5	90.26	18.6	4.37	22.9	5.38	426.0	100.0
Sri Madhopur	426.6	87.11	30.3	6.19	32.8	6.70	489.7	100.0

Source : Indian Meteorological Department, Govt. of India, Normals of Monthly and Annual Rainfall and Rainy Day (1901 - 1950).

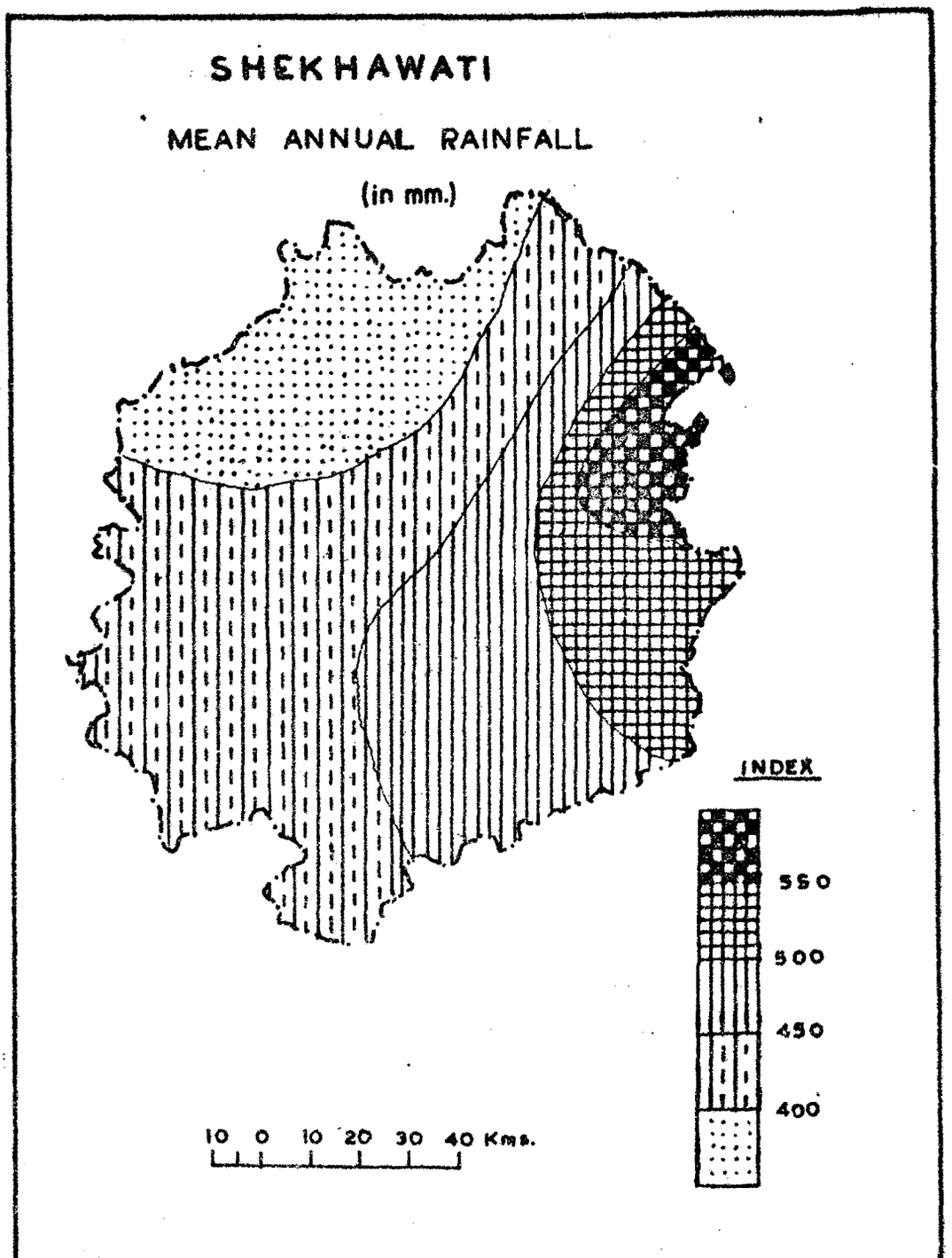
SHEKHAWATI
MEAN ANNUAL RAINFALL
(in mm.)
INDEX
550
500
450
400
10 0 10 20 30 40 Kms.

Fig. 2.4

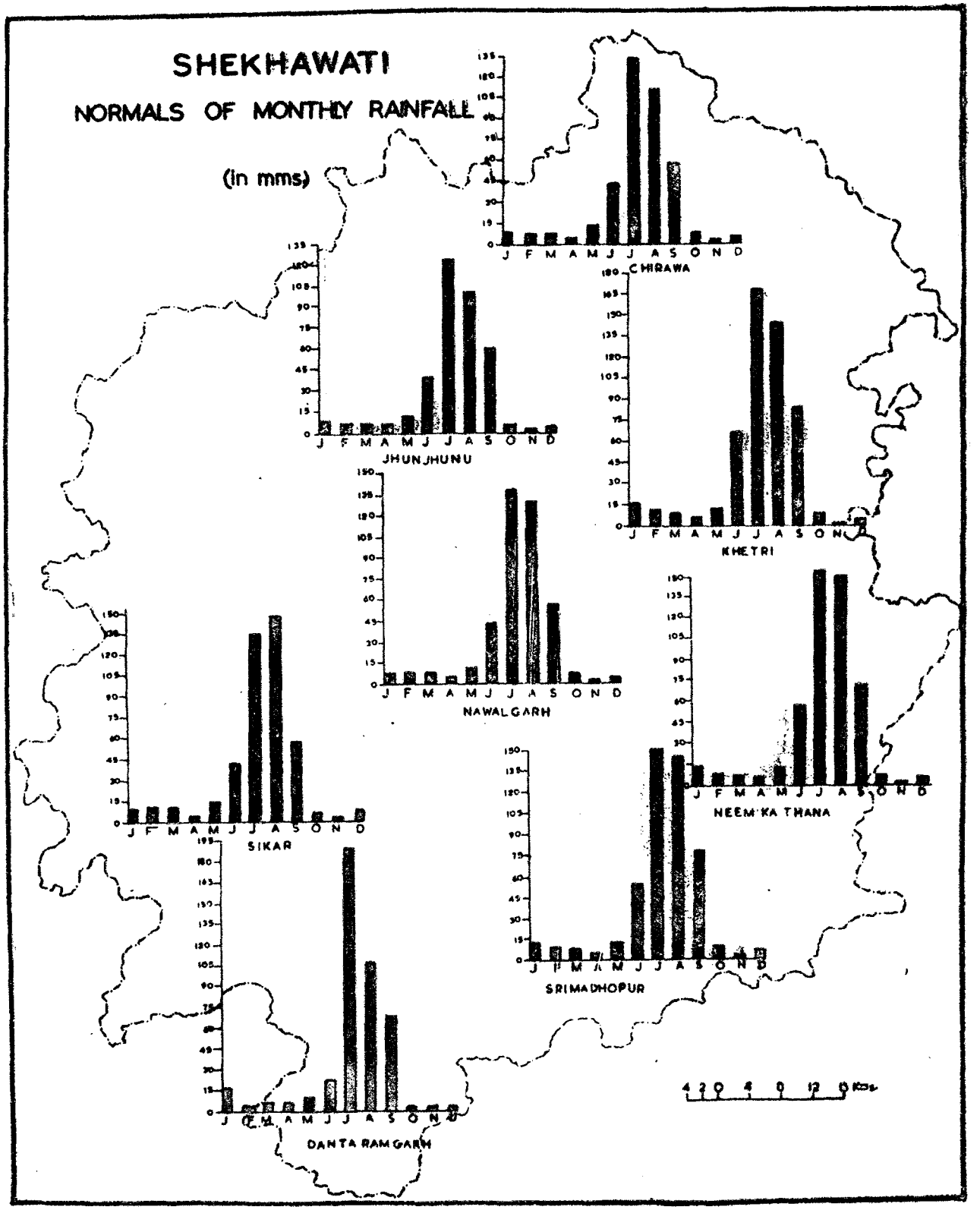
SHEKHAWATI
NORMALS OF MONTHLY RAINFALL
(in mms)
CHIRAWA
JHUNJHUNU
KHETRI
NAWALGARH
SIKAR
NEEM KA THANA
SRIMADHOPUR
DANTA RAMGARH
J F M A M J J A S O N D

Fig. 2.5

rainfall during this season, in the entire region more than 90 per cent of rainfall is received during the season of general rains (fig. 2.4).

The annual rainfall figures as given in tables (2.3 and 2.4) show the year-wise trend of rainfall. The annual rainfall at two stations Sikar and Jhunjhunu has been considered from 1960-61 to 1963-64 and again from 1967-68 to 1974-75. The highest rainfall of 472.8 mm has been recorded at Jhunjhunu in 1962-63. While the lowest amount of rainfall has been recorded in 1960-61 which is 297.5 mm. In Sikar about 85 per cent of the total rainfall is confined to the season of general rains. It recorded the highest rainfall of 554.0 mm in 1974-75 which occurred in the rainy season. The lowest rainfall in the rainy season has been recorded in 1967-68 when it received only 316 mm of rainfall (fig. 2.5).

2.4.3 Cold Weather Season

The season prevails from October to January. The temperature goes on decreasing with the approach of this season. The maximum temperature during this period is recorded to be 26.3° centigrade and the minimum temperature is only 8.0° centigrade. The diurnal range of temperature is as high as 18.3° centigrade. The relative humidity during this period slides down to 60 per cent. Though the total amount of rainfall received during this period is low as compared to hot weather season.

Table 2.3 Distribution of Annual Rainfall Amounts (in millimetres) by Seasons in Jhunjhunu District During 1960-61 - 1974-75

Seasons	Years								
	1960-61	1961-62	1962-63	1963-64	1967-68	1968-69	1969-70	1972-73	1974-75
Season of General rains - June to September	297.5 (76.8)	336.0 (80.5)	472.8 (94.0)	312.5 (88.6)	271.8 (81.2)	466,5 (93.5)	444.9 (82.5)	208.9 (89.6)	223.8 (83.0)
Cold weather season - October to January	35.5 (9.2)	33.0 (7.9)	Nil (Nil)	25.8 (7.3)	81.5 (14.2)	2.5 (0.8)	23.3 (4.3)	2.3 (1.0)	46.0 (17.0)
Hot weather season - February to May	54.5 (14.0)	48.2 (11.6)	30.2 (6.0)	14.3 (4.1)	26.7 (4.6)	16.5 (5.7)	70.9 (13.2)	22.0 (9.4)	Nil (Nil)
Total	383.5 (100.0)	417.2 (100.0)	503.0 (100.0)	352.6 (100.0)	574.7 (100.0)	290.8 (100.0)	539.1 (100.0)	233.2 (100.0)	269.8 (100.0)

Sources : Govt. of Rajasthan, Statistical Abstract of Rajasthan, Directorate of Economics and Statistics Rajasthan, Jaipur, 1973.

Note - Figures in brackets represents per cent amount of rainfall to the total

Table 2.4 Distribution of Seasonal and Annual Amounts of Rainfall (in mm) in Sikar District During 1960-61 - 1974-75

Seasons	Years								
	1960-61	1961-62	1962-63	1963-64	1967-68	1968-69	1969-70	1972-73	1974-7
Season of General rains - June to September	431.0 (91.68)	342.6 (90.6)	502.8 (97.6)	356.0 (32.7)	316.0 (64.4)	477.4 (94.0)	530.4 (74.6)	257.7 (85.0)	554.0 (87.9)
Cold weather season - October to January	11.2 (2.3)	27.4 (7.2)	- (-)	25.1 (6.4)	131.9 (26.9)	4.7 (0.9)	4.2 (0.6)	- (-)	55.0 (8.7)
Hot weather season - February to May	27.10 (5.9)	8.2 (2.2)	11.2 (2.4)	3.1 (0.8)	42.5 (8.7)	25.7 (5.1)	176.1 (24.8)	45.6 (15.0)	21.0 (3.3)
Total	470.1 (100.0)	378.2 (100.0)	515.0 (100.0)	384.2 (100.0)	490.4 (100.0)	507.8 (200.0)	710.7 (100.0)	303.3 (100.0)	630.0 (100.0)

Sources : Statistical Abstract of Rajasthan, Directorate of Economics and Statistics Rajasthan, Jaipur.

Note : Figures in brackets represents per cent amount of rainfall to the total

The cold weather season accounts for 4.37 to 6.80 per cent of the total rain in various tehsils. The rainfall during this season is very meagre and is caused by the western cyclone disturbances.

Spatially Neem-Ka-thana, Sri Madhopur and Khetri situated in the south-east part of the region receive slightly higher rainfall than the other parts of the region.

In 1974-75 the highest rainfall of 46.0 mm was recorded in Jhunjhunu while in 1968-69 it recorded rainfall of only 2.5 mm.

2.4.4 Intensity and Duration of Rainfall

The intensity of rainfall refers to the amount of rainfall received per rainy day. It is helpful in understanding the nature of surface flow of the water. The intensity of rainfall has been calculated by using average annual rainfall and the average number of rainy days as recorded at the meteorological station of the region.

The intensity of rainfall varies from 17.76 to 13.70 mm per rainy day. The table (2.5) reveals that lowest intensity is found in Danta Ramgarh, while highest intensity is recorded at Nawalgarh. Intensity is high in the eastern and southern part of the region. Chirawa, Khetri and Sri Madhopur record higher intensity as compared to the places situated in western part of the region which suggest that the aridity in western

part is more pronounced.

Table 2.5 Rainfall and Number of Rainy Days

S.No.	Stations	Average annual rainfall (mm)	Average annual number of days	Intensity of rainfall per rainy day
1.	Sikar	441.4	29.7	14.86
2.	Neem-Ka-thana	504.7	33.1	15.25
3.	Danta Ramgarh	426.0	31.1	13.70
4.	Sri Madhopur	489.7	28.2	17.33
5.	Jhunjhunu	387.4	26.5	14.80
6.	Chirawa	408.9	26.0	15.75
7.	Khetri	560.6	32.5	17.25
8.	Nawalgarh	420.8	23.7	17.76

Source : Govt. of India, Meteorological Deparment, Normal of Monthly and Annual Rainfall and Rainy days 1901-1950.

2.4.5 Variability of Rainfall

One of the most important characteristics of the monsoon is its variable nature over time and space. The variability of rainfall has been measured statistically.

The coefficient of variation has been given in the table 2.6 for seven stations for which rainfall statistics is available.

Table 2.6 Coefficient of Variation of Annual Rainfall

Stations	Coefficient of Variation in per cent
Sikar	38
Neem-Ka-thana	38
Sri Madhopur	43
Jhunjhunu	36
Chirawa	40
Khetri	36
Nawalgarh	38

Source : B.L. Teli, Hydrological Regions of Rajasthan, An Unpublished M.Phil. dissertation, JNU, New Delhi, 1977, Appendix No. I.

The table 2.6 reveals that the chances of occurrence of annual rainfall vary between 36 and 43 per cent. Here the variability means the year to year variation in the occurrence of rainfall. Coefficient of variation in this region varies between 36 and 43 per cent at Khetri and Sri Madhopur respectively. It is 38 per cent at Neem-Ka-thana, Sikar and Nawalgarh, and 40 per cent at Chirawa.

2.4.6 Water Balance

The region has only one observatory at Sikar, so the water balance has been calculated only for this station. The water balance has been calculated with the help of Thornthwaite's

method using temperature and precipitation data.

The availability of water depends on the occurrence of rainfall. The concept of water balance refers to the balance between income of water in the form of precipitation and loss of water through evaporation, evapo-transpiration, surface run-off and infiltration. The water balance equation as used by Thornthwaite is precipitation = Run off + Evapotranspiration + soil moisture storage changes.[12]

It is climatic balance since quantities of precipitation and evapotranspiration are active factors of climate. From the comparison of seasonal march of precipitation with the evapotranspiration the magnitude of moisture parametres, water surplus, water deficit, soil moisture storage and water run-off may be determined. Trewartha has arrived at a complex exponential formula for evaluating daily or monthly potential evapotranspiration from the more generally available data of mean air temperature, length of the day and latitudes of the place.

The calculated water balance according to Thornthwaite formula for Sikar station is given in table 2.7.

The water balance in Shekhawati is closely connected with temperature which dominates it. The higher potential evapo-

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12. R.G. Barry and R.J. Chorley, Atmosphere, Weather and Climate, Mathuen & Co. Ltd., London, 1972, p. 74.

Table 2.7 Statistics Showing the Water Balance* in the Shekhawati Region**
(1901 - 1950)

	J	F	M	A	M	J	J	A	S	O	N	D	Annual
P_E	51.9	73.8	126.8	166.6	215.1	214.1	155.1	133.0	134.4	133.9	68.4	48.7	1521.8
P	9.4	9.4	8.1	3.8	15.2	42.9	134.4	146.6	56.9	5.3	3.3	6.1	441.4
$\pm\Delta$	-42.5	-64.4	-118.7	-162.8	-199.9	-171.2	-20.7	-13.6	-13.6	-128.6	-65.1	-42.6	1080.4
Δ S	0	0	0	0	0	0	0	13.6	0	0	0	0	0
WS	-	-	-	-	-	-	-	-	-	-	-	-	-
WD	-42.5	-64.4	-118.7	-162.8	-199.9	-177.2	-20.7	-	63.9	+128.6	-65.1	-42.6	1080.4
AE	9.4	9.4	8.1	3.8	15.2	49.9	134.4	133.0	70.5	5.3	3.3	6.1	441.4

P_E - Potential Evapotranspiration P - Precipitation $\pm\Delta$ Storage

Δ S - Soil Mositure Storage, WD - Water deficit, WS - Water Surplus and

AE - Actual Evapotranspiration

* Data computed from the statistics regarding Monthly Rainfall and Evapotranspiration of the region.

** Date is based on the observations of the enclusive observatory of the Shekhawati Region located at Sikar

transpiration rate and lower precipitation depict the need for more water. In January the potential evapotranspiration is 51.9 mm while the precipitation is 9.4 mm which leads to a water deficiency of 42.5 mm. The same trend continues upto July. It is only after the onset of monsoon after July that the precipitation exceeds the potential evapotranspiration and some water surplus in the region is obtained.

The deficiency of water again starts from the month of September which is the month of second maxima of temperature. The water deficiency shows an increasing trend upto the month of October when it becomes 128.6 mm. While during winter because of the lowering of temperature the water deficit becomes less pronounced. In November the water deficit is recorded to be 65.1 mm followed by 42.6 mm in December.

As far as soil moisture is concerned it is absent in eleven months of the year and available only during the month of August. This shows the need for irrigation for agricultural purposes. The mositure index calculated according to the Thornthwaite formula is - 42.6[13] so that this station comes under arid climate.

2.5 SOILS

Soils constitute a major geographical factor influencing by their fertility and special qualities, not only whether a

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13. C.W. Thornthwaite, 'Approach Towards a Rational Classification of Climate', Geographical Review, Vol. XXXVIII, 1948, pp. 55-94.

population can be fed, clothed and housed but also the particular types of food and fiber or lumber products that can be obtained from a region. Soil is the generalized name for the shallow loose layers of the land surface of the earth. Biotic and abiotic components of the ecosystem are especially responsible for accelerating pedogenic process.

The soils of Shekhawati region exhibit the characteristics of desert soils like sandy in texture, reddish brown to brown and grey in colour, often calcareous and subject to severe wind erosion.

2.5.1 Soil Genesis

All the major soil forming factors play their role in the process of pedogenesis to different degrees in arid and semi-arid region as in other region. Parent material, vegetation, age and physiography are important. The high rate of evaporation (2500 mm) has resulted in the physical and mechanical disintegration of parent rocks which led to higher coarse fraction in the soil. The soil throughout the profile is more or less uniform in character because of little illuviation and soluble salts. The effect of parent material in formation of soil is more evident by the light textured soil over granite, rhyolite and sand-stone, and of heavier soils over limestone.

The physiography of the area has also played its part in the process of soil formation by giving origin and development

to deep heavy soils with imperfect drainage in valleys and well drained shallow to medium deep light textured soils along the slopes. Vegetation which is scanty xerophytic and of shrubby character has provided little organic matter which led to the development of loose particles liable to severe wind erosion. Sparse vegetation cover is unable to decrease the velocity of wind and thereby giving rise to vast sand deposits, generally resulting in creation of sand dunes.

Based on a rapid reconnaissance survey the soils of the region have been broadly grouped into the following classes[14]:

(i) Desert soil
(ii) Sand dunes and sand deposits
(iii) Red desertic soils
(iv) Lithosals and regosoils of the hilly terrain

2.5.2 Desert Soils

This type of soil is extending over the vast areas of Jhunjhunu and Sikar districts and becomes dominant north and north west part of the region. The colour of this soil differs from pale brown and light yellowish brown to greyish brown. The texture reveals the characteristics of sandy and loamy sand but sometimes with weak subangular blocky or platy structure. These are well drained with rapid permeability.

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14. B.B. Roy and A.S. Kolarkar, 'Soils of Indian Arid Zone', Proceedings of Symposium on Arid Zone of 21st International Geographical Congress, India, 1968, 1971, pp. 33-37.

Generally, these are calcareous and the calcium carbonate increases with increasing depth which finally gives rise to the formation of a compact lime concretion layer at depths between 60 to 150 cm. below the earth surface. The upper most soil is loose and non-cohesive but sometimes the surface (2-2 cm) forms hard crust or layer 200 - 300 mm. Chuwas series[15] which belongs to this group has been described as follows :

Table 2.8 Soil Characteristics of Chuwas Series

S.No.	Order of scale (cm.)	Characteristics
1.	0 - 13	Pale brown (10YR 6/3), sandy, loam, dry and loose slight effervescence with HCl.
2.	13 - 30	Same as above with increased efferves-cence with HCl.
3.	30 - 75	Highly brownish grey (10 YR 6/2) sandy loam slightly more compact than earlier and presence of small lime concretions. Other qualities as in above.
4.	75 - 105	Having more lime concretion presenting vigorous effervescence with HCl.
5.	105 and above	Hard lime concretions along with weathered granite

17. Ibid., p. 34.

Table 2.9 Analysis of the Soils

Depth	Coarse sand	Fine sand	Silt	Clay	Caco3	Ph	Origin per cent
0 - 13	23.9	55.7	4.1	11.6	3.8	8.5	0.025
13 - 30	18.7	58.6	3.0	10.5	8.3	8.5	
30 - 75	15.2	64.9	3.4	11.6	3.8	8.5	

As shown in the above table[16] (2.9) the clay content in this soil varies between 10.5 to 11.6 per cent. While the silt varies between 3 to 4.1 per cent organic carbon is very low. From plant nutrients point of view the soil is deficient in nitrogen and phosphorous. However, potash content is adequate. Short supply of water is the main problem in growing crops. The aridity index reaches to the order of 80. At some places saline water is available which helps in the cultivation of wheat and barley and in the other parts of the region bajra and pulses crops dominate. A considerable part of the area remains as fallow land for want of water. In some areas the usual practice is to grow crops at interval of two or three years and leave the land as fallow in the rest of the periods. Overgrazing is a common practice which enhances the degree of wind erosion.

16. Ibid., p. 34.

2.5.6 Sand Dunes

Sand dunes should be treated separately because of the fact that these are merely sand (mainly fine sand) accumulation having no definite development of profile. However, in stabilised sand dunes where vegetation growth is visible, soil proportion increases with depth and calcium carbonate concretion are found at the depth of 3-4 metres.

These dunes represent different shapes and size depending upon the local conditions. The main types noted in the area are longitudinal transverse, parabolic and barchan. A sand profile from Beedasar has following soil analysis[17] at varying depth :

Table 2.10 Dune Soils of Beedasar

Depths	Coarse sand	Fine sand	Silt	Clay	$CaCO_2$	pH
0-30	22.4	75.5	1.4	4.7	0.7	8.5
30-60	11.4	81.1	1.1	5.0	0.6	8.5
60-90	14.7	78.1	1.0	4.8	0.6	8.5
90-120	12.5	82.7	0.4	3.9	0.5	8.5
120-150	14.0	71.0	1.5	2.5	0.6	8.5
150-180	14.2	78.8	2.0	3.5	0.8	8.5
180-210	13.8	80.3	1.2	2.9	0.8	8.5

17. Ibid., p. 35.

The table 2.10 shows uniform distribution of pH value throughout the profile in which the proportion of coarse sand in upper most part (upto 30 cm) is as high as 22.4 per cent. Below this it remains between 11.4 and 13.8 per cent which is more or less uniform. Fine-sand also shows the variation of about ten per cent and suggests uneven distribution. In the same way silt clay and calcium carbonate form low proportion and vary unevenly at different depths.

2.5.7 Red Desertic Soil

These soils are found in the areas receiving comparatively higher rainfall, i.e., between 200-400 cm. In colour these soils differ from pale brown to dark reddish brown. The texture varies from sandy loam to sandy clay. The chief characteristic of this soil is its calcareous nature and presence of a compact lime accumulated layer at the depths between 50 to 100 cm. There is a distinct proof of some illuviation, yet horizonation in the profile is not very clear.

2.5.8 Lithosols and Regosoils

These types of soils occupy the hill slopes and foot hills of the area. The remarkable characteristics of these soils are shallow and gravelly structure with light texture and fairly drained. The texture is mostly sandy. Cultivation practices in the areas of these soils are restricted because of the stony character of soil along with other obstacles like

low rainfall, high aridity, severe wind erosion, low moisture holding capacity, scarcity of irrigation facilities, salinity and shallow depth of soil etc.

2.6 NATURAL VEGETATION

Shekhawati region is situated in arid zone so the forests are rare. Only 3.4 per cent of the total land of the region is under forest covers. Forest area is meagre due to scanty rainfall. There are, however some small thorny bushes which are being preserved. These bushes supply fodder to the animals. The forest area of Neem-ka-thana sub-division supplies fuel for domestic purposes and timber for preparing agricultural implements and roofing. No commercial product is available for tanning purposes. The major species in the hills are Dhak (Anogeissus pendula) and Babul (Acacia arabica), Pipal (Ficus religiousa), Kheira (Prosopis spicigera), Salar (Dalbergia sissoo), Siras (Albizzia-lebbeck), Sisam (Dabergia) and Rohira (Tacoma-undulata) are found in plains. The shrubs available in the region Phog (Calligonum polygonoides), Aak (Calotropis procera), Neem (Azadirachta Indica), Jal (Salvadore persica) and Mango (Mangifera indica) in Udaipurwati tehsil.

Besides these three there are several varieties of grasses also which deserve mention in the context of this arid zone. Among the important grasses are Bhurat (Cenchrus barbatus) Sewan (Eleusive hirsutus), Lomp (Aristida depressa) and Murat

(Panicum turgidum), Bhurat has prickly hust and grass is found in abundance during the rainy reason. It is used as fodder for cattle other useful grasses are Bagera and Sata eaten by Camels, a hardy grass with little sap has deep strong roots and grows around the thorny fences of houses in the villages.

The region is deficient in vegetal cover and due to the growth of aridity and human interference it has depleted and slowly became thin. A concerted effort is needed in order to have plantation as well as preservation strategies adopted to enrich the vegetal cover and change the ecological system.

Chapter 3

DEMOGRAPHIC AND SOCIAL STRUCTURE

In this chapter, an attempt has been made to examine a comprehensive understanding and the main characteristics of population in Shekhawati region. According to the census of 1971, the population of the region is 19.7 lakhs out of which rural population accounts for 82.72 per cent and urban population 17.28 per cent respectively. The region extends in an area of 13.7 thousand square kilometre recording a population density of 146 persons per square kilometre.

3.1 GROWTH OF POPULATION

The population growth variations have been shown in the following table :

Table 3.1 Decadal Variation in Population Growth (1901-71)

Year	Population	Variation	Per cent Variation
1901	808196	-	-
1911	838527	30331	3.75
1921	815735	-22792	-2.71
1931	926678	110943	13.60
1941	1105587	178909	19.30
1951	1265054	159467	14.42
1961	1539936	274882	21.72
1971	1971878	431942	28.04

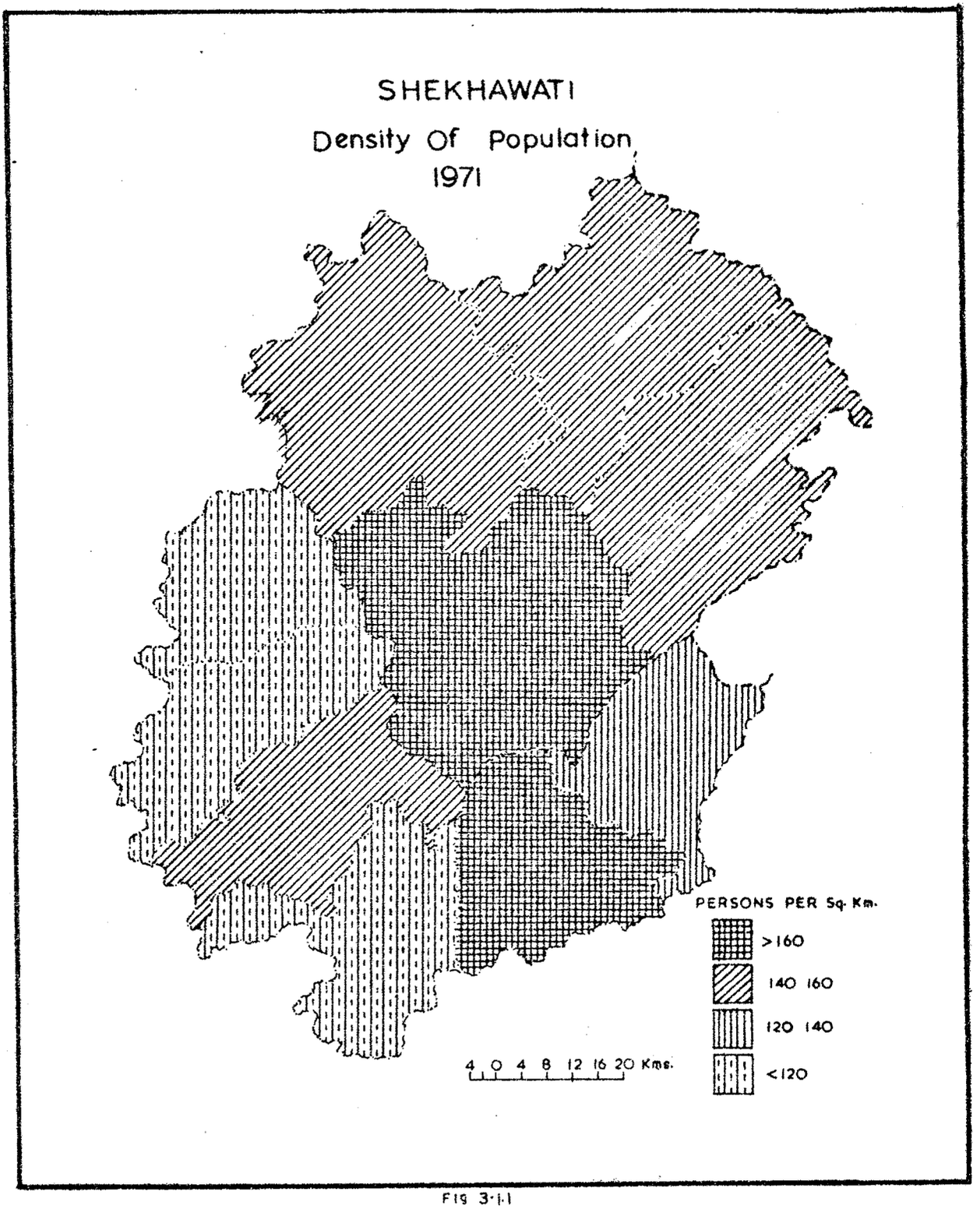
SHEKHAWATI
Density Of Population
1971
PERSONS PER Sq. Km.
>160
140 160
120 140
<120
4 0 4 8 12 16 20 Kms.

Fig 3·1·1

The table 3.1 reveals the fluctuation in growth for the years from 1901 to 1971. The table depicts a decrease of 2.71 per cent in between 1911 and 1921. Then it is marked by an increase in population in different decineal periods except minor decrease in the period between 1941 and 1961.

3.2 DENSITY OF POPULATION

The density of population which implies the persons per unit area, depends upon the factors which are again closely related with the resource-base of the region. It is the availability of livelihood and appropriate living conditions which directly effect the density of population. Thus, resources are the main focus to centralise the population in and around (fig. 3.1.1).

Generally, in the areas where the concentration of resources is high, the density of population is also bound to be higher and vice-versa. The Shekhawati region, despite of possessing semi-arid conditions, has comparatively higher density of population.

3.2.1 Arithmetic Density

Arithmetic density provides a general picture of human distribution over per unit of area. It considers the total population in relation to the total area of the areal unit. As the map reveals, the south western parts of the region has lower density than the eastern parts. Tehsils covered by lower

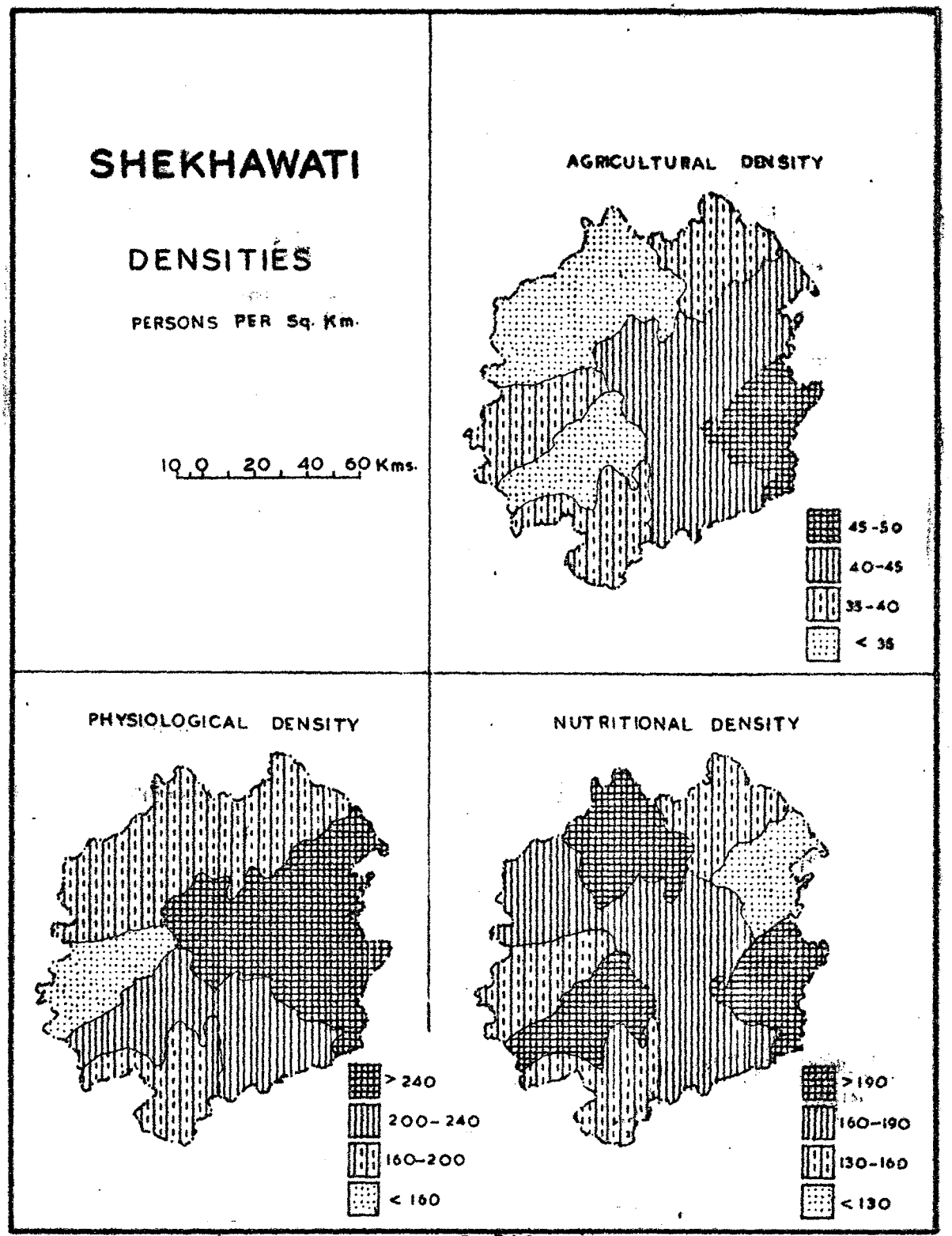
SHEKHAWATI
DENSITIES
PERSONS PER Sq. Km.
10 0 20 40 60 Kms.
AGRICULTURAL DENSITY
45-50
40-45
35-40
< 35
PHYSIOLOGICAL DENSITY
> 240
200-240
160-200
< 160
NUTRITIONAL DENSITY
>190
160-190
130-160
<130

Fig 3·1·2

density are : Fatehpur, Lachmangarh, Danta Ram Garh with a density of 120 persons per square kilometre. And the tehsils which have comparatively higher density, i.e., 160 persons per square kilometre are Udaipurwati and Sri Madhopur. Following table gives the density distribution in the region (fig. 3.1.2).

Table 3.2 Pattern of Densities (Persons Per Sq. Km.)

Tehsil	Arithmetic density	Physiological density	Nutritional density	Agricultural density	Man-Land Ratio (acres)
Jhunjhunu	142	190	226	31	1.30
Chirawa	157	197	148	37	1.25
Khetri	155	243	113	44	1.02
Udaipurwati	174	246	186	44	1.00
Fatehpur	112	174	174	29	1.41
Lachhmangarh	111	148	156	37	1.66
Sikar	153	206	206	34	1.20
Neem-ka-thana	133	290	204	50	0.85
Sri Madhopur	165	238	187	44	1.04
Danta Ram Garh	119	167	145	37	1.47
Regional	146	210	174	38	1.30

3.2.2 Agricultural Density

Agricultural density, which shows the population pressure on land, depicts the relationship between agricultural population

and the cultivated area. It can be used as an index for measuring the carrying capacity of land. The statistical information shows a very irregular distributional pattern of the agricultural density. The higher agricultural density has been recorded by Neem-Ka-thana, Kehtri, Udaipurwati and Sri Madhopur tehsils with a density of 44 to 50 persons per square kilometre of cultivated area. Tehsils having medium density of 34 to 37 persons per square kilometre are Chirawa, Lachhmangarh, Danta Ram Garh and Sikar. The low density tehsils having 31 persons per square kilometre includes Fatehpur and Jhunjhunu. The lowest agricultural density (29 persons) per square kilometre is found in Fatehpur tehsil. The distributional pattern of agricultural density is closely related with the nature of soil. The more promising and productive the land, the more agricultural density and vice-versa (fig. 3.1.2).

3.2.3 Nutritional Density

It is common fact that the well-being of the individuals depends upon the factors such as food habits, age, temperament and occupation etc., but the most dominant is food which is mostly obtained from land. The nutritional density represents the total population and the cultivated area under food crops in per unit area. This indicates the dependency of population upon land under food crops. Here, nutritional density means, persons per square kilometre of the area under food crops (fig. 3.1.2).

Nutritional density in Shekhawati region is 174 persons per square kilometre. While in various tehsils, it varies in between 113 and 226 persons per square kilometre. The nutritional density is recorded to be 113 and 145 in the tehsils of Khetri and Danta Ram Garh respectively (Table 3.2).

3.2.4 Physiological Density

The physiological density shows the ratio between the total population and the cultivated area in per unit area. In other words, it expresses the pressure of population per unit area of cultiva-ted land.

The physiological density is 210 persons per square kilometre in Shekhawati region. In various tehsils it varies between 148 and 290 persons per squere kilometre. In the tehsils of Lachhmangarh, Fatehpur, Danta Ram Garh, Chirawa and Jhunjhunu, it ranges between 148 and 200 persons per sq. kilometre. It is only in the Neem-ka-thana (fig. 3.1.2) where the density is recorded to be 290 persons per square kilometre which is the highest in the region.

3.3 MAN LAND RATIO

The rate of socio-economic development in a rural area mostly inhabited by cultivators and allied class of population is determined and controlled by various factors. Land is the main basis of agricultural activities.

To study man and land ratio situation in various tehsils of Shekhawati region, the total population of the areal unit and the area of cultivated land has been taken into consideration to calculate cultivate area per person. In the tehsils of Neem-Ka-thana and Udaipurwati, it is found to be between 0.85 and 1.00 acre per person, while in the tehsils of Khetri, Sri Madhopur, Sikar, Chirawa and Jhunjhunu, it various between 1.02 and 1.30 acres per person. The area of cultivated land per persons varies between 1.41 and 1.66 acres in the tehsils of Fatehpur, Danta Ram Garh and Lachhmangarh (Table 3.2).

3.4 CHIEF CHARACTERISTICS OF POPULATION

3.4.1 Sex Ratio

The most common measure used to show the balance of the sexes in population in any region is called the sex ratio which is indicated by the number of females per thousand males. The rural and urban segments of the population of Shekhawati have different sex ratios. In rural area the sex ratio is recorded to be higher than in urban area (Table 3.3).

The average sex ratio of the Shekhawati region is 946 females per thousand males. It is the higher side if we compare it with the sex ratio in the state of the Rajasthan which is 911 females per thousand males. The range of sex ratio between tehsils is pretty large as it varies between 893 females per thousand males in Chirawa and 998 females per thousand males in Fatehpur and Lachhmangarh. Thus the maximum range comes to

Table 3.3 Sex Ratio, Literacy Rate and Dependency Ratio (1971)

		(per 1000 males)	(per cent)	Dependency Ratio (dependents per 1000 workers)
Jhunjhunu	T	962	23.58	314
	R	964	20.67	
	U	957	31.79	
Chirawa	T	893	25.87	288
	R	915	20.87	
	U	819	44.10	
Khetri	T	896	21.54	284
	R	896	20.91	
	U	944	37.42	
Udaipurwati	T	957	22.38	303
	R	962	20.72	
	U	934	29.68	
Fatehpur	T	998	20.98	311
	R	974	15.21	
	U	0134	29.62	
Lachhmangarh	T	998	19.14	234
	R	997	16.40	
	U	1007	33.20	
Sikar	T	967	22.11	282
	R	986	17.05	
	U	923	33.59	
Neem-ka-thana	T	919	18.31	275
	R	925	16.60	
	U	846	40.00	
Sri Madhopur	T	949	18.91	282
	R	949	17.35	
	U	977	32.96	
Danta Ramgarh	T	954	17.67	246
	R	954	17.56	
	U	N.A	N.A.	
Regional	T	946	21.43	282
	R	948	18.86	
	U	935	33.82	

Source : District Census handbooks of the districts of Jhunjhunu and Sikar, 1971

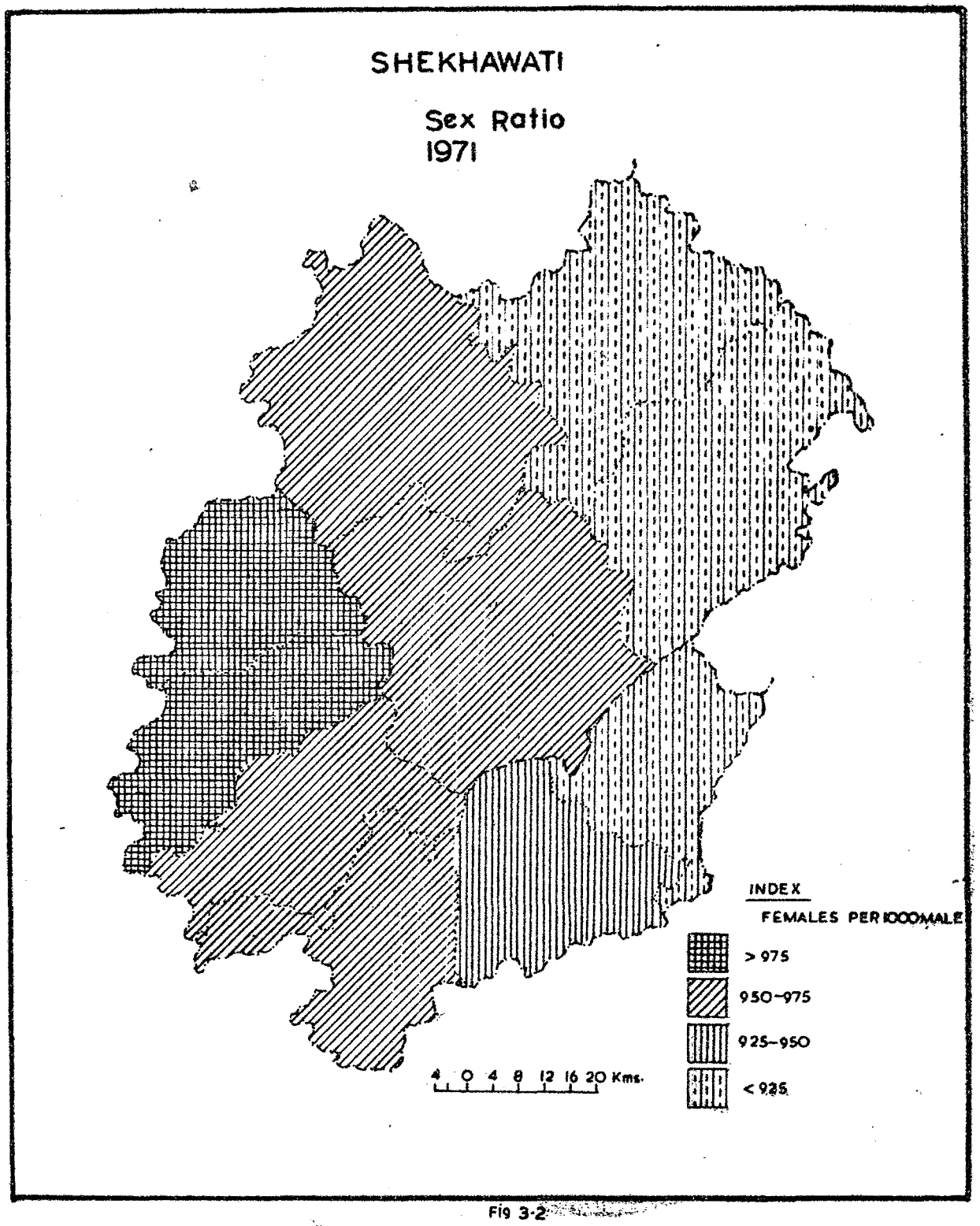
SHEKHAWATI
Sex Ratio
1971
INDEX
FEMALES PER 1000 MALE
> 975
950–975
925–950
< 925
4 0 4 8 12 16 20 Kms.

Fig 3-2

105 females between the tehsils having the highest and lowest sex ratios. The eastern tehsils of Chirawa and Khetri have low sex ratio, i.e., 893 and 896 females per thousand males while the western tehsils of Jhunjhunu, Fatehpur, Lachhmangarh and Sikar have higher sex ratio ranging between 967 to 998 females per thousand males. The other tehsils which lie in the southern part of the region have 919 to 957 females per thousand males.

Sex ratio in the rural population has been found to be high in Lachhmangarh and Sikar tehsils (ranging from 986 to 997 females per thousand persons) while low sex ratio is found in Khetri (898 females per thousand males). Among the tehsils the number of females per thousand males varies between 898 to 997 females per thousand males. It is below 900 females per thousand males in the tehsils of Khetri, while in the tehsils of Chirawa, Sikar and Neem-ka-thana it is found between 900 to 950 females per thousand males. Above 950 females per thousand males has been found in tehsils of Jhunjhunu, Udaipurwati, Fatehpur, Sikar, Lachhmangarh and Danta Ramgarh (fig. 3.2).

The Shekhawati region is backward in urbanization. Among the tehsils the number of the females per thousand males in urban areas varies between 819 to 1034 females per thousand males. It is below 900 females per thousand males in the tehsils of Chirawa and Neem-ka-thana while in the tehsils of Khetri, Udaipurwati and Sikar it is found between 900 to 950

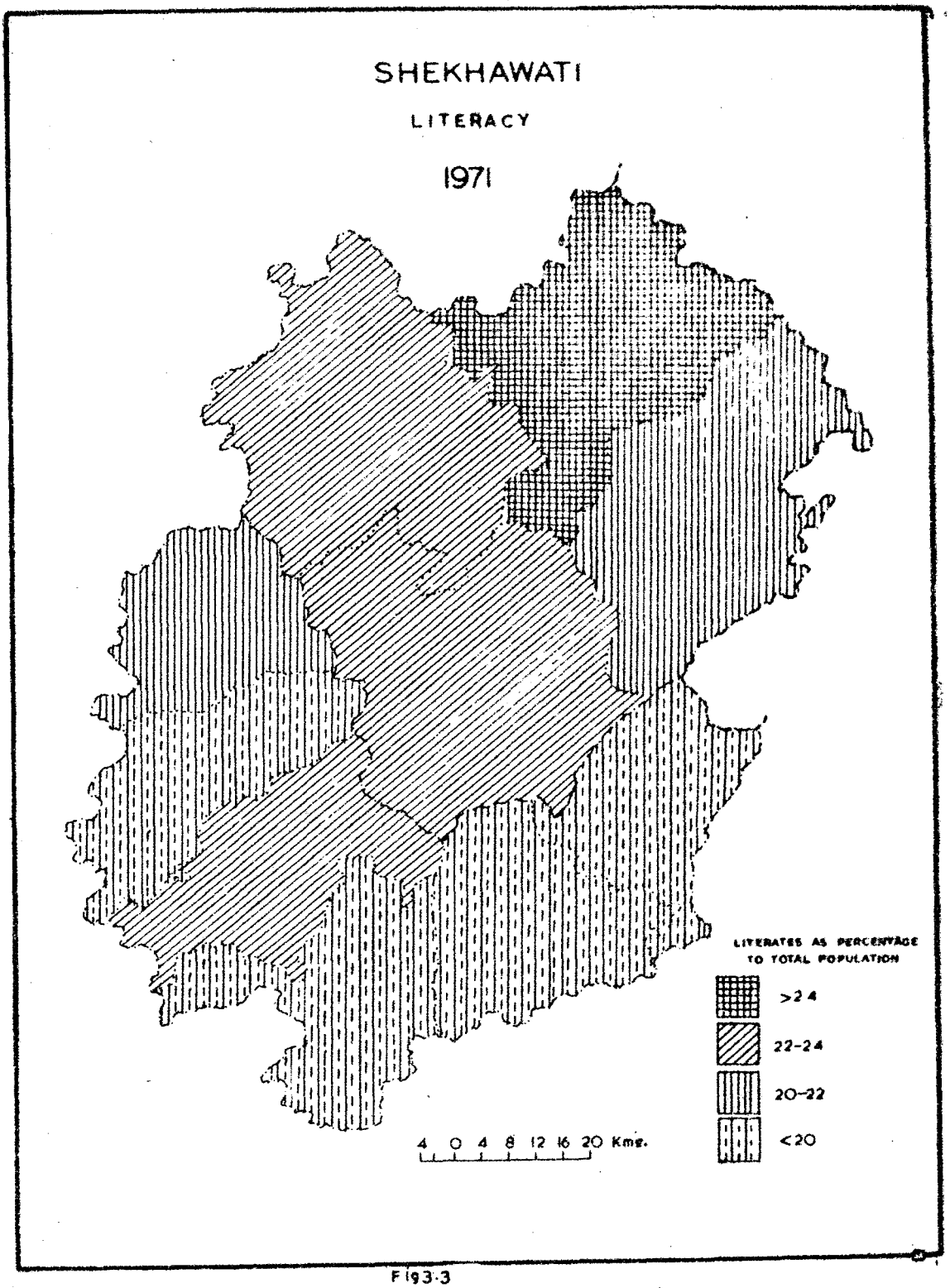
SHEKHAWATI
LITERACY
1971
LITERATES AS PERCENTAGE TO TOTAL POPULATION
>24
22-24
20-22
<20
4 0 4 8 12 16 20 Kms.

Fig 3.3

females per thousand males. Above 950 females per thousand males have been found in tehsils of Jhunjhunu, Fatehpur, Lachhmangarh and Sri Madhopur. The highest sex ratio in urban areas is found in the tehsils of Fatehpur (1034 females per thousand males). There are several probable reasons for high sex ratio in Fatehpur as migration of males to other areas in the search of livelihood and services and finally the practice of polygamy because the number of females exceed males only in the category of non-working class.

3.4.2 Literacy Rate

The rate of literacy depends upon a number of socio-economic factors in a region. Literacy rate in the state of Rajasthan is quite low (19 per cent) as compared to India (29.45 per cent). Shekhawati region has literacy rate of 21.43 per cent which is higher than the state. Spatially the literacy varies from tehsil to tehsil and ranges between 17.67 to 25.87 per cent. The highest literacy rate of 25.87 per cent is found in Chirawa tehsils while lowest is recorded in Danta Ramgarh tehsil. The table 3.3 reveals that the tehsils of Neem-ka-thana, Sri Madhopur and Danta Ramgarh recorded a literacy rate of 18.31, 18.91 and 17.67 per cent respectively (fig. 3.3).

3.4.2.1 Rural Literacy Rate

Rural literacy is very low. The literacy rate in rural areas has been found to be higher in the northern tehsils of the

region. The rural literacy rate ranges between 15.21 and 20.91 per cent in the tehsils of Khetri, Chirawa, Udaipurwati and Jhunjhunu whereas in the tehsils of Danta Ramgarh, Sri Madhopur and Sikar it is between 17.05 and 17.67 per cent. The tehsils of Neem-ka-thana, Lachhmangarh and Fatehpur represent the literacy rate between 15.21 and 16.60 per cent only. The lowest literacy is found in Fatehpur tehsil (15.21 per cent) while the highest is recorded in Khetri (20.91 per cent) (Table 3.3).

3.4.2.2 Urban Literacy Rate

It has been found that the literacy rate in urban areas is higher than rural areas. The reason of higher urban literacy is that the educational facilities exist in urban centres. The highest urban literacy of 46.10 per cent is found in Chirawa tehsil while on the other hand the lowest per cent (29.62) is recorded in Fatehpur tehsil (Table 3.3).

3.5 SOCIAL STRUCTURE

Here an attempt has been made to deal with the distribution of scheduled castes and scheduled tribes in Shekhawati region for which data is available. It is generally recognised fact that the scheduled castes belong to the segment of socially and economically backward members of our society. There is a general consensus on the subject that they are generally economically deprived unlike others in the society. About fourteen per cent

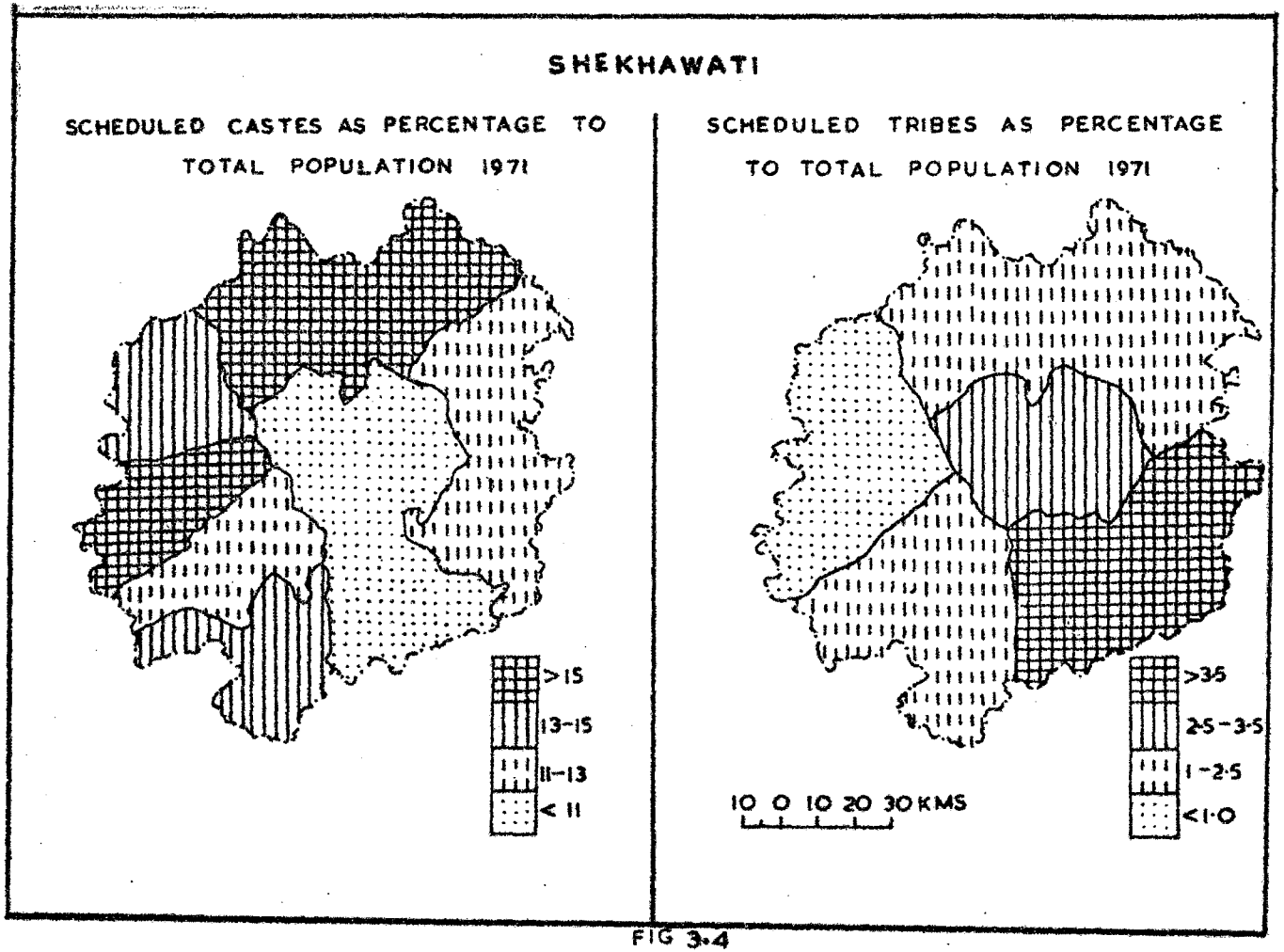
SHEKHAWATI
SCHEDULED CASTES AS PERCENTAGE TO TOTAL POPULATION 1971
>15
13-15
11-13
< 11
SCHEDULED TRIBES AS PERCENTAGE TO TOTAL POPULATION 1971
>3·5
2·5-3·5
1-2·5
<1·0
10 0 10 20 30 KMS

FIG 3·4

of total population of Shekhawati belongs to scheduled castes. The percentage of scheduled castes in rural area is 13.76 per cent while in urban areas it is 12.13 per cent (Table 3.4).

Table 3.4 Scheduled Caste and Scheduled Tribes as Per Cent to Total Population

Name of tehsil	Scheduled caste	Scheduled tribes	Combined
Fatehpur	17.10	0.40	13.50
Chirawa	16.95	1.23	18.18
Lachhmangarh	16.37	0.90	17.20
Jhunjhunu	15.91	2.25	18.47
Danta Ramgarh	14.98	2.46	17.42
Sikar	14.73	1.41	16.14
Khetri	13.10	1.41	14.51
Neem-ka-thana	11.73	5.80	17.53
Udaipurwati	10.60	2.92	12.92
Sri Madhopur	10.34	4.00	14.35
Regional	14.10	2.23	16.33

Source : D.C.H. (1971) of the Districts of Jhunjhunu and Sikar

The scheduled caste population varies between 10.34 and 17.10 per cent in the tehsils of the region. It is below 12 per cent in the tehsils of Neem-ka-thana, Udaipurwati and Sri Madhopur. While the tehsils of Danta Ramgarh, Sikar and Khetri it is found between 12 to 15 per cent it is only four tehsils of Fatehpur, Chirawa, Lachhmangarh and Jhunjhunu where the percentage of scheduled caste population is above 15 per cent (fig. 3.4).

3.5.1 Scheduled Tribes

Generally given a status equivalent to scheduled castes the tribes are lagging far behind in the field of socio-economic

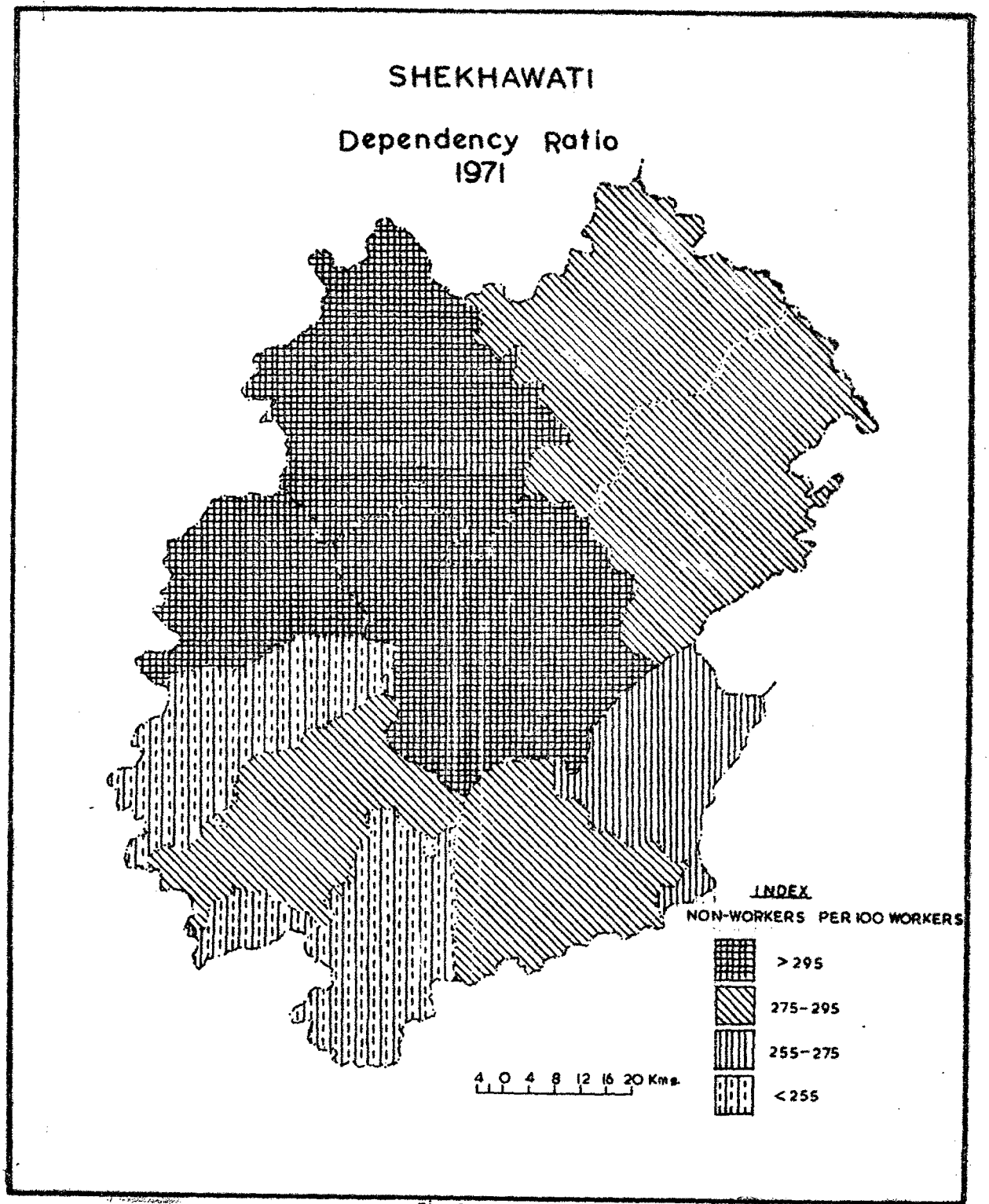
SHEKHAWATI
Dependency Ratio
1971
INDEX
NON-WORKERS PER 100 WORKERS
> 295
275-295
255-275
< 255
4 0 4 8 12 16 20 Kms.

Fig 3.5

development and therefore, proper attention to this class of community is an imperative. The distribution pattern of scheduled tribes except some of the exception cases is widely scattered throughout the region with a very low percentage (2.23) to total population. From the table 3.4 it becomes obvious that tehsil-wise distribution of scheduled tribes varies between 5.8 per cent in Neem-ka-thana and 0.40 per cent in Fatehpur. Thus, we find that scheduled tribes are mostly found in the southern part of the region.

3.6 ECONOMIC STRUCTURE OF POPULATION

3.6.1 Dependency Ratio

Dependency ratio shows the number of non-workers dependent of the workers. According to W.S. Thompson and D.T. Lewis (1965) dependency ratio is the ratio between producers and consumers. The dependency ratio in north west and central parts of the region is comparatively higher than other parts (fig. 3.5). It is highest in Jhunjhunu where 314 non-workers are found to be dependent on per 100 workers and lowest in Lachhmangarh where 234 non-workers per 100 workers are recorded. Jhunjhunu, Udaipurwati and Fatehpur tehsils have a dependency ratio of more than 300 non-workers per 100 workers (Table 3.3). The low ratio in rural areas may be mainly due to their under reporting of non-workers as is the case in other parts of India or as they share with other family members the same agricultural occupation and are reported as cultivators. The dependency

ratio differs from tehsil to tehsil and between rural and urban due to the following factors.

Due to the high birth rate the number of young dependents would increase. This increase is responsible for the increase in dependency ratio. This exists in urban areas because of the fact that most of the people living in urban areas are engaged in secondary or tertiary activities. One or two members are working members and the others of the family depends upon them. The high dependency ratio has been found in urban areas due to migration.

3.6.2 Occupational Pattern

The occupational structure of the region reflects the diversification of economic activities and presents a better indication and understanding of the level of development of an area. The selection of economic activities is highly influenced by geographical setting. The environmental conditions provide base for occupation. Therefore, occupational structure of a region focusses on the framework of the regional economy. Agriculture, so far remains the most important among the occupations being carried. It directly or indirectly supports and offers employment to about 70 per cent population.

The occupational structure in Shekhawati region varies largely in terms of sectors. According to the census of 1971 the percentage of total work-force in the region accounts for

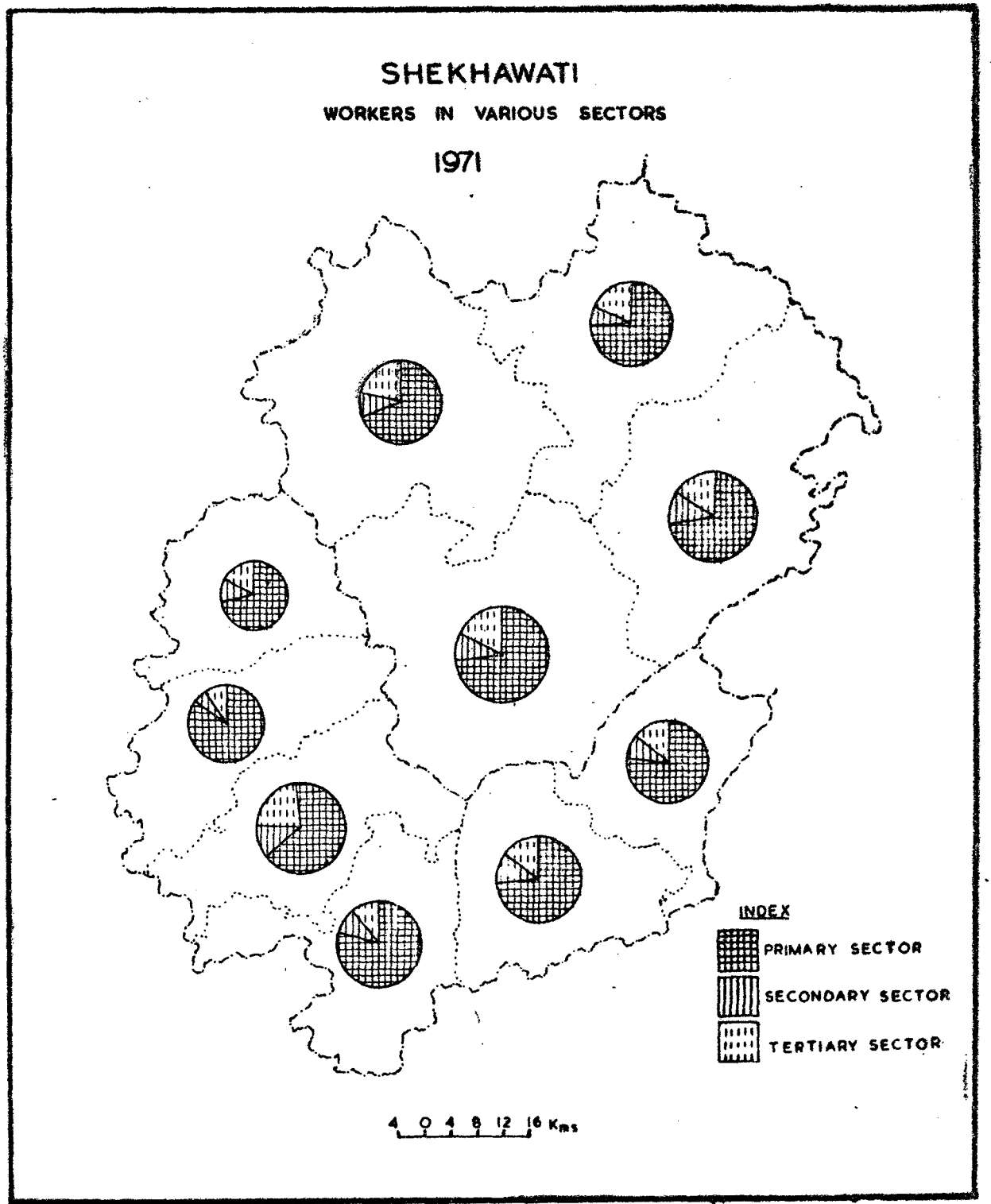
SHEKHAWATI
WORKERS IN VARIOUS SECTORS
1971
INDEX
PRIMARY SECTOR
SECONDARY SECTOR
TERTIARY SECTOR
4 0 4 8 12 16 Kms

Fig 3·6

26.16 per cent while the non-workers accounts for remaining 73.84 per cent. The percentage of the working force engaged in primary, secondary and tertiary sectors is 74.29, 9.11 and 16.60 respectively of these 83.38, 5.70 and 10.87 per cent are distributed in rural areas under the three sectors respectively and the remaining in urban areas (fig. 3.6).

3.6.2.1 Primary Sector

(1) Cultivators : Cultivation being the primary source of income for most of the persons living in Shekhavati region the number of cultivators is sufficiently large. According to the 1971 census 65.67 per cent of the population comes under the head of cultivators. The percentage varies greatly from place to place. It is 58.93 per cent in the tehsils of Sikar and between 60 and 65 per cent in the tehsils of Jhunjhunu, Khetri and Udaipurwati. It remains between 65 and 70 per cent in the tehsils of Neem-ka-thana, Fatehpur, Chirawa and Sri Madhopur while this proportion goes above 70 per cent in the tehsils of Danta Ramgarh and Lachhmangarh. The highest percentage of cultivators is found in the tehsil of Lachhmangarh (78.30 per cent). The high percentage of cultivators in the total work-force in various tehsils indicates industrial and commercial backwardness of these areal units. If we look at the proportion engaged in agriculture as cultivators in urban centres also which is 14.74 per cent of the total work-force, the total employment in this sector comes to be 74.29 per cent. Thus we

see that nearly three-fourth of the total working population is engaged as cultivators which dominates the primary sector as a whole.

Table 3.5 Percentage of Workers to Total Working Population 1971

Occupational Category	India	Rajasthan	Shekhawati
A. Primary Sector	72.6	77.24	74.29
(i) Cultivators	43.4	64.92	65.67
(ii) Agricultural Labourers	26.3	9.31	5.91
(iii) Livestock, forestry, fishing, hunting and plantation, orchards and allied activities	2.4	2.56	1.92
(iv) Ming and quarrying	0.5	0.45	0.79
B. Secondary Sector	10.7	7.87	9.11
(i) Manufacturing, servicing and repairs	9.5	6.63	6.85
(ii) Construction	1.2	1.24	2.26
C. Tertiary Sector	16.7	14.89	16.60
(i) Trade and commerce	5.6	4.45	4.44
(ii) Transport storage and communication	2.4	1.99	1.28
(iii) Other services	8.7	8.45	10.88
Total	100	100	100
Total workers	32.9	31.23	26.16
Total non-workers	67.1	68.76	73.84

From the table 3.5 it is clear that primary sector in Shekhawati accommodates higher proportion of the work force as compared to India but compared to the state it accounts for lower proportion, but secondary and tertiary sectors lag far behind as compared to those of the country. The region is industrially and commercially backward.

(ii) Agricultural Labourers : Agricultural labourers work on land owned by others and earn wages. Out of the total working force 5.99 per cent constitute the agricultural labour.

The spatial distribution of agricultural labourers varies between 3.74 per cent and 7.47 per cent in different tehsils. It is below four per cent (3.74 per cent) only in the tehsil of Fatehpur. It is found between 4 to 6 per cent in the tehsils of Sri Madhopur, Lachhmangarh and Sikar, while in the tehsils of Jhunjhunu, Chirawa, Khetri, Neem-ka-thana, Danta Ramgarh and Udaipurwati it is more than 6 per cent, the highest percentage being in the tehsils of Udaipurwati (7.47 per cent) (Table 3.6).

(iii) Livestock, Forestry, Fishing, Hunting, Plantation, Orchards and Allied Activities : The proportion of workers engaged in livestock, fishing and forestry etc. is only 1.92, 2.04 and 0.95 per cent of workers of the total, rural and urban work force respectively are engaged under this category.

Table 3.6 Percentage of Workers to Total Working Population 1971

Occupation category	Total	Rural	Urban
A. Primary Sector	74.29	83.38	21.09
(i) Cultivators	65.67	72.98	14.74
(ii) Agricultural Labourers	5.91	5.99	4.83
(iii) Livestock, Forestry, Fishing, Hunting and Plantation	1.92	2.04	0.95
(iv) Mining and quarrying	0.79	2.37	0.57
B. Secondary Sector	9.11	5.70	29.11
(i) Manufacturing processing servicing and repairs	6.85	4.63	19.74
(ii) Construction	2.26	1.07	9.36
C. Tertiary Sector	16.88	10.87	49.75
(i) Trade and commerce	4.44	1.77	20.14
(ii) Transport storage and communication	1.28	0.70	4.67
(iii) Other services	10.88	8.40	24.94

Source : D.C.H. (1971) of the Districts concerned

The spatial distribution of population engaged in this category differs according to the topographical features. Among the tehsils the percentage of persons engaged in these profession

varies between 0.53 and 4.67 per cent. It is below 2 per cent in the tehsils of Jhunjhunu, Chirawa, Udaipurwati, Fatehpur and Lachhmangarh. While in the tehsils of Sikar, Sri Madhopur and Danta Ramgarh it is found between 2 and 4 per cent. It is only the tehsil of Neem-ka-thana where the percentage of population under this profession figures 4.67 per cent of the total work force.

(iv) Mining and Quarrying : The geological structure of a region and the availability of mineral wealth determine this category of work available to people. In this category only 0.79 per cent of the total work force is engaged in mining and quarrying. Out of the total rural and urban work force break-ups only 2.37 and 0.57 per cent is engaged in mining and quarrying respectively.

The spatial distribution of the persons engaged in mining and allied activities is quite interesting. It is only the tehsils of Khetri which represent significant figure (5.25 per cent) which is because of the presence of the Khetri copper mines in the tehsil. In all other tehsils the percentage of persons engaged in this activity is less than one per cent of the work-force.

3.6.2.2 Secondary Sector

(i) Manufacturing : Manufacturing provides employment to 6.85 per cent of the total work force. 4.63 per cent of total

rural work force and 19.75 per cent of the total urban work force is engaged in this activity. The spatial distribution of population engaged in this category varies between 3.86 and 9.45 per cent of the total work force in different tehsils. The tehsils of Sri Madhopur and Danta Ramgarh are found above 9 per cent engaged in category. The low percentage found in Lachhmangarh tehsil (Table 3.6).

(ii) Construction Activities : Only 2.26 per cent of the total work force of the region is engaged in this activity. 1.07 per cent of the total rural work force and 9.36 per cent of the total urban work force is under this category of occupation. The proportion of workers in urban area is comparatively higher because in rural sector most of the construction work is assisted by the members of the household themselves.

Spatially people engaged in this category vary between 1.24 and 4.94 per cent of the total work force of tehsils. It is found between one and two per cent in the tehsils of Lacchmangarh, Neem-ka-thana, Danta Ramgarh, Chirawa and Udaipurwati, whereas it accounts for between 2 and 3 per cent of the total work force in the tehsils of Sri Madhopur, Khetri and Jhunjhunu. It is found above 3 per cent of the total work force in the tehsils of Sikar and Fatehpur. The highest proportion is recorded in the tehsil of Fatehpur that is 4.94 per cent of the total work force of the tehsil.

3.6.2.3 Tertiary Sector

(i) Trade and Commerce : Trade and commerce indicate the economic level of development of a region. 4.41 per cent of the total work force of the region is engaged in this occupation. Only 1.77 per cent of total rural work force and 4.67 per cent of the total urban work force is engaged in this category (Table 3.6). The percentage in urban as compared to rural areas is higher because the trade and commerce activities are mostly concentrated in urban centres.

The distribution of population engaged in this activity varies between 2.47 and 7.71 per cent of the total work force in the different tehsils. It is between 2 and 4 per cent of the total work force in the tehsils of Khetri, Danta Ramgarh, Lachhmangarh and Chirawa whereas it is between 4 and 6 per cent of the total work force in the tehsils of Neem-ka-thana, Udaipurwati, Sri Madhopur, Jhunjhunu and Fatehpur. It is only the tehsils of Sikar where the percentage of population under this category is above 6 per cent that is 7.71 per cent of the total work force of the tehsil. The highest percentage at Sikar is clear cut clue of comparatively higher level of development than only other tehsils of the region (Table 3.7).

(ii) Transport Storage and Communication : Only 1.28 per cent of the total work force of the region is engaged in this occupation. 4.67 per cent of the total urban work force is

Table 3.7 Sector and Tehsil wise Percentage of Workers to Total Work Force 1971

Name of Tehsil	Cultivators	Agricultural Labour	Livestock, fishing, Hunting & Plantation	Mining & Quarrying	Manufacturing & repairs	Construction	Trade and Commerce	Transportation & communication	Other services
Jhunjhunu	62.03	6.49	0.53	0.13	7.27	2.25	4.93	1.56	14.74
Chirwara	66.00	6.04	0.92	0.04	5.73	1.67	3.83	1.17	14.47
Khetri	63.78	6.23	1.81	5.25	4.32	2.15	2.47	0.84	13.09
Udaipurwati	64.86	7.47	1.12	0.24	7.24	1.84	4.47	0.87	11.85
Fatehpur	65.44	3.74	1.02	0.22	6.91	4.94	5.83	1.83	10.05
Lachhmangarh	78.30	4.95	1.48	0.10	3.86	1.24	3.19	0.53	6.32
Sikar	58.93	4.99	2.25	0.31	7.82	3.96	7.71	2.18	11.81
Neem-ka-thana	63.02	6.86	4.67	0.37	6.91	1.57	4.16	1.64	8.75
Sri Madhopur	66.75	4.52	3.02	0.32	9.45	2.00	4.52	1.46	7.92
Danta Ramgarh	70.10	6.77	2.60	0.21	8.21	1.51	2.84	0.78	6.93
Regional	65.67	5.91	1.72	0.79	6.80	2.26	4.44	1.28	10.88

Source : Census of India (1971), D.C.H. of the districts of Jhunjhunu and Sikar

engaged in these activities. This lower level of percentage in these activities is enough to represent the backwardness of the region in the field of transport and communication.

The percentage of population in this profession differs between 0.53 and 2.18 per cent of the total work force of the tehsils.

The percentage of population to the total work force in this occupation is found below one per cent in the tehsils of Lachhmangarh, Khetri and Udaipurwati. It is found between one and two per cent in the tehsils of Chirawa, Jhunjhunu, Sri Madhopur, Neem-ka-thana and Fatehpur. It is only the tehsil of Sikar where the percentage of population in this occupation is found to be above 2 per cent, of the total work force of the tehsil (Table 3.7).

(iii) Other Services : 10.87 per cent of the total work force of the region are engaged in other services. 24.94 per cent of the total urban work force of the region belongs to this category while it is only 8.40 per cent of the total rural work force. The proportion of workers in different tehsils differs between 6.32 and 14.74 of the total work force. It is above six per cent and below nine per cent in the tehsils of Lachhmangarh, Danta Ramgarh, Sri Madhopur and Neem-ka-thana whereas it varies between 9 and 12 per cent in the tehsils of Fatehpur, Sikar, and Udaipurwati. It is found above 12 and

below 15 per cent in the tehsils of Khetri, Chirawa and Jhunjhunu.

Thus, we find that it is cultivation and allied activities which accommodate the largest proportion of population in the region. Industries are very few so the proportion of industrial workers is not much. Heavy dependence upon agriculture which is essentially subsistence type shows the economic backwardness of the region.

Chapter 4

STRUCTURE OF AGRARIAN ECONOMY

Agriculture plays a vital role in the economy of the Shekhawati region. The total area comprises of this region is 13,661 square kilometres which is about 3.99 per cent of the state area (Rajasthan). The total cultivable area of Shekhawati region is about 81.47 per cent of which 71.75 per cent area is under cultivation. The important crops grown in this region are Bajra, gram, barley and wheat etc. Bajra is the dominant crop which is grown over a large area. Apart from the total output, again bajra, is very popular because it is the staple-food of the majority of the population.

The assured means of irrigation in this region are very limited. Of the total gross cropped area only 6.71 per cent has irrigation facilities. Irrigation is mainly done by wells and tubewells. The south east portion of the region (Neem-ka-thana, Sri Madhopur, Danta Ramgarh and Khetri) have comparatively more irrigation facilities than rest of the part of the region. This region has 91.18 per cent area under food crops whereas the percentage area under non-food crops accounts for only 8.82 per cent. Wherever the irrigation facilities are available, the intensity of cropping is fairly high. On an average the area sown more than once in Shekhawati region comes to about 16.72 per cent.

Table 4.1 Land Use Pattern

Categories	Average for the trinium 1961-64	Average for the trinium 1967-70	Average for the trinium 1973-76
1. Forest	1.75	3.02	3.40
2. Not available for Cultivation	10.15	9.13	8.96
3. Other uncultivated area			
(i) pastures grazing land	6.94	6.70	6.15
(ii) Tree groves miscellaneous	0.01	-	-
(iii) Cultivable waste land	2.20	1.85	1.59
4. Fallow land			
(i) current fallow	5.89	5.06	5.38
(ii) Other than current fallow	2.34	2.26	2.76
5. Net sown area	70.72	71.98	71.75
6. Area sown more than once	4.17	7.14	16.72

Source : Agricultural Statistics of Jhunjhunu and Sikar districts for the year 1961-1976

4.1 GENERAL LAND USE PATTERN

To study the land use pattern of the region the data for the triniums 1961-64, 1967-70 and 1973-76 have been taken. The land of region has been classified into five broad categories according to the village papers. These

categories are forest, area not available for cultivation, other uncultivated land, fallow land and net sown area.

4.1.1 Forest

The forests are very limited in the region. The proportion of land under forest during 1961-64, 1967-70 and 1973-76 has been 1.75, 3.02 and 3.40 per cent respectively (Table 4.1). The low figures reflect the limitations imposed by aridity on the plant growth in this region.

The afforestation programmes like "Van Mahotsava" was launched by the government to encourage the planting of more trees. At the same time the conservation activities undertaken in the region had also some effect. It can be seen that the area under forests gradually increased in tehsils of Jhunjhunu, Khetri, Udaipurwati, Lachhmangarh, Sikar, Sri Madhopur and Danta Ramgarh. In the tehsils of Fatehpur, Neem-ka-thana, it increased in 1967-70, but showed a decreasing trend during 1973-76 while the proportion of forests in Chirawa remained almost constant. During 1973-76 there has been an increase in area under forests in the tehsils of Chirawa, Khetri, Fatehpur and Neem-ka-thana but it decreased in Jhunjhunu, Udaipurwati, Lachhmangarh, Sikar, Sri Madhopur and Danta Ramgarh (Table 4.2). The main factor behind of decrease was the increasing demand of wood in the markets. We can say that the trend was towards marginal increase in the percentage of forests area. The highest percentage of area under forests has

Table 4.2 Land Use Pattern

Tehsils	Years	Forest	Land not available for cultivation	Permanent pastures & tree crops misc.	Cultivable Waste land	Current fallow land	Other than current fallow land	Net sown area
Jhunjhunu	1961-64	0.15	2.89	9.38	0.84	4.96	2.16	79.62
	1967-70	1.33	2.85	9.38	0.74	3.84	2.32	79.64
	1973-76	0.13	3.04	9.15	0.54	3.30	3.62	80.22
Chirawa	1961-64	0.06	3.23	8.58	0.56	2.66	0.61	84.30
	1967-70	0.06	3.54	8.20	0.48	2.37	0.75	84.10
	1973-76	0.07	3.30	8.11	0.44	1.63	0.56	85.89
Khetri	1961-64	5.75	17.17	7.36	3.48	1.48	0.37	64.39
	1967-70	9.42	12.39	8.28	2.17	2.01	0.63	65.13
	1973-76	11.26	11.20	8.06	1.61	1.07	0.59	66.21
Udaipurwati	1961-64	7.76	9.03	5.54	1.59	2.93	1.36	71.79
	1967-70	11.86	4.63	5.42	1.23	3.42	1.43	72.01
	1973-76	11.76	4.75	5.23	0.96	3.30	1.80	72.20
Fatehpur	1961-64	1.22	2.40	6.79	0.68	8.82	5.69	74.40
	1967-70	2.33	2.87	5.40	0.76	8.85	6.13	73.66
	1973-76	3.84	2.75	5.66	0.56	8.99	4.32	73.88
Lachhmangarh	1961-64	0.83	2.19	7.58	0.54	8.92	5.92	74.02
	1967-70	3.17	2.39	4.82	1.47	6.48	5.33	76.44
	1973-76	1.32	2.48	6.29	0.48	9.51	3.86	76.06
Sikar	1961-64	0.50	6.61	6.72	0.03	10.28	2.40	73.46
	1967-70	0.93	8.76	5.68	0.62	7.24	1.99	74.78
	1973-76	0.55	8.85	6.93	1.58	9.23	3.88	68.98

Cont'd...

Table 4.2 cont'd ..

Neem-ka-thana	1961-64	1.11	34.04	7.13	7.36	1.15	1.85	47.36
	1967-70	0.66	33.23	7.27	6.11	2.23	0.97	49.53
	1973-76	3.23	32.74	5.90	5.46	2.46	1.67	48.54
Sri Madhopur	1961-64	0.03	8.57	6.85	4.71	5.30	2.45	72.09
	1967-70	1.86	10.00	6.87	3.69	4.42	1.48	71.68
	1973-76	0.90	13.42	8.29	3.40	6.72	2.47	64.80
Danta Ramgarh	1961-64	0.19	7.37	5.37	2.73	12.90	2.18	69.25
	1967-70	0.89	11.54	6.05	1.88	11.06	1.76	66.82
	1973-76	0.18	8.04	5.05	0.93	7.65	5.09	73.06

Source : Tables of Agricultural Statistics of Jhunjhunu and Sikar Districts for the years 1961-76

been recorded in Udaipurwati tehsil while Danta Ramgarh accounts for the lowest proportion.

4.1.2 Land Not Available for Cultivation

This category includes barren and uncultivable land which are generally under rocky, hilly and silted land, river beds, sand, rivulets, ravines etc. It further consists of the land which is put to non-agricultural uses e.g. settlements, roads, railways, canals enbankments, burial and cremation grounds, playgrounds and other such uses. The percentage of area under this category during the period 1961-64, 1967-70 and 1973-76 was 10.15, 9.13 and 8.96 respectively. Generally, a declining trend is visible under this category in the region taken as a whole. But this decline is not visible every where if looked spatially and one finds variations in different tehsils. It recorded a gradual increase in the tehsils of Fatehpur, Lachhmangarh and Sikar. Some tehsils registered an increase in this category during 1967-70 but showed decrease during 1973-76 e.g. Neem-ka-thana, Sri Madhopur, Chirawa and Danta Ramgarh. Jhunjhunu and Udaipurwati tehsils witnessed decrease in 1967-70 but again registered an increase during 1973-76. Khetri tehsil has consistently witnessed gradual decrease in the area not available for cultivation. The lowest extent of land under this categpry has been recorded in Lacchman-garh and the highest in Neem-ka-thana (Fig. 4.1).

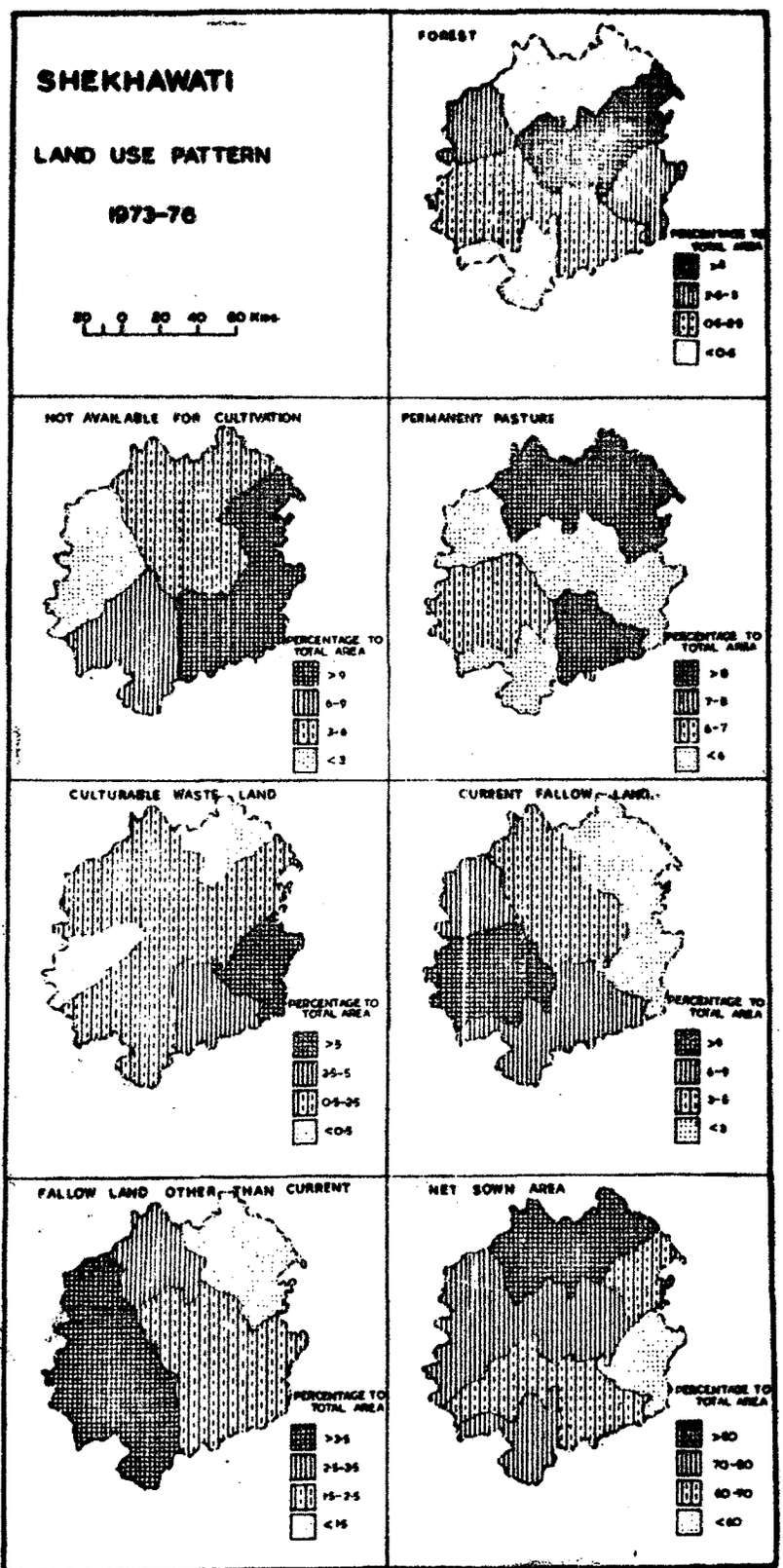
SHEKHAWATI
LAND USE PATTERN
1973-76
80 0 80 40 80 Kms
FOREST
NOT AVAILABLE FOR CULTIVATION
PERMANENT PASTURE
CULTURABLE WASTE LAND
CURRENT FALLOW LAND
FALLOW LAND OTHER THAN CURRENT
NET SOWN AREA
PERCENTAGE TO TOTAL AREA

FIG 4.1

4.1.3 Permanent Pastures and other Grazing Land and Misc. Tree Crops

This includes all grazing lands, i.e., permanent pastures and meadows, village common land and gochars etc. The area under this category has generally decreased in the region taken as a whole. The highest extent under this category is recorded in Jhunjhunu and the lowest in Fatehpur.

The categories further includes the areas allocated to tree crops and groves which are managed but are not included in the net sown area. The land under this category covered 6.94, 6.70 and 6.16 per cent respectively during the year of 1961-64, 1967-70 and 1973-76. The area under this category remained static or witnessed only marginal increase during 1973-76 over 1967-70 in the tehsils of Jhunjhunu, Khetri, Neem-ka-thana and Sri Madhopur. In Sikar tehsil, it decreased during 1967-70 but registered an increase during 1973-76.

In some tehsils the percentage decreased gradually. The examples of such tehsils are Chirawa, Udaipurwati, Fatehpur and Danta Ramgarh.

4.1.4 Culturable Waste Land

This is the land which can be reclaimed after the introduction of some soil management practices. It also includes the cultivated land which has been abandoned due to the one limitation or the other and is relegated into waste land.

Such type of land can also be reclaimed after the constraint is removed at a reasonable cost. Such land may be either vacant or covered with shrubs and bushes. The proportion of area under this category in Shekhawati during the 1961-64, 1967-70 and 1973-76 was 2.20, 1.85 and 1.59 per cent of the total area respectively.

Table 4.2 reveals that in Sikar tehsil the land under this category has consistently shown an increasing trend. Contrary to this in some tehsils, we observe a fluctuating trend, for example, Fatehpur and Lachhmangarh, where proportion under this category increased during 1967-70 over 1961-64 but decreased during 1973-76. In rest of the tehsils the trend has been towards gradual decrease. The highest proportion under culturable waste land is observed in Neem-ka-thana and the lowest in Chirawa (fig. 4.1). The main reason of decrease in the percentage of culturable waste land has been the effort to manage and improve the culturable waste land both by the government and farmers themselves. The major consideration in the reclamation of culturable waste land in an environment as that of Shikhawati is water. The whole tract is an arid area where water deficit is a chronic problem. The rainfall is not only scanty but also erratic. It is evident from the fact that there exists a very weak correlation between rainfall and culturable waste land. The coefficient of correlation of -0.04 though negatively is weak because of unreliability of rainfall. There exists a high negative correlation of -0.67

between culturable waste land and irrigation, which is significant at 1.0 per cent level. It shows that as the irrigation has increased the area under culturable waste land shrunk. There is further possibility of its decrease provided the extent of irrigation is increased.

4.1.5 Fallow Land

Fallowing is a practice which is resorted to with a view of replenishing the soil fertility which is depleted because of constant cropping.

Sometimes other socio-economic constraints operating in the area are responsible for leaving the land fallow, e.g., the poverty of the farmer, his temporary migration from the village, litigation or unremunerative nature of farming.

The fallow land is divided in two categories, viz., current fallow and other than current fallow land. During 1961-64 the percentage share of fallow land in Shekhawati region was 8.23 per cent of the total geographical area. Of the total 8.23 per cent 5.89 per cent was under current fallow and 2.34 per cent under other than current fallow. During 1967-70 the percentage share of fallow land was only 7.32 per cent of the total geographical area. Thus, there was a net decrease of fallow land by 0.91 per cent but during 1973-76 instead of decrease the fallow land increased from 7.32 per cent during 1967-70 to 8.14 per cent during 1973-76.

Thus, there was a net increase of 0.82 per cent fallow land.

The correlation analysis has been done and it has been found that the fallow land was negatively correlated with rainfall (-0.32) and irrigation (-0.03) which clearly proves that the increase or decrease in rainfall and irrigation facilities determines the fluctuation of fallow land.

4.1.5.1 Current Fallow Land

The proportion of current fallow land in the region during 1961-64, 1967-70 and 1973-76 has been 5.89, 5.06 and 5.38 per cent of the total area respectively. Table 4.2 reveals that the percentage of area under current fallow has gradually increased in Neem-ka-thana. The tehsils of Fatehpur, Lachhmangarh and Sikar registered decrease in the fallow land during 1967-70 but showed an increase during 1973-76. The tehsils of Jhunjhunu, Sri Madhopur and Danta Ramgarh have registered a constant decrease in the fallow land in 1973-76 over 1961-64 contrary to the above situation in the tehsils of Chirawa, Udaipurwati and Khetri the area under current fallow registered increase till the onset of the green revolution but afterwards started decreasing. There was a general decreasing trend in current fallow in the region. The reason for the decrease in the percentage of current fallow has been the increase in the irrigation facilities.

4.1.5.2 Other Than Current Fallow

This includes all 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 five years. In this case the constraints are more severe. The proportion of land under this category during 1961-64, 1967-70 and 1973-76 triniums was 2.34, 2.26 and 2.76 per cent of the total area respectively as seen for the region as a whole. Table 4.2 shows that the percentage under this category increased gradually in the tehsils of Jhunjhunu and Udaipurwati while it registered a decrease in the trinium in 1967-70 over 1961-64 in Sikar, Neem-ka-thana, Sri Madhopur and Danta Ramgarh but it again showed an increasing trend during the trinium 1973-76. The highest proportion of land under this category has been recorded in Lachhmangarh and the lowest in Chirawa.

4.1.6 Net Sown Area

The net sown area is the land which is physically cultivated. The proportion of net sown area to total area of the region during 1961-64, 1967-70, and 1973-76 has been around 71 per cent. There has been slight increase during the trinium 1967-70. While it declined during the trinium 1973-76. Increasing demand for more land for cultivation because of the mounting pressure of population is generally responsible for a higher proportion of land being physically brought under plough and converted into net sown area. The impact of green revolution is felt in the slight increase in the net sown area during 1967-70. The correlation between the net sown area

and irrigation is positively correlated (0.57).

4.2 SOURCES OF IRRIGATION

Irrigation is the artificial method of watering plants. The method of irrigation applied in a particular region depends upon many physical and socio-economic factors. Some important factors are the nature of terrain, availability of water (surface and ground water) and amount of rainfall.

Shekhawati being an arid region and deficit in water requires irrigation to great extent in order to have succesful cropping. The extent of irrigation in Shekhawati region is extremely limited. Only 6.71 per cent of the gross cropped area is irrigated.

4.2.1 Well Irrigation

Well is the main source of irrigation in the region. It includes both irrigation by tubewell and ordinary wells. The table 4.3 shows the proportion of well irrigation is high in the region and makes it clear that wells have a preponderant role in the total irrigated area. The irrigation in 94 per cent of the net irrigated area is done by well and generally it ranges from 94 to 100 per cent. The high proportion of well irrigation is found in the tehsils of Jhunjhunu, Chirawa, Fatehpur, Lachhmangarh, Sikar, Reem-ka-thana, Sri Madhipur and Danta Ramgarh where no other source of irrigation exists. The main cause behind the predominance of well irrigation is

Table 4.3 Net Irrigated Area by Different Sources
(Per cent)

Tehsils	Year	Canal	Tanks	Tube-wells	Other wells
Jhunjhunu	1961-64	-	-	1.00	99.00
	1967-70	-	-	25.23	74.76
	1973-76	-	-	91.75	8.25
Chirawa	1961-64	-	-	1.00	99.00
	1967-70	-	-	55.56	44.43
	1973-76	-	-	68.70	31.29
Khetri	1961-64	-	6.00	-	94.00
	1967-70	-	4.95	1.30	93.75
	1973-76	0.20	5.28	32.93	61.59
Udaipurwati	1961-64	0.07	0.07	0.68	99.18
	1967-70	-	0.47	3.62	95.58
	1973-76	-	0.12	63.06	36.82
Fatehpur	1961-64	-	-	-	100.00
	1967-70	-	-	-	100.00
	1973-76	-	-	-	100.00
Lachhmangarh	1961-64	-	-	0.05	99.95
	1967-70	-	-	-	100.00
	1973-76	-	-	-	100.00
Sikar	1961-64	-	-	-	100.00
	1967-70	-	-	2.15	97.85
	1973-76	-	-	-	100.00
Neem-ka-thana	1961-64	-	-	0.04	99.96
	1967-70	-	-	3.67	96.33
	1973-76	3.13	0.29	-	96.58
Sri Madhopur	1961-64	-	-	0.02	99.98
	1967-70	-	-	-	100.00
	1973-76	-	-	-	100.00
Danta Ramgarh	1961-64	-	-	0.25	99.75
	1967-70	-	-	-	100.00
	1973-76	-	-	-	100.00

Source : Agricultural Statistics of Jhunjhunu and Sikar Districts for the years 1961-64, 1967-70 & 1973-76.

rugged topography and non-availability of surface water for canal irrigation.

4.2.2 Tank Irrigation

The scarcity of water in the region is hardly compensated by tank irrigation but still Tank as a source of irrigation occupies the second place. Although the percentage and extent of area is very limited still it deserves mention. The data shows that the tank irrigation is prevalent in only three tehsils and percentages are not significant. The high value of percentage of tank irrigation is found in Khetri tehsil of the region. The picture shows that except in 1973-76 all the rest period (1961-64 and 1967-70) show a high percentage of well irrigation. Besides, Khetri and Udaipurwati appear in the map of tank irrigated area, but the figure stands for tehsil is unexpectedly low.

4.2.3 Canal Irrigation

The region does not get sufficient amount of rainfall, so rivers, the source of canals, are seasonal and therefore the canals linked with these rivers are also not perenial. Canals exist only in three tehsils of the region namely, Khetri, Udaipurwati and Neem-ka-thana tehsils, but the area covered by this source is almost negligible. It is only the tehsil of Neem-ka-thana where (3.13) per cent of net irrigated area is irrigated by canals. The lack of even topography and

non-availability of large water reserves alongwith sandy structure of soil are the main causes behind it.

During the trinium 1961-64 the highest percentage of gross irrigated area to gross cropped area was recorded by Sri Madhopur tehsil (29.11 per cent) followed by Neem-ka-thana, Danta Ramgarh, Udaipurwati (28.69, 20.28 and 12.93 respectively). The lowest value 0.02 per cent of gross irrigated area is observed in Fatehpur tehsil (table 4.4).

Table 4.4 Percentage Share of Gross Irrigated to Gross Cropped Area

Tehsils	Per cent 1961-64	Per cent 1967-70	Per cent 1973-76
Jhunjhunu	0.11	0.58	1.27
Chirawa	0.33	0.78	4.34
Khetri	2.99	3.51	4.07
Udaipurwati	12.93	8.36	9.33
Fatehpur	0.02	0.13	0.14
Lachhmangarh	0.81	0.50	0.90
Sikar	2.30	1.90	3.60
Neem-ka-thana	28.69	17.37	13.92
Sri Madhopur	29.11	17.58	24.88
Danta Ramgarh	20.28	12.07	11.59
Region	8.89	5.80	6.71

Source : Agricultural Statistics of Jhunjhunu and Sikar Districts for the years 1961-64, 1967-70 and 1973-76

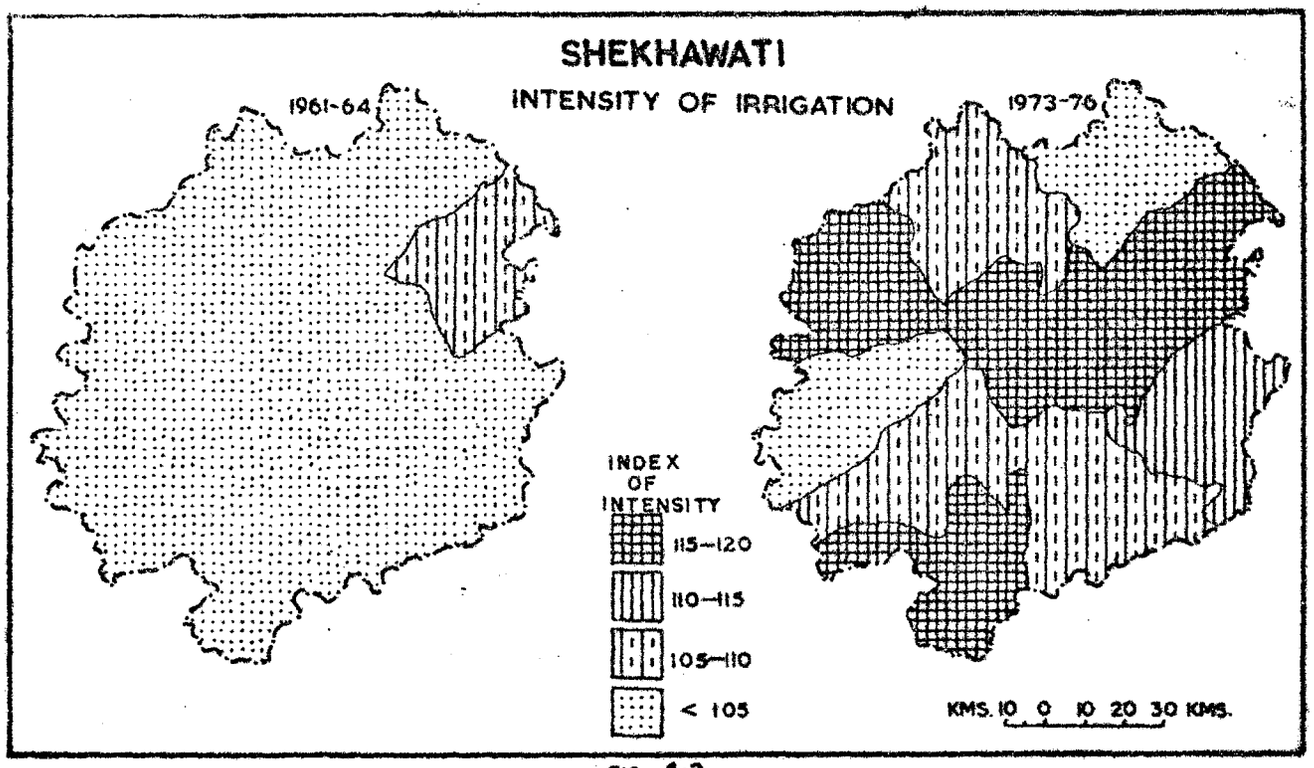
SHEKHAWATI
INTENSITY OF IRRIGATION
1961-64
1973-76
INDEX OF INTENSITY
115–120
110–115
105–110
< 105
KMS. 10 0 10 20 30 KMS.

FIG. 4·2

During 1967-70 the value of gross irrigated area declined to great extent. The highest gross irrigated area has been recorded in Sri Madhopur (17.58 per cent) against 29.11 per cent during 1961-64. In other tehsils like Neem-ka-thana, Danta Ramgarh and Udaipurwati also registered a declining trend over the period under study.

During 1973-76 on an average the gross irrigated area slightly increased from 5.80 per cent to 6.71 per cent. The highest gross irrigated area is observed in Sri Madhopur tehsil that is 24.88 per cent, followed by Neem-ka-thana (13.92 per cent) and Danta Ramgarh (11.59 per cent). The lowest gross irrigated value 0.14 per cent was found in Fatehpur tehsil.

4.2.4 Intensity of Irrigation

The index of the intensity of irrigation is obtained in terms of percentage by dividing the gross irrigated area by net irrigated area. Table 4.5 shows intensity of irrigation during 1961-64 in Jhunjhunu, Chirawa and Khetri ranges between 100-105 per cent which shows it is very marginal, while other tehsils have not recorded any intensification of irrigation (fig. 4.2). During the 1967-70 almost all the tehsils have registered intensity of irrigation. Tehsils of Jhunjhunu, Neem-ka-thana, Sri Madhopur and Danta Ramgarh recorded an index of 110 to 120. The tehsils of Chirawa, Udaipurwati and Fatehpur have recorded higher intensity ranging between 120 and 140 per cent. Other tehsils have registered intensity

index of less than 110 per cent. During the period 1973-76 the intensity of irrigation did not see any break through or significant change rather curiously enough it has decreased in most of the tehsils as compared to the previous trinium.

Table 4.5 Intensity of Irrigation

Tehsils	1961-64	1967-70	1973-76
Jhunjhunu	100.27	111.72	110.13
Chirawa	101.36	131.91	103.15
Khetri	105.85	108.07	119.87
Udaipurwati	100.00	127.34	116.95
Fatehpur	100.00	133.29	117.46
Lachhmangarh	100.00	104.49	101.62
Sikar	100.00	119.31	105.20
Neem-ka-thana	100.00	112.50	114.49
Sri Madhopur	100.00	110.13	106.43
Danta Ramgarh	100.00	118.49	116.96

4.3 INTENSITY OF CROPPING

The intensity of cropping is related to taking more than one crop from the same piece of land proportion of gross cropped area to net sown area. Intensity of cropping is generally the function of soil fertility, irrigation and other technological inputs.

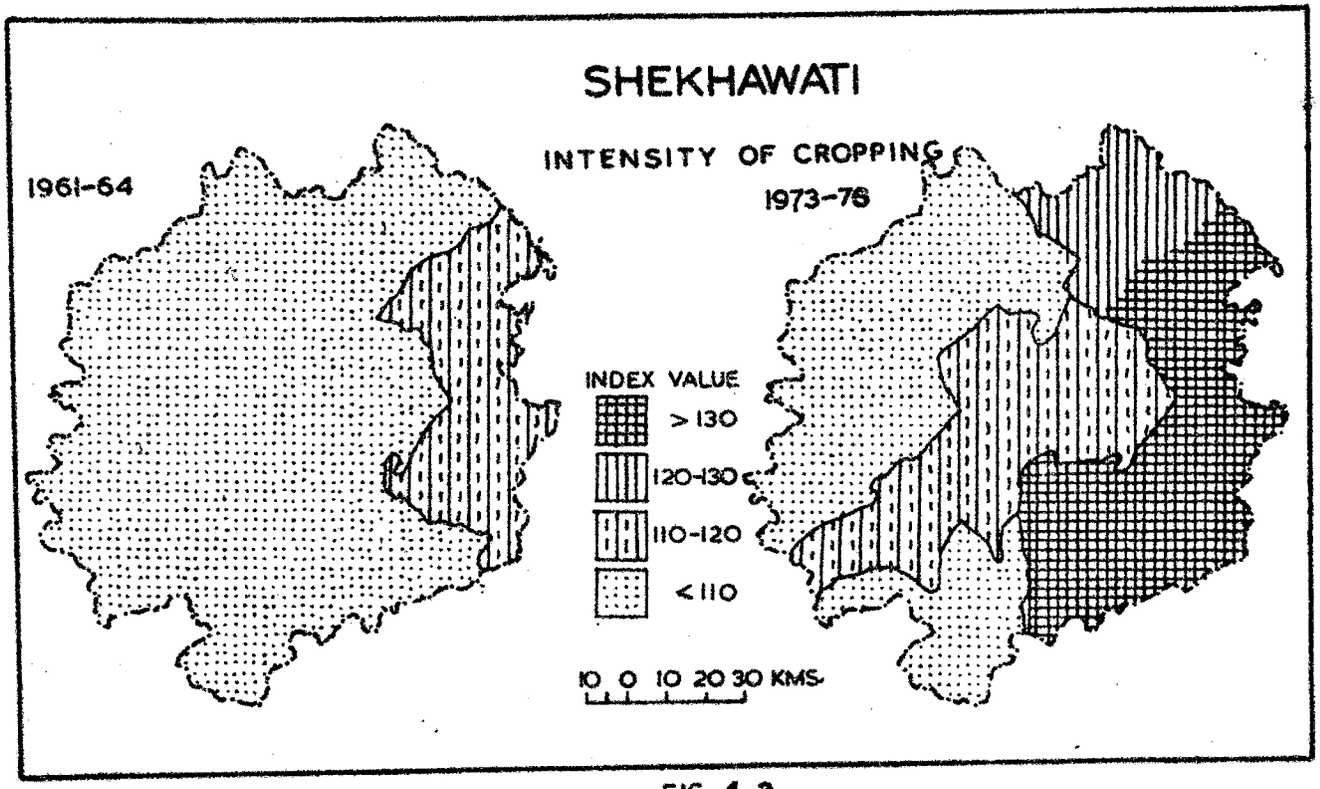
SHEKHAWATI
INTENSITY OF CROPPING
1961-64
1973-76
INDEX VALUE
> 130
120-130
110-120
< 110
10 0 10 20 30 KMS.

FIG 4·3

Intensity of cropping registers an increase with the increase in the hectarage of gross cropped area due to the intensification of agriculture and utilization of productive potential of the cultivated land. The fig. no. 4.3 showing the intensity of cropping reveals that it increases from west to east. The immediate temptation is to explain this phenomenon obviously with the help of the map of the rainfall distribution which, of course, is an important variable. The intensity of cropping closely follows the pattern of rainfall distribution. The index of cropping intensity is found to be 117.76 in the region as a whole while in the state it is 110.31. The tehsils of Neem-ka-thana and Khetri recorded an intensity of cropping of 110 and 120 per cent respectively during 1961-64 (Table 4.6). In rest of the tehsils intensity of cropping is very low indicating a very low extent of double cropping. This situation is due to the lack of irrigational facilities which were non-existent in most parts. Even during the trinium 1967-70 the situation did not change much and it continued to be the same with slight increase (fig. 4.3). During the 1973-76 the tehsils of Jhunjhunu, Fatehpur, Lachhmangarh and Danta Ramgarh still recorded an intensity of cropping below 110 per cent while the tehsils of Udaipurwati and Sikar recorded an intensity of 120 per cent. There was an increase in the intensity of cropping in the tehsils of Khetri, Neem-ka-thana and Sri Madhopur, all of which recorded an intensity of more than 120 per cent. The crucial problem of the vertical develop-

ment of cropping through intensification is the availability of soil moisture. Arid climate, continuous moisture deficit and limited surface and underground water resources coupled with very deep water table hamper the prospects of water supply for irrigation. Most of the crops are cultivated during kharif season, e.g., bajra, pulses and other coarse cereals.

Table 4.6 Intensity of Cropping*

Tehsils	1961-64	1967-70	1973-76
Jhunjhunu	100.13	102.66	103.16
Chirawa	104.65	112.69	122.91
Khetri	115.00	126.16	146.76
Udaipurwati	103.50	107.48	115.30
Fatehpur	100.00	100.71	100.10
Lachhmangarh	100.28	102.07	101.21
Sikar	100.67	102.19	115.35
Neem-ka-thana	115.80	117.11	131.59
Sri Madhopur	106.49	108.98	132.74
Danta Ramgarh	102.87	105.46	108.47
Region	104.31	107.94	108.23

* Intensity of cropping = $\frac{\text{Gross area sown}}{\text{Net area sown}} \times 100$

A weak positive correlation (0.14) has been found between intensity of cropping and rainfall. It is insignificant because table value (0.694) is higher than the calculated (0.509) value.

There is a strong positive correlation between intensity of cropping and the extent of irrigation. The coefficient of correlation has been found to 0.54 which is significant at 5 per cent level of significance. We can conclude that whatever agricultural intensification has been achieved in the region is largely due to the increase in the irrigational facilities. There still exists vast potential for intensification provided detailed survey of underground acquifers is conducted.

4.4 CROPPING PATTERN

The region of Shekhawati is predominantly an area of food-grain production. About 90 per cent of the gross cropped area is devoted to food-grains. Cropping pattern of an area is essentially a function of environmental factors particularly soils, and climate through it fluctuates in response to the price fluctuations and also because of institutional constraints. An integrated structure of the cropping pattern, to a large extent, reflects the base of an agrarian economy.

Among the crops bajra and other pulses (excluding gram and arhar) are the main crops which cover 39.42 and 27.5 per cent of the gross cropped area respectively. The pattern

shows that crop production in the region is largely cereal oriented.

The spatial pattern of certain major crops has been examined in the following paragraphs.

4.4.1 Bajra

There has been no big fluctuation in area under bajra from 1960-61 to 1974-75, except a rapid decline from 53 per cent of the total cropped area in 1973-74 to 31.10 per cent in 1974-75. The general fluctuation in the area under bajra from year to year has been only 5 per cent. In 1973-74 maximum area under bajra (53 per cent of gross cropped area) has been recorded which is the highest proportion of area under bajra during the last 15 years.

4.4.2 Other Pulses

The area under other pulses occupies 27.57 per cent of gross cropped area during 1973-76. The other pulses, i.e., pulses excluding gram and arhar, are mostly grown with bajra and jowar. A general declining trend has been observed in the area under other pulses in the region. This decline from 1960-61 to 1968-69 has been upto the extent of 2 per cent.

4.4.3 Barley

During the years 1960-61 to 1974-75 the area under barley has hardly shown any fluctuation but has remained almost constant.

The proportion of area under barley has remained about 2.5 per cent of the gross cropped area except during 1967-68 and 1974-75 in which a higher proportion of area under barley (6.30 per cent) and (4.20 per cent) of the total cropped area respectively has been recorded. Barley is a hardy soil rabi crop and requires irrigation for its successful growth. A positive correlation (0.31) has been observed between area under barley and irrigation, which is significant at 50 per cent level of significance.

4.4.4 Gram

Gram is the principal pulse grown generally for marketing out. It is an important source of nutritive livestock food especially for drought animals.[1] The area under gram occupies 9.60 per cent of the gross cropped area (1973-76). Generally gram crop is taken as dry crop but it is also grown under irrigated conditions. A general declining trend has been noticed in the area under gram from year to year till 1968-69. But it gained strength in seventies as a result of the rising prices of pulses and in 1974-75, 9.80 per cent of the gross cropped area was occupied by gram while in the late sixties i.e., 1968-69 it occupied only an insignificant proportion (1.10 per cent). The percentage of area under gram is positively

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1. Jasbir Singh, An Agricultural Atlas of India - A Geographical Analysis, Vishal Publication, Kurukshetra, 1974, p. 195.

correlated with rainfall (r= 0.37) and irrigation (r= 0.32) which have been found to be significant at 50 per cent level of significance.

4.4.5 Wheat

The area under wheat is very much limited. During 1973-76 trinium it has been recorded to be 2.02 per cent of the gross cropped area. A general increasing trend in the area under wheat has been noticed in the region. The lowest percentage (0.80) had been registered in 1962-63 while the highest percentage (2.6 per cent) has been recorded in 1972-73. The wheat crop is solely dependent on irrigation. The limited irrigation harnessed in this arid tract has seriously hampered the extension of area under wheat (r= 0.61) has been found between area under wheat and rainfall which is significant at 98 per cent level of significance. On the other hand the coefficient of correlation of 0.99 which is significant at 99 per cent level of significance indicates a very highly positive relationship between area under wheat and irrigated area.

4.5 RANKING OF CROPS

The ranking of crops has been determined on the basis of the hectarage occupied by different crops in tehsils. There are about six major crops - bajra other pulses*, fodder, gram,

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* Pulses here include all the pulses excluding arhar and gram.

barley, wheat and rape and mustard. Out of these four crops have preponderance over others and have been considered for ranking.

4.5.1 First Ranking Crops

The crop with highest proportion in area has been assigned first rank. In Shekhawati region bajra and pulses (excluding arhar and gram) are found as first ranking crops. The fig. 4. reveals that bajra has been the first ranking crop in all the tehsils during the trinium 1961-64, 1967-70 and 1973-76, except only in one tehsil i.e., Jhunjhunu where during the trinium (1973-76) pulses emerged as the first ranking crop (fig. 4.4)

4.5.2 Second Ranking Crops

During the period 1961-64, bajra, pulses, fodder and barley come under second ranking crops. Jhunjhunu, Chirawa Khetri, Udaipurwati, Fatehpur, Sikar, Sri Madhopur and Danta Ramgarh have bajra and pulses (excluding arhar and gram) as second ranking crops, while Lachhmangarh has bajra and fodder and Neem-ka-thana has bajra and barley as second ranking crops. In the period 1967-70, bajra pulses (excluding arhar and gram) and fodder emerged as second ranking crops. Jhunjhunu, Chirawa, Khetri, Sikar, Neem-ka-thana, Sri Madhopur and Danta Ramgarh have bajra pulses (excluding arhar and gram) as second ranking crop, while Fatehpur and Lachhmangarh have bajra and fodder

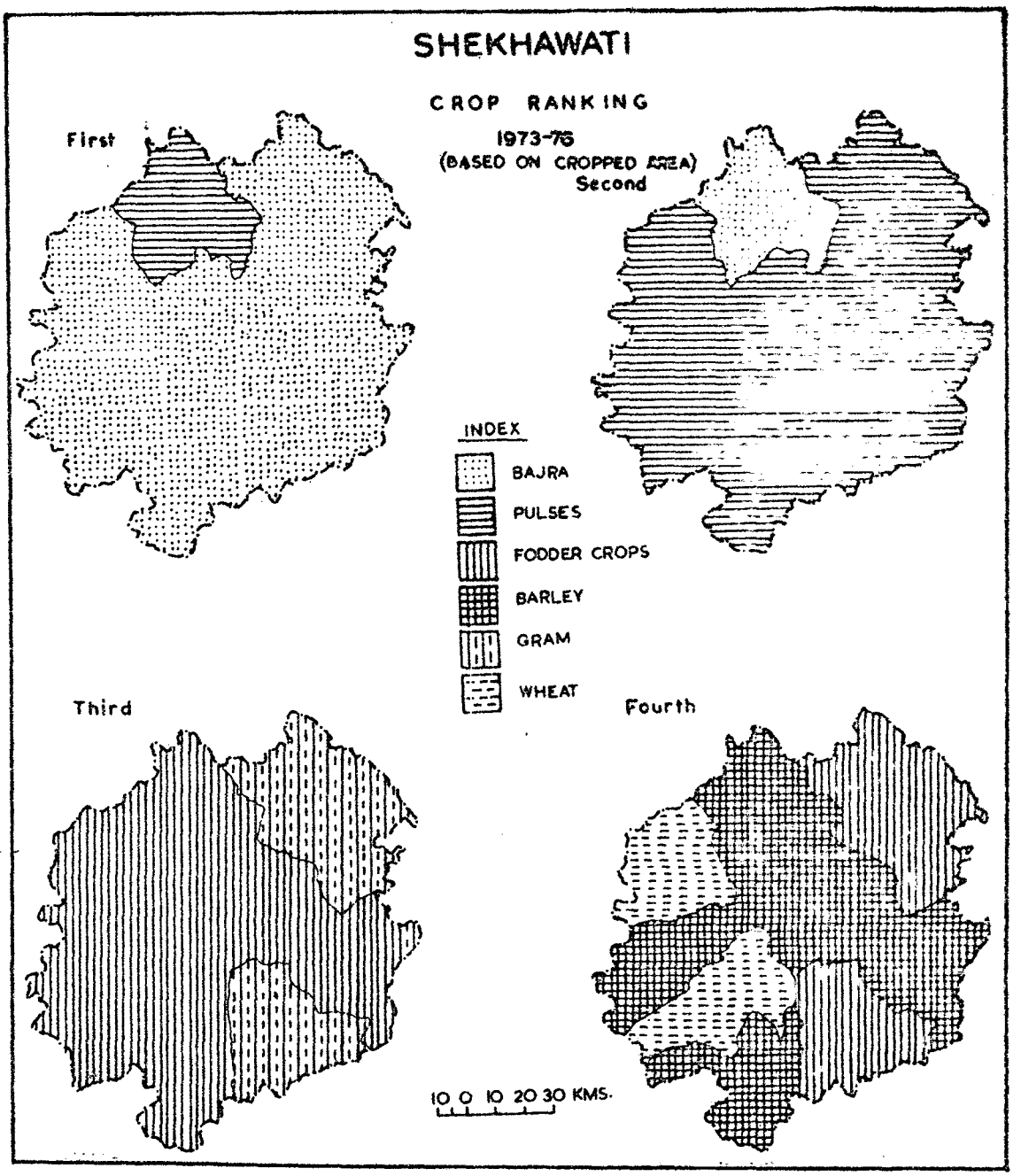
SHEKHAWATI
CROP RANKING
1973-76
(BASED ON CROPPED AREA)
First
Second
Third
Fourth
INDEX
BAJRA
PULSES
FODDER CROPS
BARLEY
GRAM
WHEAT
10 0 10 20 30 KMS.

FIG 4·4

crops. During the period 1973-76 pulses (excluding arhar and gram) and bajra have become as second ranking crops. Pulses and bajra have been found as second ranking crops in Jhunjhunu tehsil only while in all the rest of the tehsils bajra and pulses are the second ranking crops. Thus we see that it is pulses which dominates the second rank.

4.5.3 Third Ranking Crops

During the period 1961-64 bajra, pulses, fodder and barley crops emerged as third ranking crops. Jhunjhunu, Chirawa, Udaipurwati, Fatehpur, Sikar, Sri Madhopur and Danta Ramgarh have bajra, pulses and gram and in the Lachhmangarh bajra, fodder and pulses have come to be the third ranking crops. Neem-ka-thana has bajra, barley and rape and mustard as third ranking crops.

During the year 1967-70, bajra, pulses (excluding arhar and gram), gram and barley come under third ranking crops. Jhunjhunu, Chirawa, Udaipurwati, Sikar, Sri Madhopur and Danta Ramgarh have bajra pulses and fodder as third ranking crops. Khetri has bajra pulses and gram, Fatehpur bajra, fodder and pulses, Lachhmangarh bajra, fodder and pulses and Neem-ka-thana bajra pulses and barley as third ranking crops.

During 1973-76 bajra pulses, fodder and gram emerged as third ranking crops. Jhunjhunu, Khetri, Udaipurwati, Fatehpur, Lachhmangarh, Sikar, Neem-ka-thana and Danta Ramgarh have bajra

pulses and fodder as third ranking crops while Chirawa and Sri Madhopur have bajra, pulses (excluding arhar and gram) and gram.

Thus we see that in the second period, i.e., 1967-70 fodder has been replaced by gram while during the period 1973-76 gram has been replaced by fodder again and barley by gram.

4.5.4 Fourth Ranking Crops

During the year 1961-64 bajra, pulses, fodder and rape, mustard, gram and barley formed fourth ranking crops. Jhunjhunu has bajra pulses, fodder, rape and mustard, Chirawa and Khetri bajra, pulses, fodder and gram, Udaipurwati, Sri Madhopur Danta Ramgarh and Sikar have bajra pulses, fodder and barley while Neem-ka-thana has bajra, barley, rape and mustard and pulses. During the period 1967-70 bajra pulses, fodder, barley gram and wheat emerged as the fourth ranking crops.

Jhunjhunu and Chirawa have bajra pulses, fodder and gram, Udaipurwati, Sikar, Sri Madhopur, Danta Ramgarh have bajra pulses, fodder and barley, Khetri has bajra pulses, gram and barley, Fatehpur has bajra, pulses, fodder and wheat Lachhmangarh has bajra, fodder pulses and barley.

During the period 1973-76, bajra, pulses, fodder, barley, gram and wheat entered as fourth ranking crops. Jhunjhunu has pulses, bajra, fodder and barley, Chirawa and Khetri and

Sri Madhopur have bajra, pulses, gram and fodder Neem-ka-thana has bajra, gram, pulses and fodder Udaipurwati and Danta Ramgarh has bajra, pulses, fodder and barley and Sikar has bajra pulses, fodder and wheat.

The ranking of crop in the period 1967-70 differs a little from that of 1961-64 in the sense that rape and mustard have been replaced by barley and gram, while the place of gram is occupied by wheat. There is no change in ranking between 1967-70 and 1973-76.

4.6 CROP COMBINATION REGIONS

The crops are generally grown in asscciation with other crops and perfect monocultures are found either in case of plantations or due to certain serious constraints. There might be dominating crop from the point of view of areal extent but some other crops are also grown side by side. Crop combination may be helpful in understanding the importance of an individual crop and crop distributional pattern.

Various statistical procedures have been employed to demarcate the bounderies of crop associations. J.C. Weaver[2] in 1954 gave a formula for delineating crop combination and he applied for delineating crop combination regions in the

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2. J.C. Weaver, Crop Combination Regions in Middle West, Geographical Review, XLIV, 1954, pp. 175-200.

middle west, U.S.A. We have taken all the crops having a strength upto one per cent in the areal extent and have seen the deviations from the theoretical base curve. Theoretically a single crop region would have 100 per cent land under one crop, while 50 per cent under two crops asscciation and 33.33 per cent if three crops are there and so on. Standard deviation has been calculated to see the minimum deviation (Appendix 4.1).

During the three periods 1961-64, 1967-70 and 1973-76 no monoculture was found to exist in the region. Two crop combination, during the period 1961-64 were found in the tehsils of Chirawa, Khetri, Udaipurwati, Fatehpur, Sri Madhopur and Danta Ramgarh while during 1967-70 it is recorded in the tehsils of Jhunjhunu, Chirawa, Udaipurwati and Sri Madhopur but during the 1973-76 it is found only in the tehsils of Udaipurwati, Fatehpur and Danta Ramgarh. In this combination the constituent crops are bajra and pulses (excluding arhar and gram).

Three crop combination includes bajra, pulses, fodder. In 1961-64, Jhunjhunu, Sikar and Lachhmangarh recorded three crop combinations while in the period 1967-70 it was found in Khetri, Fatehpur, Lachhmangarh, Sikar, Neem-ka-thana and Danta Ramgarh. During 1973-76 Jhunjhunu, Chirawa, Khetri, Lachhmangarh, Sikar and Sri Madhopur recorded three crop combinations.

Bajra, pulses (excluding arhar and gram) rape and mustard, wheat and barley combine to constitute four combinations. During

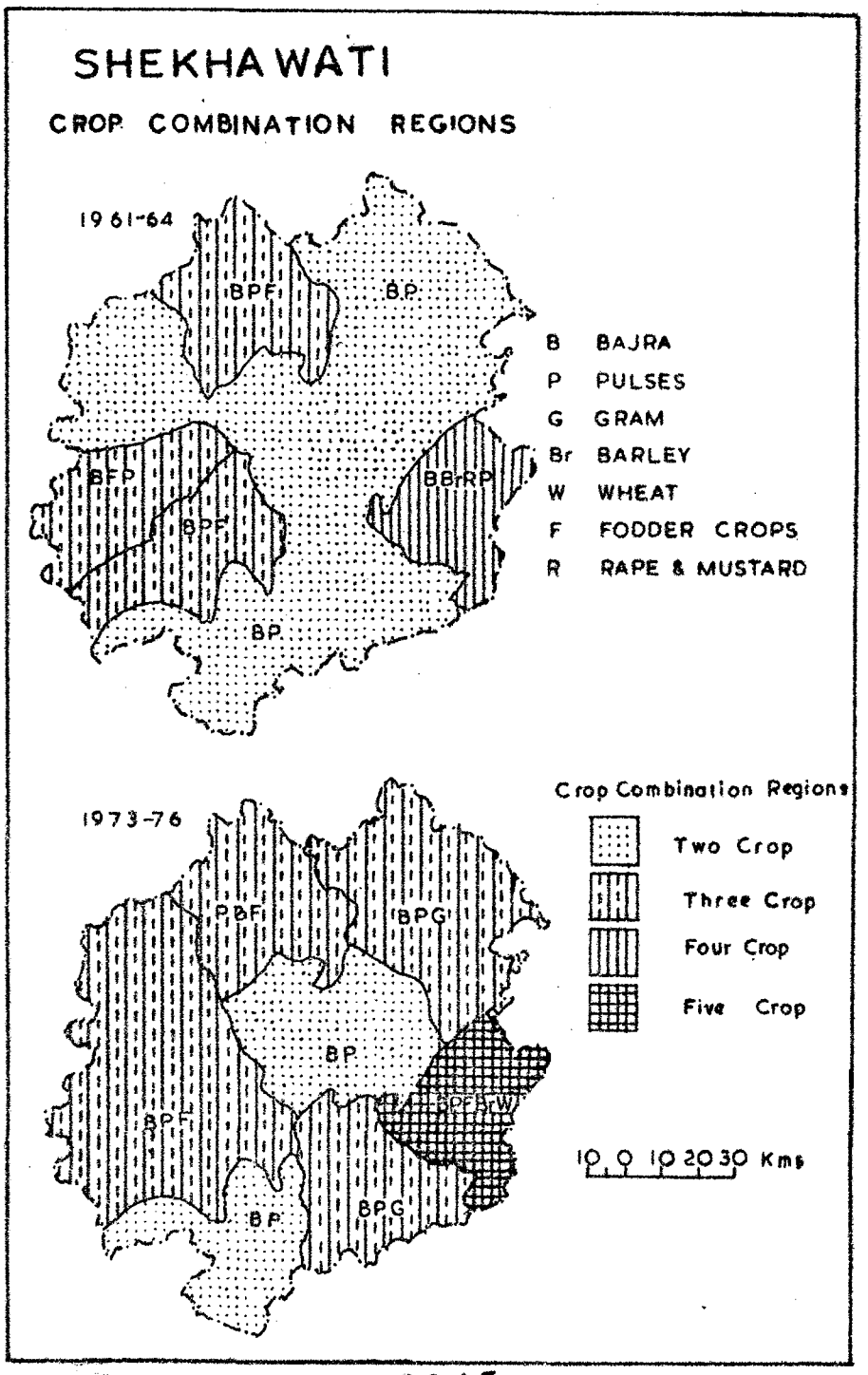
SHEKHAWATI
CROP COMBINATION REGIONS
1961-64
BPF
BP
BFP
BBrRP
BPF
BP
1973-76
PBF
BPG
BP
BPF
BPF&W
BP
BPG
B BAJRA
P PULSES
G GRAM
Br BARLEY
W WHEAT
F FODDER CROPS
R RAPE & MUSTARD
Crop Combination Regions
Two Crop
Three Crop
Four Crop
Five Crop
10 0 10 20 30 Kms

FIG 4-5

the period 1961-64, Neem-ka-thana has four crop combination in which bajra, barley, rape and mustard and pulses (excluding arhar and gram) are included while during the year 1967-70 no tehsil has four crop combination and during 1973-76 (fig. 4.5) Neem-ka-thana has again recorded four crop combination of bajra, pulses, fodder and barley.

Bajra, pulses, fodder, barley and wheat combined to form five crop combinations. During the period 1961-64 and 1967-70 no tehsil recorded this combination. It is only during 1973-76 Neem-ka-thana recorded this combination of crops. This occurred due to the development of irrigational facilities specially by tubewells. Thus we see that generally most of the tehsils have two and three crop combinations except Neem-ka-thana where four and five crop combination is noticed.

4.7 SHIFT IN THE CROPPING PATTERN

Shift of area from different crops is a common phenomena. A number of factors are responsible for such shifting. To see the shift of area from one crop to the other and to look at their temporal trends, six major crops have been considered. The percentage of area under individual crops to gross cropped area for 15 years (1960-61 to 1974-75) has been plotted on the graph (fig. 4.6). It is clear that the trend of area under bajra has a fluctuation of 10 per cent till 1973-74 and a sharp decline between 1973-74 and 1974-75. Area under pulses

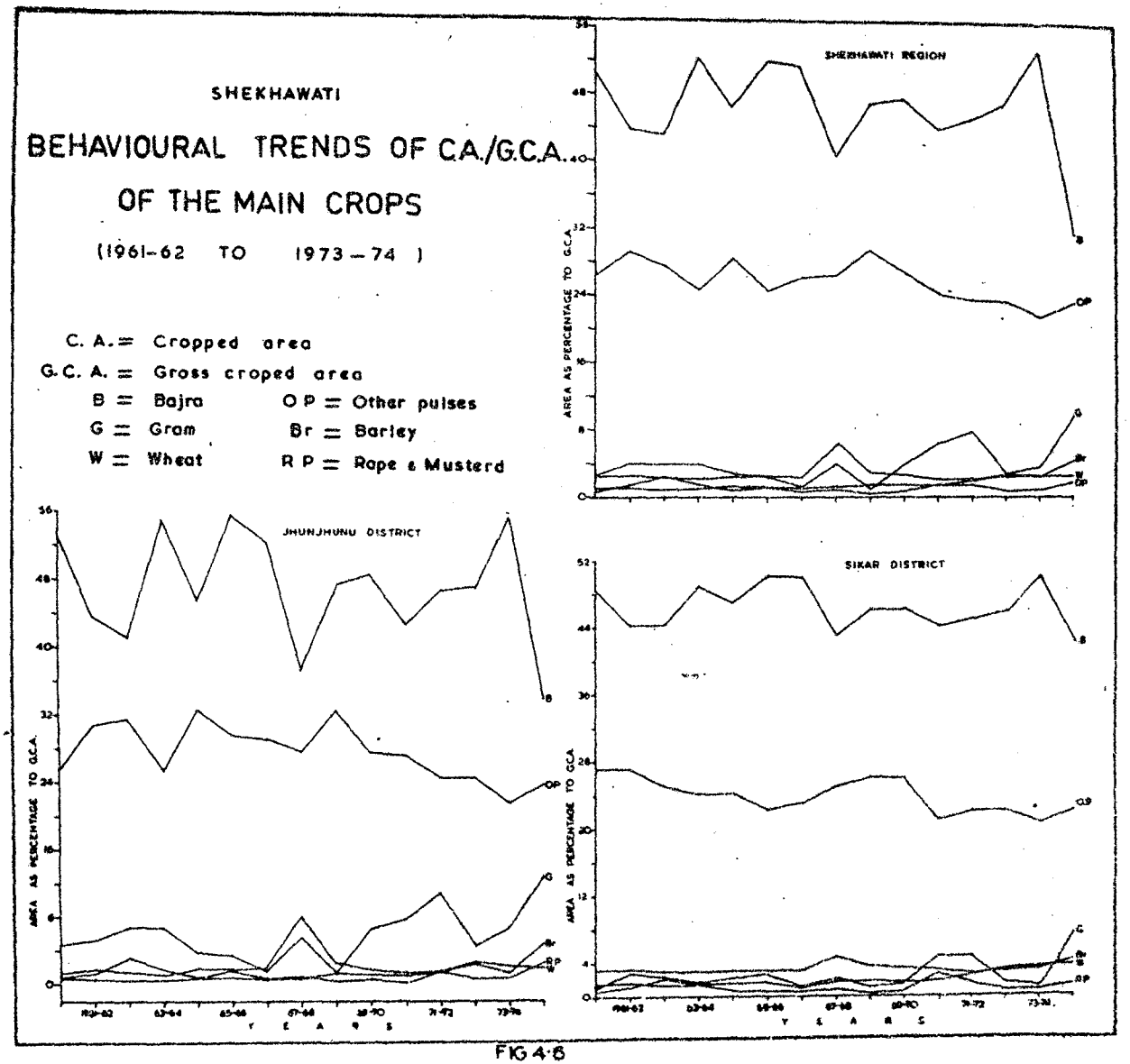
SHEKHAWATI
BEHAVIOURAL TRENDS OF C.A./G.C.A.
OF THE MAIN CROPS
(1961-62 TO 1973-74)
C. A. = Cropped area
G.C. A. = Gross croped area
B = Bajra
G = Gram
W = Wheat
O P = Other pulses
Br = Barley
R P = Rape & Musterd
SHEKHAWATI REGION
JHUNJHUNU DISTRICT
SIKAR DISTRICT
AREA AS PERCENTAGE TO G.C.A.
Y E A R S

FIG 4·6

reflects more or less a slight decrease from 26.7 per cent in 1960-61 to 23 per cent in 1974-75. The cropped area under gram, barley, wheat and rape and mustard ranges, by and large, upto 5 per cent of the gross cropped area. Among the crops the area under rape and mustard is the least. It is found that the area under wheat increases or decreases in competition with area under rape and mustard. The area under wheat has increased where the area under rape and mustard has decreased. This fluctuation takes place on account of the interactions of several factors. In this regard the technological factors can be held more responsible for such competition.

4.7.1 Selection of Variables

It was decided on the first hand approximation basis that the cropped area of the preceeding year, irrigated area, relative price and relative yield of wheat with respect to rape and mustard, and total annual rainfall were the relevant variables affecting farmers decisions as reflected through acreage allocation of the given crops. All these variables were defined as follows.

4.7.1.1 Preceeding years Cropped Area of Wheat (At-1)

It has been observed that the farmers while planning to sow their land in the present year, consider the last year's cropped area. This is due to the subsistence nature of our

agricultural economy. They are conscious of their requirements of self-consumption. No farmer thinks to go below the standard what he achieved and established in the preceeding year regarding the cropped area. Due to all such characteristics of the farmers decision for allocating the land under various crops, this independent variable (At-1) has been taken into account.

4.7.1.2 Relative Yield (Yt-1)

The relative yield figures where obtained by deflating the yields in relation to the yield of competing crop. It was also decided to take this dependent variable into account for the preceeding year (t-1). The farmers last years stock of self-consumption remains one of the main criterion as a decisive factor for the present year. In spite of this fact some other factors also play their role in the decision for allocating cropped area of the present year on the basis of the preceeding year's agricultural output.

4.7.1.3 Relative Irrigated Area

Irrigation is the main base of the agricultural production. Wheat and rape and mustard both the crops are such crops which require irrigation water. In Shekhawati region both the crops are raised in tubewells irrigated condition. Therefore, relative irrigated area of wheat with respect to rape and mustard has been considered as one of the independent variables. The relative irrigated area of the present year is considered in

sufficient in Shekhawati region - that is, in Shekhawati region the irrigated area comes to about 8.71 per cent area of the total cultivated area. Thus it is very clear that irrigation facility is very low, hence the farmers think of the preceeding year's irrigation facilities.

4.7.1.4 Relative Price (Pt-1)

Majority of the farmers in the area of study sell their produce immediately after the harvest. Consequently farm harvest prices were assumed to be exercising more influence on the decisions of the farmers. In order to achieve better estimates, relative prices of wheat with respect to rape and mustard have been taken. This independent variable has also been taken for the preceeding year (t-1), since the farmers take their decisions in allocation of the present year's cropped area on the basis of the prices of the preceeding year.

4.7.1.5 Rainfall (Rt)

Rainfall was included as a proxy for weather conditions. As farmers become more and more aware of the price relationships, they also start taking advantage of favourable weather conditions. The total annual rainfall for the present agricultural year (t) was taken to be the relevant one.

4.7.2 The Model

In the present study the Nerlovian adjustment model has been applied, the equation of which is as follows :

$$At = a + b_1 At_{-1} + b_2 It + b_3 Pt_{-1} + b_4 Yt - 1 + b_5 R_t + Ut$$

Definition of Symbols

At - Actual acreage under wheat crop of wheat in the year t (This is dependent variable)

At-1 - Actual acreage under wheat crop in the preceeding year (i.e. lagged dependent variable)

It - Relative irrigated area of wheat with respect to rape and mustard in the year t.

Pt-1 - Relative price of wheat with respect to the price of rape and mustard in the preceeding year.

Yt-1 - Relative yield of wheat with respect to rape and mustard in the preceeding year.

Rt - Total annual amount of rainfall in the year t in the area of study.

Ut - The error term

a - The intercept

b_1, b_2, b_3 .. b_5 are coefficients of the respective variables.

It is well known that such a model can either be interpreted in terms of an adjustment lag model or an expectation by coefficients of different variables can be assumed to be identical.[3] The Nerloviane adjustment model refers to analyse the facts of supply response very distinctly specially pertaining to the economic factors and considerations.

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3. K. Chopra and Swami, K.G., An Analysis of Demand and Supply in India 1951, Institute of Social and Economic Change, Monograph, No. 2, Bangalore 1975.

Table 4.7 Correlation Matrix

	1	2	3	4	5	6
1	1	.943	-.034	-0.001	0.258	-0.089
2		1	0.205	-0.176	0.326	-0.054
3			1	.926	-0.135	-0.129
4				1	0.006	-0.109
5					1	0.008
6						1

Table 4.8 Computerised Result of Regression Analysis

Case	Dependent variable At	Combination of variable	Intercept (a)	Regression coefficient symbol	value	Computed T Value	Error term Ut
I	At	2 At-1 & 3 Yt	819.58374	b_1	1.116	9.817	0.104
II	At	2 At-1 & 4 It	1509.77002	b_1	1.092	11.491	0.095
				b_2	46.282	2.009	23.044
III	At	2 At-1 & 5 Pt-1	1346.87964		1.117	10.88	23.044
					120.234	0. 748	160.781
IV	At	2 At-1 & 6 Rt	846.75464		1.116	10.347	0.108
			1		1.105	0.176	6.273
V	At	2 At-1	488.66016		1.058	10.187	0.104

4.7.3 The Analysis

4.7.3.1 Procedural Derivation

On observing the correlation matrix (Table 4.7) in all the possible combinations of variables there was high correlation between the independent variables (multi collinearity) except the combination of the lagged dependent variable (i.e At-1) with each of the dependent variables. On the other hand the variable no. 2 along with the dependent variable (At) revealed the highest correlation value .743. Therefore, the combination of the variable 2 and 3, 2 and 4 and 2 and 5, 2 and 6, along with the dependent variable in each case were run into the computer for regression analysis.

From the results the value of multiple correlation coefficients in each of the four combinations was near about equal. It was equal to .960 which led us to assume that the exact equation of regression line of each case was supporting each other. So the following examinations to test the fact that which if the factors was significant is as follows were applied.

(i) I Case

The combination of the variable no. 2 (i.e. At-1) the area under wheat of preceeding year and variable no. 3, i.e., relative yield (Yt-1) together with the dependent variable shows the fit test regression equation would be as follows :

$$At = a + b_1 At\_1 + b_2 Yt - 1 + Ut$$

$$= 819.58374 + (1.116)At_{-1} + 18.469\ Yt_{-1} + Ut$$
$$(9.817)^{**} \qquad (0.039)^{**}$$

At 13 d.f. the "t" table value at 5 per cent level and 1 per cent level of significance are 2.160 and 3.102 respectively it shows that lagged dependent variable (At_{-1}) is significant and the relative yield of wheat with respect to rape and mustard is insignificant variable. It means that At_{-1} is the dominant factor in determining the area under wheat (At) in the region.

Case II, III and IV

The table 4.8 reveals that in all the futher three cases (No. II, III and IV) the independent variable no. 2 (i.e.,At_{-1}) is most significant (as in the case no. I). It proves the fact that neither the relative price, nor the relative yield nor the annual amount of rainfall is significant with respect to the lagged area.

In all the above four cases it is very clear that the variable no. 2 (i.e., At_{-1}) viz. the cropped area of wheat of the preceeding year among all the independent variables is most significant. Therefore finally the present regression analysis ascertains the following regression equation for the present problem :

** The figures given in the parentheses shows the computed "t" values of the variables.

$$At = a + b_1 At_{-1} + Ut$$

$$At = 488.66016 + 1.058\ At_{-1} + 0.104$$

$$At = 488.76416 + 1.058\ At_{-1}$$

Trend of acreage response of wheat as has been during the period of 15 years (1960-61 to 1974-75) in Shekhawati region has been studied. If we want to know the acreage for the planned year (e.g. for the year 1975-76) it is worked out as 31170.764 hectares on the basis of regression equation computed finally in case number five. Thus the direct relationship after simplyfying the numerical values of the variables of the final regression equation may be shown as :

$$At = 488.76416 + 1.058\ At_{-1}$$

4.7.2.2 Conclusions

From the analysis of the supply response of wheat in Shekhawati attempted through the Nerlovian adjustment model the following conclusions may be inferred.

(i) Firstly, the relative price factor of wheat with respect to its competing crop of rape and mustard is found insignificant. Hence, it is obvious, that the farmers, in making area decision for wheat, do not respond to price movement. Its foremost cause may be that the farm harvest price of each crop produce has been changed proportionately.

(ii) Secondly, it is found that neither the relative yield of wheat with respect to rape and mustard, nor the

total amount of rainfall prove significant in determining the area under wheat cultivation. It means that the farmers while taking decision to allocate the area for sowing wheat do not respond positively to such factors like relative irrigated area and yield and the rainfall amount. In simplifying these factors separately it may be suggested that in making area decision for wheat the irrigation criteria has greater importance because of the low percentage of irrigated area (8.71 per cent of the total irrigated land) which amounts to an extremely insignificant irrigation facility. The yield incentives have the same place as in view of the cultivators as in the case of price unless major development programmes are instituted by the government agency in the area under study. However, an the implementation of such major development programmes instead of the prevalence of a highly intensive cultivation practices. The area under the crops more or less will remain the same because of the prevalence of the major number of small size of holdings in the region.

(iii) Thirdly in the process of making area decision for wheat cultivation the magnitude of the area held in the preceeding year was proved to be the most significant factor. Its main cause conceived according to the general psychology of the farmers in the region is that they are habituated to their routine and traditional pattern of making decisions for raising the agricultural crops over a certain area of their

land. They do not want to reduce the area under crops in comparison to the area they held in the preceding year. In this connection, their own requirements of food, their ignorance about determining the appropriate cropping pattern due to illiteracy and other traditional and social standards adopted by the farmers may be viewed to be the most important causes.

Chapter 5

STRUCTURE OF SETTLEMENTS

Settlements are essential for man because without them man cannot protect himself. These are the major features of cultural landscape. The large part of Shekhawati is arid. The human settlements in this region are largely found either on plains or along the banks of the river. Settlements are usually linked with modes of transport and the sources of water. Settlements in the hilly part of the region are found on the plains surrounded by hills. It is because of the availability of water and land for agriculture.

5.1 REGIONAL DISTRIBUTION OF SETTLEMENTS

The settlements of the plain area are generally bigger in size than those found in hilly area. These, along river banks, are without exception, very big in size. The study of settlements has been divided into seven parts based on the regional variation in their location : hummocky region, hilly region, upper Kantli river basin, lower Kantli plain, Dohan and Sahibi basin, upper Mendha basin and Fatehpur duny plain.

5.1.1 Hummocky Region

This region is interspersed with small hills of the Aravalli range. It forms the central part of Shekhawati. The non-continuity of hills has distorted the plains and as a

consequence, the total number of settlements in this region is only 26 which accounts for 1.84 per cent of the total settlements. This region covers an area of about 455 square kilometres.

5.1.2 Hilly Area

This region forms the central part of Shekhawati. The hills of the region are comparatively higher and they form the dividing line for various settlements. The settlements are mostly absent from the hills and are mostly confined to lower regions. The region covers an area of 1314 square kilometres having 122 settlements which account for 8.02 per cent of the total settlements of the region (Table 5.2).

5.1.3 Upper Kantli Basin

The region forms the central part of the Shekhawati in between the hilly area to its west and hummocky area to its east. The hillocks in this area are the source of Kantli river. The number of settlements in this area are 89 which account for 5.85 per cent of total settlements. The area of upper Kantli basin is around 759 square kilometres (Table 5.2).

5.1.4 Upper Mendha Basin

This area forms the northern part of Shekhawati. It is surrounded on the north by upper Kantli basin and on the north-west by Aravali hills. The total number of settlements is 139

which are spread over an area of 1085 square kilometres and accounts for 9.13 per cent of the total settlements (Table 5.2).

5.1.5 Fatehpur and Lachhmangarh Dunv Plain

The region is a dunv plain. It lies on the western part of Shekhawati. The number of settlements in the area is 326. It accounts for 21.43 per cent of the total settlements which are spread over an area of 3775 square kilometres. The major part of the region is covered by sand dunes.

5.1.6 Dohan and Sahibi River Basin

This region lies on the eastern part of Shekhawati. It is marked by three seasonal streams viz., Dohan, Sahibi and sota nulla. There are 106 settlements in this region accounting for 6.97 per cent of the total settlements. This part covers an area of about 656 square kilometres.

5.1.7 The Lower Kantli Basin

The region forms the northern part of Shekhawati. It covers an area of 5620 square kilometres having 711 settlements. The region ranks first in both the terms of area as well as number of settlements. The proportionate share of settlements in the area is also highest, i.e., 46.75 per cent (Table 5.2).

5.2 DISTRIBUTION PATTERN OF SETTLEMENTS IN SHEKHAWATI

One of the most fundamental geographical concepts is the concept of spatial distribution. It is a geographical identity,

because physical homogeneity is the pre-requisite for a uniform distribution. The study of settlements forms a traditional part of human geography. The extent of varying sized population clusters in the landscape is an inevitable feature in the spatial organisation of human activity. Although certain terms like sparse, dense, agglomerated and dispersed are used in identifying the settlement patterns, but this scheme of analysis does clearly distinguish the limits between the types of various patterns. Therefore, the modern statistical approach (N.N.D. Technique) has been adopted to find out the spatial patterns of human settlements. The near neighbour method has been applied to measure the distribution pattern quantitatively. The nearest distance (N.N.D.) is considered as a straight line measurement of the distance separating any location in space from its nearest neighbour.

This technique was enunciated by Clark and Evans[1] in tracing out the patterns of distribution of various plant species over the surface, subsequently it was found suitable in identifying the spacing among the settlements and has been used for the purpose by Dacey[2], King[3], Thompson[4], Browning[5] and

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1. P.J. Clark and F.C. Evans, Distance to N.N.D. as a Measure of Spatial Relationship in Population, Ecology, Vol. 35, 1954, pp. 445-54.
2. M.F. Dacey, Analysis of Central Places and Point Pattern by N.N.D. Method, Land Studies in Geography Series, pp. 55-75.
3. L.J. King, Statistical Analysis in Geography, Prentice Hall, 1969
4. H.R. Thompson, Distribution of Population Near Neighbour in a Population of Randomly distrited individuals, Ecology, vol. 37, 1956, pp. 391-394.
5. H.L. Browning and J.P. Gibbs, Some Measures of Demographic and Spatial Relationships Among Cities in Urban Research Methods Van Nostrand East West Press, 1960, pp. 436-61.

Gibbs,[6] has analysed the urban settlements in pensylvania and New Mexico. The results were approximate to random. Dacey (1962) has analysed that the distribution of hamlets, villages and towns of Wisconsin is also approximate to random. Getis[7] 1964 analysed certain findings in which the pattern was near cluster than random distribution. Regular distribution is found in a planned regions like Dutch polders and the Roman central area.[8] So far India is concerned the distribution of settlements is generally random.[9]

With the help of this analysis it is possible to measure the departure from observed spatial distribution to a theoretical random distribution between clustered and dispersed pattern.

The scale of distribution is known as "R" scale or nearest neighbour scale and its value can be calculated with the help of formula -

$$R = \bar{r}\,a / \bar{r}\,e$$

where $\bar{r}\,a$ is the mean of observed distances in a given region and $\bar{r}\,e$ is the mean of the expected distances which can be obtained by the following method.

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6. J.P. Gibbs, Some Measures of the Spatial Distribution and Redistribution of Urban Phenomena in Urban Research Methods Methods Van Nostrand East West Press, 1960, pp. 235-53.
7. A. Getis, Temporal Land Use Pattern Analysis with the Use of Nearest Neighbour and Quadrat Method Michigan University Discussion Paper I, 1964.
8. Jordon T.G., On the Nature of Settlement Geography, Professional Geographer, Vol. XVIII, No. 1, January 1966, pp. 26-28.
9. R.L. Singh, Meaning Objective and Scope of Settlement Geography, National Geographical Journal of India, Vol. VII, Part I, March 1961.

$$\bar{r}e = 1/2\sqrt{P}$$

$$P = \frac{N}{A} = \frac{\text{Total number of settlements}}{\text{Total Geographical Area}}$$

The R value can range from 2.15 in even 1.0 random and 0 to less than one clustered distribution.

A pattern that is not random is either more uniform than random or more clustered than random. Thus uniform pattern is meant by a system in which each point is equally distributed. The most suitable geometric form for this is hexagon.[10]

Clustered pattern means that all the points are aggregated and occupy single locus.

The N.N.D. has been worked out in general as well as group wise for the region. With the special reference to its sub-divisions the results of the N.N.D. vary in each sub-division.

Table 5.1 Physical Factors in the Distribution of Rural Settlements

Settlements	R Value
Total settlements	1.30
Settlements of Plains	<1.00
Settlements of the hummocky and Hilly part	1.50 to 1.80
Settlements of the river basin	1.15 to 1.80

10. P. Haggett, Locational Analysis in Human Geography, London Edward Arnold, 1965, p. 339.

The table 5.1 illustrates the pattern of settlements. The pattern of total settlement is more regular than random because "R" value is 1.30.

5.2.1 Settlement in the Plain Area

This area forms the northern part of the region comprising both of duny plain and plain area.

The pattern of Fatehpur and Lachhmangarh duny plain settlements is closed to random but less regular because the R value is 0.88. The pattern of lower Kantli region basin is similar to that of duny plain but it is more closed to random because the R value is 0.93. Here the settlements are generally found along river banks near other water bodies such as lakes etc. and along transport routes. A large number of big settlements are found in the region. The R value (<1.0) explains the distribution pattern as close to random (Table 5.1).

5.2.2 Settlements of Hummocky and Hilly Parts

The pattern of settlements in this part of the region is more regular than random because the R value is 1.5 to 1.8. The possible reason of this pattern is the interspersion of small hillocks which affect settlements. Greater R value is noticeable in the central part of the region, hence as compared to the hilly region, the central part is more regular than random. Settlements are found in the valleys because of the availability of cultivable land. The hills as well as water

bodies are next in importance for the location of human settlements in the region.

5.2.3 Settlements in River Basins

This sub-division is marked by the basins of various rivers, upper Kantli, Dohan, Sahibi and Mendha. The pattern of settlements in various basins is similar but the R value in Dohan and Sahibi basin is 1.71 which is more than that of the upper basins. Therefore, the pattern of settlements is more regular than random in these basins. The R value in this sub-division varies from 1.15 to 1.71 which shows that the pattern of settlements is between random to more regular than random. The Dohan and upper Kantli, Sahibi region being closer to the eastern and western hill ranges, shows a more regular than random distribution pattern (Table 5.1). On the contrary in Mendha river basin random distribution pattern is noticeable. It is partly because of the relief in the region being plain and partly because of better transport network. The R value of Mendha river basin is 1.15 which is less than that of the other regions.

5.3 The chi-square analysis (Table 5.3) shows a higher calculated value (1169.1579) than the tabulated value (11.34 at 0.01). It implies that the actual distribution of settlements under different environmental conditions is significantly different from the theoretical distribution. Thus, we can say,

Table 5.2 Near Neighbour Analysis

	No. of settlements	ΣNND	$\bar{r}$ a	N/A	$\bar{r}$ e	R	% to total settlements
Hummocky region	28	84.28	3.01	0.061	2.02	1.49	1.84
Hilly Region	122	362.88	2.97	0.092	1.65	1.80	8.02
Upper Kantli river basin	89	178.0	2.00	0.117	1.46	1.36	5.85
Upper Mendha river basin	139	223.4	1.61	0.128	1.40	1.15	9.13
Fatehpur and Lachhmangarh duny plain	326	485.43	1.49	0.086	1.70	0.88	21.43
Lower Kantli plain	710	928.57	1.31	0.126	1.41	0.93	46.76
Upper Dohan and Sahibi river basin	106	226.85	2.14	0.161	1.25	1.71	6.97
Total settlements	1520	3878.55	2.55	0.111	1.50	1.70	100.00

that the selected environmental factors are playing an important role in the distribution of settlements.

Table 5.3 Chi-Square Test

Factors affecting Rural settlements	Observed no. of settlements O	Expected no. of settlements E 1520/4= 380	$(O-E)^2$	$\frac{(O-E)^2}{E}$
Hummocky	28	380	123904	326.0632
Hilly	122	380	66564	175.1684
River Basins	1044	380	440896	1160.2526
Duny Plain	326	380	2916	7.6737
	1520	1520		1669.1579

$$\text{Chi-square } (\chi^2) = \mathcal{E}\frac{(O-E)^2}{E}$$

where E - stands for expected no. of settlements

O - stands for observed no. of settlements

The degree of freedom = n - 1 = 4 - 1 = 3

5.4 PATTERN OF SETTLEMENTS ACCORDING TO SIZE

The exercise has also been attempted to see the distribution pattern in different size settlements.

5.4.1 Settlements with less than 200 Persons

There are 100 such settlements . It accounts for 6.50 per cent of total settlements. The "R" value for this size

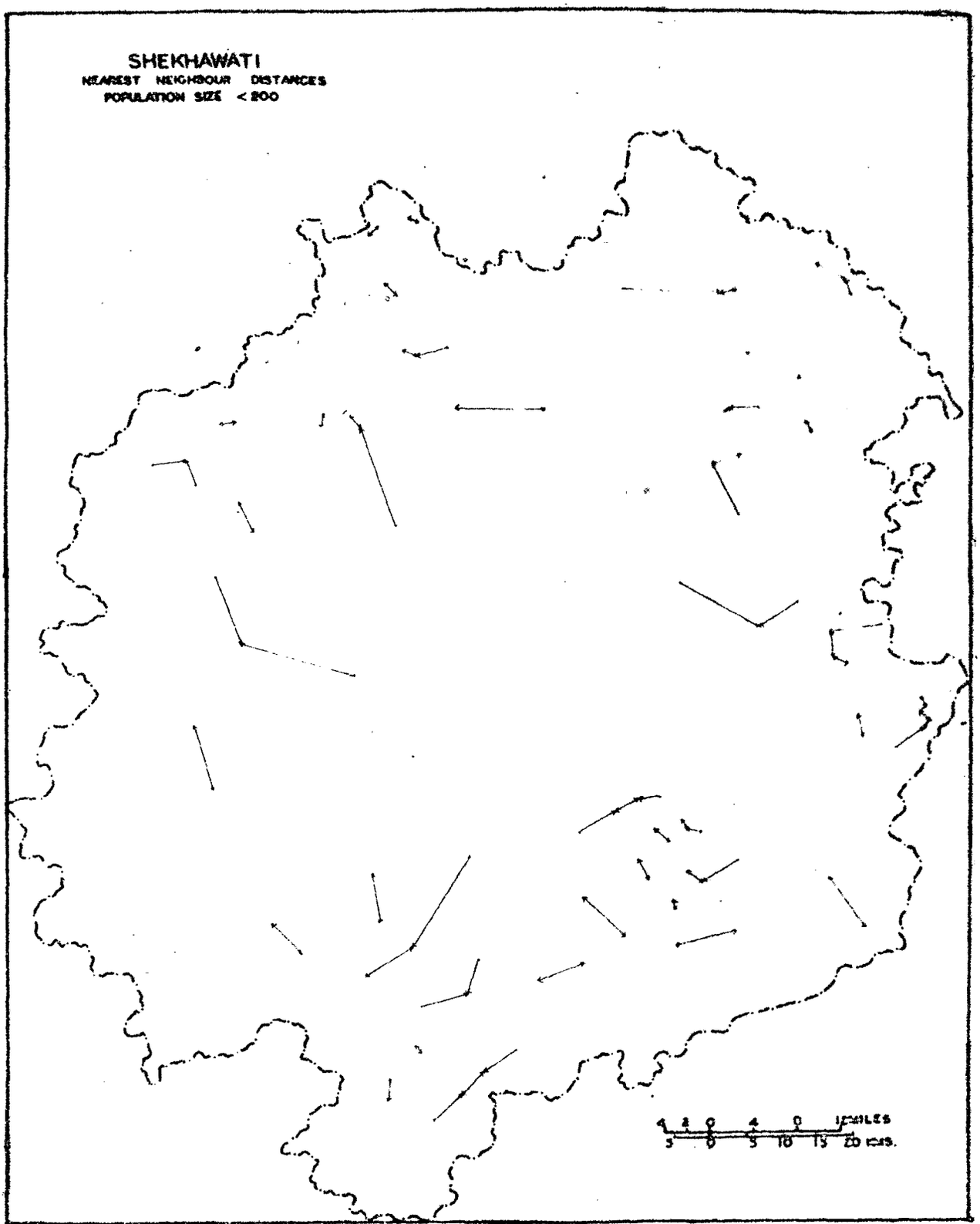
SHEKHAWATI
NEAREST NEIGHBOUR DISTANCES
POPULATION SIZE < 200
4 2 0 4 0 MILES
5 0 5 10 15 20 KMS.

FIG 5-1

group has been worked out to be 0.93. The distribution pattern, therefore, is closed to random but less regular than random. It may be attributed to their location on foothills and duny plain areas where the possibilities of large size settlements are generally rare. Such settlements are found in the locations generally devoid of essential facilities (fig. 5.1).

While comparing the r value of the region with that of total country, it is found that the region falls very much on the Indian average. But comparing it with national capital region, one of the developed areas of the country, it has been found that the area is substantially low in comparison with Delhi.[11] The inferences of the comparison make it clear that this size group is yet to develop to attain the required distribution pattern as observed in advanced area.

5.4.2 Settlements with 200-499 Persons

There are 354 settlements in this group having closed to random but less regular than random distribution pattern. The R value has been calculated as 0.93. Such settlements are found in the plain area (fig. 5.2). It accounts for 23.29 per cent to total settlements.

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11. S. Mangia, Delhi Metropolitan Region - A Study in Settlement Geography, Rajesh Publications, New Delhi, 1976, p. 187.

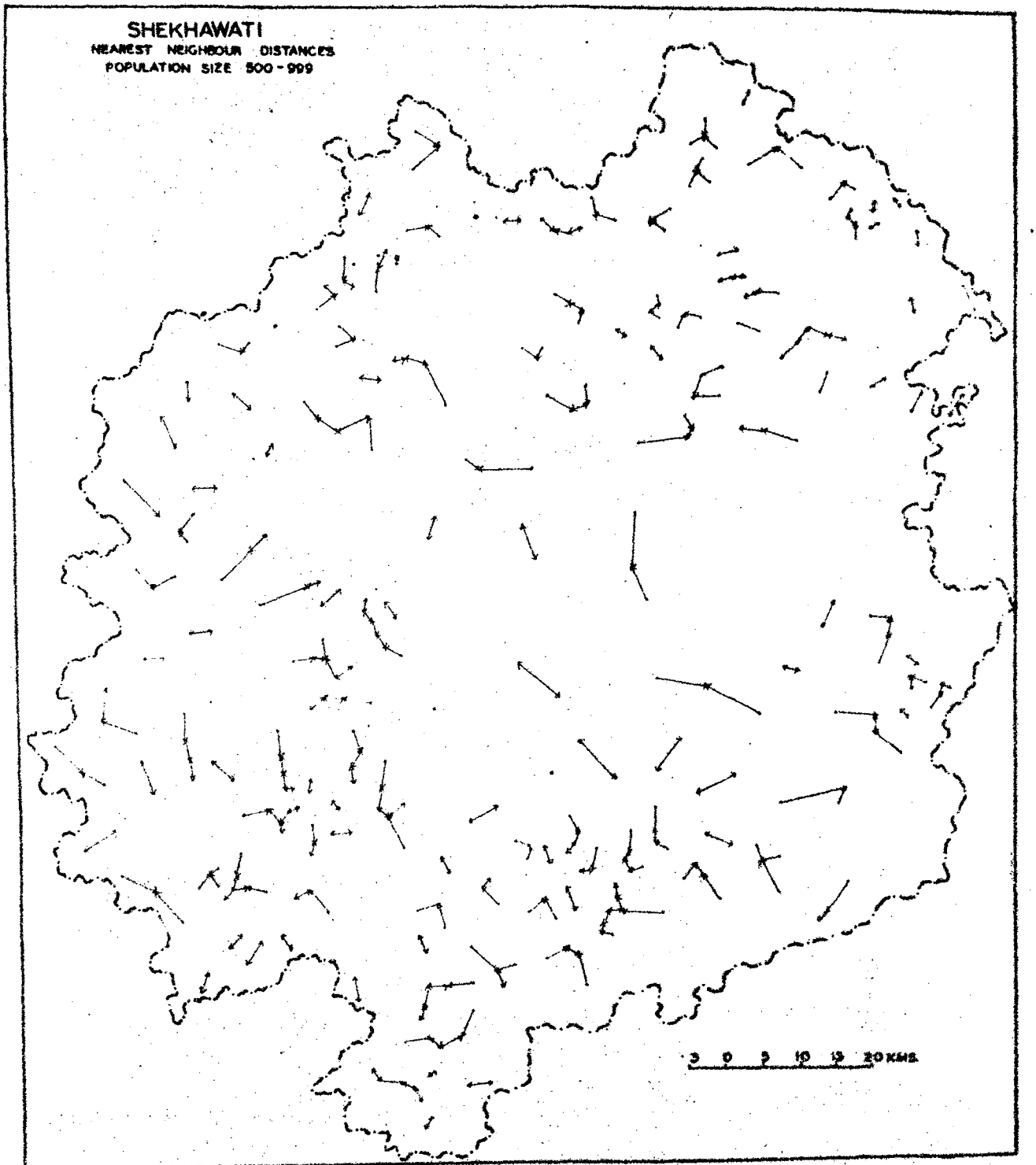
SHEKHAWATI
NEAREST NEIGHBOUR DISTANCES
POPULATION SIZE 500 - 999
0 5 10 15 20 KMS.

FIG 5-3

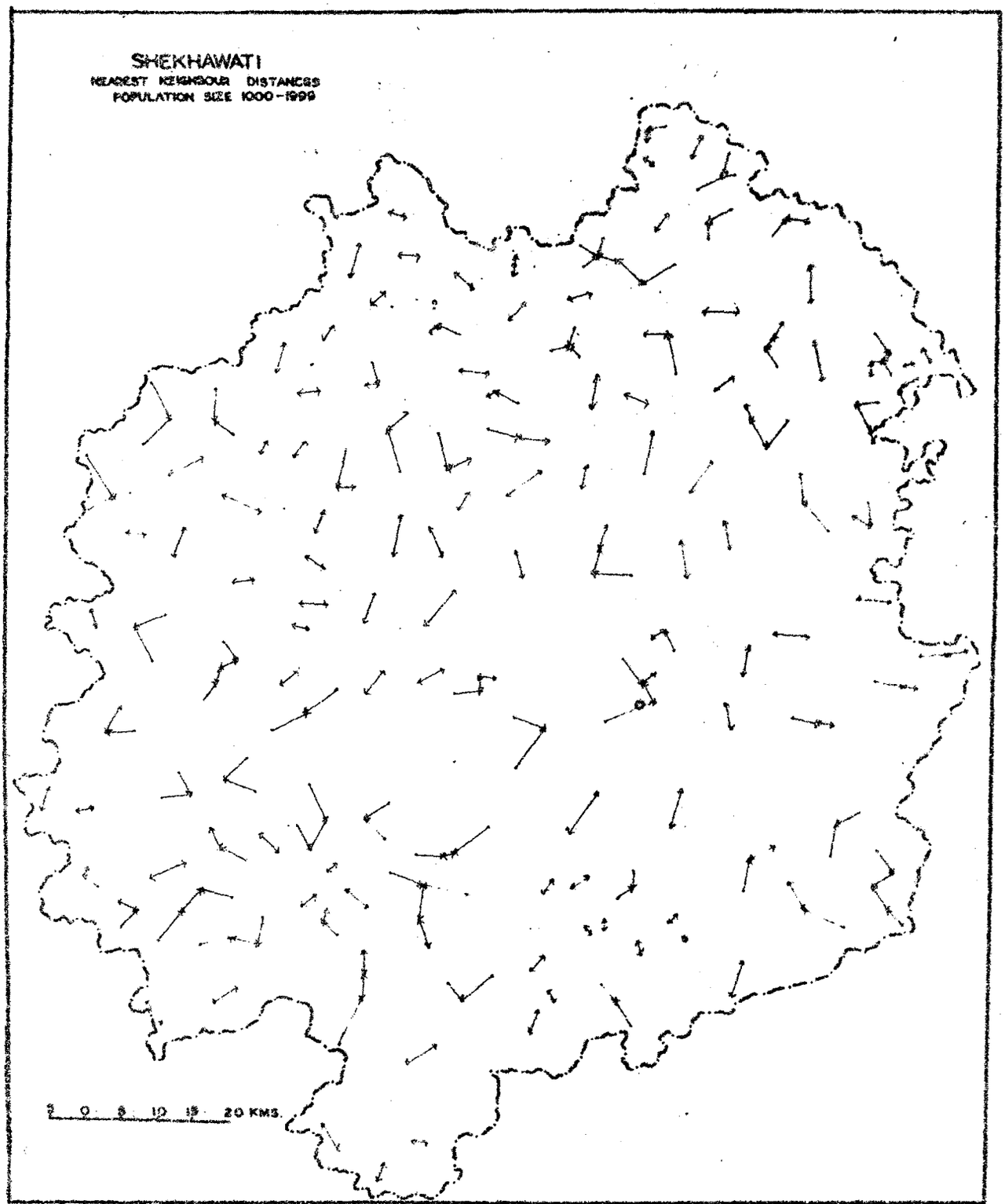
SHEKHAWATI
NEAREST NEIGHBOUR DISTANCES
POPULATION SIZE 1000-1999
2 0 5 10 15 20 KMS.

FIG 5-4

5.4.3 Settlements with 500-999 Population

There are only 547 settlements in this population size group. The settlements are found generally along the banks of rivers and ponds and have the prospects of growth. The R value is 1.13 which explains the distribution pattern to be random to more regular than random. (fig. 5.3). It accounts for 35.98 per cent to total settlements.

5.4.4 Settlements with 1000-1999 Persons

There are 343 settlements in this population size group. The R value is 1.13 so the settlement pattern is random to more regular than random. The settlements in this category are usually found along the banks of rivers and plain areas (fig. 5.4). This size group has 22.57 per cent to total settlements.

5.4.5 Settlements with 2000-4999 Persons

It has 150 settlements in this population size class. The settlement pattern is found to be more regular than random because R value is 1.13. The settlements of this size-group are found in plain areas or develop where water and other facilities are available for subsistence and development (fig. 5.5). It accounts for 9.87 per cent to total settlements.

5.4.6 Settlements with 5000 and above Persons

There are only 26 settlements in this group. The R value is 0.65 with the result the settlement distribution of this

Table 5.4 Population Size of the Settlements and Nearest Neighbour Distance

Size Group	No. of settlements	Σ NND	$\bar{r}$ a	N/A	$\bar{r}$ e.$1/2\sqrt{P}$	R	Percentage to total settlements
Less than 200	100	544.37	5.46	0.0073	5.85	0.93	6.58
200 - 499	354	1046.00	2.95	0.025	3.16	0.93	23.29
500 - 999	547	1549.71	2.83	0.040	2.50	1.13	35.98
1000 - 1999	343	1238.00	3.60	0.025	3.16	1.13	22.57
2000 - 4999	150	824.53	5.46	0.011	4.80	1.13	9.87
5000 and above	26	194.57	7.48	0.0019	11.49	0.65	1.71
All settlements	1520	3878.55	2.55	0.111	1.50	1.30	100.00

$\bar{r}a$ = observed mean distance in km. or Total distance observed between point converted to actual scale divided by number of villages.

$\bar{r}e$ = Mean of expected distance

$P = \frac{\text{No. of settlements}}{\text{Area of the region}}$

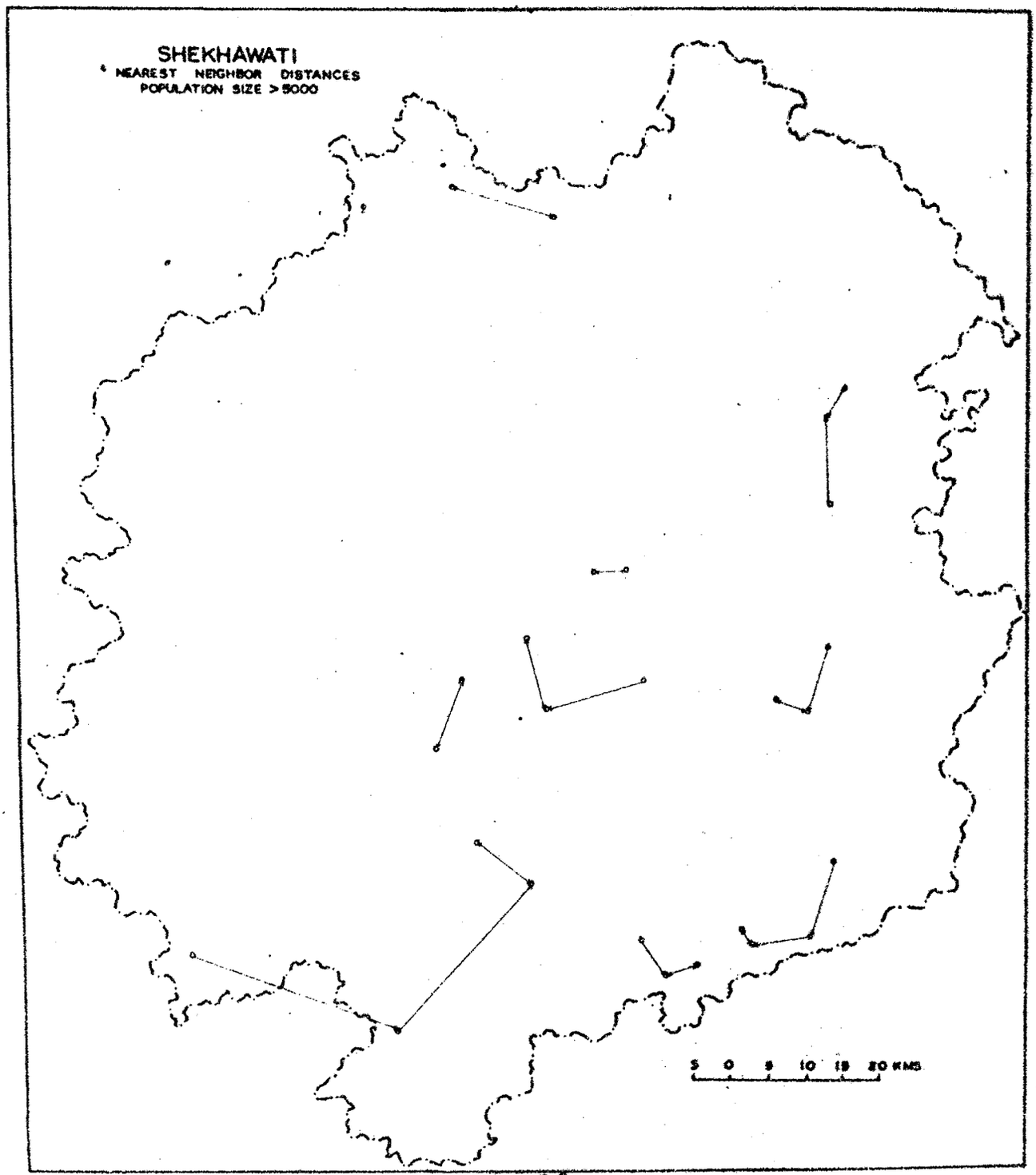
SHEKHAWATI
NEAREST NEIGHBOR DISTANCES
POPULATION SIZE >5000
5 0 5 10 15 20 KMS

FIG 5-6

size-group is also closed to random (fig. 5.6). It accounts for 1.71 per cent to total settlements.

5.4.7 All Settlements

According to 1971 Census there were 1520 settlements (fig. 5.7) located in an area of 13661 square kilometres. The R value is 1.30. The settlement pattern therefore is more regular.

Thus it is clear from the foregoing analysis that almost all size categories reflect the distribution pattern as around random. Therefore, it can be concluded that all size categories maintain a systematic ratio with the area and also with their relative groups. The phenomena of concentration and dispersion is an expression of the combination of physical influences in which scope and availability of water plays an important role.

5.5 URBAN SETTLEMENTS

The distribution pattern of the urban settlements in the region has been studied separately. All the urban centres of the region are well connected with transport network. Ten towns out of 19 are situated along the rail routes and remaining along the roads. Sikar is the only big railway station in the region.

The R value for urban settlements is 1.21 (fig. 5.8). The distribution pattern of urban settlements is more regular than random. Urban settlements have a low concentration towards

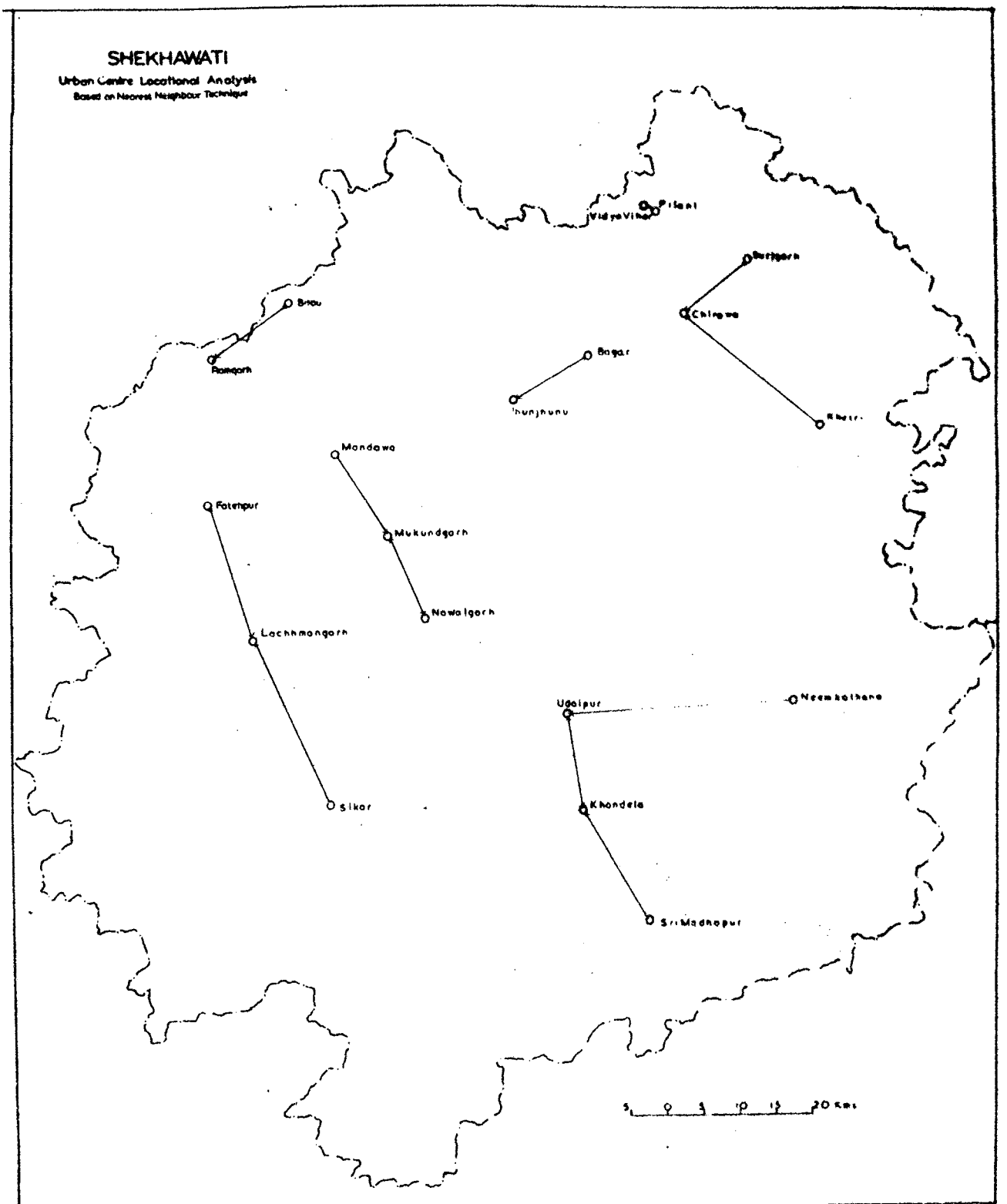
SHEKHAWATI
Urban Centre Locational Analysis
Based on Nearest Neighbour Technique
Pilani
Vidyavihar
Bharatgarh
Chirawa
Bagar
Jhunjhunu
Khetri
Mandawa
Fatehpur
Mukundgarh
Nawalgarh
Lachhmangarh
Sikar
Udaipur
Neemkathana
Khandela
Sri Madhopur
Binau
Ramgarh
5 0 5 10 15 20 Kms

FIG 5·8

south eastern part of the region. It is because the Aravalli ranges are not very suitable for urban growth. The urban centres are found in plain areas where prospects for industrial and agro-commercial development are found. Most of these centres are administrative headquarters.

5.5.1 Rank Size Rule

The rank size Rule* is an investigative hypothesis, a theoretical model or a norm to express the relationship of the city or town size. The hypothesis behind it is that cities or towns are related to each other in some orderly way forming into a system, the basis for which is the population size. There has to be some sort of relationship between the size of the towns and their ranks. Thus to test the above hypothesis the rank size rule has been applied among the urban settlements of the Shekhawati for 1961-71 and also to see what sort of pattern empirically exists in region. The concept of rank size rule is a product of the present century. Singer (1936)[12] found pareto's law explaining city size distribution in some cases but the concept has been popularised by Jefferson

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* rh (pqn) = K, where rn and pn are the rank and the population of the urban settlements respectively in the series when all the towns of a region are arranged in a discending order of population size and q and K are constant for a given group of urban settlements.

12. H.W. Singer, The Courbe des Populations A Parallel to Pareto's Law, Economic Journal, vol. 47, 1936, pp. 2354-63.

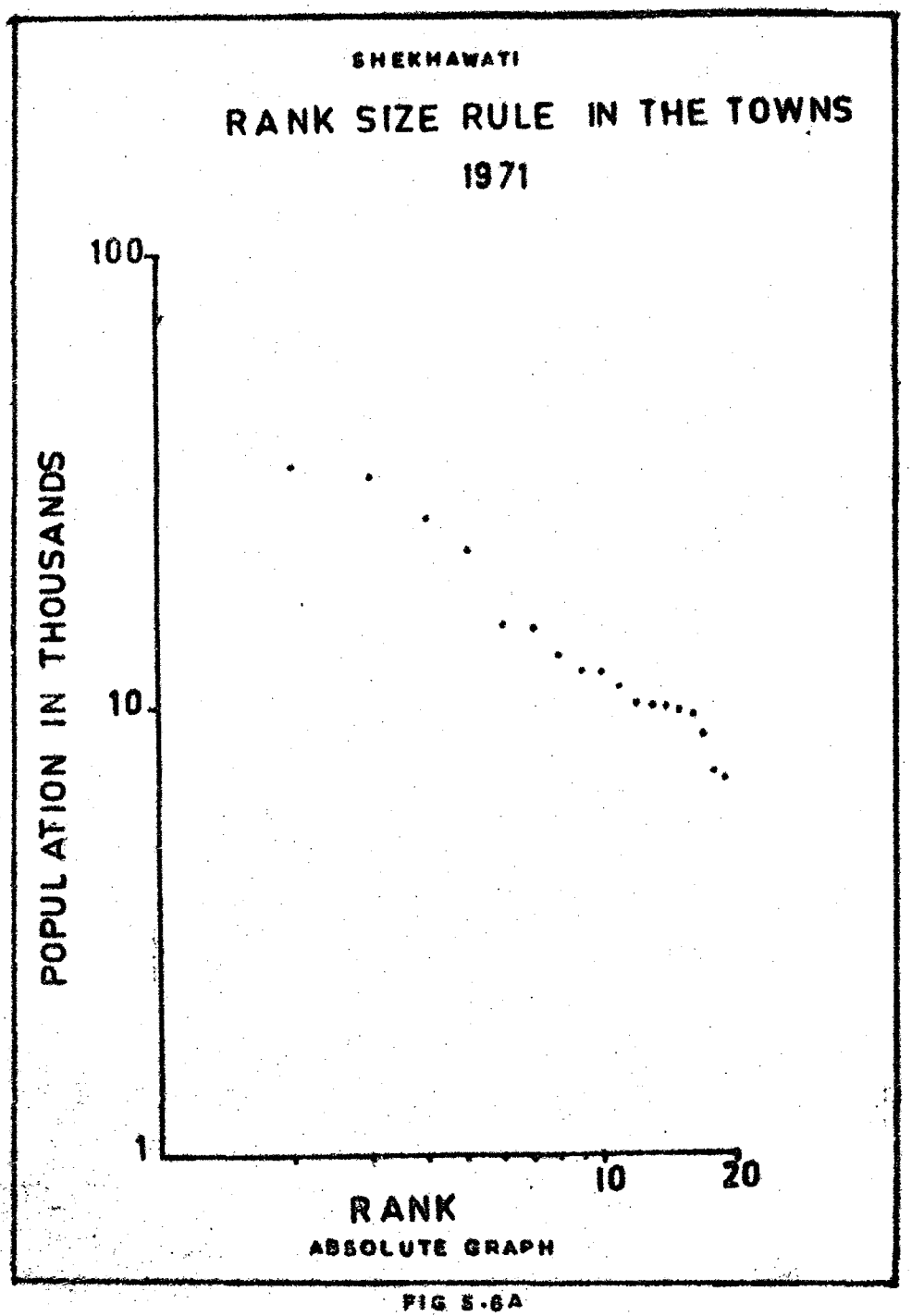
SHEKHAWATI
RANK SIZE RULE IN THE TOWNS
1971
100
10
1
POPULATION IN THOUSANDS
10
20
RANK
ABSOLUTE GRAPH

FIG 5.6A

(1939)[13], Zipf (1949)[14], Beckmann[15] and Berry (1964)[16] etc.

The rank size regularity among the urban settlements of Shekhawati was found out. The expected population for the primate town has been (Sikar) calculated by dividing the total population of all the urban settlements of the region. With reciprocals of their ranks, it was plotted on the double log graphs (fig. 5.8A) which shows actual population with respect to their ranks. The rank size relationship or the first and second ranking urban centres namely Sikar and Fatehpur remained constant during 1961-1971. The tables 5.5 and 5.6 provide the actual and expected ranks.

Thus from the above study it may be concluded that the urban centres are not showing their rank size regularity during the decade and there is no noticeable change in their size.

The tendency of the rank size relationship is more evident from the tables 5.5 and 5.6 in which it is noticeable that the

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13. M. Jefferson, The Law of Primate City, The Geographical Review, XXIX, No. 2, 1939, pp. 226-32.

14. G.K. Zipf, Human Behaviour and Principle of Least Efforts, Cambridge.

15. M.J. Beckmann, City Hierarchies and the Distribution of City size Economic Development and Cultural Change, 1958, pp. 243-48.

16. B.E.L. Berry, Approaches to Regional Analysis, A Syntheis Annals Association of American Geographer, 1965, vol. 54, pp. 2-11.

Table 5.5 Rank Size Analysis*

S.No.	Reciprocal of R(1/R)	Actual Population	Expected Population	Different	Percentage difference pa/Pe
1.	1.00000	50630	78114	-27484	35.18
2.	0.50000	27039	39057	-12018	30.77
3.	0.33333	24962	26038	-1076	4.13
4.	0.25000	24911	19528.5	5382.5	27.56
5.	0.20000	18484	15622.8	2861.2	47.00
6.	0.16666	13956	13019	937	18.37
7.	0.148282	12928	11159.14	1768.8	15.84
8.	0.12500	11765	9764.25	2000.75	20.49
9.	0.11111	11565	8679.33	2885.67	33.24
10.	0.10000	111555	7811.4	3743.6	47.92
11.	0.09090	10263	7101.2	3161.8	44.52
12.	0.08333	9723	6509.5	3213.5	49.36
13.	0.07692	8290	6000.7	2281.3	37.76
14.	0.07142	8144	5579.4	2564.5	45.96
15.	0.06666	8101	5207.6	2893.4	55.56
16.	0.06250	8058	4882.1	3175.9	75.05
17.	0.05882	7174	4594.9	2579.1	56.12
18.	0.05555	5464	4339.6	1124.4	25.91

$\Sigma R(1/R)$ 3.49505 ΣPa 273011

* The rank size rule analysis is worked out for the towns of the region on the basis of Sikar town as a primate town during 1961.

Table 5.6 Rank Size Analysis*

S.No.	Reciprocal of R(1/R)	Actual Population	Expected Population	Different	Percentage difference Pa/Pe
1.	1.00000	70987	95742	-24755	-34.00
2.	0.50000	34929	47871	-12942	27.03
3.	0.33333	32024	31914	110	0.34
4.	0.25000	26565	23935.5	2639.5	11.02
5.	0.20000	22158	19148.4	3009.6	15.71
6.	0.16666	15241	15957	-716	4.46
7.	0.14285	15068	13677.4	1390.6	10.16
8.	0.12500	13101	11967.7	1133 .3	9.46
9.	0.11111	12500	10638	1862	17.50
10.	0.10000	12442	9574.2	2867.8	29.94
11.	0.09090	11621	8703.8	2908.2	33.41
12.	0.08333	10944	7978.5	2515.5	31.52
13.	0.07692	10294	7364.7	2929.3	39.71
14.	0.07142	10154	6838.7	3315.3	48.47
15.	0.06666	9851	6382.8	3468.2	54.33
16.	0.06250	9780	5983.8	3796.2	63.44
17.	0.05882	8669	5631.8	3037.2	53.92
18.	0.05555	6958	5319	1639	30.38
19.	0.05262	6834	5039	1795	35.62

$\Sigma R(1/R)$ 3.54768 ΣPa 339661

* The rank size rule analysis is worked out for the towns of the region on the basis of Sikar town as a primate town during 1971.

population of big urban centres gradually decreases from the expected norms whereas in the cases of medium and low sized centres it is found generally above from the theoretical distribution.

5.5.2 Economic Base of Urban Settlements

The rise and fall of the urban settlements depends mainly on the natural expansion and contraction of their economic base. They exist mainly to serve its inhabitants as well as the people of their hinterland or service areas. The nature of urban centres is determined by the main functions they perform. Each urban centre is different from its neighbouring one on the grounds of the relative importance of a function. The function in the town is determined mainly by the number of people engaged in that functions with respect to the total employment. When contribution of individual function as against the total urban economy is not available employment becomes the sole criterion for determining their economic base.

The importance and economy of a town depends upon its hinterland while on the other hand the nature and character of their hinterland creates factors demanded on the urban centre. In the urban character certain functions are peculiar to site and situation of the urban settlements. Some of them are traditional, others bring modernization in the urban morphology. If an activity is concentrated in a town at a certain magnitude,

it will dominate the economic life and would be able to become its major function and quality. To understand the character of the town and to differentiate it from other functions classification of cities and towns have been attempted in India and abroad. Most of them have been used for functional classification of towns at national level. It is worthwhile to extend their use at regional level. C.D. Harris[17] pointed out that as the size of the cities increases they assume multifunctional character and vice-versa. Howard Nelson extended a statistical analysis by calculating standard deviation from the mean employment for each activity group and grouped the cities of U.S.A. according to there degree of variation from the mean in each function.

5.6 FUNCTIONAL CLASSIFICATION OF TOWNS IN SHEKHAWATI

Before attempting the classification of towns it is important to explain that the region has a low level of urbanisation. There is no big urban centre in the region. Therefore, study is limited only upto the towns (hitherto referred as urban centres of the region). Nelson's model has been used for the functional classification of towns. The data used in this exercise has been taken from the District Census Handbooks - 1971 of Sikar and Jhunjhunu. Working population of a centre

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17. C.D. Harris and Ullman, E.L., Nature of Cities", Reprinted in Mayer H.M., and Kohn, C.F., Readings in Urban Geography, Chicago, U.P., 1955, pp. 277-86.

is divided into nine major groups on the basis of their nature. It has been attempted to find out the percentage of the population engaged in each category for all the towns of the region.

As Nelson pointed out in his article that the individual percentage are meaningless without its reference to some value. The mean percentage and standard deviation has been calculated for all the workers categories for all the towns (Table 5.7).

Table 5.7 Average and Standard Deviation for Selected Activities Groups

Occupation	Average	Standard deviation	Average + 1 SD	Average + 2 SD	Average + 3 SD
Cultivators	16.48	10.34	26.82	37.16	47.50
Agri Labours	6.02	3.50	9.52	13.02	16.52
Livestock	1.04	0.64	1.68	2.32	2.96
Mining	0.97	3.36	4.33	7.69	11.05
Manufacturing	19.96	6.64	26.60	33.24	39.88
Construction	7.51	3.84	11.35	15.19	19.03
Trade & Commerce	17.51	5.94	23.45	29.39	35.33
Transport and Communication	4.09	1.81	5.90	7.71	9.52
Other Services	25.22	16.51	41.73	58.24	74.75

The degree of variations from the regional average are recognised as the base for grouping the factions in their

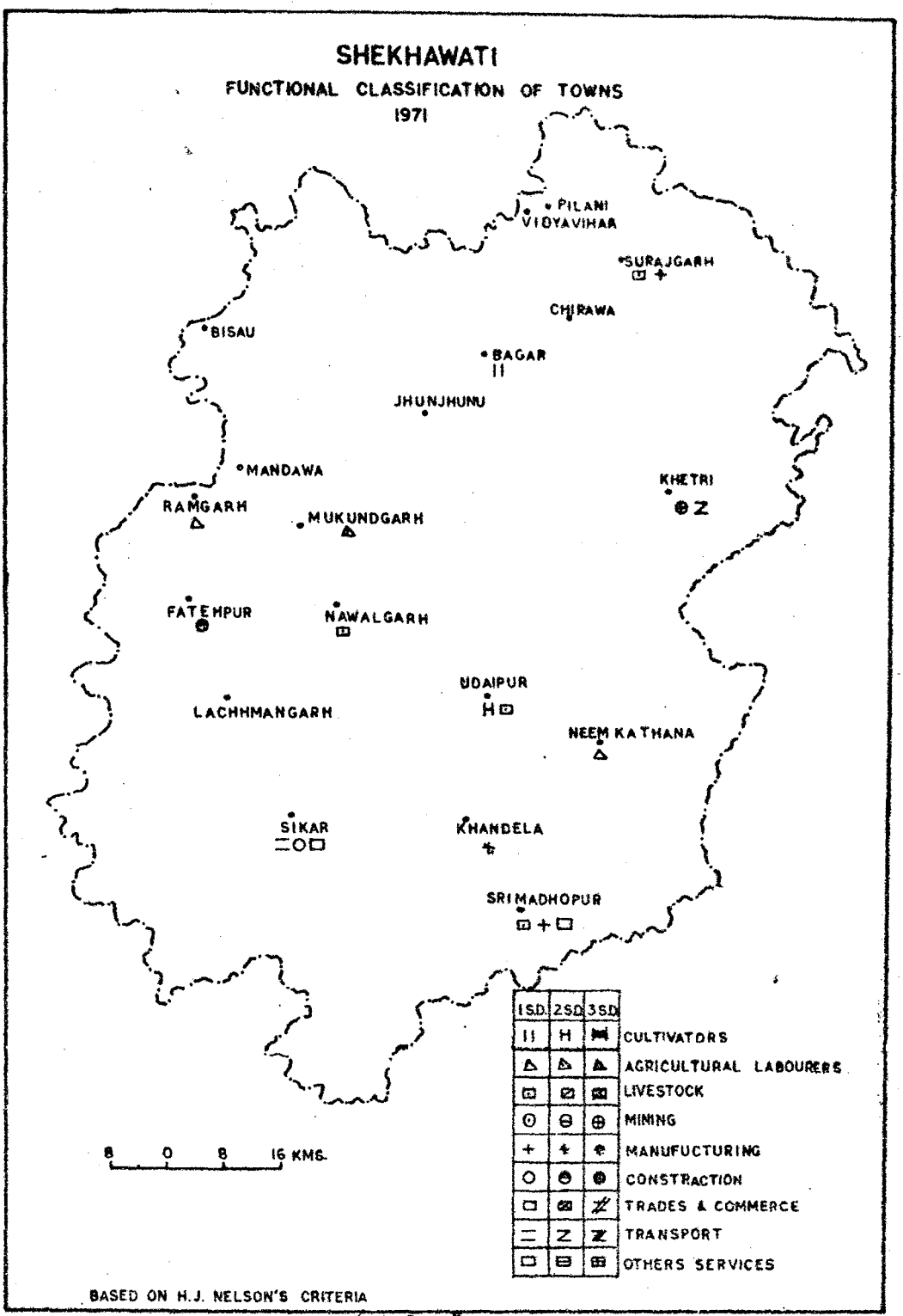

SHEKHAWATI
FUNCTIONAL CLASSIFICATION OF TOWNS
1971
PILANI
VIDYAVIHAR
SURAJGARH
CHIRAWA
BISAU
BAGAR
JHUNJHUNU
MANDAWA
KHETRI
RAMGARH
MUKUNDGARH
FATEHPUR
NAWALGARH
UDAIPUR
LACHHMANGARH
NEEM KA THANA
SIKAR
KHANDELA
SRIMADHOPUR
8 0 8 16 KMS.
1SD 2SD 3SD
CULTIVATORS
AGRICULTURAL LABOURERS
LIVESTOCK
MINING
MANUFUCTURING
CONSTRACTION
TRADES & COMMERCE
TRANSPORT
OTHERS SERVICES
BASED ON H.J. NELSON'S CRITERIA

FIG 5.9

appropriate terms. The towns recording over plus 1 SD from the regional average in any category is recognised as Mt towns and over 2 SD as Mt2 and further over 3 SD recognised as Mt3 respectively for each category (fig. 5.9). The towns registering above 1 SD in any one of the nine categories have been mapped for further analysis. The classification of 19 urban centres of Shekhawati is given below.

5.6.1 Analysis of Functions

Cultivators : Although cultivator is (one of the nine workers categories) not an urban function but most of the towns have been found recording enough employment in this category. It is because of the backwardness of the region. It is important to note that in Udaipur 48.96 per cent of the workers are engaged in cultivation followed by Bagar 28.12 per cent, Basua 26.09 per cent and Mandawa 22.21 per cent. All these towns are small in size and are located in a rural hinterland with the result these centres function as agro-service centres. Such centres generally resemble more to rural than urban centres.

5.6.1.1 Agricultural Labour

This activity is highly represented in Mukundgarh (13.32 per cent), Ramgarh (12.18 per cent), Mandawa (8.79 per cent), Lachhmangarh (7.35 per cent), Udaipur (7.28 per cent) and Besau (7.15 per cent). These towns having rural background generally perform the agricultural activities.

5.6.1.2 Livestock Rearing

This economic activity is primarily concentrated in seven towns. These are Fatehpur (1.65), Sri Madhopur (1.011 per cent), Khendela (1.57 per cent), Pilani (1.18 per cent), Srigarh (1.75 per cent), Nawalgarh (2.25 per cent), Udaipur (1.83 per cent), Mukundagarh (1.37 per cent) and remaining towns record below one per cent (fig. 5.10, Appendix 5.1).

5.6.1.3 Mining

This function, with exception of Khetri, is not important in Shekhawati as it employs very small proportion of work force (below one per cent in all the towns except Khetri). Of the 19 urban centres of Shekhawati, 9 register 20 per cent and above of the total working population as engaged in this category. Khetri records as high as 14.86 per cent of population in this function.

5.6.1.4 Manufacturing

Nine out of 19 urban centres of Shekhawati have registered 20 per cent of their work force engaged in manufacturing. The percentage employment was maximum in case of Khendela (35.91 per cent) followed by Sri Madhopur (27.05 per cent), Lachhmangarh (20.44 per cent), Bagar (20.71 per cent), Madewa (26.42 per cent), Bisau (20.54 per cent), Surajgarh (27.51 per cent), Nawalgarh (27.72 per cent) and Mukundgarh (23.7 per cent) (fig. 5.10).

5.6.1.5 Construction

There are only three towns recording a high percentage in this function. These towns are Fatehpur (17.16 per cent), Sikar (12.89 per cent) and Lachhmangarh (11.31 per cent). The employment in this function is mainly related to the size of settlements. Construction becomes a necessary service cum industry specially in bigger and growing urban centres. It finds its relationship with the size of the settlements where a large section of the population remains engaged in their work because of heavy demands (i.e., housing for residential and offices is the main demand of bigger centres) (Appendix 5.1).

5.6.1.6 Trade and Commerce

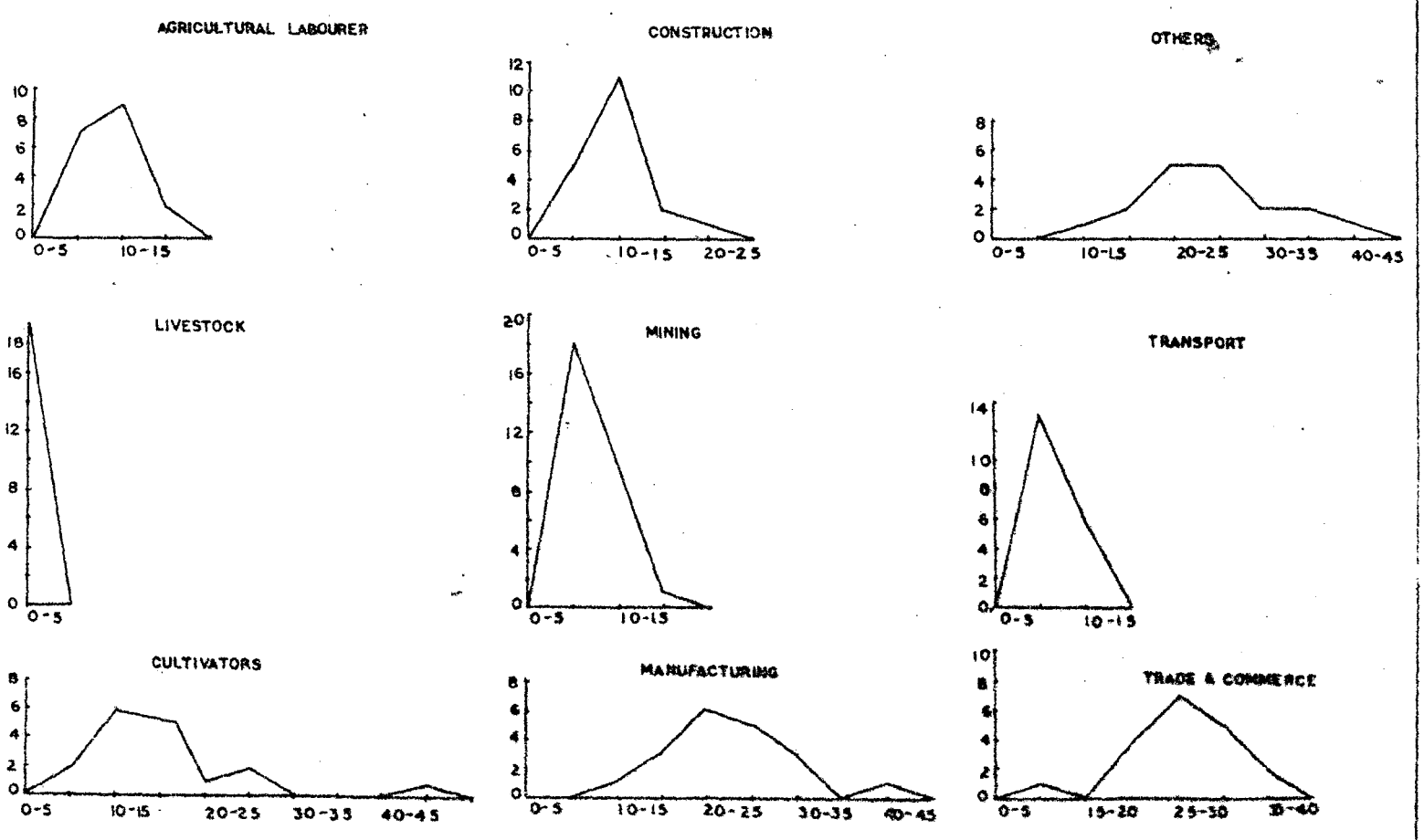
Ten towns out of 19 recorded high employment in this function. These towns are Sikar (25.81), Lachhmangarh (23.05), Sri Madhopur (28.01), Khendela (20.66), Jhunjhunu (19.27), Chirawa (22.74), Surjgarh (19.16), Nawalgarh (22.53) and Ramgarh (19.31). The percentage in these ranges between 19 to 29 per cent of the total working population. The centres are connected with transport facilities. The remaining urban centres record a low percentage in this function.

5.6.1.7 Transport Storage and Communication

The region records a small proportion of the working population in this function. Most of the towns record below

SHEKHAWATI

DISTRIBUTION OF ECONOMIC SERVICES AMONG THE TOWNS



LEGEND: ABSCISSA - PERCENT OF LABOUR FORCE
ORDINATE - NUMBER OF TOWNS

FIG 5-10

five per cent of employment in this activity. It, in other words, explains the low level of transport and related function in Shekhawati region. The percentage share in this function in individual towns is also not very high for example Khetri 8.27 per cent, Sikar 6.73 per cent, Jhunjhunu 5.61 per cent, Sri Madhopur 5.36 per cent, and Fatehpur 5.10 per cent. Remaining urban centres have registered less than 5 per cent of working population in this function.

5.6.1.8 Other Services

Substantially larger proportion of the working population in urban centres is engaged in this function. The percentages in various towns are 85.51 per cent in Vidya Vihar, 37.18 per cent in Pilani, 32.64 per cent in Khetri, 31.18 per cent in Neem-ka-thana, 29.61 per cent in Jhunjhunu and 27.79 per cent in Sikar. Remaining urban centres register below 20 per cent employment in this function (Appendix 5.1).

5.6.2 Frequency Variation Among the Towns

The frequency graph shows the distribution of economic activities among the urban centres of Shekhawati region. These graphs show the frequency with which a given percentage (presented on abscissa) and labour force employed in the 19 towns (on ordinates) in an activity (among the 9 categories graph). The respective figures indicate the distribution of an activity in the form of a trend line.

The activities such as cultivators and other services, show a greater horizontal variation and record a higher share of the total labour force whereas mining, livestock and construction display the contrary picture in the trend line. In these cases graph moves horizontally not vertically meaning thereby a lower employment in these sectors and uneven distribution of the activities.

5.6.3 Growth of Towns

As Prof. Davis suggested measuring the urban growth by "Instantaneous Method" means ascertaining the population in all urban categories and tracing the changes in each class without taking individual consideration. It shows the changing distribution of urban population by class of towns, and it also shows what is happening to specific towns as a result of their initial size difference. Thus taking the Davis's suggestion into consideration the analysis has been made to interpret the growth of urban population in Shekhawati region.

(1) Sikar Town : It is situated in the south western part of the region in a suitable plain area. It also shows slow rate of population growth particularly during last two decades 1961-71. The rate of population growth during 1951-61 was 14.70 per cent and the town was a class III urban centre. The population growth during 1961-71 increased at a tremendous rate of 40.20 per cent resulting into its being categorised as class II urban centre. The average decadal variation before and after indepen-

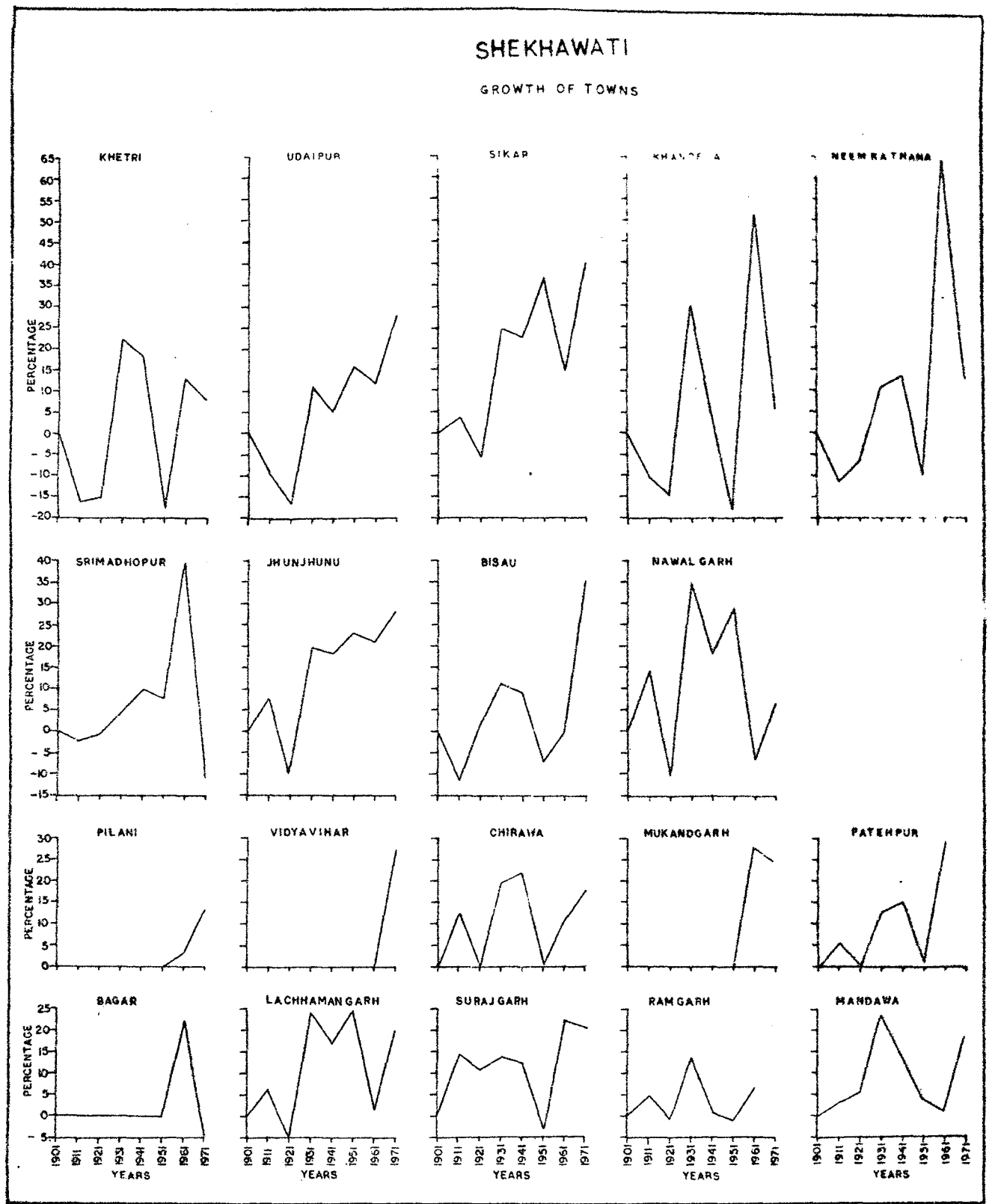

SHEKHAWATI
GROWTH OF TOWNS
KHETRI
UDAIPUR
SIKAR
NEEMKATHANA
SRIMADHOPUR
JHUNJHUNU
BISAU
NAWALGARH
PILANI
VIDYAVIHAR
CHIRAWA
MUKANDGARH
PATEHPUR
BAGAR
LACHHAMANGARH
SURAJGARH
RAMGARH
MANDAWA
PERCENTAGE
YEARS
1901
1911
1921
1931
1941
1951
1961
1971

FIG. 5·11

dence was 11.45 and 30.47 per cent respectively. It is headquarter of the district (fig. 5.11).

(ii) Fatehpur : It is situated in the western part of the region. It is headquarter of a tehsil in Sikar district. It is second town in terms of population in the Shekhawati. It showed a slight increase in population (i.e. 19.21 per cent in 1941, 15.05 per cent in 1951, 1.07 per cent in 1961 and 29.18 per cent in 1971) since 1941. During these four decades town could not promote its level rather it maintained a constant class over such a long period. It is a class III town. The average decadal variation before and after independence was 9.36 to 15.09 per cent respectively. The slow rate of population growth in this town is partly because of its poor economic base being situated in desert area (fig. 5.11).

(iii) Jhunjhunu : It is a district headquarter of Jhunjhunu district. It is situated in a semi desert area. It was class IV town for a longer period during 1901-1941 and since then it is continuing as class III towns (1951-1971). It clearly reflects its extremely slow rate of population growth. The present rate of population growth (1961-71) is 28.29 per cent. It recorded below 20 per cent population growth upto 1941 and after that it maintained its population growth (above 20 per cent) throughout. The average growth before and after independence is quite unequal. It has registered (8.93 and 24.18 respectively) a substantial increase after the independence

accounting for three times to that of before independence growth.

(iv) Nawalgarh : Nawalgarh is situated in Jhunjhunu district. It is situated in western part of the region. It was a class IV town upto 1931 and since then it maintained its status of being class III town. It noted high percentage of population increase during 1931 (34.46 per cent). The average growth before and after independence is recorded as 14.01 and 9.79 respectively.

(v) Lachhmangarh : It is headquarter of a tehsil in the Sikar district. It is situated in the western part of the region. It had an increase in population of 19.87 per cent during 1961-71. It was a class IV town upto 1961 and got the status of being class III town during 1961-71. The average percentage of population growth before and after independence is recorded as 10.80 and 15.29 respectively.

(vi) Chirawa : Chirawa town located in northern part of the region. It is a headquarter of the tehsil in district Jhunjhunu. Chirawa was class V town upto 1931 and raised to the status of being class IV town in 1941 which is maintained uptil now. The town registers a slow growth of population continuously. The average growth before and after independence is 13.61 and 9.64 per cent respectively. Chirawa is well connected with road and rail facilities.

(vii) Ramgarh Town : Ramgarh town is situated in Fatehpur tehsil of district Sikar. The town is continuing in the status of class IV town since its inception. It recorded and maintained continuously very slow rate of population growth (below 10 per cent). It is partly because of its being situated in desert area and a very weak economic base. It is rather a projection of a big village. The average growth of population before and after independence remained by and large the same (i.e. 4.75 and 4.57 per cent respectively).

(viii) Pilani Town : Pilani is situated in district Jhunjhunu and is well accessible by roads. It is because of its being an important educational centre it has grown as town. All other urban functions are supplementary to this function. It got the status of a class IV town in 1951 and is still in the small same class. The rate of population growth presents an alarming picture during 1951-61 it recorded a growth of 3.31 per cent whereas during 1961-71 it rose to 13.20 per cent. The above all growth after independence is calculated as 8.29 per cent.

(ix) Khandela Town : Khandela town is situated in district Sikar. It was a class V town upto 1951 and got the status of class IV town in 1961, which is maintained uptil now. 5 per cent population increase was recorded in 1961.

(x) Udaipur Town : It is headquarter of tehsil, it was class V town upto 1961 and got the status of class IV town in 1977.

The highest percentage of population growth (27.96 per cent) was recorded in 1971. The average growth before and after independence is calculated as 2.78 and 18.5 per cent respectively.

(xi) Neem-ka-thana : It is a famous town in Shekhawati. It is headquarter of a tehsil in Sikar district. It is surrounded by hillocks. It was class V town upto 1951, and after that the town became class IV during 1961-71. The average growth before and after independence is 1.41 and 22.37 per cent respectively.

(xii) Sri Madhopur : It is situated in Sikar district and is headquarter of a tehsil. It was class V town from 1951 and became class IV town during 1961. The population growth during 1951-61 - 39.58 per cent and during 1961-71 it recorded a negative growth of minus 10.9 per cent. The population growth before and after independence is recorded as 2.89 and 12.09 per cent respectively.

(xiii) Mukundgarh : It is situated in Udaipurwati tehsil of Jhunjhunu district. It became a town only in 1951 having a status of class V town. The population growth during 1951-61 was 28.38 per cent and during 1961-71, 24.68 per cent with the result it got the status of class IV town during 1971. The population growth after independence was calculated to be 26.53 per cent.

The remaining towns of the region are not very important. Almost all such urban centres fall in class V towns. During

1961-71 the population growth in these centres remained below average but on the whole the process of urbanization seems to be slow.

The general survey of the population growth in all towns (Appendix 5.2) reveals that during last 70 years these towns remained in the same status of class V towns. There are 6 towns showing a slight decrease in population during 1941-51 but they could maintain their status as urban centres. The decrease in the growth of population of these was -7.9 per cent in case of Bisau, -2.82 per cent in case of Surajgarh, -18.09 per cent in case of Khetri, -0.93 per cent in case of Ramgarh, -10.37 per cent in case of Neem-ka-thana and -17.85 per cent in case of Khandela. It is interesting to note that Bisau lost its status of being a town during 1961.

It can be concluded that these centres are quite small in size and net increase in population over a decade remains very insignificant in most of the cases.

5.7 TRANSPORT NETWORK

The transport system of a region is a very important indicator of development of a region, as it facilitates trade. If agriculture and industry are regarded as the body and bones of economy, transport and communications constitute its nerves. A modern economy cannot exist without an efficient system of

transport.[18]

The transport system broadens the market of goods and by virtue of this effect large scale production becomes possible. The transport system helps greatly in importing raw material machinery and other inputs required for efficient production. The lack of connectivity hinders the movement of working population and prevent rapid economic growth by restricting them to a limited area of occupation. Transport provides them the knowledge about new areas of activity by removing barriers of ignorance about space. The linkage of a backward region to a forward region helps the better utilisation and return of resources available.

5.7.1 Transport System of Shekhawati

In the Shekhawati region the prevalent popular means of transportation are railways and road ways.

5.7.2 Railways

The entire area of the region comes under western zone of Indian Railways. There are three railway lines passing through the region, Rewari Phullera via Rengues line runs through the eastern part of the region covering the tehsils of Neem-ka-thana and Sri Madhopur. Luhoru-Sikar line runs

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18. R. Dutt and K.P.M. Sundram, Indian Economy, S. Chand and Co. Pvt. Ltd., Ram Nagar, New Delhi, 1975, p. 545.

through the central part of the region passing through the tehsils of Chirawa, Jhunjhunu, Fatehpur, Lachhmangarh, Udaipurwati, Sikar, Danta Ramgarh and Sri Madhopur. Jaipur Churu via Sikar Rengus line passes through the western part connecting Sikar with Churu.

5.7.3 Roadways

Roadways are the most popular means of transportation in the region because of its suitability of local conditions. Roads connect all the important towns and centres of industries, mining etc. and cover almost all parts of the region except the hilly and extremely sandy areas.

All the ten tehsils townships and district headquarters are inter connected with roadways. It is only the tehsil of Khetri which has the facility of roadways only and all the rest of the tehsils are having both rail and road transportation facilities.

5.7.4 Accessibility

Accessibility is a relative term expressing inter connection between two or more than two places by any means of transportation. As a matter of fact no place is inaccessible yet the term accessibility deals with it in relation to the consumption of time, money and energy. "Accessibility is an index of the extent of transportation development in a region and provides

an instrument to measure the effectiveness of a transportation cover".[19]

Although there is no hard and fast rule to differentiate and define accessible and inaccessible points. Yet in modern times, the places lying beyond 8 kilometres from the nearest transport routes either by road itself or the railway station are supposed to be inaccessible and under 8 kilometres accessible.[20] In fact, some points are accessible by railways only while there are others which are accessible by roads only. Therefore, only a compound approach can provide the real accessibility which has been employed in the present study.

To determine the degree of accessibility of various places isocrones have been drawn throughout the region which show the following facts.

Table 5.8 Accessibility in Shekhawati

Range of accessibility (km.)	Total accessible area (sq. km.)	% to total area of the region
Less than 4	9786.65	71.64
4 - 8	2596.00	19.00
8 - 12	1162.60	8.51
12 - 16	110.75	0.81
Above 16	5.00	0.04
Total	13661.00	100.00

19. R.S. Lal, Transport, Accessibility in Lower Ghaghra Gandak Doab, The Deccan Geographer, Vol. VII, Jan-June 1969.
20. Ibid.

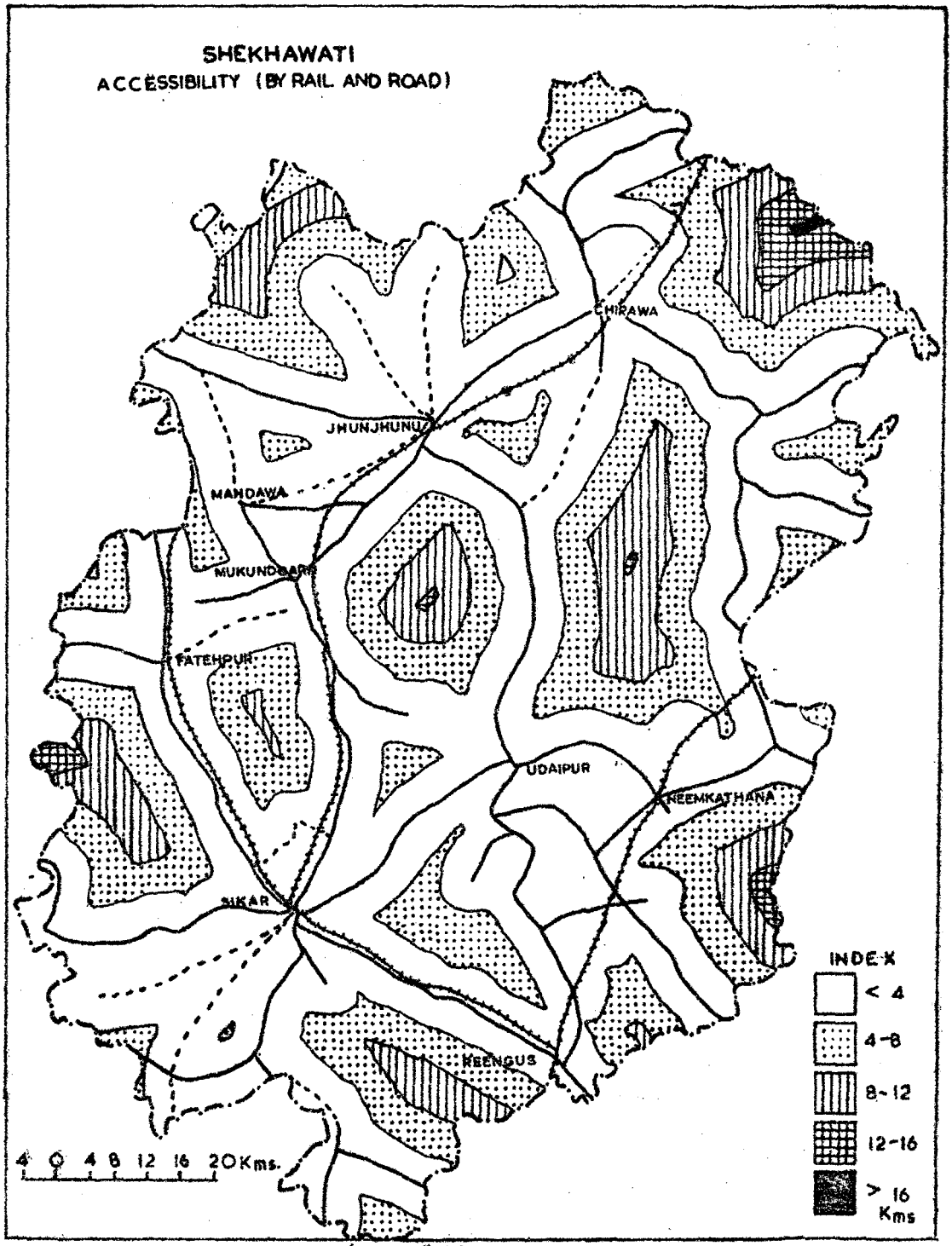
SHEKHAWATI
ACCESSIBILITY (BY RAIL AND ROAD)
CHIRAWA
JHUNJHUNU
MAHDAWA
MUKUNDGARH
FATEHPUR
UDAIPUR
KEEMKATHANA
SIKAR
KEENGUS
4 0 4 8 12 16 20Kms.
INDEX
< 4
4-8
8-12
12-16
> 16 Kms

FIG 5.12

5.7.4.1 Accessible Area

Here accessible means the areas within 8 kilometres from the nearest transport route. Thus, the area covered by 4 and 8 kilometre isochrones in the map are accessible. The data listed in table 5.8 shows that 12382.65 square kilometres or 90.64 per cent of the total area is accessible either by rail or roadways or both (fig. 5.12).

The areas covered within the isochrone of 8 kilometres are generally plain or gersey hummocky. Topography is the main factor behind the development of transport routes.

5.7.4.2 Inaccessible Area

Areas lying beyond 8 kilometres of transport route are termed as inaccessible. Such area occupy 1278.35 square kilometres i.e., only 9.36 per cent of the total area. The areas covered by isochrones of above 8 kms. are topographically sandy, hilly and rugged.

As a conclusion to the discussion of accessibility one may venture to say that major portion of this region is accessible while only 10 per cent of the area is inaccessible it should not be a serious impediment in development provided that the vehicular facilities and services are frequently available for transportation purposes.

Chapter 6

CONCLUSIONS

The present chapter is devoted to present the summary of the analysis and the main findings of the study.

The Shekhawati region has been basically a political unit under the feudal estate of Shekhawats in Rajasthan. The area at present is an administrative unit consisting of ten tehsils sprawling over about 13,661 sq. kilometres in the two districts of Jhunjhunu and Sikar. Even during the British period the Shekhawati region has been intact in its area. The region being not a well-defined areal unit requires the assessment of its regional structure and planning for socio-economic functions to achieve the optimum rationale for regional development in future.

Geologically, the region belongs to the period of Archaean age. It is characterised by closely folded consolidated rocks of Delhi system. The rocks of the region consist of Arkose quartzite, Amphibolic quartzites, schist and marble of the Alwar-series quartzite, schist slates, phyllites, limestone and calc granulites of the Ajabgarh series. The striking similarity in the formation of these rocks is that these are mostly intruded by the equidionite and granite. Besides the quartzites and granites are interspersed at several places in the upper surface. It is, however, too important to note that

towards substratum this similarity does not prevail. Other systems of rocks formations belong to Aravalli and pre-Aravalli systems.

Physiographically, the region is divided into seven geomorphic units grouped into three major physical units, i.e., Duny plain, Fatehpur Lachhmangarh riverine plain (Kantli, Mandha, Dohan and Sahibi basin) and hilly tract (central hilly and eastern hummocky region). The rivers of the region are mostly seasonal streams. Kantli is the main river of the region, but flows only during the rainy season.

Rainfall in Shekhawati is most important of all the weather elements and has foremost influence on agricultural activities because of its uncertainity, variability and scarcity. The region, broadly, experiences three seasons hot weather season, season of general rains and cold weather season.

The maximum temperature during the hot weather goes as high as 38.8 C and the minimum temperature is recorded to be 20.1 C giving an average of 29.7 C. The relative humidity remains very low. The lowest relative humidity is recorded in the month of May which is 43 per cent, whereas relative humidity is 56 per cent in the month of February. Less than 10 per cent of the total rain is received in this season.

The maximum temperature during the season of general rains is 33.8 C with a range of 11.1 C. The temperature decline because

of the onset of the rains. The weather cools down but due to high humidity weather becomes oppressive. The maximum rain is received during this season which varies from 327.7 mm in Jhunjhunu to 479.5 mm in Khetri. The rainfall received during this season accounts for more than 85 per cent of the total rainfall.

The maximum temperature of 26.3 C and minimum temperature of only 8.0 C is recorded during the cold weather season. The diurnal range of temperature is as high as 18.3 C. The relative humidity during this period slides down to 60 per cent. Though the total amount of rainfall received during this period is low as compared to the season of general rains but it is very beneficial to crops. The range of rainfall in cold weather season is recorded 4.37 to 6.80 per cent. The rainfall during this season is caused by the western cyclonic disturbances.

The soils of Shekhawati region exhibit the characteristics of desert soils like sandy in texture, reddish brown to brown and grey in colour often calcareous and subject to wind erosion. The main soil groups found in the region are : desertic soil, sand dunes and sand deposits, red desertic soils and lithosals and regosoils of the hilly terrain. The fertility and nutrient status in these soil groups vary significantly. The soils of hilly terrain are more fertile compared to the soils of desert group. The arid climate has given rise to xerophytic vegetation comprising of thorny bushes and acacias and some other trees

like Azadirachta indica and Dalbergia sissoo etc. have been introduced as planted trees.

The tehsil level density of population is high (174 persons per square kilometre) in Udaipurwati and central part of the region, while low density (111 persons per square kilometre) of population is recorded in Lachhmangarh. The literacy rate is high (25.87 and 23.5 per cent of population respectively) in the northern tehsils of Jhunjhunu and Chirawa and lowest (17.67 per cent) literacy rate has been recorded in Danta Ramgarh tehsil. Higher rural sex ratio (female per thousand males) in comparison to urban areas has been recorded, but some places have recorded high (1034 females per thousand males) urban sex ratio, e.g., Fatehpur tehsil.

The northern part of the region shows a high percentage of scheduled caste population in comparison to southern part of the region. The dependency ratio in north-west and central parts of the region is comparatively higher than other parts. It is highest in Jhunjhunu where 314 non-workers are found to be dependent on per 100 workers.

The occupational structure shows that in the whole region the proportion of workers engaged in primary sector is 74.29 per cent of the total work force followed by 16.60 per cent in tertiary and 9.11 per cent in secondary sector.

In agriculture it has been found that the net sown area has increased with the increase in level of technology.

Culturable waste land has been gradually brought under the net sown area consequently it has shown a significant decline. The distribution of culturable waste land is inversely related to the volume of irrigation (r being -0.67) and amount of rainfall (r being -0.04). Results, however, reveal that though the relationship between culturable waste land and the amount of rainfall is negative and also insignificant but the relationship with the irrigation is negative and significant, at one per cent level of significance.

It is further revealed that the area under the categories of the fallow land and the land not available for cultivation during the period have shown a declining trend, whereas the area under the forest cover shows a slight increase.

It has also been found that the distribution of fallow land is negatively correlated with each of the two variables the amount of rainfall (r = -0.32) and the irrigation (-0.03). It indicates that the growth in the area under irrigation can bring more land (presently under culturable waste land and fallow land categories) under effective cultivation. It will, in other words, bring prosperity in agricultural sector of the region.

Intensity of cropping varies from region to region. The bajra, pulses, fodder, barley, gram, wheat and rape and mustard are important crops. These crops cover more than 85 per cent of the total cropped area. The area under wheat and barley has

increased and whereas area under gram and fodder has declined.

Although it is well known fact that the crop intensity in the region increases with an increase in the level of irrigation. But, the area under study shows a weak positive correlation ($r = 0.14$). It is probably because of low irrigation development, low water table coupled with the concentration of sand dunes and hummocky patches found in the region.

Though the region is climatically semi-arid, its economy is mainly based on agriculture. An exercise of crop combination regions based on J.C. Weaver's method reveals that maximum five crops are associated in forming the crop region in the tehsil of Neem-ka-thana. The crop combination analysis shows that no monoculture is found in the area under study. The crop combinations vary from two crop combination to five crop combinations. Majority of the tehsils have recorded three crop combinations, i.e., of bajra, pulses and fodder crops. It is again interesting to note that there is only one tehsil namely Neem-ka-thana which records five crop combination. The five crops entering into association are bajra, pulses, fodders, barley and wheat. To determine the pattern of acreage response of crops the Nerlovian model has been fitted which shows that irrigation is a dominant factor, which has played an important role in these changes. It shows that the acreage response of wheat is the function of irrigation facilities in the region.

The pattern of rural settlement in the region is more regular. The settlement pattern in plain areas is close to random as the calculated R value is below one. The pattern of settlement in hummocky and hilly region and in river basins is found to be more regular than random as the R value ranges between 1.5 to 1.8. Maximum number (35.98 per cent) of settlements fall in the size groups of 500-999 persons. The chi-square test examed that the distribution of settlements is controlled by environmental conditions. An examination of the distribution pattern of the settlements according to their size class reveals that R values for these groups are 0.93 and 1.13 which reflect the distribution to be close to random and regular to random respectively.

The distribution pattern of urban settlements is found to be more regular than random, the R value being 1.21 for the urban settlements of Shekhawati.

The levels of development of the region has been identified by calculating the composite index of seven variables, i.e., literacy, percentage of workers engaged in secondary and tertiary sector, percentage of urban population, intensity of cropping and intensity of irrigation and annual rainfall (Table 6.1).

The index values of level of development vary between 5.47 to 8.95. It has been found that northern part of the region depicts moderate to high level of development, while the eastern parts of the region shows low level of development. The tehsils

Table 6.1 Index Showing Levels of Regional Development

	Literacy	Secondary	Tertiary	Urban Population	Intensity of cropping	Intensity of Irrigation	Rainfall	Composite Index
Jhunjhunu	1.16	1.10	1.17	1.82	0.95	0.99	0.83	8.10
Chirawa	1.23	0.81	0.88	1.39	1.04	0.92	0.88	7.15
Khetri	1.02	0.71	0.58	0.26	1.24	1.07	1.22	6.10
Udaipurwati	1.06	1.00	0.44	1.51	0.97	1.05	0.94	7.45
Fatehpur	0.99	1.37	1.36	1.45	0.85	1.05	0.97	8.04
Lachhmangarh	0.91	0.56	0.65	0.62	0.85	0.91	0.97	5.47
Sikar	1.05	1.29	1.84	1.99	0.97	0.94	0.97	8.95
Neem-ka-thana	0.87	0.92	1.02	0.32	1.11	1.02	1.12	6.38
Sri Madhopur	0.89	1.26	1.05	0.64	1.12	0.95	1.08	6.99
Danta Ramgarh	0.84	1.07	0.63	-	0.92	1.05	0.98	5.48

of Dante Ramgarh and Lachhmangarh show the lowest level of development.

According to the composite index the region has been divided in four sub-regions as given below (fig. 6.1 A):

1. Western sandy plains
2. North central Kantli basin
3. Eastern hilly region
4. South western undulating plains

Western Sandy Plain

It is situated in the north western part of the region. The region has scanty rainfall. It consists of three tehsils, i.e., Jhunjhunu, Fatehpur and Sikar. The main crops of the region are bajra and pulses and fodder. From the point of view of levels it is considered to be developed area. The region has got high literacy rate and high proportion of urban population. Three crop combinations are found in the region, but Fatehpur tehsil has two crop combination. The reason for its development is the location of the districts headquarters, i.e., Jhunjhunu and Sikar. The transport facilities in the region are adequate. The main source of irrigation is well. The density of population is found between 112 to 153 persons per sq. km. (fig. 6.1 B).

North Central Kantli Basin

This region covers two tehsils, i.e., Chirawa and Udaipurwati

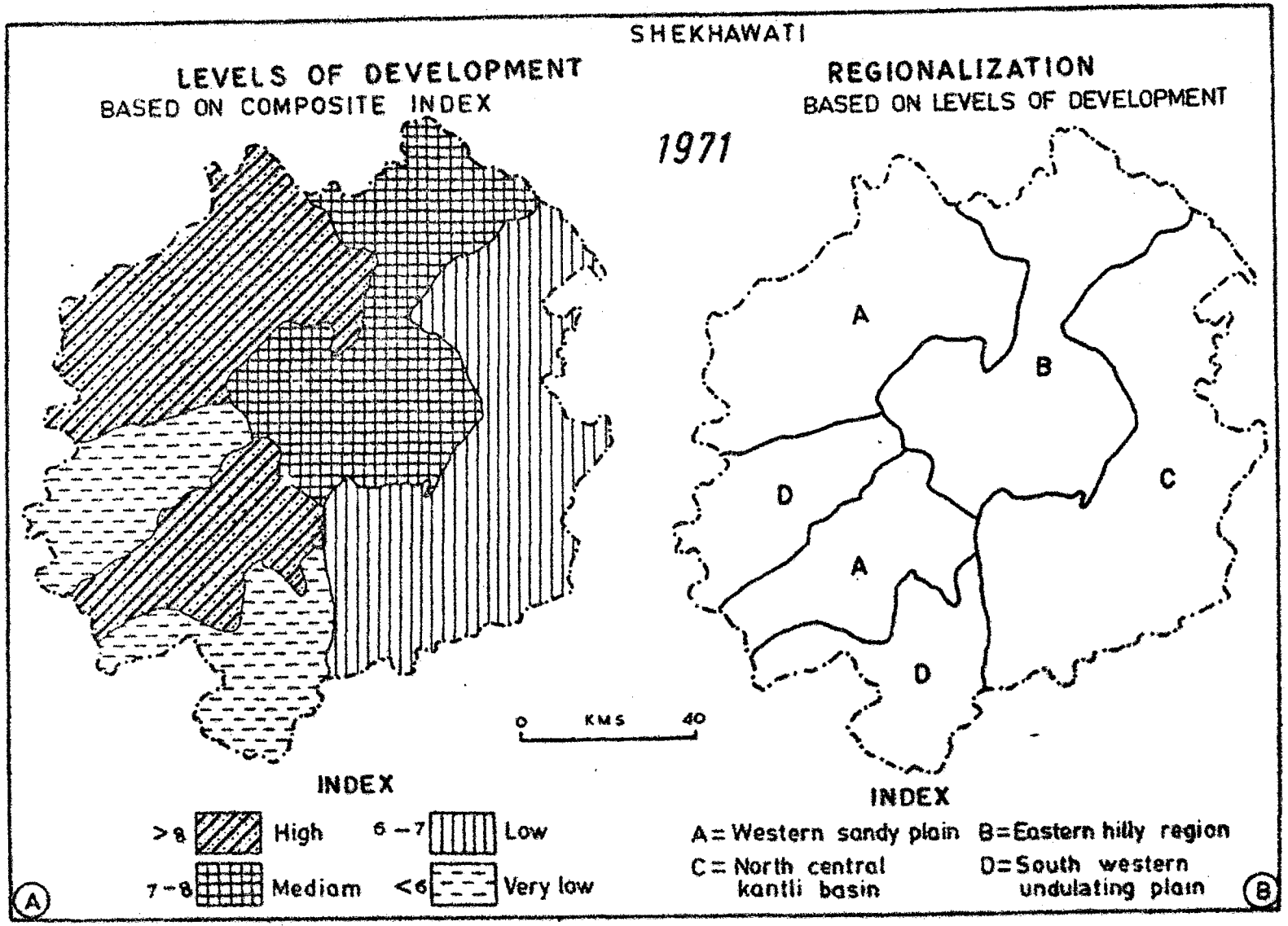
SHEKHAWATI
LEVELS OF DEVELOPMENT
BASED ON COMPOSITE INDEX
1971
REGIONALIZATION
BASED ON LEVELS OF DEVELOPMENT
A
B
C
D
A
D
0 KMS 40
INDEX
>8 High
7-8 Mediam
6-7 Low
<6 Very low
INDEX
A = Western sandy plain
B = Eastern hilly region
C = North central kantli basin
D = South western undulating plain
A
B

Fig. 6-1

The seasonal river Kantli flows in this region. The region is mostly sandy but in southern parts of the Udaipurwati, Aravalli outcrops have emerged. According to levels of development it occupies second place. The settlement pattern is found to be regular to random. The main crops are bajra and pulses. The main source of irrigation is well. The two crop combination are recorded in this region. The population density is high and ranges between 157 to 174 persons per square kilometre.

Eastern Hilly Region

It is situated in the eastern part of Shekhawati. It covers three tehsils, i.e., Khetri, Neem-ka-thana and Sri Madhopur. Aravalli outcrops are extensively found in this region. Most rivers and rivulets originate here, e.g., Kantli, Dohan and Sahibi. The rainfall is more than that of western part of the region. The main crops are bajra and pulses. The wheat and barley have also emerged as important crops with the development of irrigation. In this region cropping pattern is more diversified. Neem-ka-thana has five crop combination. The population density is found to be between 133 to 165 persons per square kilometre. The literacy rate is low (18.31 to 18.91 per cent) in Sri Madhopur and Neem-ka-thana.

South West Undulating Region

This is situated in the south western part of the region. It consists of two tehsils Danta Ramgarh and Lachhmangarh. Most

of the part is sandy, though some outcrops can be seen in Danta Ramgarh. Its level of development is low. The literacy rate is low (17.67 to 19.14 per cent) and proportion of urban population is also low (12.48 per cent). The plain is undulating and interspersed by hills. The density of population varies between 111 and 146 persons per square kilometre. There is only one urban centre in this region. This shows that the region is not equipped with the necessary socio-economic infrastructure to which the level of the development of the region is highly correlated with.

Appendix 4.1 Crop Combination Regions Jhunjhunu

	Monoculture	Two Crop Combination		Three Crop Combination		
Theoretical base on	100.00	50.00	50.00	33.33	33.33	33.33
Strength of Element	46.60	46.60	34.07	46.60	34.07	19.33
d	53.40	3.40	15.93	-13.27	-0.74	14.00
d^2	2851.56	11.56	253.76	176.09	0.54	196.0
d^2	2851.56	265.32		372.63		
d^2/n	2851.56	132.66		124.21		

Appendix 5.1 Proportion of Labour Force in Selected Economic Activities (1971)

Name of Towns	Cultivators	Agricultural Labour	Livestock	Mining	Manufacturing	Construction	Trade and Commerce	Transport	Other Services
Ramgarh	16.67	12.18	1.32	0.46	18.32	9.27	19.31	3.92	18.29
Fatehpur	18.35	2.11	1.65	0.73	19.68	17.16	16.44	5.10	18.73
Lachhmangarh	15.81	7.35	0.68	-	20.44	11.31	23.05	2.23	21.27
Sikar	6.41	1.99	0.30	0.01	18.28	12.8	25.81	6.73	27.79
Neem-ka-thana	13.78	9.50	0.31	0.13	15.0	4.24	21.74	4.04	31.18
Sri Madhopur	4.50	2.31	1.81	0.04	27.05	6.36	28.01	5.36	24.68
Khandela	14.93	5.85	1.57	0.22	35.91	4.95	20 .66	2.89	12.97
Bagar	28.12	6.03	0.29	0.21	20.71	5.30	11.26	3.27	5.15
Jhunjhunu	14.16	3.98	0.30	0.34	17.27	9.43	19.27	5.61	29.61
Mendawa	22.21	8.79	0.56	0.09	26.42	7.39	15.34	3.50	15.66
Bisau	26.09	7.15	0.53	0.24	20.54	3.47	14.06	3.38	21.94
Pilani	10.98	5.72	1.18	0.34	15.59	9.73	14.61	4.60	37.18
Vidya Vihar	0.88	-	0.66	-	5.98	0.14	4.50	2.29	85.51
Surjgarh	18.57	2.02	1.75	0.13	27.14	8.52	19.16	4.28	18.39
Chirawa	14.58	6.86	0.96	0.14	19.40	6.72	22.74	5.72	22.53

Appendix 5.1 cont'd.

Khetri	9.35	1.02	0.30	14.86	10.57	7.71	16.14	8.27	32.69
Nawalgarh	13.29	4.86	2.25	0.03	22.72	8.65	22.53	3.57	22.05
Udaipur	48.96	7.28	1.83	0.25	14.34	3.32	11.60	0.22	12.15
Mukundgarh	15.30	13.32	1.37	-	23.73	6.05	16.79	2.76	20.64
Average Region	16.48	6.02	1.04	0.97	19.96	7.51	17.51	4.09	25.22

Appendix 5.2 Growth of Towns Size from 1901 to 1971

Towns	Year	Population	Class	Decline Growth in %	Average growth in % before and after 1951
Sikar	1901	21523	III	-	
	1911	22317	III	3.68	
	1921	21080	III	-5.54	
	1931	26297	III	24.74	
	1941	32334	III	22.95	
	1951	44140	III	36.51	11.45
	1961	50630	II	14.70	
	1971	70987	II	40.20	30.47
Fatehpur	1901	16393	IV	-	
	1911	17294	IV	5.49	
	1921	17315	IV	0.12	
	1931	19505	IV	12.64	
	1941	23253	III	19.21	
	1951	26751	III	15.05	9.36
	1961	27039	III	1.07	
	1971	34929	III	29.18	15.09
Jhunjhunu	1901	12279	IV	-	
	1921	11950	IV	-9.92	
	1911	13266	IV	8.00	
	1931	14272	IV	19.43	
	1941	16874	IV	18.23	
	1951	20637	III	23.30	8.93

Jhunjhunu	1961	24962	III	20.95	
	1971	32024	III	28.29	24.18
Nawalgarh	1901	12315	IV	-	
	1911	14059	IV	14.16	
	1921	12570	IV	-10.59	
	1931	16902	IV	34.46	
	1941	20620	III	18.03	
	1951	26679	III	29.38	14.05
	1961	24911	III	-6.62	
	1971	20565	III	6.63	9.79
Lachhmangarh	1901	10176	IV	-	
	1911	10828	IV	6.40	
	1921	10353	IV	-4.38	
	1931	12839	IV	24.01	
	1941	15044	IV	17.17	
	1951	18748	IV	24.62	10.80
	1961	18484	IV	1.40	
	1971	22154	III	19.87	15.29
Chirawa	1901	7065	V	-	
	1911	7979	V	12.93	
	1921	7992	V	0.16	
	1931	9566	V	19.69	
	1941	11640	IV	21.68	
	1951	11667	IV	0.23	13.61
	1961	12929	IV	10.80	
	1971	15241	IV	17.89	9.64

Ramgarh	1901	11023	IV	-	
	1911	11556	IV	4.83	
	1921	11479	IV	-0.66	
	1931	13073	IV	13.88	
	1941	13202	IV	0.98	
	1951	13079	IV	-0.93	4.75
	1961	13956	IV	6.70	
	1971	15068	IV	7.96	5.57
Pilani	1901	-	-	-	
	1911	-	-	-	
	1921	-	-	-	
	1931	-	-	-	
	1941	-	-	-	
	1951	11194	IV	-	-
	1961	11565	IV	3.31	
	1971	13101	IV	13.28	8.29
Khandela	1901	9156	V	-	
	1911	8205	V	-10.38	
	1921	6990	V	-14.80	
	1931	9101	V	30.20	
	4941	9484	V	4.20	
	1951	7791	V	-17.85	2.30
	1961	11765	IV	51.00	
	1971	12500	IV	6.24	13.13

Udaipur	1901	8638	V	-	
	1911	7743	V	-10.34	
	1921	6441	V	-16.81	
	1931	7144	V	10.91	
	1941	7510	V	5.12	
	1951	8687	V	15.67	2.78
	1961	9723	V	11.92	
	1971	12442	IV	27.96	18.78
Neem-ka-thana	1901	6741	V	-	
	1911	5946	V	-11.79	
	1921	5547	V	-6.71	
	1931	6150	V	10.87	
	1941	6967	V	13.28	
	1951	6244	V	-10.37	1.41
	1961	10263	IV	64.36	
	1971	11612	IV	13.14	22.37
Bisau	1901	7726	V	-	
	1911	6838	V	-11.49	
	1921	6941	V	1.50	
	1931	7735	V	11.43	
	1941	8472	V	9.52	
	1951	7802	V	-7.90	2.74
	1961	-	-	-	
	1971	10417	IV	33.51	12.80

Sri Madhopur	1901	6892	V	-	
	1911	6738	V	-2.23	
	1921	6699	V	-0.57	
	1931	6995	V	4.41	
	1941	7693	V	9.97	
	1951	8278	V	7.60	2.89
	1961	11555	IV	39.58	
	1971	10294	IV	-10.90	12.09
Mukundgarh	1901	-	-	-	
	1911	-	-	-	
	1921	-	-	-	
	1931	-	-	-	
	1941	-	-	-	
	1951	6343	V	-	-
	1961	8144	V	28.39	
	1971	10154	IV	24.68	26.53
Mandawa	1901	5165	V	-	
	1911	5336	V	3.31	
	1921	5630	V	5.50	
	1931	6956	V	23.55	
	1941	7895	V	13.49	
	1951	8195	V	3.76	11.46
	1961	8290	V	1.19	
	1971	9851	V	18.82	7.92

	1901	5243	V	-	
	1911	5992	V	14.28	
	1921	5349	V	10.73	
Surjgarh	1931	6082	V	13.70	
	1941	6829	V	12.29	
	1951	6636	V	-2.82	12.74
	1961	8101	V	22.07	
	1971	9780	V	20.72	13.32
	1901	8537	V	-	
	1911	7125	V	-16.53	
	1921	6039	V	-15.24	
Khetri	1931	7378	V	22.17	
	1941	8727	V	18.28	
	1951	7148	V	-18.09	2.17
	1961	8058	V	12.73	
	1971	8669	V	7.58	0.74
	1901	-	-	-	
	1911	-	-	-	
	1921	-	-	-	
Vidyavihar	1931	-	-	-	
	1941	-	-	-	
	1951	-	-	-	-
	1961	5464	V	-	
	1971	6958	V	27.34	27.34

	1901	-	-	-	
	1911	-	-	-	
	1921	-	-	-	
Bagar	1931	-	-	-	
	1941	-	-	-	
	1951	5837	V	-	
	1961	7174	V	22.00	
	1971	6834	V	-4.00	9.00

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