

Rainfed Agriculture in Thar

A Documentation of Traditional Practices

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Gramin Vikas Vigyan Samiti

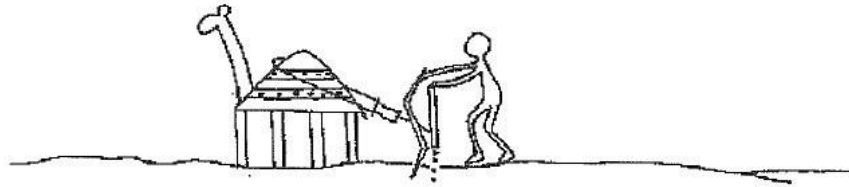
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A Documentation of Traditional Practices



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Acknowledgements

We would like to thank all the farmers of the eight villages who have assisted in this study. We would like to specially acknowledge the village people who shared with us their knowledge, their proverbs and other valuable insights. Many of the illustrations and drawings in this documents are contributed by farmers.

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Preface

Gramin Vikas and Vigyan Samiti (GRAVIS) is a voluntary organisation working in the field of rural development and rural reconstruction in Western parts of Rajasthan since last 18 years. While the agency has undertaken a number of projects focusing on development of natural resources, judicious management of these resources in a sustainable manner has been a prime concern. We believe that traditional resource management practices that evolved over centuries in tandem with the local ecological balance have much to offer in this regard.

During last two decades, GRAVIS has seen a gradual erosion of traditional agricultural practices in the desert under the onslaught of modern technology. In fact some of these practices may be on the verge of being wiped out. Therefore GRAVIS felt the necessity of undertaking an inquiry into current existence and frequency of these practices. Hopefully, this will lead to greater awareness in official and enlightened circles about traditional agriculture in Thar.

The documentation has been undertaken by Sudhir Kaman Katiyar, a development consultant based at Udaipur. The field work was led initially by Kamal and later by Narendra. They received support from members of the GRAVIS field unit based at Kalron - Ms. Rita, Kana Ram, and Chena Ram. Sri Laxmi Chand Tyagi provided advice at critical intervals. Illustrations and design work has been carried out by Ms. Laxmi Murthy. GRAVIS expresses its gratitude to all the persons listed above who made this study possible.

GRAVIS will also like to acknowledge contribution of farmers who patiently sat through long interview sessions and shared their experience. The field work for the study was undertaken in 10 villages of Baap and Phalodi blocks. We thank the farmers of these 10 villages. Special thanks are due to Omprakash and Kana Ram who participated in a two day workshop to comment upon the draft report, and draw various illustrations.

Shashi Tyagi
Secretary
GRAMIN VIKAS VIGYAN SAMITI

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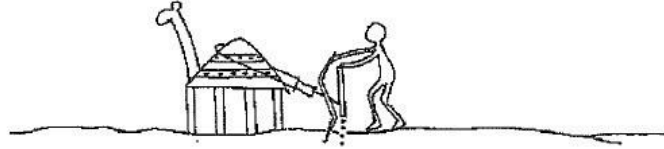
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Thar is the driest part of the country, a desert. In popular perception also it is associated with lack of water and drought. Water and drought are recurring themes in folk sayings of the area. Extent of drought in the region and its severity at various points is reflected in this local saying

पग पूंगल धड़ कोटड़े उदरज बीकानेर
आवत जावत जोधपुर ठाड़ो जैसलमेर

*My feet are in Poongal,
main body in Kotda,
and stomach is in Bikaner.
I keep visiting Jodhpur while
I am perpetually standing at Jaisalmer.*

Purpose of the Study

Contrary to popular perception, Thar is not an expanse of sand where nothing grows. Instead it has supported agriculture in its heartland for centuries. Traditional agricultural practices evolved over a period of time and are finely attuned to the delicate ecological balance. Development of modern agriculture has introduced significant changes - introduction of power machinery, new seeds, and irrigation. There are signs that the delicate ecological balance derived over centuries may be getting disturbed under the onslaught of these changes. It is feared that the current mode of utilisation of natural resources may not be sustainable. Area under cultivation has increased significantly. Marginal lands that may not be suitable for agriculture have been brought under plough. The period of fallowing has decreased, putting pressure on soil fertility.

Under the impact of modern agricultural techniques, traditional practices have been undergoing changes and some of them may be on the verge of disappearing. **This study documents traditional agricultural practices of rain fed agriculture in Thar desert.** The purpose is to find out as to which traditional practices are still being pursued vigorously and which are declining. It also takes note of the new practices that have been introduced. Here the term 'traditional' is used for practices that predate changes in agriculture referred to in the above paragraph - power machinery, new seeds, and irrigation.

Government agricultural development policies bypass these traditional practices as discussed later. It is expected that this documentation will

- Establish current status of traditional practices - which traditional practices are persisting and which have given way
- Provide a starting point for deeper study into desirable practices leading to recommendations for increasing their adoption
- Influence Government policy by establishing the vibrance of rainfed agriculture in Thar

Methodology

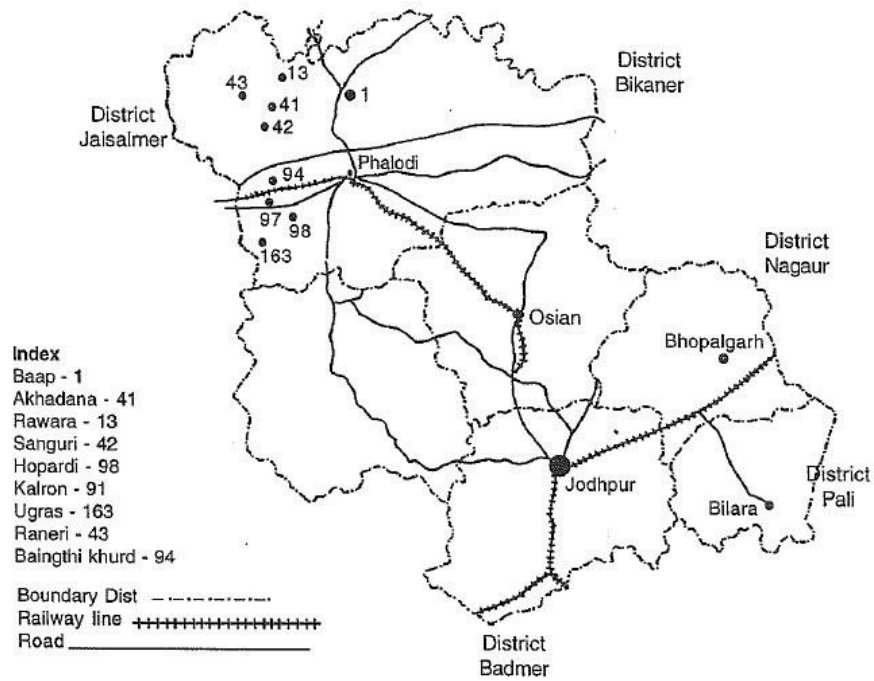
Documentation is based upon the field work carried out in eight villages of Phalodi tehsil in October November 1998. Constituting the Western border of Jodhpur, Phalodi is located at a distance of 132 kms from Jodhpur town. It is almost in the middle of agro climatic zone 1A which covers most of Thar. Phalodi tehsil is divided into two panchayat samitis - Phalodi and Baap. Four villages have been studied from each of the two panchayat samitis. The villages selected were those where GRAVIS had been working.

A total number of 75 farmers were interviewed through a semi structured questionnaire to find out practices being followed in rain fed agriculture. Care was taken to ensure that farmers represented a broad spectrum of the social profile. Of the 75 farmers, 30 belonged to SC/ST communities, 24 belonged to Other Backward Castes, and rest 21 were from other/ upper castes. The questionnaire is given in Annexure 1. The list of villages and number of farmers studied is given in the following table.

Table 1 List of Villages and number of Farmers studied

Sl. No.	Village	No. of farmers	Panchayat Samiti
1	Baingathi Khurd	10	Phalodi
2	Hopardi	10	"
3	Kalron	9	"
4	Ugras	8	"
5	Sanguri	7	Baap
6	Raeneri	10	"
7	Akhadhana	11	"
8	Rawara	10	"

Location of the eight villages is shown in the following map (Map 1)



Findings of the survey were shared in a workshop with local villagers and their feedback taken. Discussions were held with GRAVIS staff who were knowledgeable about local agricultural practices. Background information has been sourced from various publications. These are listed in the bibliography at the end.

Limitations of the Study

The study is a **documentation** of existing traditional practices. It is not an attempt at research seeking to prove or disprove certain hypothesis. Villages are those where the local NGO Gramin Vigyan Vikas Samiti (GRAVIS) has been working. GRAVIS has been carrying out a programme of agricultural development also besides other development activities.

Chapterisation

The purpose of the study, methodology, and limitations are given in the current introduction section. The next chapter provides the context of agriculture in Thar. The bio physical parameters that determine the state of development of agriculture in any location are given in this section. The next section presents the survey findings. It describes the various practices and the frequency of their occurrence in the sample. The next chapter looks at economics of dryland agriculture through case studies of two farmers. The last chapter analyses the findings. It also critiques the existing government policies before presenting a set of recommendations.

GRAVIS and its Role

Gramin Vikas Vigyan Samiti (GRAVIS) is a voluntary organisation that was founded by Gandhian social activists in 1983 to assist the people of Thar in rural development and environmental conservation. GRAVIS focuses on sustainable development programmes for alternative rural reconstruction (GRAVIS 1996).

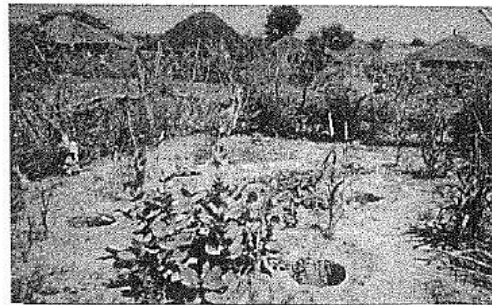
GRAVIS has undertaken a number of programmes in natural resource management. It has concentrated on conservation and development of water and land resources and their use in a most judicious manner. It has endeavored to act as a catalyst in reviving and improving traditional management practices of native wisdom in blend with modern inputs.



1



2

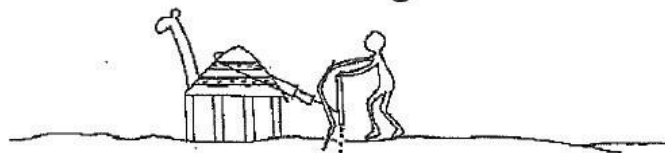


3

1. Experiments on improved seeds
2. Construction of khadin
3. Development of horticulture unit

2

Agriculture in Thar



Aravali range, running from South West to North East divides Rajasthan into two parts. Area West of the range is known as 'Marwar'. This is the drier part of Rajasthan and is associated with desert in popular perception. However not all Marwar is equally dry. There are distinct ecological niche in Marwar also with arid and semi arid regions distinctly identifiable. Generally the area immediately bordering Aravali is semi arid. It receives more rainfall and also run off water of the Aravali range. This area also has some irrigation.

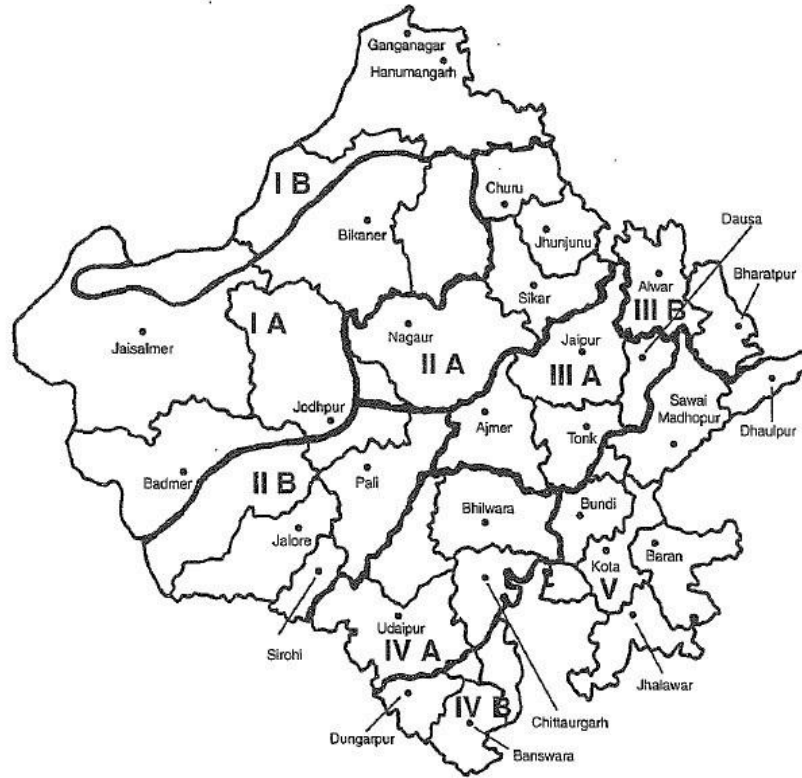
Agro Climate Zone

Rajasthan is divided into nine agro climatic zones on the basis of geo physical conditions, rainfall, soil types, water availability for irrigation, and cropping pattern (see Map 2). Most of the Thar region falls in zone 1A, known as Arid Western Plains. This comprises of the districts of Jaisalmer, Western Barmer, Western Jodhpur, Bikaner, and Western Churu. Zone 1B is also part of Thar. However agricultural conditions in this zone have changed drastically with coming of Indira Gandhi Canal and introduction of irrigated agriculture.

The zone 1A covers more than a quarter of the state area. Average annual precipitation ranges from 100 mm to 300 mm. Major agricultural crops are bajra, kharif pulses, and guar. The study area in Phalodi tehsil, falls in Western Jodhpur and is located almost in the middle of this zone.

Agro Climatic Zones in Rajasthan

(Map not to scale)



- IA Arid western plain zone
- IIA Transitional plain zone of inland drainage
- IIIA Semi arid and eastern plain zone
- IV A Sub humid southern Plain and Aravalli hill zone
- IB Irrigated north western plain Zone
- IIB Transitional plain zone of LUNI river basin
- IIIB Flood prone eastern plain zone
- IV B Southern humid plain zone
- V South eastern humid plain zone

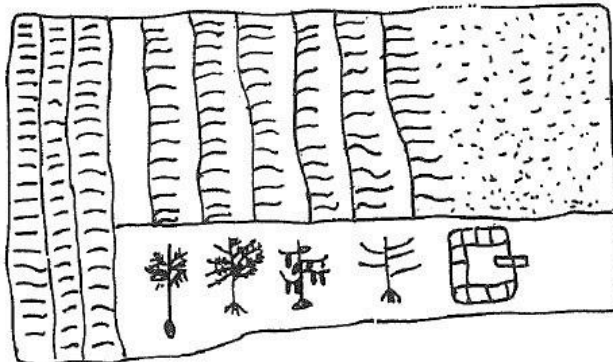
Land Use

Land use in Phalodi and Baap panchayat samitis is in the Table below.

Table 2. Land Use in Phalodi and Baap

<i>Land use</i>	<i>Phalodi(Land in ha)</i>	<i>Baap(Land in ha)</i>
Forest	583	36
Irrigated	165	0
Unirrigated	267433	330201
Culturable waste	35722	68536
Not available for cultivation	19880	44347
Total	323783	443120
%age land cultivated	82.65	74.52

Source : District Census Handbook for Jodhpur



This illustration made by a farmer shows a field with a standing crop of Bajra. The dhani (house) is shown with a few trees beside it. People in these areas live where their fields are located.

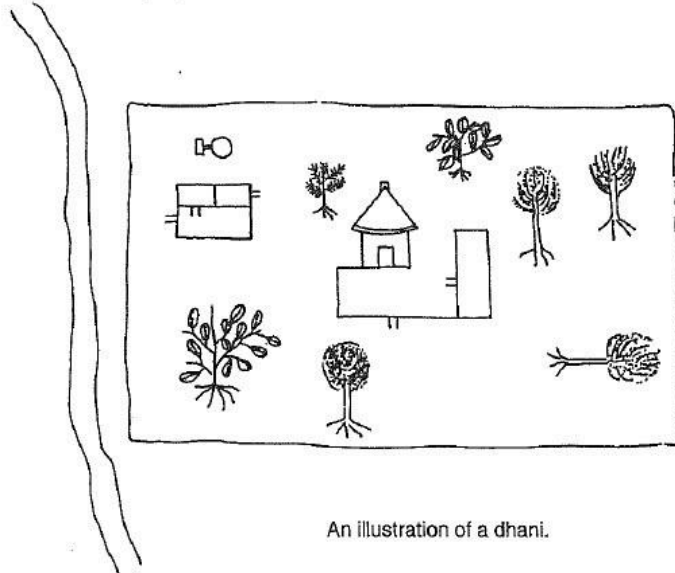
Land Holdings

Size and structure of land holdings is a crucial element of agrarian system of any region. Desert areas are marked by large landholdings. This is evident in the table below which gives land holdings in Jodhpur district .

Table 3. Landholdings in Jodhpur District

<i>Size of landholding</i>	<i>Number</i>	<i>Area</i>
Less than 1 ha	14255	7490
1-2	20087	30557
2-3	22198	55047
3-4	16232	56560
4-5	14459	64846
Above 5 ha	105583	1569153
Total	192814	1783653

Source : RI project document



An illustration of a dhani.

Normally, holdings below 1 ha are categorised as marginal. In Jodhpur, the number of holdings below 1 ha comprise only 7% of the total number of holdings. For the whole state, marginal holdings comprise 29% of the total number of holdings and 3% of the total area. However keeping in view the special characteristics of desert areas, a different categorisation is used which is given below:

marginal	less than 4 ha
small	4 to 7 ha
medium	7 - 12 ha
large	above 12 ha

Using this definition, we find that in Jodhpur district 38% of the holdings are marginal. These holdings comprise 8% of the total area. Thus an analysis of the phenomenon of large holdings reveals that inequity in land distribution is as high in desert regions as elsewhere.

Rainfall

Desert regions are marked by low rainfall. In popular perception these are drought prone areas, marked by a condition of perpetual drought. However a local saying captures frequency of drought more succinctly.

सात काल सत्ताईस जमाना
तिरसठ कोरिया काचा
तीन महाकाल जद मां
पूत मिलै ना पाछा

In a century of 100 years, there are 27 years of good rainfall when crop production is good. Another 63 years are mixed when some production is there. There are 7 years of drought and 3 of extreme drought when even mothers and sons separate, never to meet again.

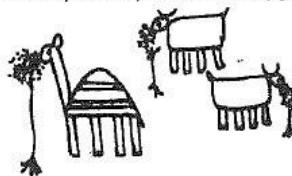


Table 4 Annual Rainfall at Phalodi

<i>Year (mm)</i>	<i>Rainfall</i>	<i>Year (mm)</i>	<i>Rainfall (mm)</i>
1961	333.1	1980	217.0
1962	365.7	1981	197.0
1963	154.3	1982	297.0
1964	380.6	1983	536.0
1965	203.0	1984	145.0
1966	353.7	1985	196.5
1967	227.5	1986	168.0
1968	95.7	1987	234.0
1969	138.0	1988	166.0
1970	374.3	1989	140.0
1971	175.6	1990	250.0
1972	130.8	1991	55.5
1973	354.3	1992	252.0
1974	206.9	1993	178.0
1975	433.6	1994	311.0
1976	383.0	1995	143.0
1977	304.0	1996	265.0
1978	N.A.	1997	287.0
1979	254.0	1998 (till Sept.)	179.0
		AVERAGE	241.5

Source : *Raingauge station at Phalodi*

Analysing this data with modern meteorological standards, we use the following criteria

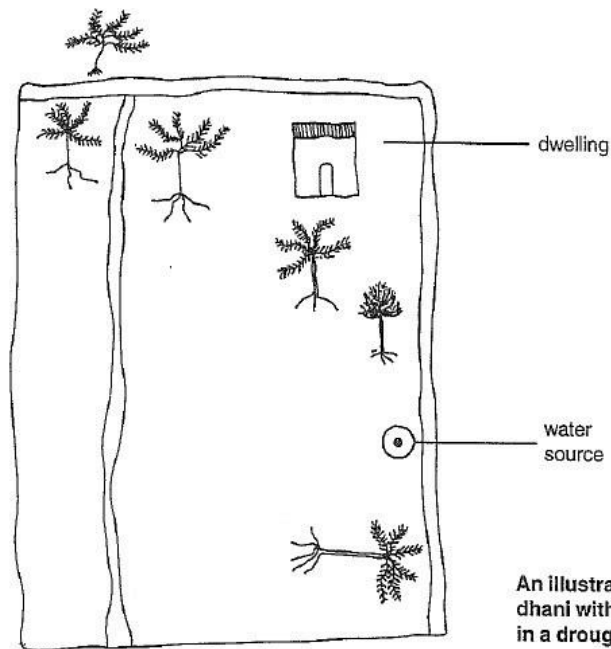
rainfall greater than 20% of normal i.e. > 290 mm	Good
rainfall within 20 % of normal on both sides i.e. 194 - 290 mm	Normal
rainfall less than 20% of normal i.e. < 194 mm	Deficient
rainfall less than 60% of normal i.e. < 97	Highly deficient

If we use the above criteria to analyse the rainfall figure at Phalodi, we get following picture

Table 5 Drought Years in Phalodi

<i>Status of rainfall</i>	<i>No. of years</i>
Good	10
Normal	14
Deficient	11
Highly deficient	2

This more or less corroborates the local saying quoted above. Some of the deficient years clearly would have been drought years. And very deficient years would be years of extreme drought. On the other hand, 10 good years are obviously years of good production.



An illustration showing a dhani with empty fields in a drought year.

Soil Types

Three types of desert soils are mostly found (Srivastava 1996)

Calcic Brown Soil : These soils are mostly found in the inter dunal areas. the fertile soil is loamy-sand to sandy loam in texture with kankar modules at shallow depth.

Non Calcic Brown Soil : These soils vary from sandy loam to loam. They have calcium carbonate in lower layers.

Sand Dunes : Sand dunes exist over a large area, forming the periphery of above two sub groups. The soil is mostly coarse grained with high permeability and so soil moisture is easily lost from the top soil.

Water and Irrigation

Jodhpur has seen a rise in irrigation in recent years. Of the total cultivated area, 2.84% is irrigated. Nearly all this irrigation is from wells and tubewells. Recent years have seen a spurt in the number of tubewells being sunk. There has been a rapid drop in the depth of the water table. Statistics released by State Groundwater Development Department show that groundwater exploitation in Jodhpur stands at 131% of the total potential. Three panchayat samitis of the district - Bhopalgarh, Bilara, and Osian - have been placed in the dark category.

Development of irrigation is restricted to Bilara, Osian, and Jodhpur tehsils. In Phalodi and Shergarh tehsils, there has been very little development of irrigation. This is also borne out by the Table 3 given above which shows that in Baap, no area has been reported under irrigation while in Phalodi only 165 ha is reported under irrigation.

Cropping Pattern

Kharif crops

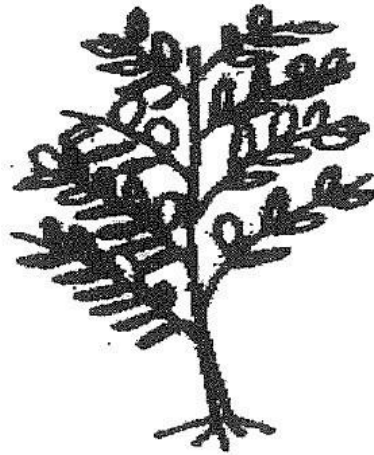
Bajra (*Pennisetum glaucum*) : This is the most important crop of desert regions and also the staple food. It is grown under poor climatic and soil conditions. It

requires dry weather with intermittent rain followed by bright sunshine. Due to extensive root system, the crop gains sufficient moisture and starts vigorous growth even with light showers of 30 to 40 mm (Gheesa Lal 1996).

In the desert areas, it is almost never sown alone. It is always sown mixed with moth, moong, til, and matira. The crop takes 80 to 90 days to ripen. Harvesting starts by end September and continues till end October.

Moth (*Vigna acontifolia*): It is the most important Kharif pulse. It is used for preparing many eatables like *dal*, *bhujiya*, and *bari*. It is successfully grown in sandy soils and needs very little moisture. Three light showers are sufficient for this soil.

Moong (*Vigna radiata*): It is also one of the important crops amongst the pulses and is used just like the moth except for *bhujiya*. It is a good cash crop.



Moong

Til (*sesamum indicum*) : It is an important oilseed crop of desert regions. It can not tolerate heavy rain or prolonged drought at any stage of growth. While its oil is used as a cooking medium, oil cake is fed to domestic animals. While it is sown mixed with bajra, it may also be grown separately.

Guar (*Cymopsis tetragonoloba*): It is an important fodder crop. However it is also the most important cash crop of the area. With establishment of guar gum factory at Jodhpur, guar rates have gone up.

Jowar (*Sorghum vulgare Pers*): This crop is also grown over extensive areas. It requires comparatively heavier soil and more water than bajra. However it can withstand considerable drought. Its straw is considered best fodder amongst cereal straws being rich in protein.

Matira : An integral part of the bajra mixture that is sown as the major crop in Kharif, matira is the water melon of the desert. The juicy flesh is eaten raw and the seeds are preserved to be sold in the market.

Rabi Crops

Tara mira : It is a recent entrant. It is a lower variety of rapeseed. It requires very less water and is therefore ideal for being grown in desert conditions. It is a good cash crop.

Mustard (*Brassica juncea*): It is a good cash crop of oilseed and is sown in the khadin areas in the years when good rainfall occurs in the month of September - October. Sowing under rainfed conditions is preferably done from mid September to mid October. No fertiliser of any kind is applied. It matures in khadin areas in 115 days.

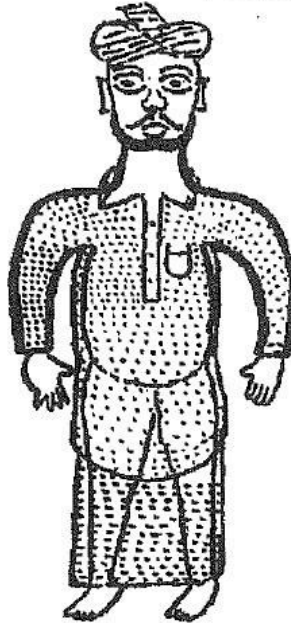
Wheat : Wheat is sown in a limited area when the sowing of mustard and tara mira has been completed and still some land is left with sufficient soil moisture. Sowing is done as early as end October or by mid November. No fertiliser of any kind is applied. It matures in 120 days.

Barley : Barley is sown as a pure crop or as a mixture of wheat and barley in khadin areas. Its sowing is done at the same time as wheat.

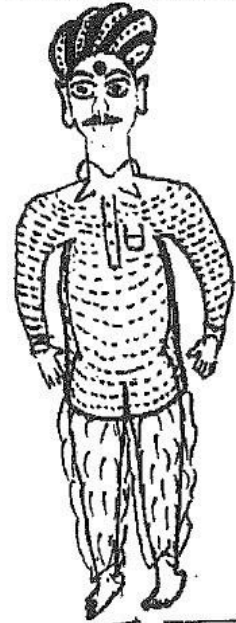
Rural Communities in Thar

Indian desert is widely known as the most populated desert in the world, supporting a high population. Thar has been settled for ages. Rural society is governed by the Hindu caste rules as elsewhere in the country. Indian rural society can best be analysed through the concept of dominant caste. Dominant castes are those whose members occupy a high social status (though not necessarily the top most), own maximum land, have a high numerical presence, and are the natural leaders in rural society.

Dominant castes in the area surveyed are *rajputs*, *paliwal brahmins*, *bishnois*, and *moslems*. Most villages have a high population of one of the dominant castes. There is a good sprinkling of other backward castes (OBCs) like *goswami*, *suthaar*, *nai* etc. At the bottom of the social ladder are Scheduled Castes and Tribes. Main scheduled caste of the area is *meghwal* and main scheduled tribe is *bhil*.



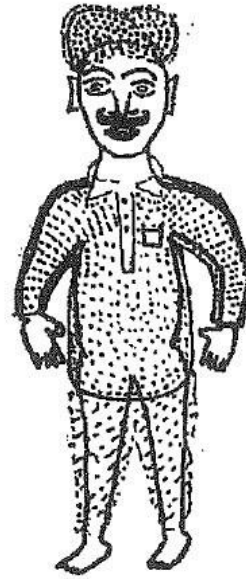
MUSLIM FARMER



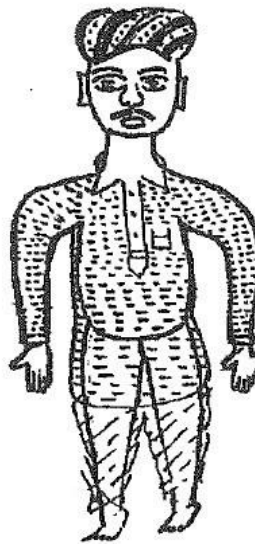
PALI WAL FARMER



BISHNOI FARMER



RAJPUT FARMER



MEGHWAL FARMER

Relationship between Caste and Landholding : As expected, there exists a correlation between caste and land holding. This can be best illustrated by taking case study from one village Hopardi in Phalodi block. The land distribution by caste is given in the table below :

Table 6 Distribution of Land holding by Caste in Hopardi Village

Sl.	Caste	No. of farmers					Total
		Big	Medium	Small	Marginal	Landless	
1	Paliwal	72	35	25	15	3	150
2	Suthaar	1	4	20	5	-	30
3	Meghwal	2	4	20	56	2	84
4	Goswami	-	2	2	-	-	4
5	Nai	-	2	2	8	2	14
6	Moslem	10	-	2	18	12	42
7	Bhil	-	-	-	5	-	5
8	Harijan	-	-	-	-	1	1
9	Dholi	-	-	-	-	3	3
10	Darji	-	-	2	-	-	2
	Total	85	47	73	107	23	335

Source : Field survey

Above table shows

- Low incidence of landlessness.
- Highest land holding with dominant caste - Paliwal brahmins.
- High correlation between caste and landholding. As we move down the social ladder, average size of landholding decreases.

3

Traditional Practices Of Rainfed Agriculture



Survey Findings

This chapter presents the traditional practice of rainfed agriculture in Thar. It describes the practice and then gives its incidence amongst the farmers surveyed.

Soil Conservation

Soil erosion is a serious problem in Indian desert. The chief agent of soil erosion is the South Westerly winds which blows, at times, at a velocity greater than 140 km per hour. The wind removes the moisture content of the soil through intense evaporation and also removes the surface physically from one place and causing accumulation of sand in other. The wind borne sand often encroaches on arable land (Chauhan TS(ed.) 1995).

Overgrazing and trampling by animal is another potent cause of the depletion of top soil. This is best illustrated by a local saying

घर घर बकरी घर घर ऊँट
छिपना फिर गियो चारों खूंट

*Goat and camel at every house
ensure a drought all around.*

Soil conservation measures accordingly are the mainstay of agriculture in Thar. Farmers have evolved a number of practices to check erosion of soil.

Jhoor kootna (झूर कुटना)

Dry and green grass is cut into small pieces and spread on the field to check wind erosion. It serves both the purposes - preventing soil being blown away and holding back the soil that has been blown in. Most common species used for the purpose is *kair* followed by *bordi* and *aakda*. *Kair* has the advantage that it keeps out termites from the field. Old twigs of *bordi* kept on field bunds are also used. Bajra stalks called *doka* that are used for thatching purposes may also be used after they have got old and new thatching is required. This practice also increases soil fertility.

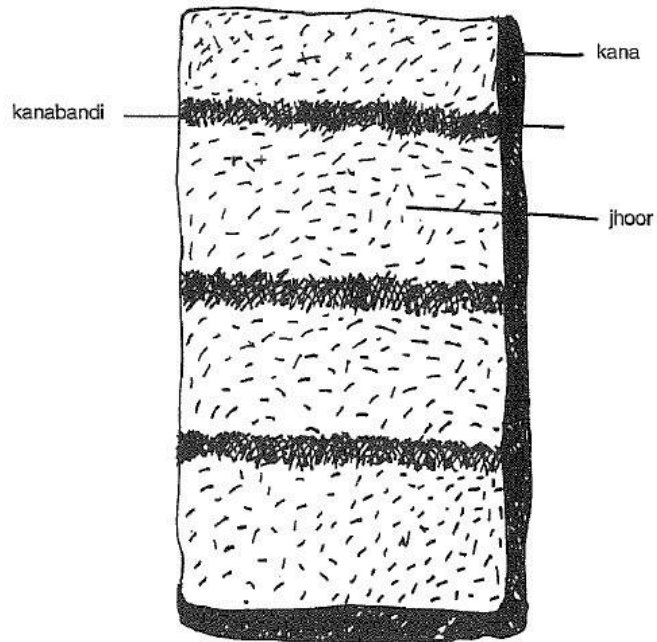
Kanabandi (कणाबंदी)

Rows of thorny shrubs up to 1 foot high are laid across the direction of wind. Distance between two rows may be 50 feet. On the side of the wind, some soil will be placed upon the shrubs so that these do not get blown by wind. The shrubs act as vegetative barriers checking soil erosion. Normally the first row will be highest.

Kana (कणा)

Earthen bunds (धोरे) of one to one and a half feet height are constructed across the slope and two sides along the field boundary. On top of the bunds, thorny branches of *bordi* may be kept. The height of the bund is raised every year by putting more earth on it. The practice serves a number of purposes listed below and hence is widespread.

- checks wind and water erosion
- conserves moisture
- marks the boundary of the field, *kana*
- acts as a protection against goats and cattle



A field that has been treated for soil conservation.

Retaining Vegetation in the Field

It is common to find a number of plants – herbs, shrubs, and trees – in the field besides the main crop. Some of the shrubs like *bordi* are not removed from the fields and allowed to co-exist with crops. Other type of vegetation is allowed to remain during summer months and removed just prior to sowing. This vegetation helps in checking wind erosion in the summer months when wind velocities are maximum.

Incidence of soil conservation practices in Phalodi Tehsil as revealed by the field survey is given in table 7:

Table 7. Incidence of Soil Conservation Practices in Phalodi Tehsil

<i>Soil Conservation Practice</i>	<i>No. of Farmers</i>	<i>Amount of Land Treated</i>
<i>Jhoor</i>	7	92 Ha
<i>Kanabandi</i>	10	268 Ha
<i>Kana</i>	40	1970 Ha
None	17	

Source : Farmer survey

Figures reveal that

- Almost half of the total land holdings are under some sort of protection.
- Earthen bunds topped by thorny bushes constitute most common practice of soil conservation. One reason is that this practice serves a number of other purposes also.
- Incidence of *kanabandi* and *jhoor* has come down.
- Not all land needs protection. Certain types of land, locally called *mudh wali jameen*, are not prone to erosion.

Soorh Karna (सूढ़ करना)

The first task with the beginning of farming season is clearing of field. As pointed out before, farmers do not remove vegetation from field in the summer months. However with the impending arrival of rain, fields are cleared of vegetation. Normally root stalks till the depth of ploughing are removed, while deeper roots remain in the field for later regeneration. Thorny bushes are kept for fencing while the rest may be used as fuelwood. Heavier clearing is carried out by men, while women carry out lighter work. Intensity of clearing operation may also depend upon crop to be sown. Normally *bajra* fields are cleared extensively while *gwar* fields are not cleared to the same extent. Amount of man power required for clearing operation will depend upon amount of vegetation to be removed. One *harli* of land (5 bighas) will normally require one full man day.

Ploughing

A variety of ploughing and sowing practices are used depending upon the soil requirement and financial position of the farmer. Desert soils being light, a single ploughing is often sufficient. However in certain cases secondary ploughing may also be carried out. Desert region has also seen use of a number of animals for ploughing. These are camels, donkeys, and bullocks. Further a single bullock may also be used for ploughing.

The various practices and the area under them are given in table 8.

Table 8 Ploughing Practices in Phalodi Tehsil

<i>Practice</i>	<i>No. of Farmers</i>	<i>Area(ha)</i>
Cultivator + Cultivator	10	240
Cultivator	48	1801
Disk (लवी) + Cultivator	26	897
Disk	26	585
Animal Ploughing	7	183
Total	75	3706

Source : Farmer survey

Table reveals that dominant form of ploughing is single use of cultivator. Almost half of the total land is sown through one time use of cultivator. There are many features of the current ploughing practices.

Use of Disk Ploughing

Recent years have seen an increase in deep ploughing with the use of disk. This form of ploughing is unsuitable for light desert soils. It overturns deep soils leaving them exposed to erosion. However it is gaining popularity for the following reasons

-
-
- Disk overturns the soil from depth. It brings up the unused soil lying deep below and carries down used soil. Thus it replenishes soil fertility.
 - Disk is used for clearing away unwanted grasses and shrubs even though these grasses and shrubs have an important role to play in binding the soil.
 - Disk ploughing increases moisture retention by soil.

Farmers say that they use disk every three years. Farmer's survey also highlighted the fact that proportion of land ploughed by disc is almost one third of the total land reported under plough.

Disappearance of Ploughing by Animals

With increasing use of tractors for ploughing, use of animals for ploughing is on the verge of disappearance. Only 7 farmers out of a total of 75 reported use of animals. Amount of land ploughed by animals is less than 5% of total land ploughed.

Rates of Different Types of Ploughing

Ploughing by cultivator costs Rs. 125/hr. However in one hour, five bighas can be ploughed. Thus the effective rate works out to Rs. 25/bigha. Disk ploughing costs Rs. 100/ hr. In one hour, only one bigha can be ploughed. Thus per bigha rate amounts to Rs. 100. For animals, a camel plough costs Rs. 125 per day. In one day, a camel will plough 5 bighas. Thus animal ploughing costs the same as mechanised ploughing by cultivator.

Little Delay in Ploughing

In rainfed agriculture, timing of sowing is critical. Low rainfall means that all available moisture must be used up. Therefore sowing time assumes critical importance. If there is any delay in sowing after rains, moisture will go waste. However most respondents were able to sow their land in time. Only seven farmers reported delay over 123 bighas. This shows that availability of tractors is not a constraint. There are enough number of tractors to meet the demand.



**Advantages of Ploughing and Sowing
by Animals over Mechanised Ploughing**

Most farmers admit that sowing by animals is more beneficial compared to mechanised sowing. The distinct advantages are:

Low Seed Requirement

Sowing by animals is more controlled compared to a tractor. In tractor because of movement of tractor more seed is spilled. Also seed can go deep and be wasted. Thus more seed is required in mechanised sowing.

Table 9. Seed Requirement for Different Types of Sowing

<i>Sowing</i>	<i>Seed Requirement (mixture) in kg / 5 bigha</i>
Animal	2 kg
Cultivator	3 kg
Disk	6 kg

Source : Farmer survey

Higher Germination Rate

Sowing by animals also results in a higher germination rate. This happens because seed falls at an uniform depth in sowing by animals. In tractor ploughing because of uneven depth of seed placement, seed may go deep and may not germinate thus leaving behind patches. Scientific observations have shown that germination in mechanised sowing may be upto 35% less compared to animal sowing.

Weeding Operations

Most farmers undertake extensive weeding operations to remove unwanted grasses from the field. In the land where disk ploughing has been undertaken, there are almost no weeds. Normally weeding is done only once. Weeding operations result in substantial amount of fodder for animals. At the time of weeding, if rainfall is good, transplantation of *bajra* is also done.

In the farmer survey, 58 farmers reported carrying out weeding operations over 2053 bighas of land. This is almost 55% of the total land sown. Normally one person can carry out weeding operations in one bigha of land in one day. Thus the cost of weeding operations works out to be Rs. 50/bigha @ a daily wage rate of Rs. 50.

Crop Protection

Crop protection is a key activity in desert agriculture where landholdings are large and spread around. Two main pests are wild animals and birds. Deer roam freely as they enjoy religious protection from 'bishnoi' community which is dominant in the region. Another wild animal *nilgai* also roams freely over wide areas. Protection is such a critical necessity that village settlement is spread out all over. Most farmers live right by the side of their fields. The spread out hamlets are called *dhaanis*.

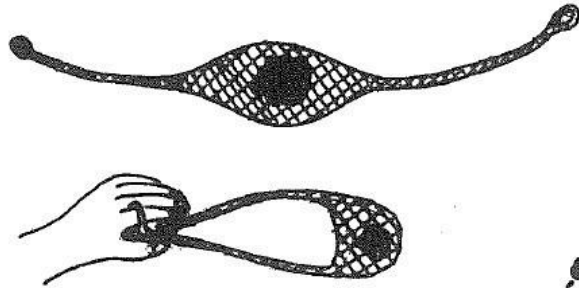
Concept of social fencing is prevalent. In rainy season, after crop has grown to a certain height and production is assured (there is no chance of a drought), free grazing is banned. This is called *phaatak*. All farmers keep their animals at home. If animals are caught, they may be sent to *kaanzi* house. This is an enclosure for keeping stray animals from where the animals are released only after their owners pay a fine. The practice is reversed after harvesting when animals may roam freely on any land. However in the 1998-99 season, *phaatak* continued for the Rabi season as there was extensive sowing of tara mira.

It is the duty of farm owners to protect their fields if they undertake irrigated agriculture in Rabi season when animals roam freely. We find that most tube well owners go for extensive fencing using wire.

Protection mechanisms used are :

Gophan (गोफण)

A woven sling used for throwing pebbles at a great speed. The pebbles make a sound as they travel and frighten away the birds.



Loud shouts to shoo away the birds.



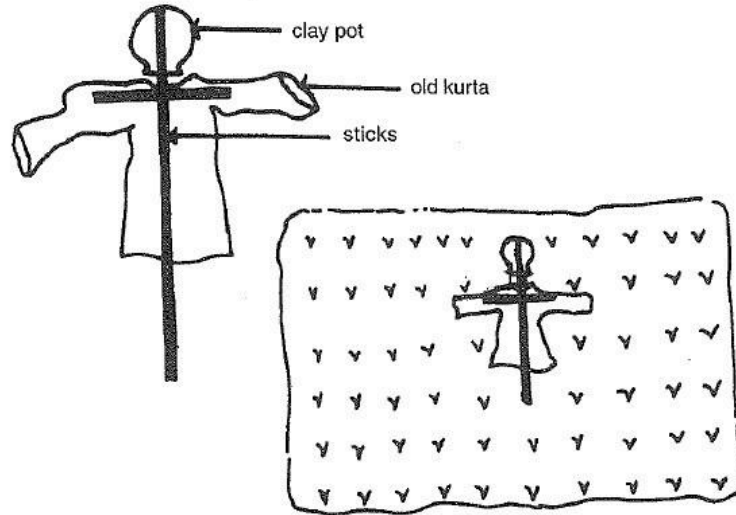
Haanka (हांका)

Dabki
Leather is mounted on a utensil. A small hole is made through which feather of a peacock is dragged making a raucous noise. This is used for frightening away wild animals.



Arhwa (अडुवा)

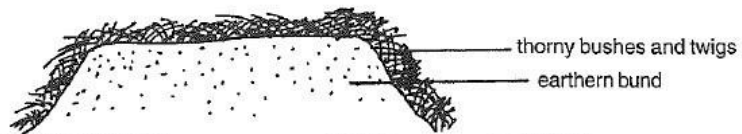
At times a scare crow called *arhwa* may also be erected. Different types are erected depending upon whether the purpose is to frighten away wild animals or birds.



An *arhwa* in the middle of the field

Dhora (धोरा)

As pointed out earlier, earthen bunds topped by thorny bushes and twigs are a very effective means of protection against grazing by animals.



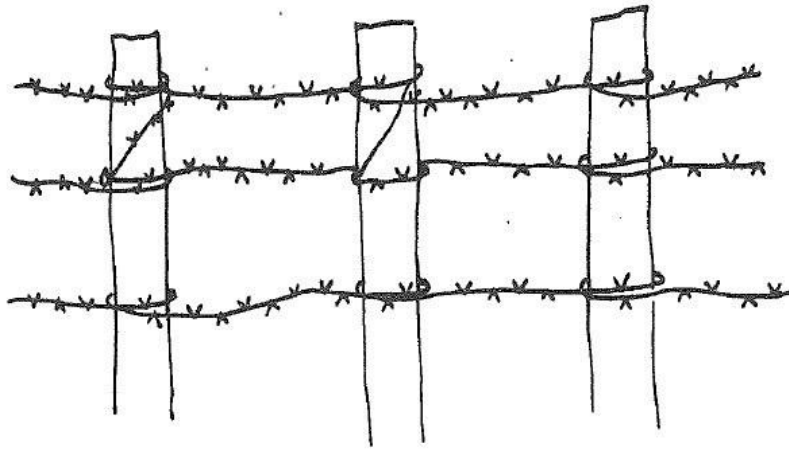
Pai chhaap (पाई छाप)

Pai chhapna is the practice where thorny twigs and branches are dug into field boundaries. Normally two shrubs of bordi will be stacked against each other so that they support each other and are stable. On both sides of the branches, soil is stacked.

Fencing

Wire fencing is also done. Normally this is the mode for irrigated land which need protection for longer duration.

If household manpower is not sufficient, hired labour is used for protection.



Soil Fertility

Number of practices are used to improve soil fertility.

Following/ Grazing

A rotation of cultivation and following / grazing is adopted to replenish soil. Typically all the land available with a farmer is not cultivated. Some land is left fallow. On this land animals graze and leave their droppings. Next year this land is brought under plough and some other plot left fallow.

Crop Rotation

The normal practice for restoring soil fertility is to use a rotation of *bajra* and *gwar*. On the land on which *gwar* has been sown, *bajra* is sown next year. It should be noted that *gwar* is a leguminous crop. However in the field in which the house is located and which receives maximum manure, *bajra* is sown year after year.

Use of Fertiliser

There is negligible use of chemical fertiliser in rainfed agriculture. Amongst the surveyed households, not a single household reported use of chemical fertiliser.

Use of Manure

There is extensive use of manure. Sixty farmers, that is 80% of farmers surveyed, used manure. However it is used only on part of the land. Mostly manure is spread in the fields around the house which receive better care. Use of manure was reported on 841 bighas. This constitutes nearly 25% of total land under plough. Use of manure is rotated. Thus a field on which manure has been spread this year will not receive manure next year.

Sheep/goat dropping is more valued compared to cattle/ buffalo dung mainly because it is rich in nitrogen. It takes longer to decompose and so its effect lasts longer. On the other hand cow/ buffalo dung improves the texture of soil and increases moisture absorption capacity of soil.

Sale of Manure

A recent development is sale of manure. This practice has developed with introduction of tubewell irrigation in desert. Tubewell farmers buy manure from dry land farmers with surplus manure. Mostly farmers with large herds of sheep and goat have surplus manure. Sheep goat droppings sell at a rate of Rs. 600 to 800 per trolley while cow buffalo dung manure sells at a rate of Rs. 300 to 400 per trolley. In smaller units, the rate is Rs. 4 per *koonda*, an iron tray roughly 2 cu. ft. in volume.

In Hopardi village, 150 trolleys of manure is sold every year. Mostly Moslem farmers owning large herds of sheep and goat are in the business of selling manure. In the survey, seven farmers reported selling manure worth Rs. 9800/-.

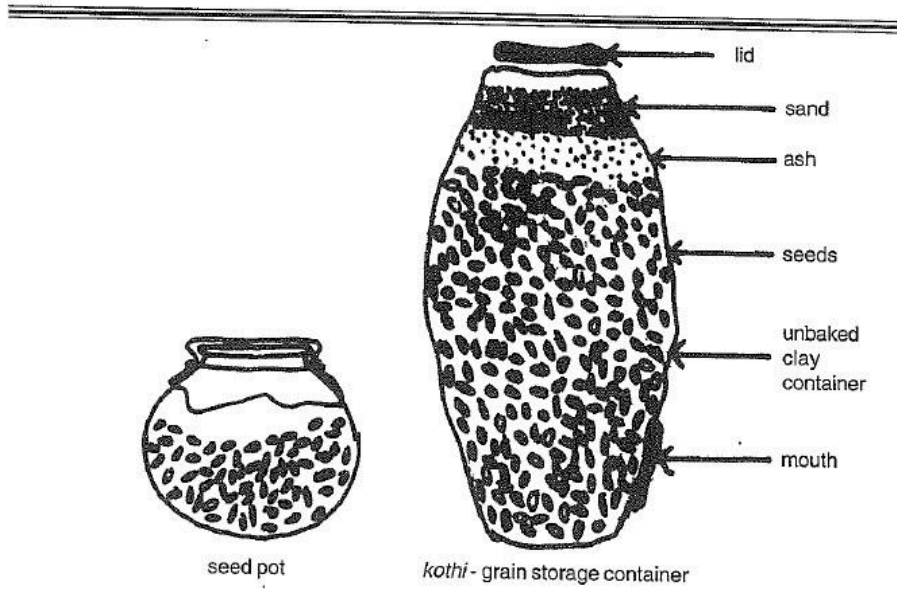
Seed

Source of Seed

For the major crop of Kharif, mostly farmers keep their own seed. In some cases they may also borrow it from outside. However Kharif seed is almost never bought from the market. On the other hand seed for the Rabi crop of tara mira is almost always bought from the market.

Seed is retained for long periods, up to three four years if necessary. Farmers will prefer to buy grain for consumption at home but will retain the home seed.

Seeds are normally stored either in a *kothi* or a fired clay pot. A *kothi* is a grain storage container. It is made up of a mixture of clay and donkey dung and hand built. Seeds are stored in this container and covered with a layer of ash and sand. This way the seeds are retained upto long periods. Seeds are sometimes stored in a fired clay pot with the mouth covered by a cloth. In this system, the seeds cannot be retained for too long and as they "burn out" and do not germinate.



Seed Selection

Normally two methods of seed selection are used.

Grain Selection

In this method good grain is kept aside for use next year. Selection of grain is done during winnowing. While winnowing, the heavier grain falls near while the lighter grain falls at some distance. The heavy grain is kept aside to be used for seed.



Sitta Selection (सिट्टा)

Selection : The second method is to select and keep aside whole *sittas* (ear heads) of pearl millet. While selecting, *sittas* with big, thick grains that are packed tight with grain are selected. *Sittas* that carry more hair (moos) are eaten less by birds. These are given preference in selection.

Quite a large number of farmers do not undertake any selection. Survey results show that about 35% farmers did not undertake any selection. Of those who did, two thirds selected grain while one third selected whole *sittas* for seed.

Seed Treatment

Normally no treatment is done if the seed is used in the first year. If the same seed is to be retained for the second year, then treatment is applied. Most common treatment is to treat the seed with ash. Now chemical insecticides like DDT are also used with ash.

Water Conservation

Water conservation is crucial in desert agriculture. Field bunds erected on three sides of the field boundaries conserve some moisture. But this is limited. The major structure used to conserve water is *khadin* (खडीन) This is a 1-2 metre high earthen bund across a sloping surface. It intercepts run off water. Run on area may be 3-10 ha and catchment area will normally be more than this.

Of the surveyed farmers, 12 farmers had *khadins* on their land with a run on area of 523 bighas. This gives an average of 7 ha per structure.

In three of the surveyed villages, exhaustive listing of all the *khadins* was carried out.

Table 10 Status of Khadins in Three Surveyed Villages

Village	No. of khadins	Total run on area (ha)	Total cultivated land in village (ha)	%age of land under khadin
Raneri	48	260	7278	3.5
Ugras	51	112	8550	1.2
Hopardi	14	74	410	18

Source : Village survey

Thus we find that in one of the villages, a significant part of the land is under *khadins*.

Cropping Pattern

Cropping pattern of the area is highly attuned to the particular agro climatic conditions prevailing.

Kharif Crops

Major crop sown is a mixture of *bajra* (बाजरा), *moong/moth* (मूंग / मोठ), *til* (तिल), and *matira* (मतीरा). To this mixture *kaachra* and *tinda* may also be added, taking the total number of crops sown to seven. At times a little *gwar* is added in the two three rows near the house so that it may be used as vegetable. Mixed cropping serves a number of functions

- Drought proofing. Various crops have different water requirements. Bajra is the first crop to dry up, followed by moong/moth, followed by til, and then matira. Thus even in very low rainfall, some output is assured.
- Legumes like moong/moth enrich the soil.
- A good nutritional balance for the diet is obtained with simultaneous production of cereal, pulse, and oil seed.

Ratio of Crops in the Mixture

If sowing is to be done by tractor, then for five bighas of land (traditional unit of land measurement called *harli*) seeds are taken in the following ratio

bajra	3 kg	moong/moth	250 gms
til	250 gms	matira	500 gms

To this mixture, a sprinkling of *kaachra* and *tinda* seeds may also be added. The ratio given above is changeable depending upon a number of factors - soil condition, farmer preference, seed availability. Some of the saplings may be removed after they grow up. Thus often *matira* and *kachra* may be removed if they clutter around *bajra* saplings:

Nearly all the farmers in the area undertake mixed crop sowing as a priority. However single crops are also sown. The single crops sown are guar, jwar, til, and moong. Gwar is a cash crop. It is also the most drought resistant crop.

Matira serves multiple purpose including that of being a cash crop. Its seeds are sold at the rate of Rs. 10 per kg. Farmer incomes from sale of its seed may vary from Rs. 2000 to Rs. 18000. Its flesh is eaten by humans and skin by animals. However separating seeds from the rind is a very labour intensive process, these days, it is done by mechanical process.

Correlation between Crop and Land

Selection of crop is also determined by the type of land. A folk saying captures this relationship very well

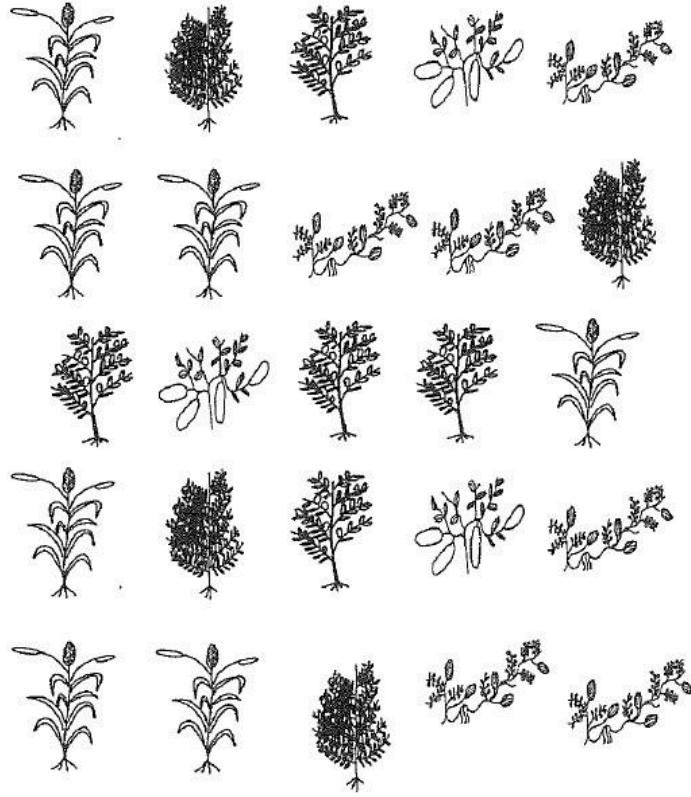
तिल तालरिये मूंग भंगरिये
धौरा धरती री ज्वार बाजरी

Til is best sown on flat plain land with hard and heavy soil while moong should be sown on hilly and rocky fields. Jwar and bajri are best suited for land between sand dunes.

Rabi Crops

In Rabi, mostly *tara mira* (तारा मीरा) is sown. Wheat and *raida* (रायड़ा) may also be sown. In *khadin* areas corriander, radish, and barley are also sown.

Rabi cropping in dry agriculture is dependent upon late monsoon showers. If there are good late monsoon showers, large area will be sown. Thus in 1998, while most of the Kharif crop was lost because of low rainfall, late showers resulted in a high amount of land (almost 30% of total) being sown with *tara mira*.



A field in which mixed cropping has been done.



Matira
(water melon)



Moong
(pulse)



kakdi
(cucumber)



Til
(sesame)



Bajra
(Pearl millet)

Table 11 Cropping Pattern of Surveyed Farmers for the last three years

Crop	1998 No. of farmers	Acreage in bigha	1997 No. of farmers	Acreage in bigha	1996 No. of farmers	Acreage in bigha
Kharif						
Bajra+mix	65	2059	72	2346	64	1905
Gwar	48	1103	47	1128	35	792
Jwar	34	543	32	446	18	280
Til/moong	10	100	7	101	5	119
Total		3805		4021		3096
Rabi						
Tara mira	52	1812	30	789	6	125
Raida	2	28	2	35	6	125
Wheat			1	20		
Total		1840		844		250

Source : Farmer survey

Table 11 reveals

- Bajra mixture is sown almost universally by all the farmers. It accounts for more than half the acreage under Kharif.
- Gwar is the second most important crop. It is a cash crop and also provides good fodder for animals. It is sown by almost 60 % of the farmers and accounts for 30% of Kharif acreage.
- Jwar is also significantly sown. It is mostly used as a fodder crop.
- Higher acreage in 1997 compared to 1998 matches with the rainfall data. Average rainfall in 1998 (till Sept.) was only 179 mm compared to 287 mm for 1997.
- Most important crop in Rabi is tara mira.

Common Diseases

A variety of diseases attack crops. Table 12 below gives the common diseases and their local treatments.

What is remarkable is that there is almost no use of pesticides. Farmers cope with disease without resorting to extensive spraying of chemicals.

Table 12. Common Diseases

<i>Disease and its description</i>	<i>Treatment</i>	<i>No. of farmers reporting the disease</i>
<p>Kaatra (कातरा) It is a black and yellow coloured <i>sundi</i>. It moves in herd and attacks any vegetation that comes in its way. Attacks all crops.</p>	<p>Dig a 1ft. wide and 6 inch deep trench around the field which prevents <i>kaatra</i> from crawling inside. According to local farmers, the insect does not survive beyond the sixth day of <i>Bhaadon</i>.</p>	11
<p>Karwa (करवा) Insect attacks bajra. It sucks away at the grain as soon as grain formation begins, thus reducing productivity.</p>	<p>Insect is attracted towards fire. Can be destroyed by lighting fire at a number of places on the field boundary. High incidence of this pest has ensured it a place in folk lore and some interesting treatments</p>	33
<p>मामा चढ भणिजी आयो करवा छोड खेत परायो Maternal uncle takes his nephew to the field and feeds him bread while repeating the above.</p>		
<p>Jaala (जाला) Affects crops of til. A web appears stunting growth.</p>	<p>Ash is sprinkled on affected parts.</p>	36

<p>Teliya/chopda (तेलिया / चोपड़ा) Small green insect that sucks away at leaf juice and green bean. Affects gwar and matira. Insect appears after Diwali when dew formation starts.</p>	<p>Early sowing and keeping the field clean. Gwar is not sown late, even though moisture may be available, fearing its attack.</p>	12
<p>Termites(दीमक) Affects roots of crops and trees. Dry areas provide favourable conditions for termite growth.</p>	<p>Crop straws should be burnt or removed from field.</p>	13
<p>Goondia (गूंदिया) Affects bajra at the time of grain formation, disease caused by rainfall. Instead of grains, small drops of gum appear on <i>sitta</i>.</p>	<p>Early sowing and mixed cropping reduce the impact. Affected crop should be submerged in 20% mixture of water and salt and grains floating on top should be thrown.</p>	14
<p>KaliKagan (कालीकागण) Affects jwar. On crushing grain black powder comes out.</p>		2
<p>Lat (लट) Attacks moong, moth, and creepers of matira</p>	<p>Best way to control is to destroy adult insects at night. These can be found eating leaves of khejdi and ber. They can be shaken down from trees or attracted by light and then destroyed.</p>	9
<p>Gandio (गंदियो) Attacks matira crop</p>		3
<p>Locust (टिड्डी / फाके) Dangerous insect that can destroy whole crops</p>	<p>Trench is dug in the direction in which insects are moving. Trenches are filled with sand after insects have moved in.</p>	1

Sowing should be done by

Shoofly Damage is noticed soon after germination in wheat and barely crop. Central leaf of the plant turns pale and inclines downwards.	mid November
Blue beetles, field crickets, aphids Insects that attack wheat and barely crops	Tobacco should be kept in water for 24 hours. Then the clear liquid should be diluted and sprayed on the crop.

Source : Farmers' survey

Note : The last column gives number of farmers who have reported the disease.

What is remarkable is that there is almost no use of pesticides. Farmers cope with disease without resorting to extensive spraying of chemicals.

Laah (लाह)

Agricultural operations require large amounts of labour at critical periods like harvesting. Rural communities developed traditions of collective labour to meet such needs. With break down of traditional systems, in most parts of the country such traditions have gone out of use. However in Jodhpur, this tradition continues to retain its vibrancy. System of collective labour is called 'laah'.

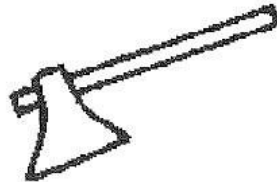
Number of people invited in 'laah' may vary depending upon the occasion and status of the host. The number may reach upto 500 even. Host is obliged to provide good food. Mostly it is 'ghee' and 'halwa' along with tea at intervals. Opium is also served at such occasions. For the 'khoontni laah' (harvesting), food is provided three times. Normally it is two times only. Fodder is provided for the animals. Women may also go for 'laah' depending upon occasion. Some occasions when a laah may be called are weeding (normally women only are called for this), building house, and harvesting.

'Laah' operates within the confines of a hierarchical society and the inequality is reflected by the customs. Thus higher caste men will go to a 'laah' of a lower caste farmer only if the host happens to be a neighbour and food arrangements for them will be separate. This also dissuades lower caste farmers from inviting higher caste farmers. But lower caste farmers will go to 'laah' of all farmers in the village. Similarly women from higher caste will not go to 'laah' of a lower caste farmer but the opposite can take place.

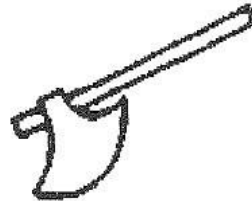
Common Implements Used in Agriculture

Implements used in agriculture evolve over a period of time fulfilling the needs of agricultural operations. Every distinct agricultural region will have its own specific implements. Some of these may be unique to the region. Thus agricultural implements give a lot of information about agricultural practices of the area.

Kawadi कुहाड़ी
For cutting wood



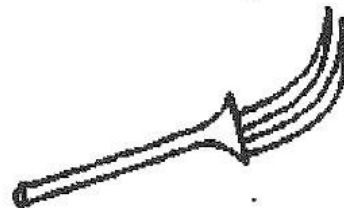
Kassi कसी
A small 4 inch blade on a
5-6 ft wooden handle used
for weeding operations



Pawda पावड़ा
Used for soil work, digging,
moving soil



Bai बेई
A wooden implement used
for lifting and carrying thorny
shrubs and fodder
Dantri दांतरी



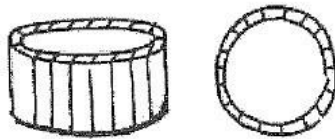
Sickle, used for harvesting



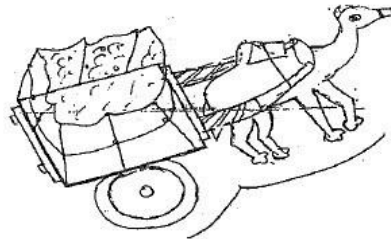
Dantra दातरा
Large sickle, used for cutting
grass, stalks of crops



Odha ओढा
Wooden tray for keeping
things



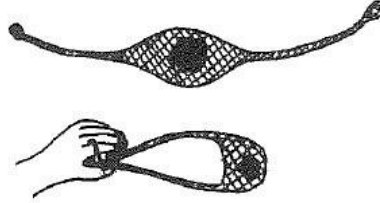
Jhaal झाल (पटिया)
Used on the back body of
the cart for increasing its
carrying capacity



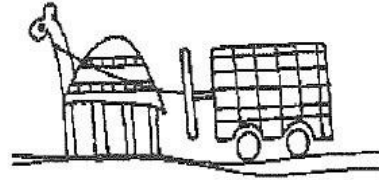
Koonda - Iron tray



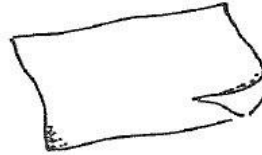
Gophan गोफण
A woven sling which is used
to throw stones to frighten
away birds



Chhakra छकड़ा
A wooden cart in which a
camel or a bullock is har-
nessed



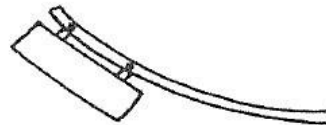
Jholi झोली
A bag used at the time of
harvesting for storing *sittas*



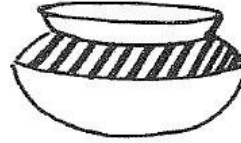
Sanwar सांवर
Flat block of wood used for
flattening the land and bury-
ing the seed after ploughing



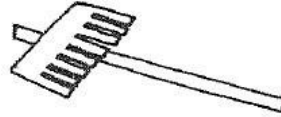
Jhaarbat झारबट
Used to cut grass and small
thorny bushes



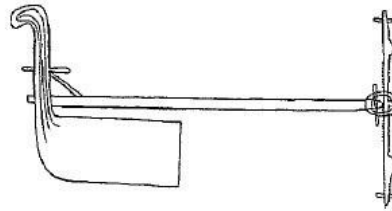
Chaadha चाढा
An earthen pot used for
washing of matira seeds



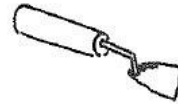
Khaudi खौड़ी
Used for making field
boundaries



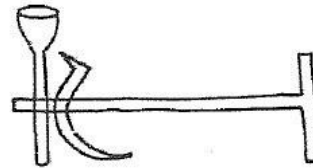
Ghiyo घीयो
This is also used for making
field boundaries



Khurpi खुरपी
Used in weeding operations



Hal हल
Wooden or iron plough are
used for ploughing



Agro Forestry

Tree Species - Indigenous and Exotic

Thar is not a tree less expanse. A number of drought resistant species have traditionally flourished in desert areas. Scientists have put the total number of plant species in desert area as 600. These are

Prosopis cineraria - Khejdi
Accacia senegal - Kumbat
Zizyphus spp. - Bordi
Capparis decidua - Kair
Tecomella undulate - Rohida
Calligonum polygonoides - Phog
Salvadora oleoides

However Government Departments have also experimented with exotic species on the ground that most indigenous trees are slow growing. Two of these species have picked up and spread on a significant scale. These are

Accacia tortilis used for stabilising sand dunes
Prosopis juliflora known for its fast bio mass production

Khejdi is the most common tree of the desert. Almost all parts of this tree are useful for man. It is a good source of firewood. Lopped branches are used as fuel wood. Its pods are used for human consumption before ripening and fed to animals after ripening. Dry pod *saangri* is one of the constituents of *panchkuta*, a famous dry curry. Leaves provide nutritive green fodder through out the year and dry leaves are also liked by animals. Even its bark, roots, gum, and seeds are extensively used.

The trees are lopped for foliage, locally known as *loong*, in a systematic manner, without causing any injury to the tree in the month of November and December each year (Mann and Saxena). The lopped trees remain dormant upto middle of February. the plant sprouts well with several new twigs. The tender twigs are once again cut during May June for livestock feeding. All this keeps the crown cove with less foliage and uneffective for checking sun light. In June-July the sown crops and the tree crown develop simultaneously. The crops and trees do

not have any competition with each other. Annual crops draw their moisture and nutrients from top 50-60 cms of soil and whereas the effective root system of trees is below this depth.

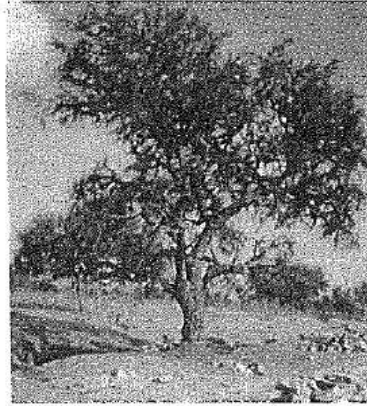
Bishnoi, a major peasant community, is very famous for its conservation ethos and protection it provides to Khejdi tree.

Bordi is the other most common tree. Its leaves provide fodder and are called *paala*. Goats and camels prefer it to almost any other fodder (Purohit and Khan). Its wood is used for making handle of implements. Fruits are highly relished and eaten both fresh and dry. Thorny twigs are used for numerous purposes in agricultural operations.

Trees in the Field

Agriculture in desert has always co-existed with trees. Historically cultivation of crops has been undertaken between standing rows of trees. This is well illustrated by a folk saying on the subject

कैर कुमटिया बोर रोहिड़ो
फोग खेजड़ी भावे
मरूधर रे इण सिंगारा बिन
जीव कटै जक पावे



Photograph of Khejdi

Incidence of Agro Forestry

The two major species found on the field boundaries and inside are khejdi and ber. Accordingly field survey documented only these two trees. Field survey documented a total of 1867 trees of khejdi and 544 trees of ber on the fields of farmers. This gives an average tree density for these two trees as one tree for every two bighas of land.

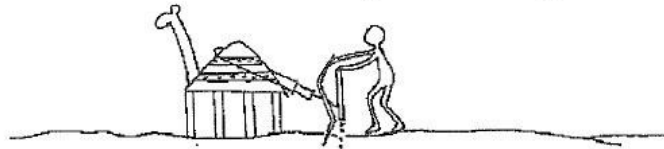
It is clear that incidence of agro forestry is coming down. Farmers do not prefer to keep trees in between their fields. Primary reason is that trees hinder ploughing by tractors. The trees that remain are on the boundaries of fields.

Bishnoi community is normally known for the protection it provides to khejdi. However it is found that this community has very few trees on their land. Their fields are mostly clear. One reason given is that they do not keep goats and therefore do not need *paala* and *loong*.

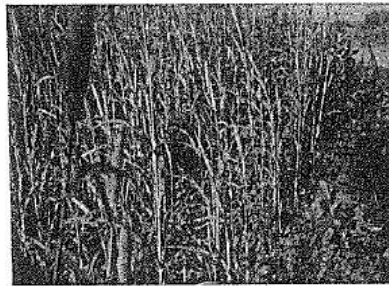
Income from Agro Forestry

Agro forestry can be a good source of income also as is illustrated by the case of Lal Din Khan of village Kalron. Lal Din has 145 bighas of land. On his land there are 25 trees of khejdi and 207 trees of ber. He sells 25 *monds* (40 kg) of *paala* every year at the rate of Rs. 150/*monds*. He also sells grass worth Rs. 20,000 at the rate of Rs. 125/*monds*.

Economics of Dry Land Agriculture



We look at economics of dry land agriculture by looking at the case of two farmers - Sri Sohan Lal Bishnoi of village Raneri and Sri Poona Ram of village Baingathi Khurd. For keeping the analysis simple, we will take up only the major crop of bajra mixture in Kharif and Taramira in Rabi in 1998-99 season. This was a deficient rainfall year and Kharif crops sustained heavy losses. However the year also saw good rains in October. As a result there was large scale sowing of taramira in Rabi.



1. Photo of the field of Shri Sohan Lal Bishnoi, Raneri



2. Photo of the field of Shri Poona Ram, Baingthi khurd

Case 1 : Sohan Lal - Table 13 . Kharif crop of Bajra mixture

Area sown 25 bighas	<i>Income</i>	<i>Sub total</i>	<i>Expenditure</i>	<i>Sub total</i>
Bajra 30 kg @ Rs 6/kg	180		Land preparation Sooth 7 man days	350
Bajra stalks (<i>Dhoka</i>) 4 qtl @Rs. 100/qtl	400		Ploughing by Tawi 20 hrs @ Rs. 110/hr	2200
Til 1 qtl @ Rs. 1800	1800		Sowing of seed Bajra seed 30 kg @ Rs. 10/kg	200
Moong 32 kg @ Rs. 18/kg	576		Til seed 1.5 kg @ Rs.24/kg	36
Matira Seeds 1 qtl @ R.6.75/kg	675		Moong 2 kg @ Rs. 21/kg.	42
Matira skin (<i>Khupri</i>) 1 qtl @ Rs. 1/kg	100		Matira 6 kg @ Rs. 8/kg Sowing by sitting on tractor 2 mds Weeding not required because of tawi ploughing Protection 1 month labour @ Rs.50/day, then discontinued because of drought	48 100 0 1500
			Harvesting and threshing Bajra 7 mandays Til 10 mandays Moong 2 mandays Matira 12 mandays Transport to home 3 trips of camel cart @Rs. 50/trip and two trolley trips @Rs. 100/trip	350 500 100 600
				350 6376

3731

Net return : A loss of Rs. 2645

Area sown 37 bighas
Income

Tara mira
12 qntls @ Rs. 920/qtl
Culti for 10 hrs @ Rs. 130/hr

Table 14 Rabi crop of Taramira

<i>sub total</i>	<i>Expenditure</i>	<i>sub total</i>
11040	Land preparation	1300
	Sowing 2 mandays	100
	Seed 5 kg @ Rs. 25/kg	125
	Protection Fencing of thorny shrubs trolley hire and labour	1200
	Harvesting 32 mandays	1600
	Transport to home 5 trolley trips @ Rs. 100/trip	500
	Threshing 3 hrs of tractor @ Rs. 150/hr and 16 mandays for cleaning	1250

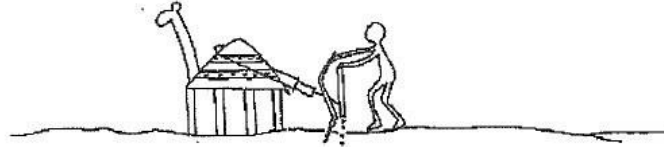
Table 16 Rabi crop of Taramira Area sown 15 bighas

<i>Income</i>	<i>sub total</i>	<i>Expenditure</i>	<i>sub total</i>
Taramira 9 qntis @ Rs. 940/qnt	8460	Land preparation Tawi for 9 hrs @ Rs. 90/hr and cultivator for 3 hrs @ Rs. 130/hr	1200
		Sowing 1.2 mandays	60
		Seed 3 kg @ Rs. 20/kg	60
		Protection Fencing of thorny shrubs trolley hire and labour, watchkeeping	1350
		Harvesting 10 mandays	500
		Transport to home 2 cart trips @ Rs. 60/trip	120
		Threshing 2 hrs of thresher @ Rs.225/hr	450
		Bagging 1 manday	50
		Transport to market @ Rs. 15 /bag	135
	8460		3925

Net returns : A profit of Rs. 4535

Analysing the returns we find that
 • The farmers sustained a loss in Kharif and got profit in Rabi. Taking both crops together, they had positive returns of Rs. 2030/ and Rs. 2223/ respectively for 25 bighas of land.
 • However even in Kharif, if we leave out the labour cost assuming opportunity cost of labour to be zero in that season, then the first farmer Sohan Lal got a net positive return of Rs. 855/- . However the second farmer Poona Ram still has a net negative return of Rs. 112/-.

The above results show the vibrancy of desert agriculture where there is some production every year. It should be noted that the Kharif crops faced extreme moisture stress at the crucial maturing stage when there was no rainfall. As a result there was high loss of production.

5**Government Policies**

Government is the primary agency responsible for agriculture development. Its policies have a crucial bearing on development (or lack of development!) in any sector. This section reviews government policies vis a vis rain fed agriculture in the desert. It looks at the Government structure, the package of programmes undertaken by the Government agencies, and then critiques these.

Government Infrastructure for Agriculture Development

There are two major wings for agriculture development - research and extension. Indian Council for Agriculture Research is the primary national level agency for research. Research efforts in the arid zone are led by Central Arid Zone Research Institute (CAZRI) at Jodhpur. In addition there is a network of Agriculture Research Stations (ARS) - one in each agro climatic zone. In the arid zone, research stations are located at following places

Zone I A	Mandore
Zone I B	Sri Ganganagar
Zone I C	Bikaner
Zone II A	Fatehpur Shekhawati
Zone II B	Luni Keswana

There are also sub stations under these main stations. In addition, an Arid Forest Research Institute has also been set up at Jodhpur.

CAZRI has lead functions for forage crops, arid fruits, agro forestry, and silvi pasture. The ARSs have lead functions for grain crops.

Extension activities are undertaken by the Agriculture Extension department of the Government of Rajasthan. Agriculture extension activities in the district are

led by the Deputy Director of Agriculture. He is supported by a complement of Assistant Directors, Agriculture Officers, Assistant Agriculture Officers, and Agriculture Supervisors. Of the nine blocks in Jodhpur district, two are non extension blocks.

Government Programmes

The Government extension department promotes use of improved techniques, tools, seeds by providing subsidy. The main schemes of the Department are listed below

- Sprinkler system
- Demonstration of improved techniques
- Integrated pest control demonstration
- Cotton demonstration
- Plant protection through chemicals
- Use of gypsum in oil seeds and for land improvement
- Improved agriculture implements
- Seed mini kits

The research institutes have focussed on rain fed crops. The various aspects of research are

- improved seeds
- agronomic practices like weeding and inter cropping
- entomology
- plant pathology

Critique of Government Policies

The survey findings indicate that there has been little impact of government agriculture development efforts on the agricultural practices in the area. While the study area falls in a non extension block, some impact of Government efforts should have been discernible from the diffusion effect. Some instances that indicate low impact of government programmes are

- For the Kharif crops, the farmers use their own seed almost exclusively. For the main crop of pearl millet, while the Department has propogated a number of new varieties, none is currently used.
- While mixed cropping is a universal practice in the study area, there has been

little Government intervention in this crucial aspect. For a long time, Government departments continued to promote mono cropping as a superior practice. Now mixed cropping has been adopted as a research area. However the Government research establishment is yet to appreciate the highly evolved nature of traditional practices. Thus while the jowar - guar combination is suggested as the best by the ARS scientists, this is the one combination not used at all by the farmers in Phalodi area.

- There is no use of chemical fertilisers though the Department continues to promote these as an inseparable part of the new production packages.

Government policy on agricultural development has focused on what is known as 'green revolution technology'. This package seeks to achieve quick increase in agriculture production by introducing

- High Yielding Variety (HYV) of seeds
- Irrigation
- Chemical fertilisers

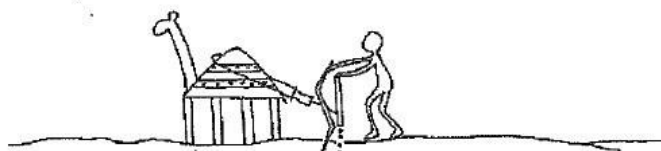
The package revolves around assured irrigation. The water scarce region of Thar does not have much potential for introduction of this package. A CAZRI researcher notes in his paper '..... important factors which contributed to non adoption of green revolution in the Kharif season were erratic and less rainfall and meager availability of irrigation facilities in the region.' It has to be noted that factors listed are in the nature of constraints. Any agricultural development in this area has to be built upon an acknowledgment of these constraints. The same researcher writes ' Looking to the physical conditions of the district, there is very little chance of increasing Kharif production.'

Above is more in the nature of a random quote from writings of one Government researcher. But it very well illustrates the mind set where any agricultural growth is contingent upon adoption of green revolution package. If the area in question does not have conditions favourable for them, then it is the bad luck of that area.

The mind set is further revealed when we look at deployment of Government Agriculture Extension staff in the district of Jodhpur. District has full complement of government staff posted. Of the nine blocks in the district, Phalodi and Baap are non extension blocks. That means there is no extension staff in these two blocks. A major part of Shergarh block also falls in this category. These are the three blocks which have least irrigation and are part of desert region.

6

Findings and recommendations



The objective of the current study was to determine the status of traditional agricultural practices in desert region. Current scenario presents a mixed picture. Some practices - like ploughing by animals - are on the verge of disappearing. On the other hand some practices like mixed cropping in Kharif, are going strong. We also find appearance of new practices. While some of them are beneficial, some are also cause of concern.

Accordingly we present a listing of agricultural practices under three heads

- (i) practices that continue to be followed vigorously,
- (ii) practices whose incidence is going down and
- (iii) new practices that are a cause of concern.

Traditional agricultural practices that continue to be followed vigorously

1. A large proportion of fields are surrounded by earthen bunds which prevent soil erosion from wind and water.
2. Use of traditional methods of increasing soil fertility continues. Practice of leaving land fallow and use of manure are still most widespread methods of increasing soil fertility. There is virtually no use of chemical fertilisers in rain fed farming.
3. Farmers invariably use their own seed for Kharif crops. In fact there is a great premium on using home seed to the extent that seed may be retained for three four years. Thus impact of HYV seeds on Kharif crop is

negligible. However seed of tara mira for Rabi sowing is almost always purchased from the market.

4. Bajra mixture continues to be the dominant crop in Kharif. More than half the area in Kharif is under this mixture.
5. Farmers continue to use traditional methods of pest control. No use of insecticides has been reported.
6. Traditional farming implements continue to be used showing their relevance in the agriculture even under changing circumstances.
7. Water conservation is now getting more attention. Both Government and NGO active in the area have promoted construction of *khadins* and their numbers have gone up.

Declining Traditional Agricultural Practices

1. Traditional practices of soil conservation like *jhoor kootna*, and *kanabandi* have come down sharply.
2. With introduction of tractors and mechanised ploughing, ploughing by animals is on the verge of disappearance. Less than 5% of surveyed land was ploughed by animals in the Kharif season of 1998.
3. Incidence of agro forestry - co existence of trees, shrubs, and grass with crops - is going down. Farmers are resorting to deep ploughing to clear away the field completely.

New Practices

1. A large proportion of land is subjected to deep ploughing by disk. A three year rotation of disk ploughing is fast becoming the norm. This is happening as farmers seek to convert rangeland to agriculture fields and remove vegetation from the field.

-
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2. Practice of sale of manure has started with introduction of irrigated farming in the region. Tube well farmers are purchasing manure from farmers with surplus - usually those who have large herds of sheep and goat.
 3. Cultivation of tara mira in Rabi has picked up in a major way. Thus in 1998-99 Rabi season, almost a third of the arable land was sowed with tara mira.

Recommendations

It is proposed that the traditional practices that are on the verge of disappearing be studied more thoroughly. Some changes may be irreversible. However it may be possible to revive some of the desirable practices with suitable mechanisms. A decision as to the 'revivability' of a certain practice can be reached only after a more intensive study.

To illustrate the above point, it may be difficult to go back to animal ploughing inspite of its various advantages. However it should be possible to meet some of the harmful effects of tractor ploughing by encouraging soil conservation measures. Ways and means should be considered for reviving traditional practices like *kanabandi* and *jhoor kootna*.

For practice that continue to be followed, improvements should be considered to further increase their efficacy. Some of the areas that are desirable for further study and action are

- Seed drill for use in tractors that is suited to the sowing practices of desert regions
- Innovations in mixture composition that will further enhance the productivity and nutritional value of the output
- Encouraging practice of leaving the land fallow
- Improvements in seed selection procedure

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