

## Chapter 2

# Ecological Context: The Environment of Western Rajasthan

### **Introduction**

The purpose of this chapter is to outline the main features of the environment of western Rajasthan. The emphasis will be on the macro-environment, setting the broad context, although, where appropriate, I will point out the specific features of my field area. I will also provide a brief account of human occupation and land use.

### **The Thar Desert**

Rajasthan is situated in north-west India [Map 1] and has borders with the Punjab in the north, with Haryana, Uttar Pradesh and Madhya Pradesh in the east, with Gujarat in the south and with the Pakistani Province of Sind in the west.

During the British period the area was known as Rajputana (the land of the Rajputs) and consisted of twenty-two states ruled by Rajas and Maharajahs. Apart from Ajmer-Merwara, which they ruled directly, the British employed a system of indirect rule, controlling external affairs, but allowing (for the most part) the Rajput rulers to control the internal affairs of the states. The various Rajput kingdoms were formally abolished and joined together into the United State of Greater Rajasthan in 1949, two years after Indian Independence.

Rajasthan can be roughly divided into two more or less distinct geographical parts [Map 2]. The Aravalli Mountains (running roughly from the north-east to the south-west) are the important dividing line between the Thar Desert on the west and the more fertile east.

Much of the literature talks about the Indian Desert, or the Rajasthan Desert. Very few writers explicitly acknowledge the fact that eastern Pakistan is part of the same desert. Generally the terms Indian Desert, Thar Desert or Rajasthan Desert are used quite inconsistently in the literature. McGinnies (1979) gives an account which transcends the political boundaries. He describes the Thar Desert (meaning the

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contiguous Indo-Pakistan desert) as part of the afro-asiatic desert belt which stretches from the Sahara to the Thar.

I use the names Thar Desert and Indian Desert to refer to the contiguous Indo-Pakistan desert and the term Rajasthan Desert to refer to the part within Rajasthan. This study concentrates on the part of the desert on the Indian side of the border.

The Aravalli Mountains, for most purposes, can be described as the eastern boundary of the Indian Desert, although the exact boundaries are disputed depending on how deserts and arid zones are defined. In the west the desert reaches almost to the Indus river in Pakistan.

Between the eastern and western extremes, the main geographical feature is the basin of the Luni River (literally, the salt river). The Luni rises in the Aravalli hills and runs south-west into the Greater Rann of Kutch. To say it runs is merely conventional, as there are no permanent rivers in western Rajasthan. Usually there is little water in the Luni, and even when there is it quickly dissipates in the sands of the desert. The area of the Luni Basin is 57,000 square kilometres and the total length of the river is 805 kilometres (Kaul and Thalen 1979).

The Rajasthan Canal is one very major artificial geographical feature with significant implications to the ecology of western Rajasthan. The construction of the canal commenced in 1958. The major construction work has now been completed. The canal was planned to service the north-western parts of Rajasthan near the Pakistan border. Sen, writing in 1982, stated that the canal would have substantial benefits, apart from the obvious benefits to agriculture, in that a strip 300m wide along the canal would be 'planted over with grasses and trees for the binding of sand and to provide food for livestock and trees for fuel and shade' (D.N. Sen 1982:43).

At the time I completed my fieldwork in 1987 the project, which includes many kilometres of feeder canals, was incomplete. However, the impact in terms of increased irrigation and improved grazing had been felt for some time in some areas. One drought relief project in 1985 involved cutting grass near the canal and shipping it for sale in Bikaner District.

The area to the west of the canal (towards Pakistan) was expected to benefit most, because of natural slope. Some lifts were included in a revised form of the project to provide water to some areas to the east (Khanna 1983). However, as these are relatively small scale most districts on the eastern side were expected to receive no direct impact. (This includes Jodhpur District.) There has been some political debate about the emphasis on agriculture, which favours the western side of the canal. In 1983, state opposition politicians were arguing that greater emphasis

should be placed on improving grazing facilities. This was linked to the discussion of lifts and maximising benefits to the east of the canal (Khanna 1983).

While agriculture in my field area has remained monsoon-based and has not been affected by the canal, there seemed possibilities for a spin-off for pastoralism. In 1987 it seemed that the development of good grazing lands to the west could provide an alternative goal for herd migration and could significantly reduce the impacts of drought on livestock. However, long term effects on the impacts of the canal remain to be seen and detailed study of impacts remains necessary. (I have made some tentative observations on the impact of the canal up to 1994 in the Afterword.)

Geomorphologically, the Indian Desert consists mostly of plains, with some areas of sand dunes and low hills (McGinnies 1979). Singh and Ghose (1980) identify two major zones of sand dunes in western Rajasthan, covering 58 per cent of the area. Generally the soil is sandy, of low fertility (high mineral and low organic content) and improves towards the east and north-east (Kaul and Thalen 1979).

At first sight much of the Indian Desert does not look like the popular conception of a desert at all. Even in Jaisalmer District, where the average population is very low (according to Sharma, 1972, it was four people per square kilometre in 1961) it is difficult to go very far without seeing people or villages. The common perception, within India, of Jaisalmer District as having a low population seems odd to those who think of low population density in terms of the Sahara or Central Australian Deserts. In Jodhpur District the population density is much higher being 73 persons per square kilometre for the entire district and 48 per square kilometre for rural areas in 1981 (Census of India 1981a). There were 705 inhabited villages. As the total area of the District was 22,850 square kilometres this gives each village an average area of 32.4 square kilometres.

A second feature which makes the word desert seem odd is that much of the land is cultivated (at least during the monsoon) and fields often less than a hectare in area are usually clearly marked by thatched fences or raised ridges of soil. Sometimes these ridges are deliberately constructed. The unintended effects of the role of man in this desert are highlighted by the way in which sand dunes sometimes follow the boundaries of fields. Sand is blown against thatched fences or raised ridges and gradually (presumably over centuries) the level rises. New thatched fences are placed on top of the new ridge of sand and the process continues.

The popular notion of a desert as an arid, poorly populated waste land needs to be reconsidered in the context of the Indian Desert. Aridity is the only element of this sort of definition which is evident. From a

geographer's point of view aridity and other climatic factors are of central concern in defining a desert.

## **Climate**

### *(a) Rainfall and Moisture*

Apart from the physical features of the land itself, the most important characteristic of the Indian Desert is its climate, which is itself characterised by very low rainfall. Whether it should be defined as arid or semi-arid depends on the criteria used.

Degrees of aridity can be defined in a number of different ways. The most simple approach is to take mean annual rainfall as the criterion. Le Houerou (1970) argues (in reference to North Africa) for this approach. He regards areas with less than 100 mm of rain per year as desert; areas with between 100 and 400 mm per year are classified as arid; areas with more than 400 mm per year are semi-arid, semi-humid or humid.

All attempts at definition revolve around mean annual rainfall. Many authorities, however, regard this as an inadequate indicator in itself. Thornwaite (1948) developed an aridity index which measured the amount of water effectively available for plant growth. The index was calculated on the basis of the relationship between mean annual precipitation and the potential for evaporation and transpiration due to temperature, soil type, wind and other factors.

Meigs (1953) followed Thornwaite's approach in producing a series of climatic maps for UNESCO. He admits that the problems of climatic classification are considerable. In a footnote he points out that some writers have called for the abandonment of complex formulae for defining arid areas, and for a return to simple criteria. Meigs replies that the world itself is complex.

Meigs divides dry climates into arid and semi-arid (which, he says, coincide with the common usage of desert and steppe). Arid lands are unsuitable for agriculture, whereas some agriculture is possible on semi-arid lands. Within the arid category it is possible to distinguish extreme aridity. His criteria for defining aridity and semi-aridity are based on the moisture index developed by Thornwaite.

Debates about definition are often not very helpful. For my purposes it is not necessary to take sides. The types of criteria used in defining the boundaries of arid and semi-arid areas can obscure the fact that there are environmental differences within the categories arid or semi-arid. Broad systems of classification are useful in constructing global models, but at the micro-level it is more useful to describe environments than to categorise them within broad types.

For convenience (and following common usage) I will continue to treat the Aravalli Mountains as the eastern boundary of the Thar Desert. Generally speaking, between the Aravalli Mountains and the Pakistan Border rainfall is very low in the west, around the Pakistan border and increases towards the east. Most of the rain which falls is monsoonal and 90% of all rain falls between June and mid-September (Pisharoty 1980).

McGinnies describes the Thar Desert as

... a transition zone between major wind belts. . . . The monsoon movement of moist air terminates in Western India, resulting in a small and irregular rainfall in the Thar. (1979:11)

Pisharoty (1980) describes the dry, stable mass of air over the area which limits the action of convective currents. This type of phenomena is one of the general causes of aridity described by McGinnies.

The general trend of an increase in average rainfall from west to east means that the status of Jodhpur and Jodhpur District is described as arid on the Thornwaite/Meigs criteria or as semi-arid on the criteria used by Bharucha (1955). The mean annual precipitation at Jodhpur is 362 mm (Kaul and Thalen 1979). Within Jodhpur District a shift in mean annual precipitation is evident, following the wider trend of increase from west to east. Useful figures are not consistently available for smaller towns and are not available at all for villages. Nevertheless examination of a map in Sen (1972) indicates that the villages in my field area fall at the upper end of the range between the 300 and 400mm isohyets.

Low average annual rainfall is an important characteristic affecting human ecology and adaptive strategies. However it is the combination of low average with irregularity which is most critically important. This point is fundamental to the argument in this book. Pisharoty has surveyed the literature and concludes:

There have been several studies looking for a systematic change in the rainfall over these parts during the last hundred years, for which some rainfall records, although not strictly homogeneous, are available. The general conclusion is that there are no systematic trends, and that the rainfall variations have been practically stochastic. Power spectrum analysis have [sic] shown several peaks with several periodicities; but they have been found to be of no forecasting value. Decade rainfall means have not remained the same; they have shown fluctuations; but none that could be anticipated. (1980:42)

Krishnan, Ram Krishna and Rao (1980) examined rainfall data for a number of different stations in western Rajasthan for the period 1901 to 1970. They found that there were two periods when large deficit rainfall

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was particularly common. These periods were 1901-1920 and, at the other end of the sample period 1961-1970. There was a trend of decreasing rainfall in areas with less than 300mm averages from 1962-1971. However the overall fluctuations were seen as being a result of the randomness and unpredictability of rainfall.

The occurrence of drought in Jodhpur Tehsil (sub-district) between 1901 and 1908 has been analysed in a paper provided to me by the Collector's office in Jodhpur (Collector's Office, Jodhpur n.d.<sup>1</sup>). The paper classifies drought years in terms of the aridity index calculated for each year. A negative aridity index represents a statistically average or better than average year and is defined as a year of no drought. Years with a positive index of aridity (that is, greater than statistically normal aridity) are classified, in increasing order of severity, as years of moderate, large, severe or disastrous drought. The analysis shows that there was drought of one kind or another in 44 years while 36 years were drought free. In other words there was drought in 55% of the 80 years in the sample. (See Table 2.1 for a summary of this information.)

**Table 2.1**  
**Occurrence of drought by severity in Jodhpur Tehsil 1901-1980**

<i>Classification</i>	<i>No. of Years</i>	<i>% age</i>
No drought	36	45
Moderate	18	22.5
Large	13	16.25
Severe	13	16.25
Disastrous	0	0
Total 80		

Two further points about the pattern of monsoon rainfall are important. Firstly there are large variations within comparatively small areas, even within districts. For example, in 1943, the then Famine Minister of the erstwhile Marwar state (roughly equivalent to modern Jodhpur District) gave the annual rainfall averages for various centres within the District (Table 2.2).

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<sup>1</sup> This paper was an extract from a roneoed report entitled *Identification of the Drought Prone Areas in the District Jodhpur*. No publication or authorship details were provided.

**Table 2.2**

**Rainfall averages for various cities in Marwar**

(From Singh 1943:3-4)

Bali (South)	19.65 inches
Phalodi (North West)	9.93 inches
Bilara (East)	19.49 inches
Jodhpur	13.92 inches

The second feature is that the actual annual rainfall in each location varies widely and unpredictably. Furthermore there is a great variation in the pattern of rainfall within a given year - it is not always spread conveniently over the normal monsoon months.

Singh sums it up neatly. Regarding the *kharif* (monsoon) crop he says:

. . . four showers of about 2 1/2 inches each at proper intervals is quite enough. But this is too much to expect of nature. (1943:4)

An indication of the great extremes is that occasionally there are floods in western Rajasthan, centred on the Luni Basin. Although floods are rare, there were serious floods in July 1979 (Kolarkar, Choudhari and Dhir 1981). The floods resulted from 4-5 days of very heavy rain in the Upper Luni catchment. In some places between 600 and 920 mm of rain fell in the period. The result was unprecedented flooding which rendered 160,000 ha of land infertile.

In other words, rainfall is highly variable and unpredictable. A consequence of this irregularity is that famine is common and, like the rain, unpredictable. This is a basic fact that farmers and pastoralists have to come to grips with.

*(b) Other Climatic Features*

In addition to low and unpredictable rainfall the climate of western Rajasthan has the following characteristics:

- (1) Extremes of temperature. The temperature during the summer is very high. In winter months temperature falls considerably and night time temperatures are particularly low. The change in temperature is rapid due to 'the dryness of the atmosphere and lack of vegetation' (D.N. Sen 1982:33). The annual cycle of seasons is quite marked. The cold season lasts from December to February. In March the warm weather starts, cooling somewhat when the monsoon starts (hopefully) in July. The monsoon may last from July to early September. Then, following a few more hot weeks,

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the weather starts to cool again. Sen (1982:36) gives mean and maximum temperatures, on a monthly basis, for a number of stations in Rajasthan. Table 2.3 summarises some of this information for Jodhpur, Bikaner and Jaisalmer. In each case the hottest month is May and the coldest month is January.

- (2) Humidity. Throughout western Rajasthan the humidity is highest during the monsoon months and lowest during the hot period March to May (D.N. Sen 1982).
- (3) Wind. During the period March to May there are frequent dust storms. Wind is environmentally significant for two reasons. Firstly, it is an agent of erosion. Secondly, it encourages evaporation of surface moisture and is thus important as an aspect of the aridity index.

**Table 2.3**

**Mean maximum and mean minimum temperatures  
at Jodhpur, Bikaner, Jaisalmer in degrees centigrade**

	<i>Jodhpur</i>	<i>Bikaner</i>	<i>Jaisalmer</i>
Full year-			
mean max	33.2	33.3	33.6
mean min	19.2	20.2	18.7
Hottest month ( <i>May</i> ) -		( <i>June</i> )*	
mean max	40.8	41.7	42.8
mean min	26.3	29.4	26.8
Coldest month ( <i>Jan</i> ) -			
mean max	24.6	22.1	23.8
mean min	9.2	8.3	8.9

\* In Bikaner the mean maximum temperature in June equals the mean maximum temperature for May. However the mean minimum (29.4°C) is higher in June than in May (27.7°C)

Source: Abstracted from D.N. Sen (1982:36)



## **Fauna**

In this section I intend to give only a very brief summary of the natural fauna of the Indian Desert. Domesticated livestock and crops will be dealt with later. Natural flora will be dealt with in the chapter on agropastoralism, mainly in terms of use as fodder. A detailed study of the flora of the Indian Desert has been published by D.N. Sen (1982). Despite the heavy human population there is considerable variety of fauna. The following account is based both on my own observation and on a monograph by Prakash (1977).

There are numerous varieties of insects, including scorpions. There are many varieties of reptiles, including both lizards and snakes. The most common venomous snakes are the cobra, the krait and the *phoorsa*, or saw-scaled viper. There are also several non-venomous species. The entire desert is rich in bird life, the peacock (Rajasthan's state symbol), the partridge and the vulture being particularly common.

There are also large numbers of mammal species. In a survey carried out between 1953 and 1956, Prakash (1964) collected 38 species and subspecies. Up until twenty or thirty years ago some larger carnivores such as the leopard were found, according to accounts by my informants. Hyenas, wolves and foxes and some smaller species of feline, including the caracal and desert cat, are still found.

The numbers of deer and antelopes have been greatly reduced due to the activities of hunters and poachers. Nevertheless it is possible to find nilgai, blackbuck and chinkara in many areas, particularly where there are members of the Bishnoi caste in the area. Protection of all life is a tenet of the Bishnoi sect and the theme of many encounters between the Rajputs (who tend to see hunting as part of the Kshatriya role) and the Bishnois. I will return to this point later.

## **Human Occupation of the Thar Desert**

Human occupation has been a factor in the environmental history of western Rajasthan since palaeolithic times. The evidence about palaeolithic and mesolithic man in the Indian Desert is covered by Allchin *et al.* (1978) and, briefly, by Dhir (1982). It is sufficient to say that evidence has been found of cultures dating at least to the middle palaeolithic. Allchin *et al.* argued that mesolithic cultural remains found in western Rajasthan are probably the products of pastoral nomads who penetrated the desert. For much of its human history western Rajasthan's population probably consisted of pastoral nomads.

The Indus valley (Harappan) Civilization flourished in what is now Pakistan and north-western India from about 2500 BC until it was

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destroyed by the Aryan invaders in about 1500 BC (Wheeler 1950). The Pre-Harappan and (later) Harappan cultures extended into Rajasthan along the rivers of the north-western parts of the modern state, especially on the banks of the no longer existing Ghaggar river (Dhir 1982). However, there is no evidence of the Harappan culture spreading to the south away from the rivers and apparently the more arid areas to the south remained accessible only to pastoral nomads and hunter-gatherers (Dhir 1982).

The first major wave of immigrants moved south of the main rivers in the fourth century BC (Dhir 1982). The influx was largely of people from the Indo-Gangetic plains fleeing from waves of invaders, including the Greeks under Alexander (Dhir 1982) and, later, the Huns (Dhir 1982; Sharma 1972).

Despite the predominance of pastoral nomadism as the main economic adaptation, small scale agriculture began relatively early. Dhir (1982:325) suggests that agriculture was probably practiced continuously in Rajasthan following the movement of settlement away from the rivers (about 400 BC). Dhir examined a Gazetteer of Marwar compiled by Muhnot Nainsi between 1658 and 1662 (Nainsi 1968-1974).<sup>2</sup> On this evidence Dhir showed that selected villages in the Phalodi area (in the north west of Jodhpur District) had cultivated land averaging 1.5 ha per household in the period covered by Nainsi's data. Dhir points out that the holding size is very small and that agriculture must have been carried out in combination with pastoralism. Elsewhere, in Merta, agriculture seems to have been much more substantially established at the same time. According to Nainsi there were 6500 wells in use in Merta at the time.

### **Environmental History**

McGinnies, in reference to the claims of some authors that the Indian Desert ranges from the Aravalli to the Sind in Pakistan, expresses some doubt

. . . as to how much of this area is naturally arid and how much of this arid appearance has resulted from the activities of man. (1979:11)

The question as to whether the desert is natural or man-made is of obvious relevance to this study. There are two sub-issues: (1) is there evidence of recent origin for the Thar? (2) is there evidence of recent desertification (the transformation of arable land into desert)?

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<sup>2</sup> Nainsi was the Diwan (Finance Minister) of Maharajah Jaswant Singh of Jodhpur from 1658 to 1666. For a discussion of Nainsi's work see Bhati (1979).

A number of authors claim that aridity in western Rajasthan is of comparatively recent origin in terms of geological time. Wadia (1960) suggests that aridity was a post-glacial phenomenon. Wheeler (1950) states that the present desert was wooded, marshy and even inhabited by elephants and rhinoceros about 4000 to 5000 BC. He argues that drier conditions gradually developed until desert conditions were established by 1,000 AD and that human behaviour and land use were partly responsible for this change. Bharucha (1955) also claims that the desert is mainly man-made. A recent date for aridity caused by over exploitation of vegetation is supported by Bryson and Baerreis (1967).

There is no doubt that there have been some very significant environmental/geographical changes in comparatively recent times. Allchin, Goudie and Hegde (1978) point out that there were three main river systems in northern India during the late Pleistocene and Early Holocene geological eras. These were the Indus, the Saraswati and the Ganga. At that time the Jamuna flowed into the Saraswati, not the Ganga. By about 1000 BC the Jamuna had changed path and flowed into the Ganga, and by 1300-1500 AD there was no Saraswati at all. These changes were caused, according to Allchin *et al.* by geological changes, not by increasing aridity. This is not to deny that aridity has also increased.<sup>3</sup>

In their comprehensive survey, covering geological evidence and archaeological evidence, Allchin *et al.* (1978) conclude that the Thar is an ancient phenomenon, not a post glacial one. From the analysis of data collected from desert areas in both India and Pakistan, they put forward a picture of a series of alternating wet and dry phases. The oldest identified phase was a major dry phase just before the middle paleolithic period. This was followed by a major wet phase (characterised by humid climate, dune stability, grasslands and through-flowing rivers) beginning possibly less than 40,000 years ago. Sometime before 10,000 years ago there was a further dry phase. Another relatively moist phase, beginning about 10000-9500 years ago, followed this. The current dry phase is, if all this is correct, part of a cycle.

All of this supports the view that the Indian Desert was humid at about the time of the Harappan civilisation (2500-1500 BC), but it differs from accounts which see the desert as a late development in that the basic desert geomorphology is dated much earlier. While some human impact

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<sup>3</sup> Whether the decline of the Saraswati can be attributed to changes to the geological structure of the region, or to increased aridity (due to lower rainfall) there is no doubt that the decline of the Harappan city of Kalibangan in northern Rajasthan is directly associated with changes to the river system. Kalibangan was built on the edge of the river Saraswati (now known as the Ghaggar) and was apparently abandoned when it dried up.

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on the ecology of the modern desert is not ruled out, the analysis by Allchin *et al.* suggests that the Thar is essentially a 'natural' desert.

In a review of the literature on this issue Dhir (1982) concludes that . . . after traversing the length and breadth of the western arid zone of Rajasthan I have not come across any soil formation characteristic of a humid environment, even on landscapes that have remained stable during late Pleistocene climatic fluctuations... It appears, therefore, that the humidity of the late Pleistocene and Holocene could not have been as high as had been made out. (1982:315)

This supports the view that the desert is not a new phenomenon, but does not support the view that there have been major and cyclical climatic variations. Dhir acknowledges that there may have been more moisture at some stages in the past but believes this has been exaggerated. In other words the area has remained more or less arid.

A related question is whether or not there have been major environmental changes in the present century. Mann, Malhotra and Kalla (1974) examined the common view that the Rajasthan Desert is expanding in terms of parameters such as land use capabilities, crop yield and water availability. They concluded that there is no conclusive evidence of an advancing desert, but warned of future risks. Sen and Mann (1977) state that the question is open, although some features suggest that the desert is not expanding. But, importantly, they point out that conditions within the desert itself are deteriorating. This picture of a desert which is getting worse, but not bigger, is further supported by an interpretation of geomorphological evidence by Ghose, Singh and Kar (1977).

Jodha (1980) regards the 'march of the Rajasthan desert' as an unsettled question, but supports the consensus view that desert conditions themselves are getting worse. He lists a number of factors as demonstrating declining conditions. Factors identified include:

- growth of waste lands due to the covering of soil by sand dunes or the loss of topsoils;
- drying up of wells;
- increasing salinity of water;
- reduced crop productivity.

Jodha sees the changes as being the result of changing land use patterns, particularly associated with the implementation of land reforms (1980, 1985, 1987). I will return to this point in Chapter 5.

In summing up this section, there are some broad conclusions:

- The evidence that the origin of the Thar Desert is a product of human activity is highly doubtful. Some researchers in palaeogeography (e.g. Dhir) suggest that the region has been essentially arid for a very long time. Other research (Allchin *et al.*) suggests that the aridity is natural, environment having gone through major fluctuations not attributable to human activity.
- While the size of the desert may not have increased in the present century, there is considerable evidence that environmental conditions have been getting worse and that the major reason for the decline is associated with human factors - especially increasing land use.

### **Famines**

The result of the extreme unpredictability and unreliability of rainfall in western Rajasthan is that subsistence is risky. At worst it may lead to famine. It is important, however, to remember that drought is not necessarily famine. Drought is a failure of rainfall; famine is a failure of subsistence. Drought is determined by climatic conditions; famine does not necessarily follow from conditions of drought. Food shortage may be ameliorated by transfer of food from other areas, or famine may occur in a situation of overall food surplus.

As this study is centrally concerned with responses to famine and strategies intended to avoid the worst consequences of famine, it is important to put the incidence of famine in historical perspective.

At least from Mughal times some of the Rajput states have had a degree of centralised administration which collected data on income from the various fiefs and which kept records on land grants, taxes and major events, including famine. By the later part of the nineteenth century administration was on a fairly firm footing, with annual reports being prepared by the governments of the various states. Many of the older records are still extant, although the task of cataloguing has not yet proceeded very far. Nevertheless there are a number of reports written in the twentieth century by officials or Ministers of the Government of Jodhpur state which summarise the incidence of famines in Rajasthan from the beginning of the nineteenth century or earlier. There is scattered evidence of famines in Rajasthan at least as far back as what Sharma (1972) calls the Proto-Rajput Period (400-1200 AD). A study of the history of famines in Rajasthan by Kachhawaha (1985) contains a discussion of famines in this period.

Rajasthanis classify famines into four types: *trinkal*, a famine involving fodder shortage; *annakal*, a famine involving grain shortage;

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*jalakal*, a famine involving water shortage and *trikal*, a treble famine, involving shortage of grain, fodder and water (Kachhawaha 1985).

In a report on the Jodhpur Government's Famine Relief Programme, Kothawalla (1939) lists twenty-one famines which occurred from 1804 to the time of his writing. There are some inconsistencies between his account and that of Madho Singh, the Famine Minister in his report on the 1939-40 famine (Singh 1943). For the fifty year period preceding the 1939-40 famine Singh lists eleven trikal (treble famines) affecting Jodhpur State. Several of the famines Singh describes as trikal are given less serious classifications by Kothawalla. Table 2.4 is a composite table listing all of the famines from 1804 to 1938-39 indicating the classifications given by each author.

The word 'famine' usually refers to an extreme food shortage causing hunger and suffering to a population or part of a population. The usual connotation is that a famine is a crisis. As it is presently used in India, 'famine' has an administrative definition which does not necessarily indicate crisis, high mortality or great suffering. Famine is declared on the basis of an assessment that a particular village has a net food deficit, that is, more food is needed for the population than is available from agriculture in a given period. Indian government statistics rely on this definition.

Table 2.5 identifies declared famine areas (by village numbers per sub-district) for Jodhpur district from 1963-64 to 1985-86. The drought that followed failure of subsequent monsoons in 1986, 1987 and 1988 is commonly regarded as one of the worst to strike India this century.

Historically, the most typical response to drought and famine was to migrate. In the famine of 1868-69 there was massive movement from some of the western states, including the migration of one and a half million people from Marwar (Kachhawaha 1980). In the 1891-92 famine 199,600 people (8% of the population of Marwar) left with 661,906 head of livestock (Resident, Western Rajputana States 1893).

Migration remains a common response, but the mass migrations of the past have been largely replaced by rural-urban migration of people seeking employment and by limited migration by specialist herders only.

A major factor in management of famine, at least since the beginning of the Mughal period, has been the response of the state to famine. The practices of the modern Indian and Rajasthan governments centre around grain subsidies and famine relief employment projects, which provide relief labour on projects such as water storage construction. (These responses, and their effectiveness, will be discussed in Chapter 9.) The Rajput states also made attempts to deal with famine.

**Table 2.4**

**Famines affecting Marwar State from 1804 to 1939-40**

Year	Type according to	
	Kothawalla (1939)	Singh (1943)*
1804	Annakal	
1812-13	Trikal	
1833-34	Trikal	
1838-39	Annakal	
1848-49	Trikal	
1850-51	Annakal	
1853-54	Annakal	
1868	Trikal	
1869	Annakal	
1877	Trikal	
1891-92	Trikal	Trikal (First year in sample period)
1895-96	Annakal	Trikal
1898-99	Annakal & Trinkal	Trikal
1899-1900	Trikal	Trikal
1905-06	Trinkal	Trikal
1915-16	Trinkal	Trikal
1918-19	Cheap grain shops opened due to high price of grain #	Trikal
1921-22	As above	Trikal
1925-26	Trinkal	Trikal
1928-29	Cheap grain shops opened due to high price of grain	Trikal
1936-37	Various parts of state affected differently	Not Mentioned (Not Trikal)
1938-39	Not included in sample period	Trikal

\* Occurences of Trikal Famines only recorded.

# From this point Kothawalla tends to switch from use of threefold classification to short description of conditions.

**Key:**

*Trinkal*  
fodder shortage

*Annakal*  
water shortage

*Trikal*  
grain, fodder and water shortage  
(triple famine)

## *Ecological Context*

Bhati (Introduction to Nainsi 1968-1974), discussing Marwar during the period when it was a Mughal tributary state, points out that land rent was reduced to a nominal level during famine and drought conditions. In the late nineteenth and early twentieth centuries the Rajput states responded to famine by the same strategy of reducing taxes. They also provided relief funds which were supplemented by voluntary contributions (often large ones) from merchants. These practices are described by Kachhawaha (1985) in a general study of the history of famine in Rajasthan.

In 1935 famine was declared in a number of parts of Marwar. In an annual administrative report the relief measures taken were described:

With a view to afford relief to the agriculturalists in the affected parganas the following relief measures were ordered to be adopted:-

- (1) Opening of grass and fodder depots in the affected parganas and selling of grass at the rate of -/8/- a maund and wheat straw at the rate of -/4/- a maund...
- (2) Throwing open of all reserved forest areas for free grazing and making arrangements at a cost of Rs. 3,000 for improvement of water supply for the animals grazing in these areas.
- (3) Remission of fees charged by the Forest Department for grazing cattle in the affected areas...
- (4) Opening of poor houses and grain shops, where required.
- (5) Distribution of... loans to agriculturalists.
- (6) Suspension of all revenue realisations in the affected parganas.
- (7) Starting of Relief works by the P.W.D. where required.
- (8) Stopping the execution of decrees against agriculturalists in the affected areas, and the suspension of all proceedings against them under the Marwar Public Demands Recovery Ordinance for one year.

Three famine Depots of grass were opened in September 1936, and other relief measures were adopted later on whenever they were essential. (Government of Jodhpur 1938:21)



Table 2.5 - Famine-affected villages in Jodhpur District 1963-86

Samvat year affected	Roman year	No. of affected villages by Tehsil						Total No. of villages (725)
		Jodhpur (209)	Bilara (161)	Osian (135)	Phalodi (128)	Shergarh (92)	Bhopalgarh (115)	
2020	1963-64	55	104	99	128	71	-	457
2021	1964-65	nil	nil	6	4	39	-	49
2022	1965-66	4	nil	17	104	12	-	137
2023	1966-67	nil	73	38	43	9	-	163
2024	1967-68	nil	nil	19	43	23	-	85
2025	1968-69	209	161	135	128	92	-	725
2026	1969-70	209	161	132	127	92	-	721
2027	1970-71	nil	nil	nil	38	11	-	49
2028	1971-72	126	79	56	105	51	-	417
2029	1972-73	193	149	130	128	92	-	692
2030	1973-74	nil	nil	nil	nil	nil	-	nil
2031	1974-75	209	161	135	128	92	-	725
2032	1975-76	nil	nil	nil	nil	nil	-	nil
2033	1976-77	nil	nil	nil	nil	nil	-	nil
2034	1977-78	nil	nil	nil	nil	nil	-	nil
2035	1978-7	114	10	79	125	92	-	420
2036	1979-80	161	161	135	128	92	-	677
2037	1980-81	209	161	130	128	92	-	720
2038	1981-82	209	161	135	128	92	-	725
		<b>(209)</b>	<b>(78)</b>	<b>(103)</b>	<b>(128)</b>	<b>(92)</b>	<b>(115)</b>	
2039	1982-83	209	78	103	128	92	115	725
2040	1983-84	nil	nil	nil	nil	21	nil	nil
2041	1984-85	101	7	74	110	80	54	426
2042	1985-86	209	77	103	128	92	115	724

- Notes: 1. Bhopalgarh Tehsil formed in 2039 from villages taken from Osian and Bilara Tehsils. Numbers of villages by Tehsil at head of columns refer to total pre-2039. Revised numbers in **bold** after 2038.
2. There were some typographical errors on the paper from which this data was abstracted. In each case the totals have been corrected for consistency with Tehsil figures. Any errors are minor.
- Source: Collector's Office, Jodhpur

## **Human Population**

I have already pointed out the importance of the human presence in the Indian Desert. The population of western Rajasthan is rapidly increasing. Malhotra and Saha (1985) point out that the population of the Rajasthan Desert increased more than threefold in the period 1901-1981. Consistent with this figure, the population of Jodhpur District increased by a fraction under 293% from 1901 to 1981 (calculated from the Census of India 1981a). Mehta (1984:44) points out that the semi-arid and arid districts more than doubled their population in the period 1901-1961. Five districts in Rajasthan, including three in the arid region (Jodhpur, Bikaner and Ganganagar) have exceeded the state decadal growth rate in each of the last three decades while Jodhpur and Ganganagar have exceeded it 'in every decade in the century' (Mehta 1984:45).

In a study of fertility patterns in selected villages in western Rajasthan, Tewari (1980) found that fertility was lowest in arid and highest in sub-humid villages. However the survival rate is slightly higher in the arid areas. Mehta, without citing figures notes that the survival rate is highest in the arid parts of Rajasthan (1984).

One of the characteristics of population growth in the twentieth century is the change in the balance between rural and urban dwellers. For all of Rajasthan, the percentage of urban population to the entire population has increased. In 1911 it was 13% and it was 17.6% in 1971 (Mehta 1984). Mehta suggests that the earlier increases were due to the inclusion of new towns in the census (partly, I assume, due to the reclassification of larger villages as towns as they reached the critical population level which defines towns for census purposes). However later increases to the growth of the proportion of urban dwellers to the whole population were due to the growth of the existing urban centres. As an indication of the rate of increase in urban populations, Jodhpur city has increased from 79,109 in 1901 (Census of Marwar 1931b) to 506,345 in 1981 (Census of India 1981a), an overall increase of 540%. This is higher than the threefold general increase for western Rajasthan.

Despite the general growth in the population of Rajasthan since 1901 there have been fluctuations. These are usually attributable to migration and mortality associated with drought/famine.

Table 2.6 gives the population of Rajasthan at decennial censuses from 1891 to 1981. Over the sixty year period the overall increase was 23.5%, but there were severe fluctuations. Firstly, in 1901 (following the great famine of 1898-1900) there was a drop of 20.3% compared to 1891. Again, following an increase from 1901 to 1911, there was a drop from 1911 to 1921. In fact, it was not until between 1931 and 1941 that the 1891 population was again reached.

## *If Rain Doesn't Come*

After 1951 there was a sudden take-off, with the 1981 population reaching 34,261,862 (Census of India 1981c). Some possible reasons for this sudden change, after a slow start, will be discussed in Chapter 7.

In addition to general trends of increase or decrease there are fluctuations at the local level. Even in adjacent villages it is quite common for fluctuations to go against the general trends. An examination of population figures for the villages in my field study (Table 7.1) emphasises this point.

**Table 2.6**

**Population of Rajasthan from 1891 to 1981**

1891	12,943,836
1901	10,318,677
1911	11,031,827
1921	10,339,655
1931	11,786,004
1941	14,253,901
1951	15,984,169
1961	20,155,602
1971	25,765,806
1981	34,261,862

Note: Populations 1891 to 1951 are taken from Census of India 1951 and figures for 1961 to 1981 are taken from Census of India 1981a. The figures for 1891 to 1951 were calculated by adding figures for Rajputana and Ajmer. There is a discrepancy of just over 15,000 (underenumeration) between 1951 figures calculated in this way and the 1951 figure cited in Table 26, Census of India 1981a. The source of the error is not clear but probably relates to an adjustment of boundaries.

### **Land Use and Economic Activity**

#### *(a) Rural*

The main forms of rural economic activity in western Rajasthan are agriculture and pastoralism. Just as the relative rainfall increases from west to east, so does the relative importance of agriculture. Predominantly, agriculture is monsoonal. Irrigation is rare. Nevertheless, apart from the extreme west where semi-nomadic and nomadic pastoralism are predominant, agriculture and pastoralism co-exist in some mix or other throughout the entire region.

## *Ecological Context*

It is important to stress this point because the Census of India tends to distort this picture. Sometimes the inconsistencies involved are quite blatant. In 1983 I visited several villages in Jaisalmer District. Agriculture was obviously not a more significant occupation than pastoralism in these villages or, for that matter in the district as a whole. The 1961 Census of India explicitly states that 'animal husbandry is the main occupation of the people living in the district' (Census of India 1961a: Introduction, para. 18).

The same Census handbook says that the net sown area of Jaisalmer was 3.7% of the total area in the district. Yet according to the census tables there were 34,744 cultivators, 350 agricultural labourers and only 8461 workers in Category 3, which includes pastoralists. I would suggest that the large proportion of cultivators to pastoralists is quite inconsistent with the small proportion of agricultural land. This is particularly important given that the agricultural land is only useful in monsoon periods anyhow, and given that the monsoon in Jaisalmer is particularly unreliable.

Regarding my field area, the Census of India (1971 and 1981a) gives the main occupations of all four villages as cultivation and agricultural labour. This is quite inconsistent with observable facts and reflects a systematic bias towards the overemphasis of cultivation and agricultural labour in the reporting of the Census of India. Table 2.7 abstracts the main occupations for each of the four villages in 1981.

The failure of census respondents to describe either their primary or secondary occupations (in terms of time spent) as livestock husbandry, is odd. Agriculture, in Hinganiya particularly, is never more than a seasonal activity, while pastoralism is a significant aspect of economic activity and is the only one of year round importance.

A partial explanation for the undervaluing of pastoralism may be in terms of a tendency to confuse cash income and days worked as criteria for determining primary occupation. For most (not all) of the household heads in Hinganiya, agriculture, or wage labour may be the main sources of cash income, but not necessarily the main type of activity in terms of total days worked. Pastoralism requires a steady input of labour, but does not earn as much. Yet, according to the census criteria (Census of India 1981b) categorisation should be on the basis of days worked, not on the basis of income.

There is a further explanation for the undervaluing of pastoralism. A significant amount of the work involved in pastoralism is done by children, particularly by young unmarried girls. Although all people who do some form of work apart from domestic work should be accounted for in the census, in practice the work of women or children is largely ignored or undervalued. In Table 2.7 the numbers of 'non-workers' of

**Table 2.7**

**Hinganiya, Kur, Khokhariya and Kukunda - types of workers in 1981**

Village	Cultivators		Agricultural Labourers		Household Industry Manufacturing Processing services and repairs		Other Workers		Total Main Workers		Total Marginal Workers		Total Non-Workers	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Hinganiya	91	77	-	-	-	1	2	-	93	77	-	6	116	117
Kur	293	31	7	3	12	1	41	6	353	41	-	116	344	358
Khokhariya	155	3	-	-	2	-	27	-	184	3	-	164	151	151
Kukunda	228	-	4	-	1	-	52	-	285	-	8	286	244	261

Note: Workers in pastoralism are recorded under 'Other Workers'

Source: Census of India, 1981a

## *Ecological Context*

each sex are approximately equal in each of the four villages and it seems reasonable to assume that the figures largely represent children. As they are not counted as workers, pastoralism is undervalued. As a general point it is also worth noting here that female labour is also systematically undervalued as women are largely categorised as marginal workers. This does not accord with reality.

The variables, nomad, pastoralist and agriculturalist can be combined in a number of ways to describe types of land use or economic activity.

### (1) Nomadic Pastoralism

This is now a rather rare adaptation, except in areas such as the highly arid parts of Jaisalmer, Barmer and Bikaner districts. Even in these areas, because of the low population densities, the absolute numbers of nomadic pastoralists are small.

### (2) Semi-nomadic pastoralism

Throughout western Rajasthan there are pastoralists who live in permanent villages, but who migrate with their herds on a seasonal basis. In many districts there are specialist pastoralist castes. The Raikas (also known as Rebaris) are the best known Rajasthani pastoralists and who have been the subject of recent research by anthropologists (Srivastava 1991, Köhler-Rollefson 1992, Agrawal 1993, 1994). Sometimes members of castes not traditionally pastoralists will individually become specialists. This is comparatively common among the Bishnois, although their traditional caste occupation is agriculture. In the far west members of all castes tend to be pastoralists and an analysis of census figures carried out by Sopher (1975) suggests that specialist pastoralist castes are not found in the region.

The extent and frequency of migrations by semi-nomadic (or migratory) pastoralists is highly flexible. It depends very much on annual conditions. For example, in times of water or fodder shortage large numbers of livestock are taken on migrations, within, through and out of Jodhpur District. There is no fixed annual pattern: in very bad years the migrating herdsman may stay away throughout the whole year; in some years they may take their herds only short distances and/or for short periods; in other years they may move to other states; in particularly good years they may not go anywhere at all. The range of migrations may be immense, with journeys into Gujarat or Madhya Pradesh being common. Although the Pakistan border is a legal barrier to herd migration, in fact some illegal migration does occur.

Among semi-nomadic pastoralists it is common for the herds to be accompanied only by men. Women and children tend to remain in the village to which they will return after the migration. In fact some men

also remain in the village, either because they are old, unwell or because they have other occupations.

### (3) Non-pastoralist nomads

There are a number of castes in western Rajasthan which are fully or substantially nomadic and which travel around performing a number of different (and often peripheral) economic roles. These include the Banjaras (who trade in salt and bullocks/donkeys), the Gawariyas (merchants dealing in trinkets including bangles and cheap toys), Gadular Lohars (nomadic blacksmiths) and Joghis (snake charmers and musicians). There have been several papers on non-pastoralist nomads in India (Misra 1969; Hayden 1979; Fisher 1981) and there are monographs by Misra (1977) and Ruhela (1968) on the Gadular Lohars (a caste of nomadic blacksmiths). Apart from Misra's and Ruhela's work the literature specifically on Rajasthani non-pastoralist nomads is sparse.

### (4) Agro-pastoralism

Where people are agriculturalists they generally also participate to some extent in pastoralism. The mix ranges from people who are primarily farmers, but keep a few goats or cows for milk, to those who concentrate on livestock but also own small amounts of land. Unless an agro-pastoralist depends significantly on livestock, he is unlikely to migrate with his herds. If migration is necessary due to drought conditions, it is likely that the animals will be placed in the hands of a paid shepherd (usually a Raika) who takes the animals with him, leaving the owner to sow his crops if (and when) the monsoon next comes. Alternatively, several households may combine herds under the control of one or more men who migrate with them.

### (5) Pure agriculture

Pure agriculture is a possibility, but very few rural people actually own farming land without keeping at least a few animals for milk. The largest proportion of agriculture, whether pure or mixed with pastoralism, is monsoon dependent. It is for this reason that pure agriculture is rarely viable. Dependence on agriculture is most viable when land is irrigated. In 1971-72, only just over 2% of the cultivated area of Jodhpur District was irrigated (Agarwal 1979).

I am not suggesting here that agriculture is not important. Rather, I am stressing that the agro-pastoral mix is a characteristic and essential aspect of the economy. In fact, there is a great deal of agriculture in the arid zone, and this is something of a paradox. Jodhpur, for example, is within the arid zone according to Meigs' criteria (1953), and Meigs says that one of the defining characteristics of arid areas is that they are unsuitable for agriculture. Yet, in 1972-73, 49.12% of land in Jodhpur District was cropped (Agarwal 1979).

## *Ecological Context*

There is considerable evidence that the extent of agriculture is increasing, and that this is leading to an environmental crisis. Jodha (1980) emphasises the recent trend of increase in area under crops. He cites a 49.5% increase (for the arid region of western Rajasthan) from 1951 to 1961, with a further increase of 13% by 1971. Land which was earlier classified as 'cultivable wastes and barren lands' is now used for agriculture.

It is tempting to argue that the increase in agriculture represents a movement towards the sedentarisation of pastoral nomads. To a certain extent this is correct, as there is considerable evidence for a process of sedentarisation and sedentarisation is an underlying theme of government policy. It appears that pastoral nomads occupied parts of eastern Rajasthan, or at least the eastern fringes of the desert, into the early years of this century. Most of these have now settled. Inder Dan Detha, a farmer with a very informed interest in anthropology, told me that his grandfather was a pastoral nomad (a Charan) who settled in Borunda in eastern Jodhpur District about sixty years ago and became a farmer, despite conflict with the landlords.

While agriculture has been a factor for some time in western Rajasthan, it has increased immensely in recent years. But, to what extent has this been at the expense of pastoralism? Both agriculture and pastoralism have, in fact, increased in intensity. Marginal lands have been taken over for agricultural purposes, but, at the same time there has been a massive increase in livestock numbers. Jodha (1980), while describing the expansion of agriculture, also points out that livestock numbers increased by 45% from 1951 to 1961 and by another 5% by 1965. The result is not just a crisis in agriculture, but, as Salzman points out, there is a crisis in pastoralism as well. The crisis involves

. . . increasing costs per livestock unit and concomitant reduction in return, social conflict resulting from competition over scarce resources, and environmental degradation as the limited resources available are over-exploited. (1986:49)

### *(b) Urban*

Much of the population of western Rajasthan is rural and thus primarily concerned with agriculture or pastoralism. Nevertheless, a significant and growing number of people live in cities or large towns. Jodhpur and Bikaner are the largest, but there are also a significant number of middle size towns distributed throughout the region. The *raison d'être* of most towns is as market and service centres. In many cases the prominence of towns as trading centres has great antiquity and is related to positions on caravan routes. The prominence of Jodhpur and Bikaner was associated with their status as capitals of major states, but



they are also significant as market centres and Jodhpur, in particular, is becoming something of an industrial centre.

In this century western Rajasthan has been the source of much of the merchant wealth in India. Throughout India many of the largest merchants are called Marwaris, highlighting their links with Marwar (see Timberg 1978). Many of these Marwaris maintain ties with their home towns and villages. In Jodhpur today there is a powerful merchant class made up of various castes of Jain merchants, as well as some Hindu castes (including the Sonis, or goldsmiths).

One of the features of the cities of western Rajasthan (again, I am referring particularly to Jodhpur) is their rapid growth. The huge growth of the population of Jodhpur has been associated with increased industrialisation. The thriving building industry in Jodhpur has meant that work requiring unskilled wage labour is available and this has been a powerful force attracting the rural poor to the city, either temporarily or permanently.

Another major factor in the growth of urban centres is the heavy military presence associated with proximity to Pakistan. Both Bikaner and Jodhpur have large military establishments. The Indian Western Air Force is commanded from Jodhpur and there is a large permanent army presence. This factor has affected the economy of the city, in the sense that service industries and businesses have developed accordingly. Military service (in the Army or Border Security Force) is a common career choice for villagers, although the great majority of villagers who join the services are Rajputs. Service in the Police or the Rajasthan Armed Constabulary is also common.

The final factor in urban growth is the increasing tourist industry. In the last few years a popular picture of Jaisalmer as an exotic medieval paradise in the desert has led to a rapid development of tourism. Jodhpur, being on the most convenient route to Jaisalmer, has experienced changes, mostly in terms of new hotels and restaurants. Outside of Jodhpur, Bikaner and Jaisalmer the impact has been small, apart from those villages which are on the routes for tours and camel safaris. Nevertheless jobs in hotels, tourist bungalows and tour agencies are increasingly attractive to those villagers who have been to school (usually from the higher castes) and they present yet another aspect of the interrelationship between the cities and the rural hinterland.

## **Conclusion**

In this chapter, I have discussed the major features of the environment of western Rajasthan. In summary, the climate is characterised by low annual rainfall which is both variable and unpredictable. There is some evidence that the environment has become arid in the last two or three thousand years and there is considerable evidence that the desert conditions have deteriorated within the present century. The human history of the region paradoxically shows a shift from a sparse population of pastoral nomads during the humid period about 4000 years ago (the Harappan civilisation did not penetrate the desert itself) towards a large and essentially sedentary agricultural population in all except the most arid areas in the last few centuries, at a time when the environment has been arid. In the current century population increase has been very rapid and there has been an increasing urban population and a growth of industry.

The critical problem faced by the rural population is how to cope with the inevitability and unpredictability of drought conditions, and the famine which is related to drought. I have described the opportunities for wage labour opened up by increasing urbanisation; I have described the role of migration; I have also described the broad parameters of the mixture between agriculture and pastoralism which are the main components of rural economy. The focus for the rest of this study will be to show how the changing socio-economic conditions are related to environmental parameters and particularly to the uncertainty of the environment. The interaction between these factors can best be seen at the village level. In the next chapter I will introduce a particular village setting in which these interactions occur.