C H A P T E R I

INTRODUCTION

Conceptually "Dry Farming" refers to the technique of crop production in such regions which are marked by scarce rainfall and inadequate irrigation facility. In India out of net sown area of 143 million hectares, 105 million hectares are under dry farming which accounts for nearly 73 per cent of the net sown area (Table No.1.1). Agriculture in these large area is still a gamble of annual rainfall. Rainfall in these regions is extremely uncertain in regard to both its quantity and distribution. As water is the most important single factor of crop production, the inadequacy and uncertainty of rainfall often causes partial or complete failure of crops, that leads to frequent scarcities and droughts. Such conditions naturally, therefore, cause disturbances in economy of the farmers resulting in hardship in dry farming areas.

Table No. 1.1. Statewise Rainfed Area in India - 1978-79

Sr. No.	State	Net Area Sown	Net area irrigated	Net rainfed area	Percentage of net rainfed area to net area sown
(1)	(2)	(3)	(4)	(5)	(6)
1.	Andhra Pradesh	11349	3655	7694	67.8
2.	Assam	2679	572	2107	78.6
3.	Bihar	8532	2960	5572	65.3
4.	Gujarat	9543	1715	7828	82.0
5.	Haryana	3650	1918	1732	47.5
6.	Himalchal Pradesh	561	89	472	84.1
7.	Jammu & Kashmir	724	305	419	57.9
8.	Karnataka	10315	1409	8906	86.3
9.	Kerala	2204	228	1976	89.7
10.	Madhya Pradesh	18847	2315	16532	87.7
11.	Maharashtra	18245	1896	16349	89.6
12.	Orissa	6097	1148	4949	81.2
13.	Punjab	4177	3262	915	21.9
14.	Rajasthan	15471	2895	12576	81.3
15.	Tamil Nadu	6251	2873	3378	54.0
16.	Uttar Pradesh	17482	8892	8590	49.1
17.	West Bengal	5539	1489	4050	73.1
18.	Other States	1272	340	932	73.3
	Total..	142938	37961	104977	73.4

Government of India, Ministry of Agriculture, New Delhi (1983), Discussion Papers - "National Workshop on Rainfed/ Dryland Farming", April, 23-24.

According to Krishnaswami and Patel[1], dry farming regions are characterised by a diversity of climatic, agronomic, topographic, social and economic factors. The feature common to these regions, otherwise so diverse in character are the poor economic status and social backwardness of the dryland farmers, the low fertility of soils, the ill-nourished farm cattle and the poor and unstable returns to farm investments. According to them, factors responsible for such a poor state of affairs are partly economic, partly social and partly technological in character. Soil are poor due to heavy errosion and remain poor due to over-exploitation without periodic replenishment of nutrients.

1.1 Extent and Significance of Dry Farming

The history of Indian agriculture in general is one of the low productivity of land and instability of farm output and income of the farm families. For decades

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1. Krishnaswami, M. S. and Patel K. V. (1973), "Managing an Action Programme for Dryland Agriculture", C.M.A. Monograph No.48, Indian Institute of Management, Ahmedabad.

preceeding independence, agriculture remained mostly neglected. In early fifties with launching of First Five Year Plan for economic development, the country entered into an important phase of agricultral development. Technological break-through, particularly biological and chemicals ones, achieved in sixties have brought spectacular improvement in Indian agriculture. Evolution of hybrid/ high yielding varieties of crops like Pearlmillet, Sorghum, Cotton, Rice, Wheat etc. have increased the production potential to a great extent which,in fact, has brought green revolution in the country. However, it confined to very limited areas well endowed with natural resources of irrigation. The problem of low and unstable agricultural production still remain to be tackled in the vast area, arid and semi-arid, of the country.

However, not all the regions falling in the catagory of rainfed tracts are equally vulnerable. As these regions are spread over the length and breadth of the country, their physical, economical and technological characteristics differ widely and so do their potentialities. For instance, at one extreme are the regions which receive reasonably

high rainfall and can be placed at par with the regions having assured irrigation so far productivity is concerned. At the other extreme, the areas receiving miserably low rainfall and with no adequate irrigation network and therefore lack potential required for development. Leaving aside these very dry and wet regions in the country, however there is a sizeable area of about 36 percent of net sown area where the rainfall is low and no adequate irrigation facilities exists. These dry farming areas have been identified and defined by the Indian Council of Agricultural Research (ICAR)[2] as those receiving annual rainfall between 400 mm and 1000 mm which have less than 25 per cent of the sown area under irrigation. This low rainfall area is spread over the states of Andhra Pradesh, Gujarat, Hariyana, Jammu and Kashmir, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Rajasthan and Uttar Pradesh. Available statistics indicate that 84 districts in the country fall in this catagory. Agriculture in these regions

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2. Indian Council of Agricultural Research (1970) "A New Technology for Dryland Farming", New Delhi, I.A.R.I, p.5.

is faced with twin problems of low productivity and high instability.

Dry farming assume a strategic position in the overall Indian context as it is clear from the fact that only about 27 per cent of the cropped area in the country enjoy assured irrigation while the balance is left to the vagaries of monsoon. According to the National Commission on Agriculture[3], even if all the irrigation potentials are harnessed by 2025 A.D., not less than 40 per cent of the gross cropped area in the country will continue to be rainfed. The drylands contribute nearly 42 per cent of the foodgrains, almost all of coarse grains and 75 per cent of pulses and oilseeds. More than 90 per cent of Sorghum, pearlmillet, groundnut and pulses are grown as rainfed crops in arid and semi-arid tracts of the country[4].

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3. Government of India (1976), "Report of the National Commission on Agriculture", Ministry of Agriculture and Irrigation, New Delhi, Vo. V, pp. 90-91.

4. Gautam, O. P (1982), A Key-Note Address delivered at the National Seminar on "A Decade of Dryland Research in India and Thrust in Eighties", Hyderabad, 18 January.

Despite the large acreage under different major food-grain crops, the dryland area barely accounts for one-fifth of the total foodgrain production of the country which is a measure of their technological backwardness according to Kanitkar[5]. Not only crop yields are very low but fluctuation in yields is also very high which makes agriculture a gamble in dry farming tracts too. Among the individual states, out of 19 districts of Gujarat State, 14 are covered under dry fa-rming tracts. Eighty eight per cent of its total area fall under arid and semi-arid climatic zones. The arid zone comprises of 36 per cent while semi-arid forms 52 per cent. (Table No. 1.2). This constitute roughly 20 per cent of arid and 9 per cent of semi-arid regions in the country,as a whole, respectively[6]. In Gujarat State out of net sown area of 96.5 lakh hectares dry farming is practised in 76.3 lakh hectares which accounts for 79 per cent of the net sown area (Table No.1.3).

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5. Kanitkar, N. V. (1969), Dry Farming in India, 2nd edn., I.C.A.R., New Delhi, pp. 1-2.
6. Parmar, M. T. and Gandhi, A. P. (1981), Dryland Agricultural Research (1971-1980) , G.A.U, Targhadia, Rajkot. p. 1.

Table No. 1.2. Distribution of Area under Arid and Semi-arid Zone in Gujarat.

Sr. No.	District	Total area KM^2	Arid zone (%)	Semi-arid zone (%)
1.	Kutch	44203	100	-
2.	Jamnagar	10291	80	20
3.	Surendranagar	10377	29	71
4.	Junagadh	10842	20	80
5.	Banaskantha	10456	18	82
6.	Mehsana	11200	7	93
7.	Rajkot	11882	6	94
8.	Ahmedabad	8964	6	94
9.	Amreli	3283	-	100
10.	Bhavnagar	12068	-	100
11.	Kheda	6790	-	100
12.	Sabarkantha	7360	-	100
13.	Panchmahals	3030	-	21
14.	Bharuch	7759	-	26
15.	Vadodara	7647	-	4

Source: Dryland Agricultural Research (1971-1980) Main Dry Farming Research Station, Gujarat Agricultural University, Targhadia (Rajkot)

Table No.1.3 : Districtwise Rainfed Area in Gujarat
(Av. tri-annum ending 1981-82)

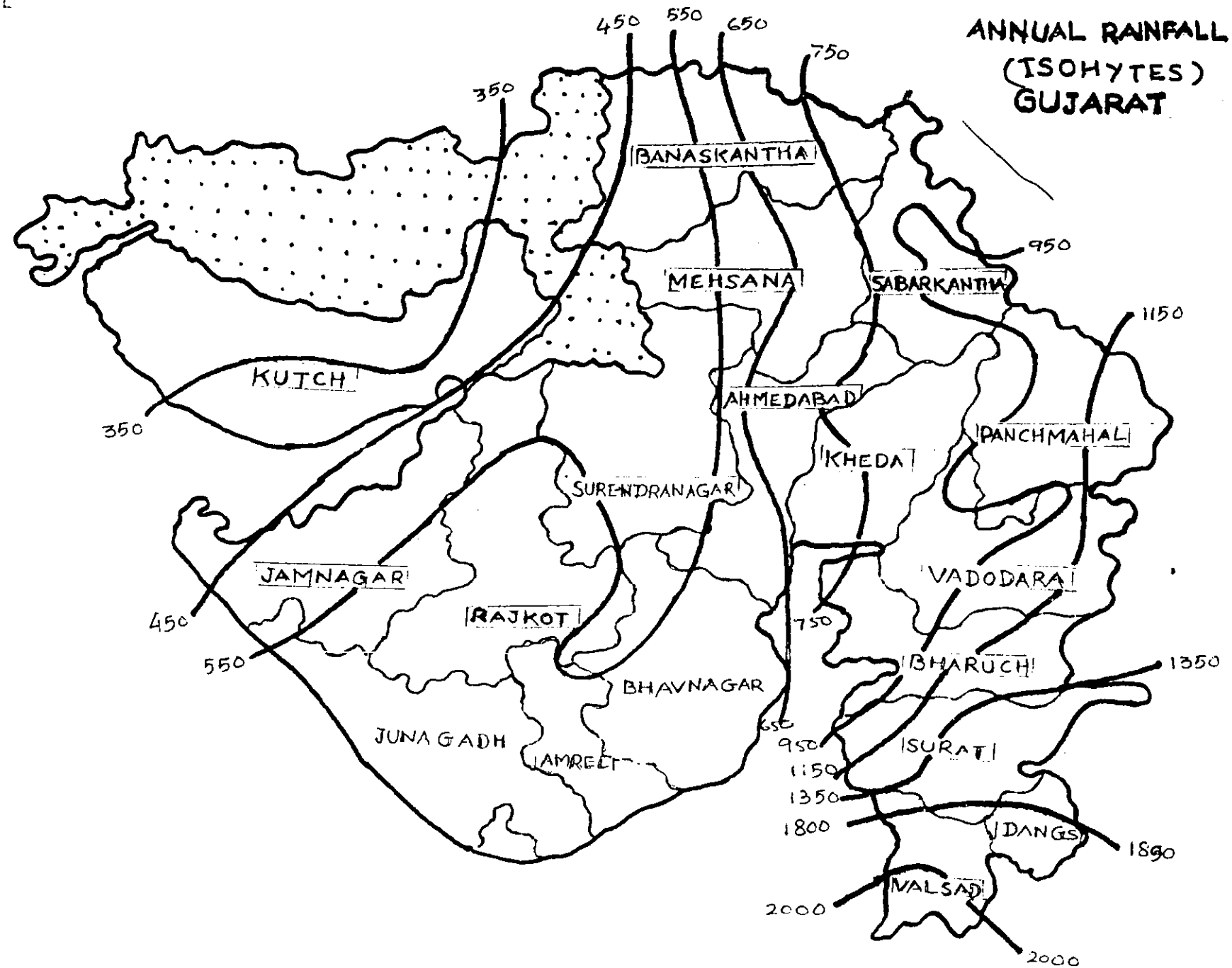
(Area in '00 hectares)

Sr. No.	District	Net area sown	Net area irrigated	Net rainfed area	Percentage of net rainfed area to net sown area
(1)	(2)	(3)	(4)	(5)	(6)
1.	Ahmedabad	5897	938	4959	84.09
2.	Banaskantha	8264	2128	6136	74.25
3.	Baroda	5352	1106	4246	79.33
4.	Broach	4344	456	3888	89.50
5.	Bulsar	2960	455	2505	84.63
6.	Dangs	501	1	500	99.80
7.	Gandhinagar	485	220	265	54.64
8.	Kaira	5171	2047	3124	60.41
9.	Mehsana	6796	2908	3888	57.21
10.	Panchmahals	4743	421	4322	91.12
11.	Sabarkantha	4438	1470	2968	66.88
12.	Surat	3953	1109	2844	71.95
13.	Amreli	4952	674	4278	86.39
14.	Bhavnagar	6253	1320	4933	78.89
15.	Jamnagar	5941	1071	4870	81.97
16.	Junagadh	6116	1113	5003	81.80
17.	Kutch	6630	528	6102	92.04
18.	Rajkot	7180	1597	5583	77.76
19.	Surendranagar	6573	740	5833	88.74
	Total...	96549	20302	76247	78.97

Source: Directorate of Agriculture, Gujarat State, Ahmedabad.

Agricultural prospects in these areas are governed by South-West monsoon rains which normally commence in mid-june and over by the end of September in most parts of the State. Monsoon rains over large tracts of the state are not only inadequate but also extremely uncertain, highly fluctuating from year to year (Map 1 & 2). Analysis of districtwise annual rainfall data for 22 years (1960-1981), presented in Table No. 1.4 shows that co-efficient of variation (C.V) of annual rainfall was more than 40 per cent in almost all the districts except in the districts of Vadodara, Surat, Dangs and Valsad. The highest C.V. was observed in Kutch district (65.35%) and the lowest being 27.91% in Valsad district. The high variability of rainfall causes high instability of crop yields, resulting in high degree of instability to the economy of such regions. Gujarat is one of the most affected state by scarcity conditions in the country. Frequent droughts and scarcities are the common phenomenon in the state which can be judged from the data on number of villages affected by scarcity/semi-scarcity in Gujarat during last 20 years presented in Table No. 1.5. Government of India has

MAP -1


ANNUAL RAINFALL (MM)
(ISOHYTES)
GUJARAT
N
450
550
650
750
350
950
1150
1350
1800
1890
2000
BANASKANTHA
MEHSANA
SABARKANTHA
KUTCH
AHMEDABAD
PANCHMAHAL
KHEDA
SURENDRANAGAR
JAMNAGAR
VADODARA
RAJKOT
BHARUCH
BHAVNAGAR
JUNAGADH
AMRELI
SURAT
DANGS
VALSAD

MAP-2

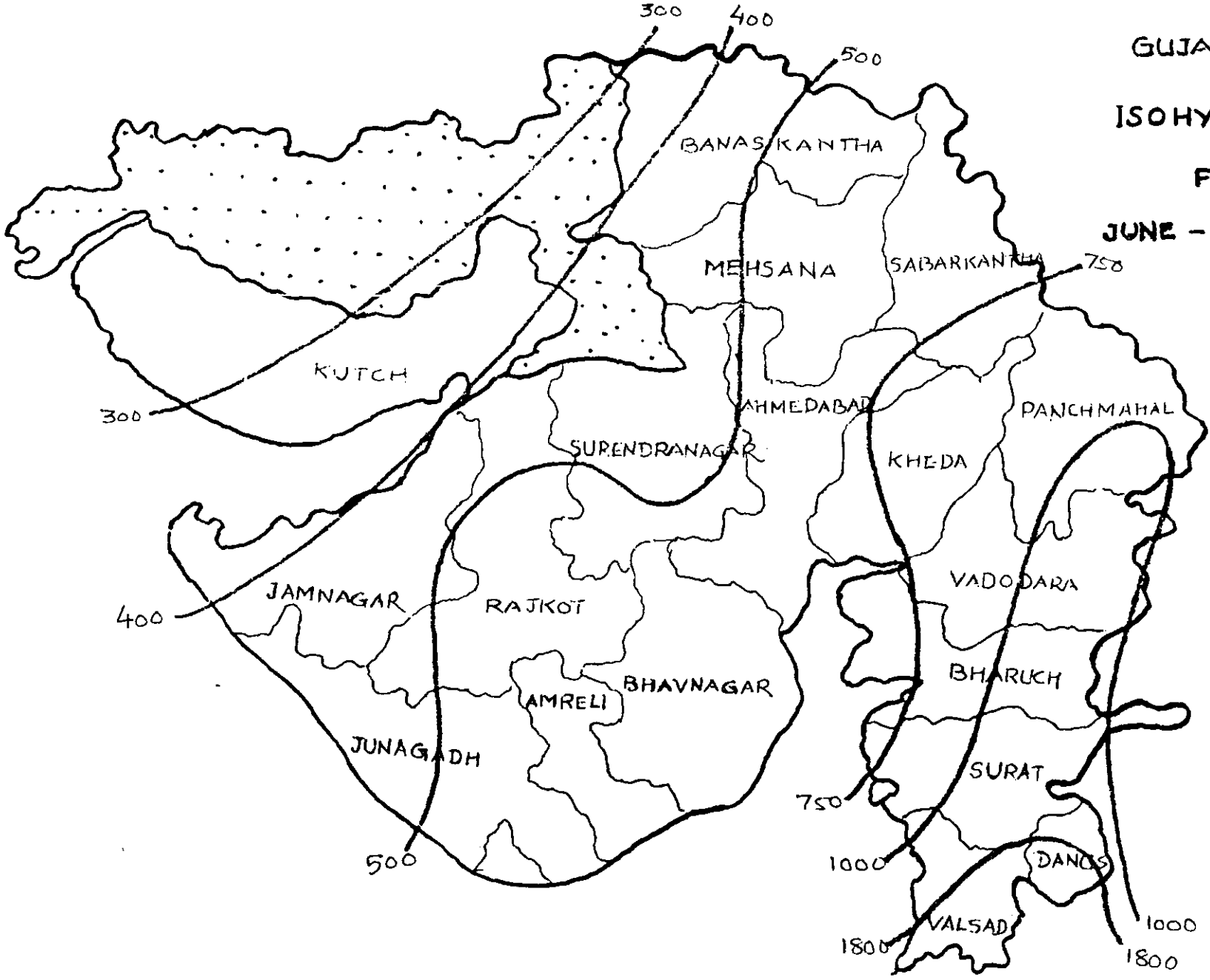

GUJARAT
ISOHYTES (MM)
FOR
JUNE - SEPTEMBER
300
400
500
750
1000
1800
BANASKANTHA
MEHSANA
SABARKANTHA
KUTCH
AHMEDABAD
PANCHMAHAL
SURENDRANAGAR
KHEDA
JAMNAGAR
RAJKOT
VADODARA
BHARUCH
AMRELI
BHAVNAGAR
JUNAGADH
SURAT
DANGS
VALSAD
N

Table No. 1.4. Districtwise Annual Average Rainfall and its Variability in Gujarat (1960 - 1981)

Sr. No.	District (Headquarters)	Annual rainfall in mm			Coefficient of variation (%)
		Av. of 22 years (1960-81)	Maximum rainfall in 22 years	Minimum rainfall in 22 years	
1.	Ahmedabad	785	1282	392	40.43
2.	Gandinagar*	745	1406	184	55.37
3.	Mehsana	611	1702	183	54.98
4.	Banaskantha (Palanpur)	640	1274	196	43.54
5.	Sabarkantha) (Himatna-gar)	775	1405	352	43.21
6.	Kheda (Nadiad)	964	1963	271	44.97
7.	Panchmahals (Godhra)	900	1942	381	41.19
8.	Vadodara	863	1715	261	37.83
9.	Bharuch	932	2467	321	49.19
10.	Surat	1206	2398	614	34.60
11.	Valsad	1947	2830	760	27.91
12.	Dangs (Ahwa)	1991	3450	1188	30.47
13.	Amreli	535	929	242	41.66
14.	Bhavnagar	592	1430	147	46.10
15.	Junagadh	937	1653	286	44.23
16.	Rajkot	612	1291	297	40.76
17.	Jamnagar	577	1369	142	59.64
18.	Surendranagar (Wadhwan)	526	1123	147	47.01
19.	Kutch (Bhuj)	351	840	62	65.36

*Average of 9 years (1973-81)

Source : Department of Agriculture, Gujarat State, Ahmedabad.

Table No. 1.5. Number of Villages affected by scarcity/ semi-scarcity in Gujarat State during 1960-61 to 1979-80

Year	Villages affected	Year	Villages affected
1960-61	2516	1970-71	678
1961-62	49	1971-72	483
1962-63	1592	1972-73	12592
1963-64	1486	1973-74	2586
1964-65	366	1974-75	12716
1965-66	5352	1975-76	-
1966-67	5662	1976-77	-
1967-68	102	1977-78	3720
1968-69	10323	1978-79	1525
1969-70	5114	1979-80	6121

Source : Department of Agriculture, Gujarat State, "Districtwise Rainfall (1960-61 to 1981), Ahmedabad, p.45.

identified 41 talukas, comprising of 10 districts, as drought prone areas. Districtwise drought prone talukas and area affected is given in Appendix I. Thus, the dry farming is the most important component of the state economy. Development of these dry farming regions are, thus has an importance not only for improving the economic prosperity of the inhabitant of such regions but also for bringing about balanced regional development. This calls for the development of package of economically viable technology, which can help in increasing productivity per unit of land, water, time and energy. According to Dr. Swaminathan[7], however, agricultural transformation and agrarian prosperity occure only when an economically viable technological package is supported by appropriate package of services and public policies. Beyond a point, unless the new technology is introduced the addition to production would level off.

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7. Swaminathan, M. S. (1979), "New Technology : Problems and Potentialities", Agricultural Development of India, Policy and Problems, edited by C. H. Shah

1.2. Dry Farming Research and Development in India.

In as early as the eighties of the last century, the Government of India realised the problems of dry farming areas and accepted the recommendations of the Famin Commission of 1880 to initiate the protective irrigation works for benefit of dryland agriculture[8]. But such a protection by irrigation has become possible only to a limited area and these tracts will largely depend upon rainfall only for growing crops.

The first systematic and scientific research on dry-land agriculture was initiated by Tamhane in 1923 at Manjri Farm near Poona. Subsequently, a rather more comprehensive research programme was formulated by Kanitkar in 1926. This formed the basis for research on dryland farming. A few years later, the then Imperical (now Indian) Council of Agricultural Research (ICAR) sponsored an integrated research project under which research works on various aspects of dry farming was initiated at five regional research centres viz.

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8. Indian Council of Agricultural Research (1970), "A New Technology for Dryland Agriculture", I.A.R.I., New Delhi, p.1.

(a) Sholapur and Bijapur in 1933, (b) Raichur and Hagari in 1934, and (c) Rohtak in 1935. The outcome of these research projects was a series of dry farming practices commonly known as (a) Bombay, (b) Hyderabad and (c) Madras, Dry Farming Practices. The basic features of these dry farming practices were bunding to conserve soil moisture, application of farm yard manure to supply plant nutrients, low seed rate and wider spacing, interculture of crops etc. Nevertheless, the marginal return of 15 to 20 per cent over the base level yield of 200 to 400 Kg/ha did not enthuse the dryland farmers very much to adopt these research results[9].

Another effort to improve the productivity of dryland agriculture was made in 1954 by establishing soil conservation research and demonstration centres in different tracts of the country. This project aimed at intensifying the work on land use classification, monitoring of rainfall pattern, run-off collection, fertilizer response etc. This research project also provide an insight into the factors limiting production

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9. Singh, R. P. (1982), "Dryland Research in Retrospect and Focus in the Seventies" in A Decade of Dryland Agricultural Research in India - 1971-80, edn. All India Coordinated Research Project for Dryland Agriculture, Hyderabad, pp.1-2.

in dry farming areas. However, the problem of low productivity continues to loom a large period of time. In mid sixties, short duration hybrids/high yielding varieties of Sorghum, Pearlmillet and Cotton appeared on the scene. These varieties grown with improved dry farming methods represented the first major advance in the dry farming agriculture in mid sixties[10]. Prior to this, in 1958, a first dry farming research centre was started at Targhadia in Rajkot district in Gujarat. Later on seven more research centres were started in different agro-climatic zones to conduct research on different aspects of dryland agriculture. Details of these research centres are given in Appendix II.

With the Green Revolution becoming a reality, there arose the problem of imbalance in the development of irrigated and dryland agriculture. Commenting on the unequal opportunities and incomes created and accentuated by the green revolution, Jakhde observes..... " if new technology brings about a major aggregate increase in production ..... this region (dry regions) for no inovation has been evolved, will

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10. Gautam, O. P. (1982) Ibid.

have no advantage of increased efficiency and reduced cost in production, but still will be affected by the decline in prices. Hence in this region incomes may decline in an absolute as well as relative sense[11]. Alarmed by such considerations, the Fourth Five Year Plan specially emphasised the urgent need for creating circumstances that would enable the hitherto neglected dryland farmers meaningfully to participate in the agricultural development process[11].

Having been enthused by the performance of the hybrid/high yielding varieties of different crops, the I.C.A.R. took a step forward by launching a comprehensive multi-disciplinary research programme under the name of All India Coordinated Research Project for Dryland Agriculture, initiated in 1970 in active collaboration with the Government of Canada. The distinctive features of this project lies in multi-disciplinary approach in identifying and analysing the constraints limiting crop yields in the dryland agriculture in the country and developing a relevant location specific

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11. Jakhde, V. M. (1970), Agricultural Development and Income Distribution", Indian J. Agril. Econ., 25(1), p.4.

research programme. The project has 23 co-operating regional research centres located in typical agro-climatic regions in India[12]. Among them, one of the centres is located at Targhadia (Rajkot) in Gujarat. Further, to go indepth investigation for testing the evolved dry farming technology at field level, 24 Integrated Dryland Agricultural Development Pilot Projects were set-up simultaneously in 1971. The improved practices evolved by the research centres were tested on a large scale over an area of 800 to 3200 hectares to access their feasibility and profitability. These pilot projects were helping to identify the socio-economic and operational constraints in the adoption of dryland technology from experimental station to farmers' fields. Meanwhile, international interest in upgrading the productivity as well as stability of the production of dry farming regions of Asia, Africa and Latin America grew which resulted in the establishment, by the consultative group for International Agricultural Research, of an International Crop Research Institute for Semi-arid Tropics (ICRISAT) at Hyderabad in July, 1972. These efforts resulted in considerable research on better moisture

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12. Singh, R. P (1982), Ibid.

conservation and use, new cropping patterns, crop life saving techniques and mid-season corrections in crop planning in the drought prone areas. Findings of the research carried-out under All India Co-ordinated Research for Dryland Agriculture during last 10 years has showed a ray of hope that there still exists an untapped yield reservoir which can be exploited by suitable inputs and appropriate agronomic practices (Rastogi, 1982).

It is clear from the foregoing discussion in this chapter that there is an urgent need for improving the economic and technological status of the dryland tracts of the country. It is also very clear that considerable expertise in dryland agricultural techniques has been accumulated but its adoption by the farmers has not attained a satisfactory level. In view of this an empirical study of agro-socio-economic characteristics of dryland tracts and the farmers with major emphasis on techno-economic aspects is quite relevant for evolving right strategy for popularising such a technology to increase and stabilise agricultural

production in rainfed areas. This study constitutes one such efforts. The specific objectives of the study are -

(1) To examine the agro-economic profile of dryland farmers, nature and degree of instability in rainfed farming;

(2) To findout the resource utilization pattern among the selected dryland farmers;

(3) To examine the extent of adoption of dry farming technology among different size group of land holdings;

(4) To examine the economics of crop production in dry farming areas with respect to important dryland crops;

(5) To identify the constraints restricting the farmers in adoption of recommended technology;

(6) To study the resource use efficiency in dryland agriculture.

1.3 Research Methodology

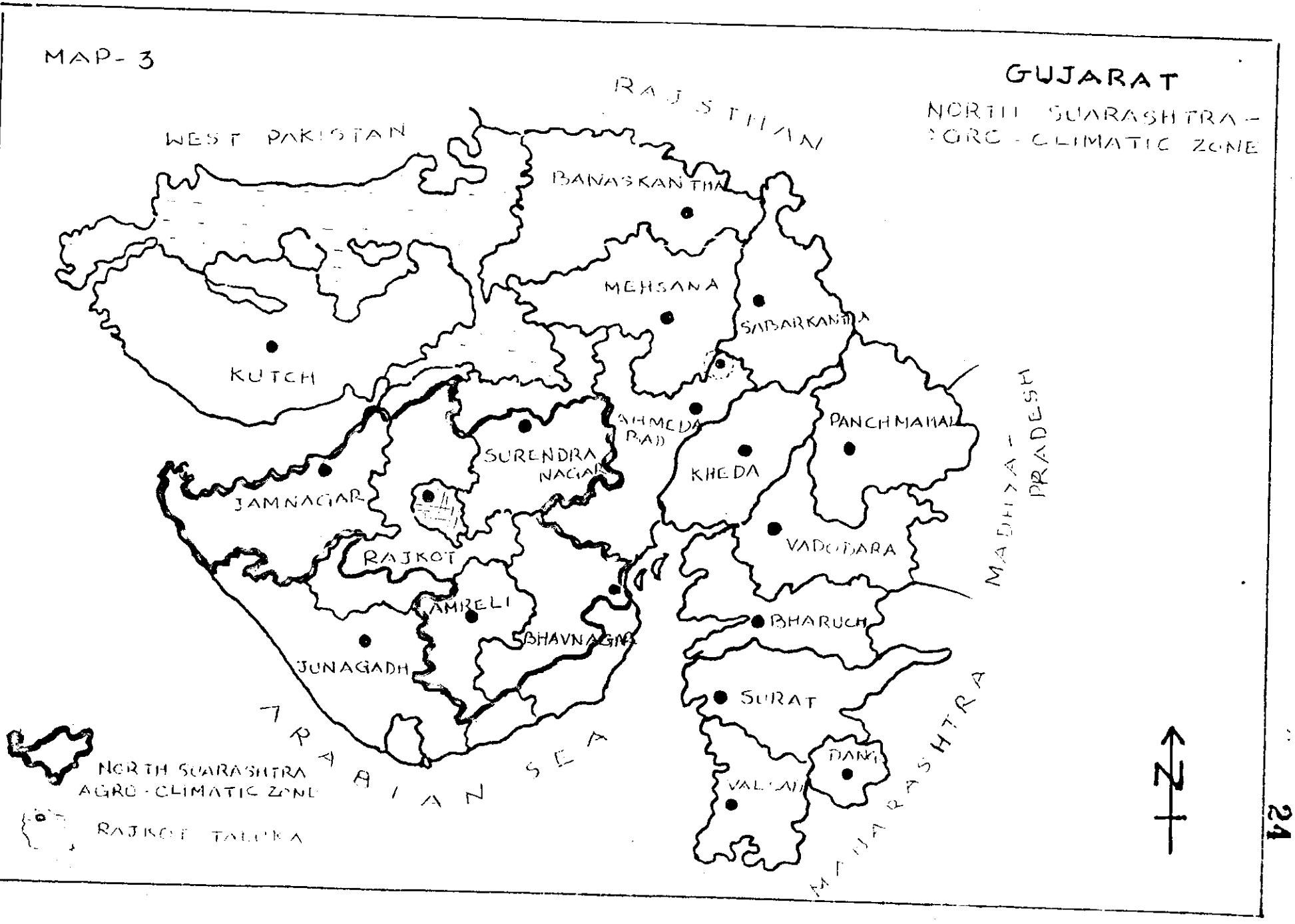
In Gujarat State, about 79 per cent of net sown area is rainfed. Majority of this area falls in Saurashtra region of the state. Rajkot district is located in the centre of peninsular Saurashtra. Rajkot district possesses all the characteristic features of typical dry farming area, like annual rainfall between 400 mm to 1000 mm, and less than 25 per cent of sown area under irrigation. It is also representative of the climatic conditions of the districts of Jamnagar, Bhavnagar, Amreli and Surendranagar of the North Saurashtra agro-climatic region (Map. 3). Therefore, Rajkot district is selected for this study purposively. Further, main dry farming research station of the state is located at Village Targhadia of Rajkot taluka. Incidentally, All India Co-ordinated Research Project for Dryland Agriculture has been instituted at Targhadia since 1971. Moreover, Integrated Dryland Agricultural Development Pilot Project has been implemented in Rajkot Taluka from 1971-72 to 1979-80. Therefore, selection of the Rajkot taluka for the study was also purposive.

For the selection of villages, list of villages, which have less than 25 per cent of the net sown area under irrigation

MAP- 3

GUJARAT

NORTH SAURASHTRA - AGRO - CLIMATIC ZONE



was prepared for the selected taluka. From this list, 9 villages were selected randomly. For each of the selected villages a complete list of operational holdings were prepared barring holdings having irrigated area more than 25 per cent of the net sown area. These holdings, thereafter, were classified into four size-groups of holdings, viz.; 0-2 hectares, 2-4 hectares, 4-8 hectares and 8 hectares and above. A sample of 20 farmers was selected randomly from each of the selected villages in proportion to the number of holdings in each size-groups. Thus, in all 180 farmers were selected and their break-up is as under :

0 - 2 hectares	:	32 farm holdings
2 - 4 "	:	62 " "
4 - 8 "	:	59 " "
8 hectare and above	:	27 " "

The detailed distribution of farmers in different villages are given in table No. 1.6.

Table No. 1.6. Total number of farmers in sample villages and proportionate selection of the farmers from the different size groups for the study

Sr. No.	Name of villages	Size groupss of land holding (Hect).	Total number of farmers in each size group.			No. of farmers selected	Total selected sample from the village
1.	Aniara	0 - 2	46	I		5	20
		2 - 4	75	I	177	8	
		4 - 8	43	I		5	
		8 and above	13	I		2	
2.	Deroi	0— 2	22	I		3	20
		2 - 4	51	I	137	7	
		4 - 8	53	I		8	
		8 and above	11	I		2	
3.	Gavridad	0 - 2	35	I		2	20
		2 - 4	93	I	284	7	
		4 - 8	97	I		7	
		8 and above	59	I		4	
4.	Kasturbadham	0 - 2	62	I		5	20
		2 - 4	73	I	241	6	
		4 - 8	82	I		7	
		8 and above	24	I		2	
5.	Khijadia	0 - 2	17	I		2	20
		2 - 4	52	I	140	8	
		4 - 8	40	I		6	
		8 and above.	31	I		4	
6.	Khorana	0 - 2	14	I		1	20
		2 - 4	79	I	213	7	
		4 - 8	70	I		7	
		8 and above	50	I		5	

Table No. 1.6 (Contd...)

7.	Kutchiyadad	0 - 2	48	I	6	20
		2 - 4	54	I 158	7	
		4 - 8	39	I	5	
		8 and above	17	I	2	
8.	Sajadiali (Lili)	0 - 2	25	I	3	20
		2 - 4	70	I 190	7	
		4 - 8	67	I	7	
		8 and above	28	I	3	
9.	Targhadia	0 - 2	47	I	5	20
		2 - 4	47	I 194	5	
		4 - 8	74	I	7	
		8 and above	26	I	3	

1.4 Data Collection

The primary data were collected by visiting each of the selected farmers personally and interviewing them with a set of questionnaires (Appendix III). In structuring the schedule for collecting primary data objectives of the study were kept in view, covering the items such as family size and workers, farm resources, land-use pattern, cropping pattern, farm inventory, cost and return structure of different crops, extent of adoption of recommended technology, reasons for non/low adoption of technology, disposal of farm produce and other ancillary details of farm family having influence on farm management decisions etc.

The general recommendations for increasing crop yields in dryland areas are - land shaping, soil conservation measures on a watershed basis such as contour bunding, water harvesting and water storage practices for life saving irrigations (supplementary irrigations), sowing of crops across the general slope of the field, timely sowing etc. Appreciating that it may not be possible for the farmers having differential

resource base and management skills/ability to adopt these practices along with other package of practices. In view of this, some important practices which are considered crucial for increasing productivity in dryland areas were considered for this study. These include, use of appropriate variety seeds, application of organic manures (F.Y.M/Compost) for water retention and nutrient supply, application of fertilizers, inter-row spacing, plant protection, weeding and interculturing etc. The details of recommended practices for major dryland crops viz., Groundnut, Pearlmillet, Sorghum and Cotton are given in Appendix IV(A) and IV(B).

The primary data collected pertained to the agricultural year 1982-83. The secondary data on rainfall, area, production and yield of important crops, farm (harvest) prices of these crops, demographic information for selected areas were collected from the Gujarat State Department of Agriculture, Gujarat Agricultural University, District and Taluka Panchayats, Directorate of Census and the available literature.

1.5 Imputation of Items of Costs & Output

Farmers use inputs produced on their own farms and rely on the markets for the rest. For purchased inputs the prices are known but owned inputs should be evaluated on their opportunity costs, which are sometimes difficult to calculate. The procedure followed for cost estimation was on the basis of cost concepts evolved in the farm management studies during fifties[13]. However, all the cost concepts were not used per se owing to limitation of time and lack of properly recorded data. The modifications in the cost concepts made were basically with reference to imputation of the value of farmers' owned inputs and services. For example, in the conventional cost concept the cost of owned bullock power is imputed on the basis of cost of maintenance of bullocks. However, as the study on cost of maintenance of bullocks by itself would have been a time consuming task, the cost of owned bullock power in the present study was computed on the basis

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13. "Studies in the Economics of Farm Management", Directorate of Economics and Statistics, Ministry of Food and Agriculture, Government of India, New Delhi, 1954-55 to 1956-57.

of hire charges of a pair of bullocks in vogue in the sample villages for various agricultural operations. Similarly, the charges for owned machines like tractors, threshers, openers etc. were also computed by using the prevalent market rates for such machines in the area, as such machines were used largely for custom services. Details of imputation of various items of cost and output, following procedures were adopted. All the costs have been worked out on per hectare basis.

(1) The value of purchased inputs like seeds, pesticides etc. were recorded as reported (actual price paid) by the respondents.

(2) Farm produced seeds were valued on the basis of prevailing market price at the time of sowing taking into consideration of varietal quantity. Similarly, the farm produced manures also valued at the rates prevalent in the sample villages.

(3) Consumption of chemical fertilizers, as reported by respondents was recorded into its nutrients forms and its value was calculated on the basis of unit price of each nutrient contained in the fertilizers used.

(4) Irrigation charges: Cost of irrigation was worked out at the prevalent custom service rate in the villages.

(5) Human and Bullock labour: The cost of human and bullock labour used for different farm operations, whether family or hired were imputed at the prevailing hiring wage rate in the villages.

(6) Interest on working capital: Interest has been charged at the rate of 12% per annum for a six month, in case of groundnut, pearl millet and sorghum and for eight months in case of Cotton, on the working capital i.e. cash or kind expenses (excluding items in respect of which payments are generally made after harvest i.e. land revenue etc.).

(7) Fixed costs: The fixed costs are incurred by the farmers for their entire farming business, hence such costs were worked out pro-rata for each crops considered for the study. It is also noteworthy that the items included in the farm investments were exclusive of the investments on bullocks, irrigation pump-sets, tractors and other machineries etc. as the cost of use of such

items was taken separately. The investment on farm buildings, implements, carts etc. were considered for depreciation and interest. Interest on present value of fixed assets has been charged @ 6% per annum.

(8) Rent on land: The rental value of owned land has been evaluated at the rate of 16% of the gross income of the crop concerned.

(9) Depreciation: For convenience, the straight line method of depreciation was used. This considers the salvage value and productive life of the assets. The rates of depreciation for items are given in Appendix - V.

(10) Miscellaneous Costs: Sundry minor expenses like land revenue hiring of threshers/openers, transportation charges etc., are included in the miscellaneous costs.

(11) Valuation of farm produce: The farm produce consisting of main and by-products were expressed in physical units per hectare basis. The valuation of main produce like groundnut and cotton (Kapas) has been done on the basis of price at which products were sold by the farmers, whereas in case of pearl millet and sorghum main products has been valued at the post-

harvest prices prevailing in the selected villages. Similarly value of by-products also imputed at the post-harvest prices prevailing in the selected village.

1.6 Cost Concepts

The cost concepts used in Indian farm management studies such as Cost A, Cost B and Cost C have been used in the analysis[14]. The input items included under each category of cost are indicated below:

Cost A :
1. Value of hired human labour
2. Value of bullock labour (both owned and hired)
3. Value of seed (both farm produced and purchased)
4. Value of manure (both owned and purchased)
5. Value of fertilisers
6. Value of insecticides/pesticides
7. Irrigation charges
8. Miscellaneous expenses
9. Depreciation
10. Interest on working capital.

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14. Kahlon, A. S. and Singh, K (1980): Economics of Farm Management in India - Theory and Practice, Allied Publishers Pvt. Ltd., New Delhi, pp. 8-9. Also see Kapre, S. N. (1974), "Comprehensive Scheme for Studying the Cost of Cultivation of Principal Crops," Agricultural Situation in India, 24(5), p. 326-327.

Cost B : Cost A + imputed rental value of owned land + imputed interest on owned fixed capital.

Cost C : Cost B + imputed value of family labour.

It may be noted that cost A is analysed without dividing into Cost A_1 and Cost A_2, as there were no tenant farmers in the sample.

1.7 Concept of Income

1. Gross income : Value of main products and by-products.

2. Net Income : Gross income - Cost C.