Chapter 8

Land Use and Cropping Pattern

CHAPTER – 8

LAND USE AND CROPPING PATTERN

Land use constitutes an essential element in planning and management of land resources. The increasing pressure due to population and human activities on land resources to meet the increasing demands are contributing to significant transformations of land for a variety of land uses. Nearly, two-third of the country's population is dependent on agriculture and is living in rural areas. However, one of the primary problems that is being faced today is inadequate land use practices due to lack of institutional framework, evaluation of responsibilities of various concerned departments and inability to revise the plans based on the changing situations. In order to realise a successful land use / land cover management plan, it is imperative to exercise an effective control over the different uses of land.

Land is that basic resource which serves the socio-economic ends of the community. It is therefore assigned different functions to meet different needs. But over time, the phenomenon of change does affect community either in a positive or negative direction.

8.1 Meaning and Definition

"One of the most basic of all Geographical problems is how land is allocated among the many human" and also non-human, "activities competing for it". (Conkling Yeast 1976). Any aspect of land, moreover, functions as a primary factor of production, revealed in which is the interest of man. In relation to human activities, the land is assigned a host of economic, social and cultural function, whereas in relation to non-

human activities, the land is subject to national phenomena, which also serve, or have the potentials to serve the interest of man. The general land use, therefore, comprises occupancies both of nature and man. Besides, "Change is an ever present feature" in this primary factor of production, for which are responsible, among others, changing population characteristics, technological development and sometimes, natural hazards. These ensure a constant competition or conflict between the various uses of land, which is the dynamic aspect of land use.

The term land use and land utilization, as suggested by the Oxford Dictionary, are synonyms. The Longman Dictionary of Geography, and in many other texts two terms have been used interchangeably. However, some scientists have attempted to make a subtle difference between the two, as they were of the opinion that institutional factors should not be included in land use, but in land utilization (Vink). But Vink (1975) is of the opinion that "Land as attract" i.e. as a geographically defined specific area, does include the permanent or cyclic institutional attributes. He further says, "A rural land use in its widest sense is including agriculture, forestry and game cropping as well as wildlife conservation and the development and management of recreation grounds. In this sense, therefore, both terms are used interchangeably by him.

8.1.1 Land use Dynamics

According to Vink (1975) land use itself is a dynamic concept. It changes with the passage of time and also with the changes in the processes of intervention by man. Since the forces, factors and phenomena are hardly stable at any place on the earth, the use of land hardly bears stability. The

land is the maker of the ecosystem and itself is a part of it (Vink, 1975). The various components of the ecosystem have some degree of permanency unless intervened by man or become subject to any natural catastrophy. Each element and element complex composing the environment exerts deep influence on man's interaction with land. These forces have decided the past, devised the present, and, to some extent, define the future uses of land. A host of natural and cultural factors are responsible for shaping and reshaping the patterns of land use on any geographically defined specific area.

Compared to agricultural land use, the general land use is less changeable, e.g., the land under non-agricultural uses such as the pasture and grazing land, the water bodies, tanks and ponds, the settlements, burial and cremation grounds, roads etc., show less changeability unless any natural, cultural or economic interruption takes place. However, the land use, whether undergoing fast or slow changes is a dynamics rather than a static concept. The term dynamics belongs to the science of Mechanics. It deals with the matter in motion (Kinamatics) and the forces that produce or change such motion (Kinetics). In short it may be defined as the science that deals with the forces, which set any matter to momentum, and or change them from their previous positions.

In this sense the term dynamics may be used for the purpose of understanding the level of change in any branch of study e.g., dynamic equilibrium, dynamic geology, dynamic lapse rate, dynamic spatial model and all land use changes, and the patterns produced by these changes, and the processes causing these changes over time. It includes spatial changes, changes in pattern and changes in productivity (Longman). When applied to

land use studies the dynamics of land use would mean the change taking place in land use and its systems by the intervention of the physico-cultural forces over time. The changes may be for the better or for the worse depending on the situations and the levels of intervention by nature or by man. The task of the students of these aspects of land use is to measure the levels of changes and identify the forces responsible for it.

8.2 Land Use in Study Area

Table 8.1 and 8.4, gives an idea of the changing pattern of general land use in the study area.

Man's interaction with nature is basically for the economic gain as his livelihood depends on it. It. is, therefore, natural that the largest share of the total land would go for. Thus the net sown area (N.S.A.) in 1981 and 2001 and current fallow together hold the largest share i.e., 72.88% and 74.38% economic use respectively. The increase in its area is natural and linked with the growth of population. The remaining 27.12 per cent and 25.62 per cent respectively were shared by other uses.

The current fallow at both points of time was insignificant with 1.83 and 3.05 per cent. But the others fallows had occupied 2.00 and 0.009 per cent respectively. The increasing trend is noted in current fallow, and decreasing in the other fallows, which is definitely need based.

Animals have been an integral component of the rural economic activities and thus, they share the rural land for grazing. The total area under grazing land forms 4.08 and 3.60 per cent at both points of time. The negative change is mainly due to certain developmental programme

executed in the area partly due to expansion of N.S.A. But a meager 0.48 per cent decrease itself reveals the larger degree of constancy of this use in the rural environment.

The area has a negligible forest cover, as its climatic and soil conditions are not congenial to this type of use. However, a negligible 1.63 per cent of this area (13609 ha) under forest is found in the region.

Human settlements have a tendency to grow. Total area under settlement was 12.92 and 11.81 per cent, showing decrease by 1.11 per cent between 1981 and 2001. However, on an average each village has increased its area under settlement. Thus the increase in the built up area is the natural result of this growth.

Table 8.1: General Land Use: 1980-81

Sr. N0.	Region	Taluka	Forests	Barren And Uncultivable land	Land put to non Agricultural uses	Culturable waste	Permanent pasture and other Grazing land	Land under tree crops	Current fallows	Other fallows	Net Area Sown	TOTAL Geog. AREA
1.	I	NANDOD	994	124	939	0	10	0	1	0	1288	3356
2.		TILAKWADA	964	340	2205	50	3248	0	957	0	19250	27014
3.		NASVADI	6422	2783	1406	1005	681	0	539	0	30198	43034
4.		SANKHEDA	3003	1282	6559	283	3814	0	2874	0	53109	70924
5.		PAVI JETPUR	86	3	42	3	29	0	40	0	293	496
6.		WAGHODIA	1055	1556	6703	0	3686	0	0	0	39946	52946
7.		SAVLI	0	1838	10083	495	3183	0	1288	0	52163	69050
8.		JAMBUGHODA	56	0	0	0	12	0	16	0	208	292
9.		HALOL	0	33	12	37	276	0	67	0	2132	2557
10.		KALOL	0	379	87	89	172	0	213	0	4312	5252
TOTAL			**12580**	**8338**	**28036**	**1962**	**15111**	**0**	**5995**	**0**	**202899**	**274921**
11.	II	VADODARA	0	1523	12357	981	3686	0	4669	0	43782	66998
12.		DABHOI	0	2676	4172	425	3248	0	325	0	52421	63267
13.		SINOR	0	36	3470	245	1490	0	30	0	23980	29251
14.		KARJAN	0	143	5104	0	2674	0	419	0	51848	60188
15.		PADRA	1029	1364	8295	0	1515	0	335	81	42841	55460
TOTAL			**1029**	**5742**	**33398**	**1651**	**12613**	**0**	**5778**	**81**	**214872**	**275164**
16	III	BHARUCH	0	0	4829	536	809	0	0	614	37440	44228
17		VAGRA	0	0	3145	11768	1213	0	2190	9051	29599	56966
18		JAMBUSAR	0	0	19632	604	1711	0	0	482	41871	64300
19		AMOD	0	0	2994	332	502	0	0	381	23212	27421
TOTAL			**0**	**0**	**30600**	**13240**	**4235**	**0**	**2190**	**10528**	**132122**	**192915**
18	IV	VAGRA	0	0	1928	7213	744	0	1343	5548	18141	34917
19		JAMBUSAR	0	0	12032	370	1048	0	0	295	25663	39408
20		AMOD	0	0	1835	204	307	0	0	233	14228	16807
TOTAL			**0**	**0**	**15795**	**7787**	**2099**	**0**	**1343**	**6076**	**58032**	**91132**
TOTAL (I+II+III+IV)			**13609**	**14080**	**107829**	**24640**	**34058**	**0**	**15306**	**16685**	**607925**	**834132**

Table 8.2: General Land Use: 2000 - 01

Sr. N0.	Region	Taluka	Forests	Barren and Uncultivable Land	Land put to non Agricultural Uses	Culturable Waste	Permanent Pasture and other Grazing Land	Land Under Tree Crops	Current Fallows	Other Fallows	Net Area Sown	TOTAL Geog. AREA
1.	I	NANDOD	994	124	939	0	10	0	1	0	1288	3356
2.		TILAKWADA	964	201	2221	23	681	0	8	0	19398	23496
3.		NASVADI	6422	1122	1651	678	778	0	976	0	31562	43189
4.		SANKHEDA	3003	567	6752	128	3075	0	1934	0	54827	70286
5.		PAVI JETPUR	86	3	22	3	29	0	40	0	293	476
6.		WAGHODIA	1055	1356	6809	0	3183	0	1312	0	41228	54943
7.		SAVLI	0	1282	10150	212	3814	0	39	0	57277	72774
8.		JAMBUGHODA	56				12	0	16	0	208	292
9.		HALOL	0	33	12	37	276	0	67	0	2232	2657
10.		KALOL	0	379	87	89	172	0	213	0	2512	3452
TOTAL			**12580**	**5067**	**28643**	**1170**	**12030**	**0**	**4606**	**0**	**210825**	**274921**
11.	II	VADODARA	0	1067	13213	388	3187	0	3166	0	44119	65140
12.		DABHOI	0	2167	4172	425	2844	0	325	0	53124	63057
13.		SINOR	0	36	3470	245	1267	0	30	0	24376	29424
14.		KARJAN	0	143	5104	0	2133	0	419	0	53084	60883
15.		PADRA	1029	1264	8295	0	1315	0	335	81	44341	56660
TOTAL			**1029**	**4677**	**34254**	**1058**	**10746**	**0**	**4275**	**81**	**219044**	**275164**
16	III	BHARUCH	0	723	7982	2220	1735	0	2174	0	45209	60043
17		VAGRA	0	867	3145	8008	1213	0	4112	0	31353	48698
18		JAMBUSAR	0	2974	11763	547	1711	O	1536	0	40818	59349
19		AMOD	0	1660	3004	0	502	O	552	0	19107	24825
TOTAL			**0**	**6224**	**25894**	**10775**	**5161**	**0**	**8374**	**0**	**136487**	**192915**
18	IV	VAGRA	0	287	1928	8354	744	0	2520	0	17377	31210
19		JAMBUSAR	0	1678	5970	5585	1048	0	941	0	25018	40240
20		AMOD	0	1018	1841	0	307	0	4806	0	11710	19682
TOTAL			**0**	2983	9739	13939	2099	0	8267	0	54105	91132
TOTAL (I+II+III+IV)			**13609**	**14080**	**107829**	**24640**	**34058**	**0**	**15306**	**16685**	**607925**	**834132**

Source: Compiled from Directorate of Agriculture and Census of Year 1981 and 2001

Rural transport lines were foot paths, cart tracks etc. However, the records show three types (a) road (b) paths leading to fields and (c) railways. At the first point of time, the total area under this use was 2.67 per cent (including area under railways) in which the share of the field-paths was 1.54 per cent and that of the roads was 0.82 per cent. At the second point of time, the road development programmes led to decrease of the former by 0.20 per cent and increase in latter by 0.16 per cent. 0.31 per cent. Area under railway remained unchanged. The railways for obvious reasons are not the popular mode of transportation for the area. Roadways are popular and serving almost each village for day-to-day activities. Each village is being connected with the main road by an all-weather link road.

The struggle between man and nature has been going on since the birth of civilization and would continue eternally in changing forms. At the first point of time i.e., 1981, the dominance of nature, what may be called deterministic behaviour of nature, was highly pronounced. As much as 16551.05 ha of total area was under the sway of the tidal waves from three sides, north, west and south. This sizeable chunk of land was known as "Khar no Khar also" (Kharland), which is in region-IV of the study area. Of late, the land management scheme undertaken by Kharland Development Board of Government of Gujarat how put a bar to spread of the Gulf water by constructing longitudinal dams in north to south and west to east directions. By this action, the extent of Kharland has decreased to some extent. Attempts are on to reclaim more of the area. The reclaimed area is put, or is in the process of being put, to agriculture use, or, in some cases, for plantations.

An overall view of the change shows that of nine types of uses mentioned, the N.S.A. (Net Sown Area), the current fallow and some others have shown positive change. Land put to non-agriculture uses pasture and grazing land, other fallows have show negative changes. This explains the fact that the growing rural population on one hand and the diversifying occupation on developmental programmes on the other would have the effect of decreasing the areal extent of most of the uses in future. It is thus, established that each category of the general land use is subject to change over time, some rapid and some sluggish, depending on the prevailing geo-socio-economic factors (Figure 8.1 to 8.4).

After having an overall view of the changes in the general land use of the area, the need is to sharpen the focus and take an intensive look at the changes region wise.

8.3 LAND AVAILABLE FOR CULTIVATION

The land available for cultivation includes the land actually utilized for growing crops as well as different forms of fallow lands and wastelands.

8.3.1 Net Sown Area

The net sown area almost invariably occupies the largest percentage of the land area. Rarely this situation changes as will be evident from the discussion that fallows. In 1980-81, all the four regions together had 72.88 percent of the total geographical area under N.S.A. In 2000-01, with an increase of 1.5 percent it went up to 74.38 percent, (Figure 8.5).

Breakup of Gross Cropped Area by Talukas – 1980-81

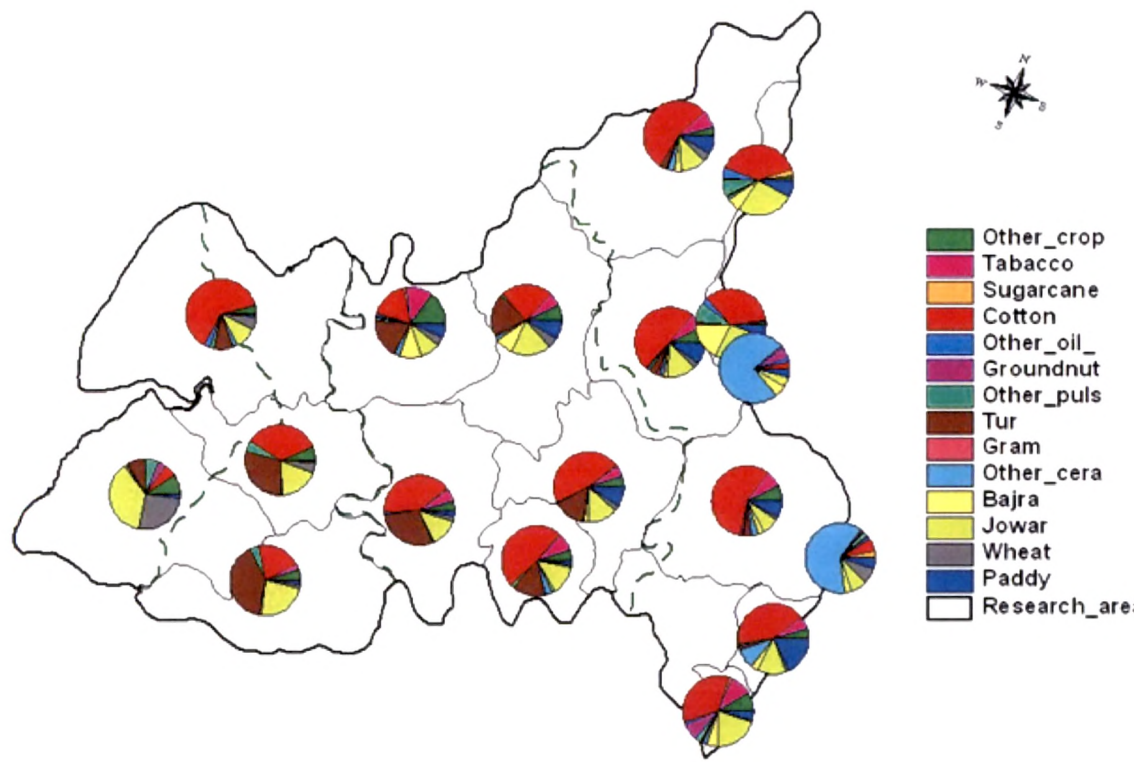


Figure 8.1

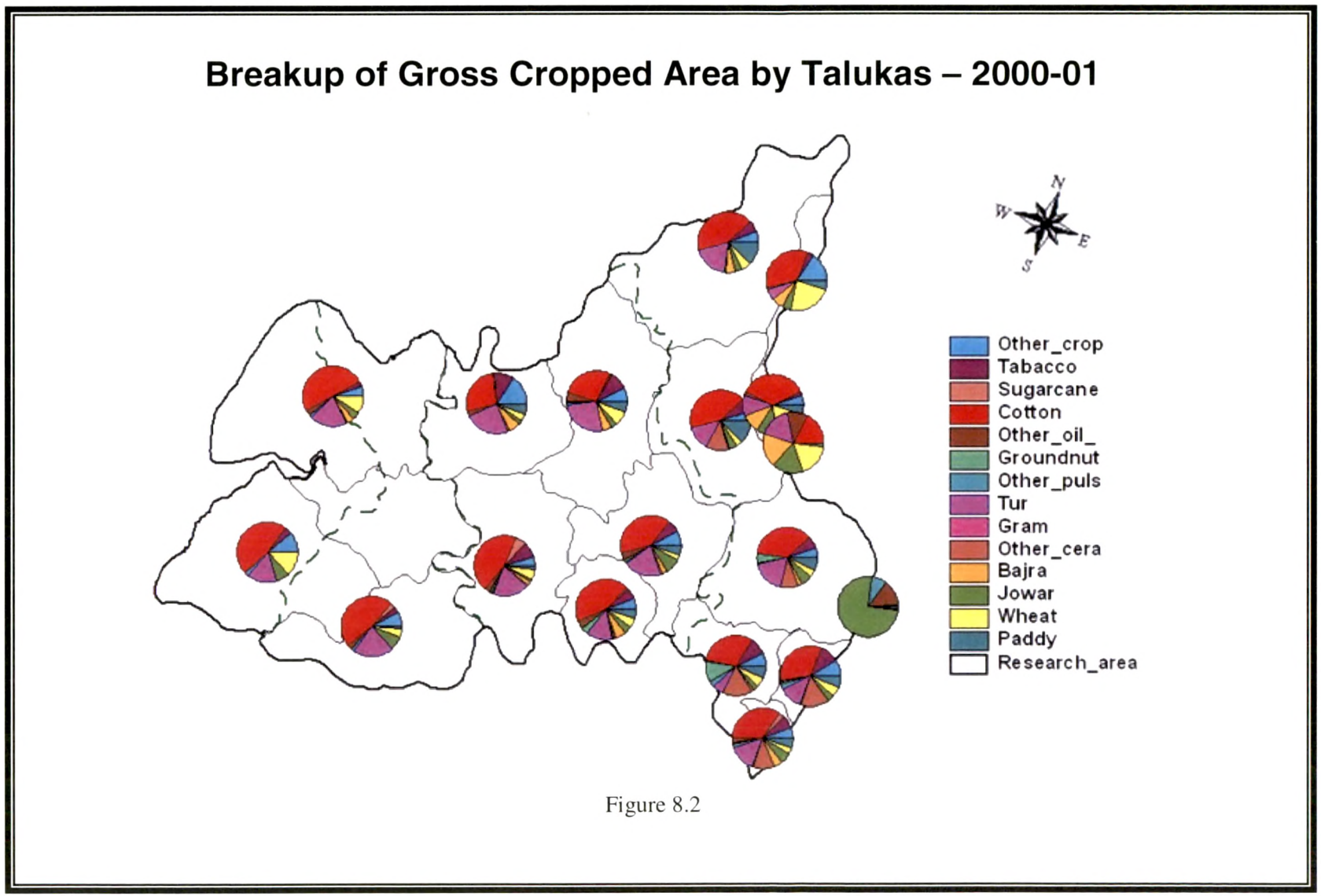

Breakup of Gross Cropped Area by Talukas – 2000-01
N
W
E
S
Other_crop
Tabacco
Sugarcane
Cotton
Other_oil_
Groundnut
Other_puls
Tur
Gram
Other_cera
Bajra
Jowar
Wheat
Paddy
Research_area

Figure 8.2

Breakup of Gross Cropped Area by Regions – 1980-81

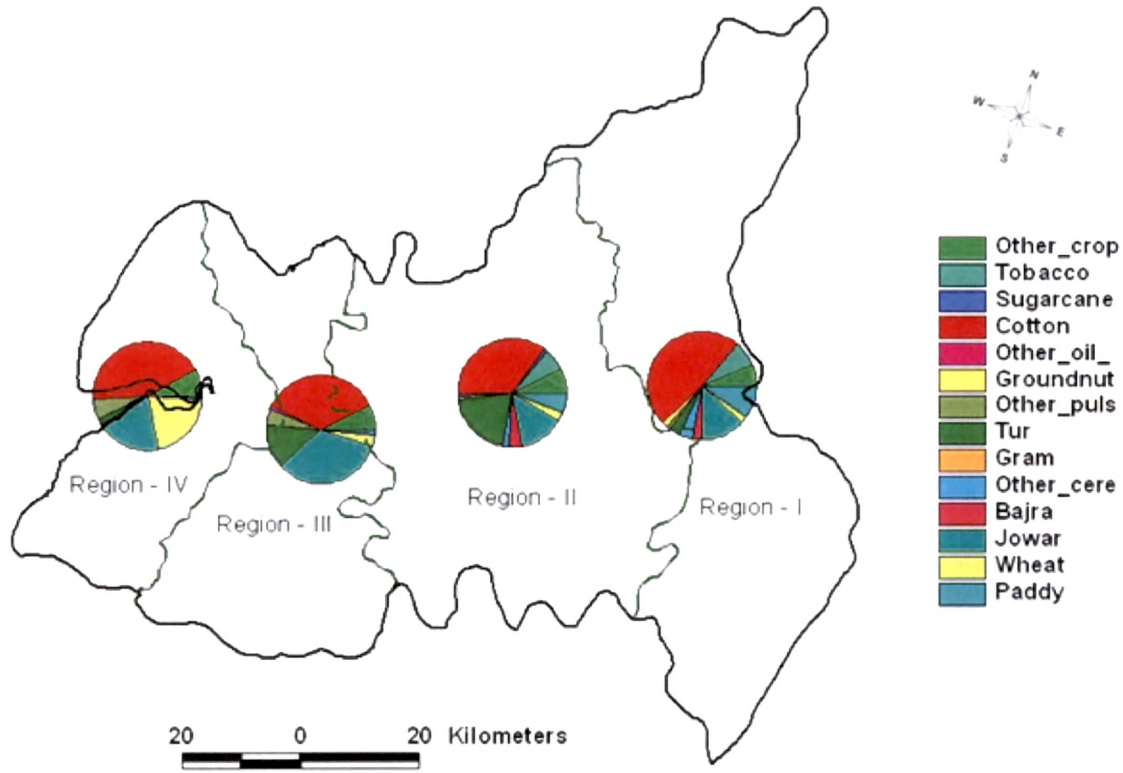


Figure 8.3

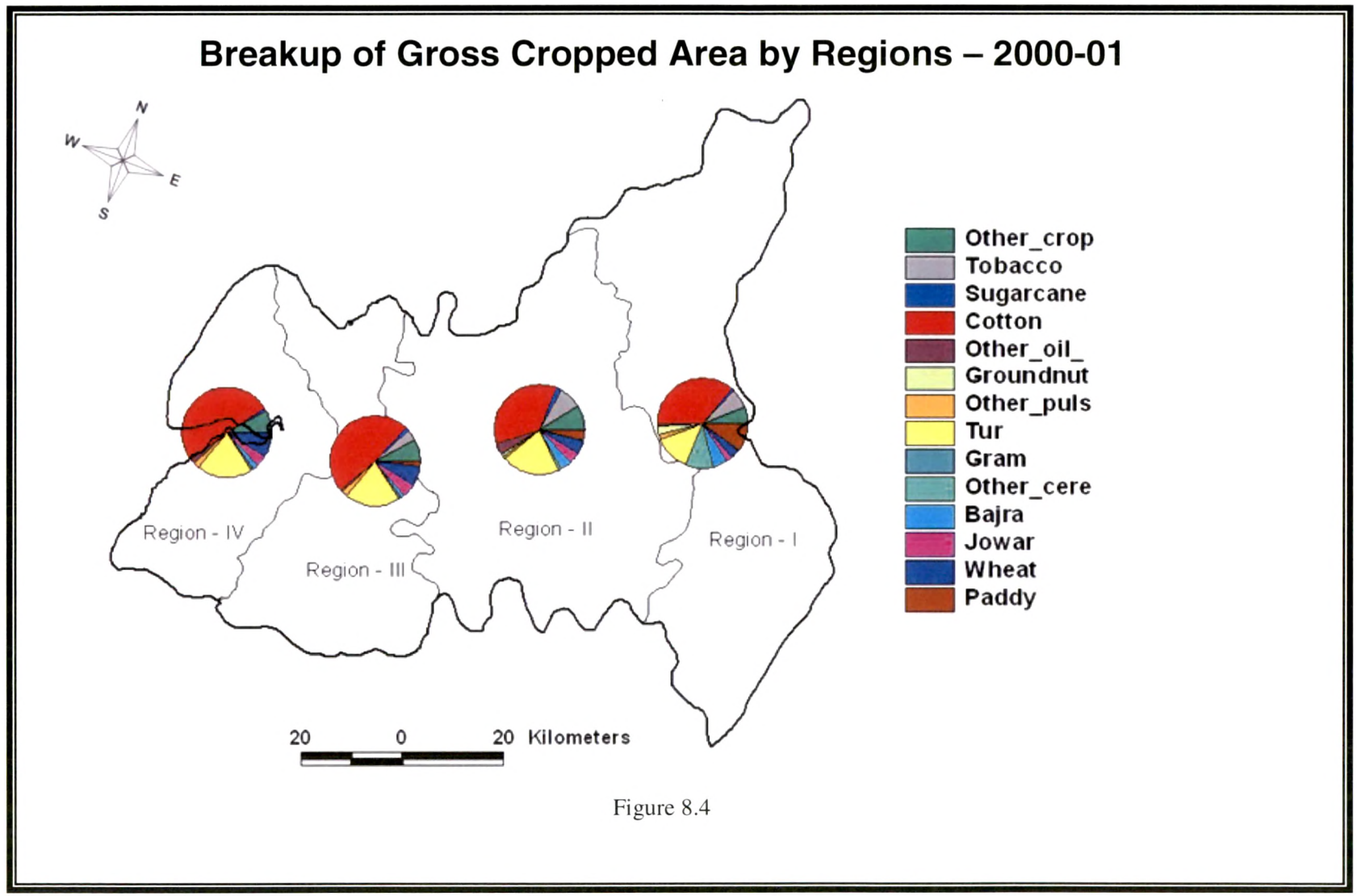

Breakup of Gross Cropped Area by Regions – 2000-01
N
W
E
S
Region - IV
Region - III
Region - II
Region - I
20 0 20 Kilometers
Other_crop
Tobacco
Sugarcane
Cotton
Other_oil_
Groundnut
Other_puls
Tur
Gram
Other_cere
Bajra
Jowar
Wheat
Paddy

Figure 8.4

Region I of the study area is located much away from marine influences, and also free from other physical problems. However, the region has 3 small irrigation projects, namely, Pannam, Dev and Dhanora. As a result, it had 73.80 percent of its land area under the plough in 80-80 and 76.68 percent in 2000-01, which is second the largest percentage of all the regions of the area.

Region II, being placed in the middle has some similar, some dissimilar conditions to that of region I. The region has good fertile soil, because the region is carved by rivers Dhadhar and Vishwamitri with their tributaries. As a result, it had 78.08 percent of its land area under the plough in 80-81 and 79.60 in 2000-01, which is the largest percentage of all the regions of the area.

Region III, being placed near the Gulf of Khambhat, is haunted by the tidal currents of Mahi in the north, and Narmada in the south. The region has poor quality soil. As a result, it had 68.48 percent of its land area under the plough in 80-81 and 70.75 percent in 2000-01, and is the third largest among all the regions of the area.

Region IV being located very near to marine influence is inundated by the tidal current of river Mahi in the North and the river Dhadhar in the South. Further, the backwater creeks penetrating deep in to the region, have taken toll of large chunks of area in different villages. This has resulted in lesser percentage of area under N.S.A. In all, in 1980-81, the N.S.A. was only 63.67 percent, which moved down to 59.37 percent in the year 2000-01.

The increase in net sown area (N.S.A.) is linked with the increase in population and diffusion of agricultural innovations, which are seem in the form of improved seeds, fertilizers, the improved means of cultivation and allocation of land to landless people. However, population pressure is above all the most significant factor.

As such, no significant spatial pattern of change emerges.

The reason for the mixed patterns of negative and positive change in the new sown area over the region may be sought in the amount of fallow land with each village, and the reclamations of the wastelands during the temporal span of two decades.

8.3.2 Fallow Lands

In the villages cadastre two types of fallow lands are usually recorded: (a) current fallow, and (b) other fallow. The current fallow is more well defined, which is applied to only those left over fields, which for some reasons, have not been cultivated during the current agriculture season. But the fallows of a year or more fall in to the category of "Other fallow". Thus, it is the time factor that converts the current fallow in to other fallow. The following discussion pertains to these two types of fallow lands.

In 1980-91, both current and other fallows amount to 31991 ha (3.83%) in which the share of current fallow was 15306 ha (1.83%) only and that of other fallow 16685 ha (2.00%), which was more than the former. In 2000-01, the total fallow decreased by 6388 ha (0.76%) which of course is a healthy sign of growth.

(a) Current Fallow

In the area with extensive type of cultivation, keeping fallow is not a general practice. However, the little percentage of fallow land is seen either due to paucity of rain or to the poverty of the farmer and partly due to rotation.

Tables 8.3 and 8.4 reveal the comparative figures of current fallow and other fallow lands for each region at the two points of time.

In 1980-81, total area under fallow land in the region was 15306 ha (1.83%). In 2000-01, the area under it increased to 25522 ha (3.05%). The N.A.S. over the two-decade period increased by 13929 ha (i.e. 2.29%) and the fallow increased by 10216 ha (66.74%), which is very high.

In year 80-81, region-I, total area under current fallow was 5995 (2.18%). In 2000-01, the area decreased to 4606 ha (1.67%). The N.S.A. area over two decade period increased by 7926 ha (2.88%).

In year 80-81, region-II, the total area under current fallow was 5778 ha (2.09%). In 2000-01, the area decreased to 4275 ha (1.55%). The N.S.A. area over two decade period increased by 4172 ha (1.51%).

In year 80-81, region-III, the total area under current fallow was 2190 ha (1.13%). In year 2000-01, the area increased to 8374 ha (4.34%). The N.S.A. area over two decade period increased by 4365 ha (2.26%).

In year 80-81, region-IV, the total area under current fallow was 1343 ha (1.47%). In year 2000-01, the area increased to 8267 ha (9.07%). The N.S.A. area over two decade period decreased by 3927 ha (4.30%).

The spatial dimension of change, in a nutshell, reveals that the regions placed on the upland parts have attempted to bring under the plough as much land as possible. Thus region I and II have shown decrease in current fallow in varying percentages, while those towards the low lying riverine and coastal littorals have shown increase (Figure 8.6).

(b) Other Fallow

As defined by the Revenue Manual, the other fallow is that current fallow, which lies uncultivated for five years or more. But loosely, often the wasteland has also found its places in the line of this fallow.

In the region the other fallow has decreased drastically from 16685 ha (2.00%) to 81 ha (0.009%) in 2 decades.

In year 80-81, in region I, the other fallow is totally absent and in region II it is just 81 ha (0.029%) which is very negligible. But in region III, it the highest i.e. 10523 ha (5.45%) and in region IV it is 6076 ha (6.66%).

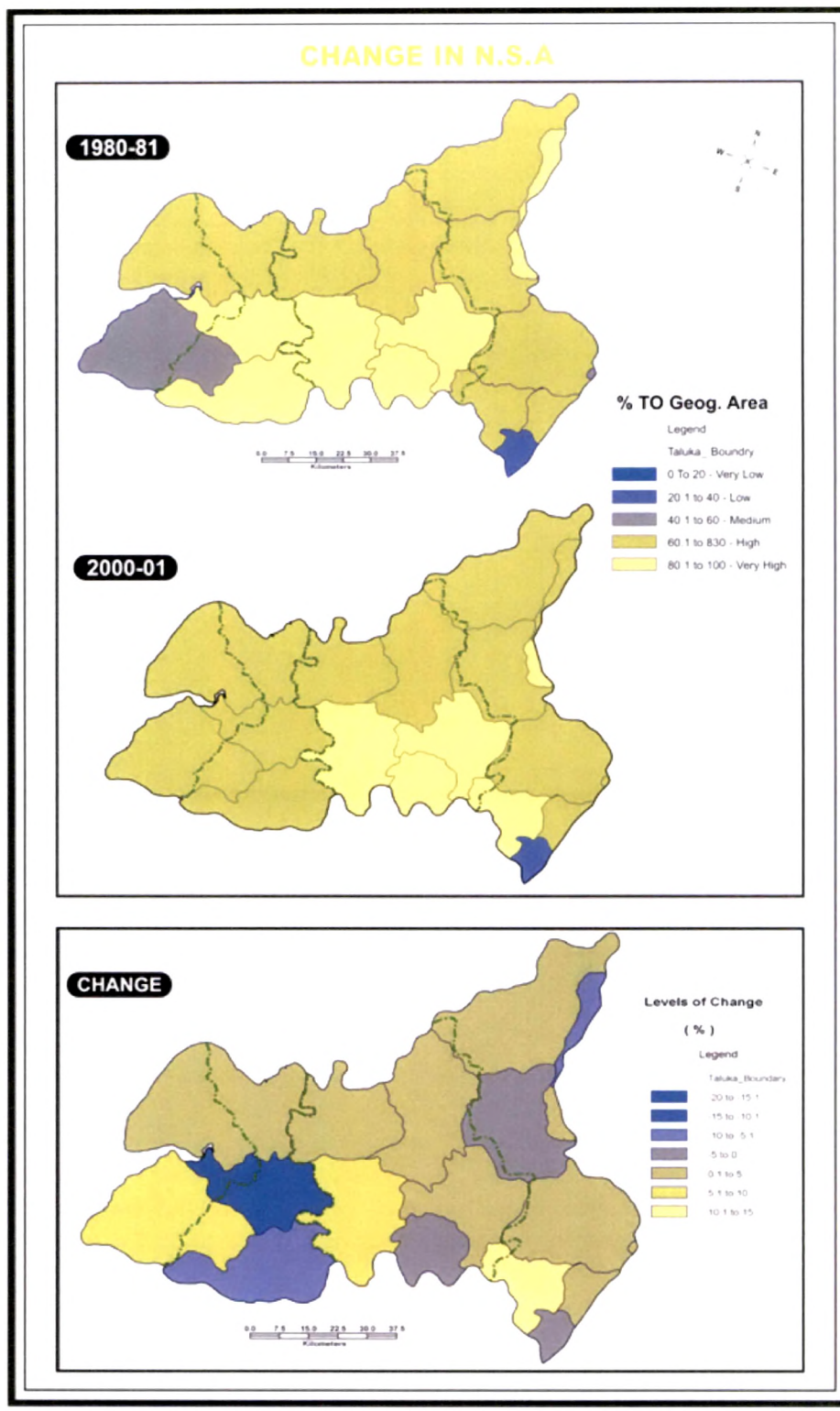

CHANGE IN N.S.A
1980-81
% TO Geog. Area
Legend
Taluka_Boundry
0 To 20 - Very Low
20 1 to 40 - Low
40 1 to 60 - Medium
60 1 to 830 - High
80 1 to 100 - Very High
2000-01
CHANGE
Levels of Change
(%)
Legend
Taluka_Boundary
20 to -15.1
-15 to -10.1
-10 to -5.1
-5 to 0
0.1 to 5
5.1 to 10
10.1 to 15

Figure 8.5

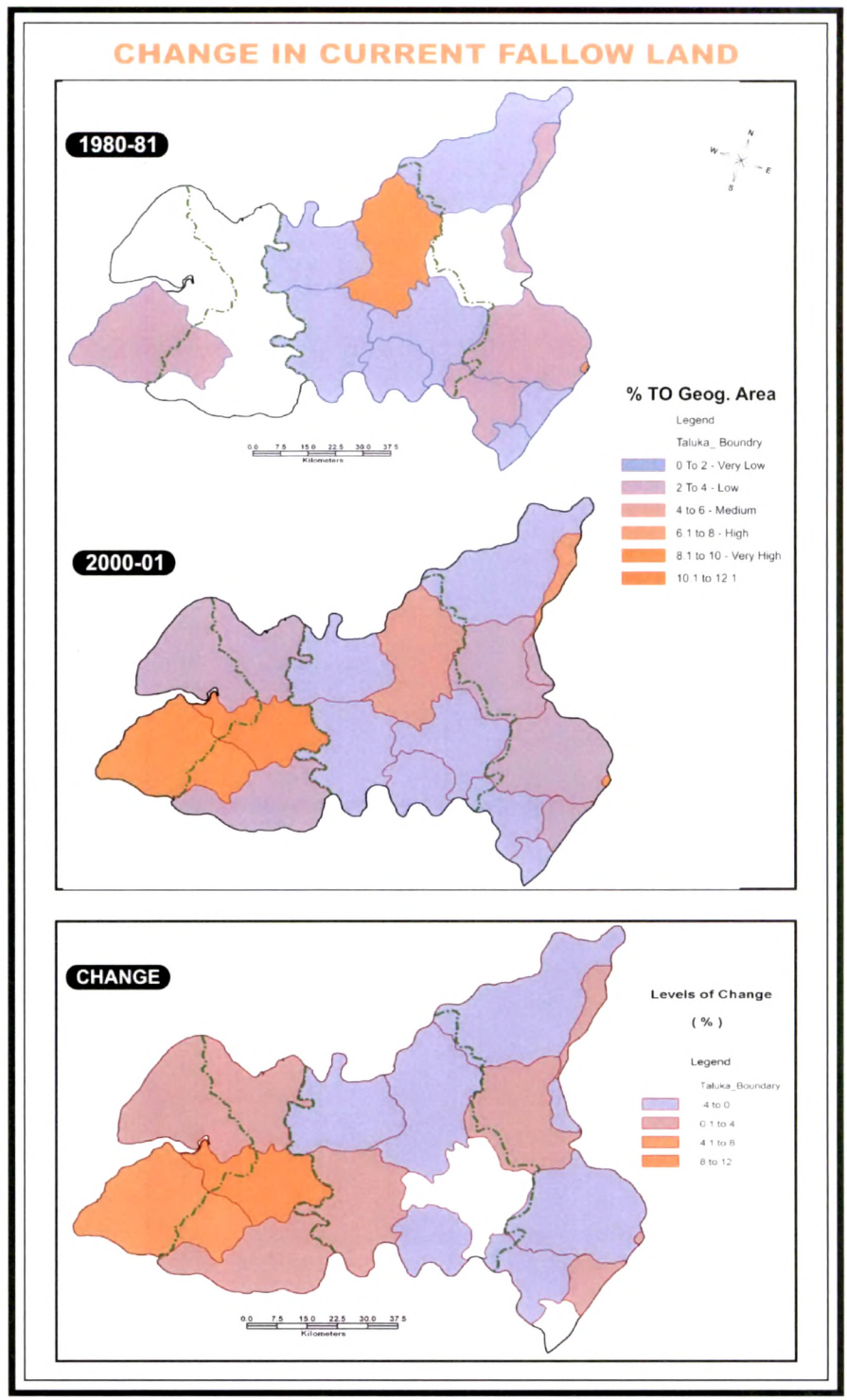

CHANGE IN CURRENT FALLOW LAND
1980-81
2000-01
CHANGE
% TO Geog. Area
Legend
Taluka_ Boundry
0 To 2 - Very Low
2 To 4 - Low
4 to 6 - Medium
6.1 to 8 - High
8.1 to 10 - Very High
10.1 to 12.1
Levels of Change
(%)
Legend
Taluka_Boundary
-4 to 0
0.1 to 4
4.1 to 8
8 to 12
0.0 7.5 15.0 22.5 30.0 37.5
Kilometers

Figure 8.6

Table 8.3: Regional Land Use: 1980-81

CATEGORIES	REGION - I		REGION - II		REGION - III		REGION - IV		TOTAL	
	AREA	%	AREA	%	AREA	%	AREA	%	AREA	%
Forest	12580	4.57	1029	0.37	0	0	0	0	13609	1.63
Barren and Uncultivable Land	8338	3.03	5742	2.08	0	0	0	0	14080	1.68
Land Put to Non Agriculture Uses	28036	10.1	33398	12.13	30600	15.86	15795	17.3	107829	12.92
Culturable Waste	1962	0.71	1651	0.60	13240	6.86	7787	8.58	24640	2.95
Permanent Pasture and other Grazing Land	15111	5.49	12613	4.58	4235	2.19	2099	2.30	34058	4.08
Land Under Tree Crop	0	0	0	0	0	0	0	0	0	0
Current Fallows	5995	2.18	5778	2.09	2190	1.13	1343	1.47	15306	1.83
Other Fallows	0	0	81	0.02	10528	5.45	6076	6.66	16685	2.00
Net Area Sown	202899	73.80	214872	78.08	132122	68.48	58032	63.67	607925	72.88
TOTAL	**274921**	**100**	**275164**	**100**	**192915**	**100**	**91132**	**100**	**834132**	**100**

Table 8.4: Regional Land Use: 2000-01

CATEGORIES	REGION - I		REGION - II		REGION - III		REGION - IV		TOTAL	
	AREA	%	AREA	%	AREA	%	AREA	%	AREA	%
Forest	12580	4.57	1029	0.37	0	0	0	0	13609	1.63
Barren and Uncultivable Land	5067	1.84	4677	1.69	6224	3.22	2983	3.27	18951	2.2794
Land Put to Non Agriculture Uses	28643	10.41	34254	12.44	25894	13.42	9739	10.6	98530	11.81
Culturable Waste	1170	0.42	1058	0.38	10775	5.58	13939	15.29	26942	3.22
Permanent Pasture and other Grazing Land	12030	4.37	10746	3.90	5161	2.67	2099	2.30	30036	3.60
Land Under Tree Crop	0	0	0	0	0	0	0	0	0	0
Current Fallows	4606	1.67	4275	1.55	8374	4.34	8267	9.07	25522	3.05
Other Fallows	0	0	81	0.02	0	0	0	0	81	0.009
Net Area Sown	210825	76.6	219044	79.60	136487	70.75	54105	59.37	620461	74.38
TOTAL	**274921**	**100**	**275164**	**100**	**192915**	**100**	**91132**	**100**	**834132**	**100**

The scenario in the year 2000-01 has changed drastically. Only region II has the presence of other fallow, where as it is totally absent in region I, II and III (Figure 8.7).

8.3.3 Culturable Waste

In 1980-81, the area of land accounted under this sub-category was only 24640 ha (2.95%). By the next point of time, it was 26942 ha (3.22%).

Like other categories, this is also not free from regional variation. Earlier region III had the largest area 13240 ha (6.86%) followed by 7787 ha (8.58%) of IV, region I by 1962 ha (0.71%) and region II by 1651 ha (0.60%). By 2001, its area was reduced to 10775 ha (5.58%) in region III, 1170 ha (0.42%) in region I, 1058 ha (0.38%) in region II whereas there was an increase noted in region IV to 13939 ha (15.29%).

The overall trend of decrease seen in region I, II and III, reveals the declining nature of such uses. Other things being equal, the increasing population is that forceful factor which compels bringing more area under cultivation rather than leaving it useless. Thus, the future would bring still more areas under the plough and other relevant uses rather then leaving them in the categories of wastes or unused lands (Figure 8.8).

8.4 Land Not Available For Cultivation:

All the land area not categorized as cultivated and assigned other functions are included in this broad category. They are put to the following uses:

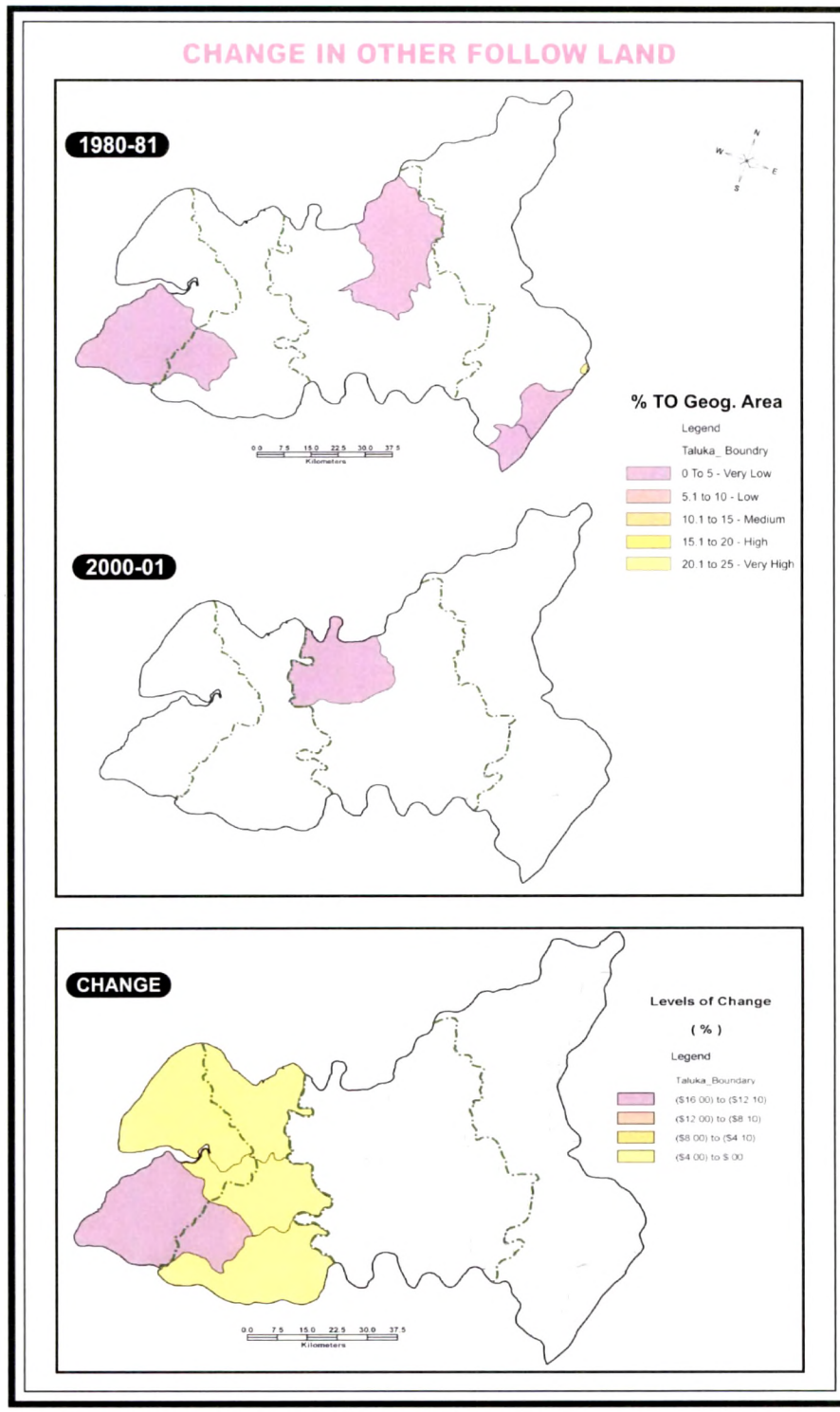

CHANGE IN OTHER FOLLOW LAND
1980-81
% TO Geog. Area
Legend
Taluka_ Boundry
0 To 5 - Very Low
5.1 to 10 - Low
10.1 to 15 - Medium
15.1 to 20 - High
20.1 to 25 - Very High
2000-01
CHANGE
Levels of Change
(%)
Legend
Taluka_Boundary
($16.00) to ($12.10)
($12.00) to ($8.10)
($8.00) to ($4.10)
($4.00) to $.00
0.0 7.5 15.0 22.5 30.0 37.5
Kilometers

Figure 8.7

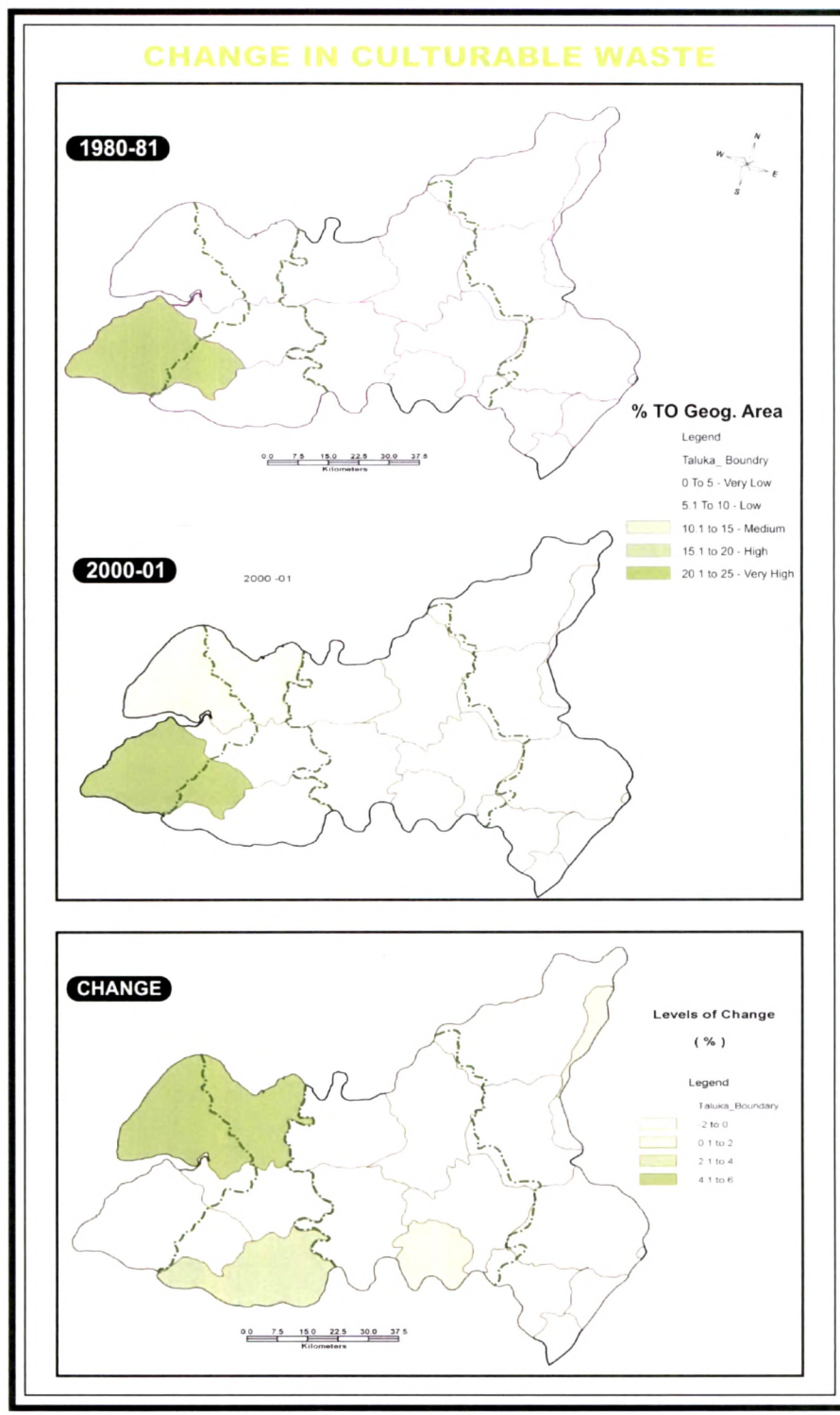

CHANGE IN CULTURABLE WASTE
1980-81
N
W
E
S
% TO Geog. Area
Legend
Taluka_ Boundry
0 To 5 - Very Low
5.1 To 10 - Low
10.1 to 15 - Medium
15.1 to 20 - High
20.1 to 25 - Very High
0.0 7.5 15.0 22.5 30.0 37.5
Kilometers
2000-01
2000 -01
CHANGE
Levels of Change
(%)
Legend
Taluka_Boundary
-2 to 0
0.1 to 2
2.1 to 4
4.1 to 6
0.0 7.5 15.0 22.5 30.0 37.5
Kilometers

Figure 8.8

8.4.1 Permanent Pasture and Other Grazing Land (Hindi – Gauchar, Gujarati – Dhorcharan):

That piece of land on which the domesticated animals are allowed to graze is called grazing land or "Gauchar". However, the increasing temptation of man to grab more and more land for cultivation is working against this privilege of animals. Though, mechanization of agriculture is gradually reducing the number of farm oxen, the increasing requirement of milk tends to increase the number of milky cattle which require the retention, and perhaps, enlargement of grazing land in the rural areas.

Like other uses of land, this is an important feature of the land use system of the study area. All the villages, irrespective of their geographical area, have allotted a sizeable portion of the land, with variation of course, to the use. The grazing land in 1980-81 occupied 34058 ha (4.08%) of the total area in the region, which came down to 30036 ha (3.60%) in 2000-01, showing a decrease of only 422 ha (0.48%).

The region wise distribution of grazing land (Table 8.3 and 8.4) seems quite disproportionate. Region I had 5.47 and 4.37 percent of its area under this use at the two points of time. Region II, which is largest in area and largest in respect of number of villages had 4.58 and 3.90 percent of its area, and region III had 2.19 and 2.67 percent, at the two points of time showing an increase of 0.48 percent (926 ha) and smallest in respect of number of villages had 2.30 percent at both points of time indicating no change.

In respect of grazing land, however, a trend of decrease is discernible. Region I and II showing decrease, region III showing increase, while region IV showing no change or unchanged. With the increasing population, on the one hand, and the cultivation of improved varieties of grass, on the other, it may lead to a further decrease in the area under this use in future. The increasing use of farm machinery, especially, tractors, is reducing the number of oxen – as people perceive that the perpetual cost of maintenance of animals is higher than the hired tractors. Thus this techno-economic factor is not the least important in assisting to predict a further fall in the area of grazing land (Figure 8.9).

8.4.2 Forest

A total area of 13609 ha (1.63%) is devoted for this category of land-use which remaining unchanged at the two points of time in the region.

Region I had 12580 ha (4.57%) and region II had 1029 ha (0.37%) of its area under this use. Whereas regions III and IV are totally devoid of forest cower, being salinity ridden, this area is deprived of any forest in true sense of the term. Only short statured acacious bush type trees are seen scattered over the area. From its appearance, the area looks like a desert, due to the absence of trees. However, a small piece of land covering 23.71 ha, called as Mangrove forest, is seen on the costal Marshes of the village Malpur in region IV. No change is noticed in its areal extent over the temporal span of study (Figure 8.10)

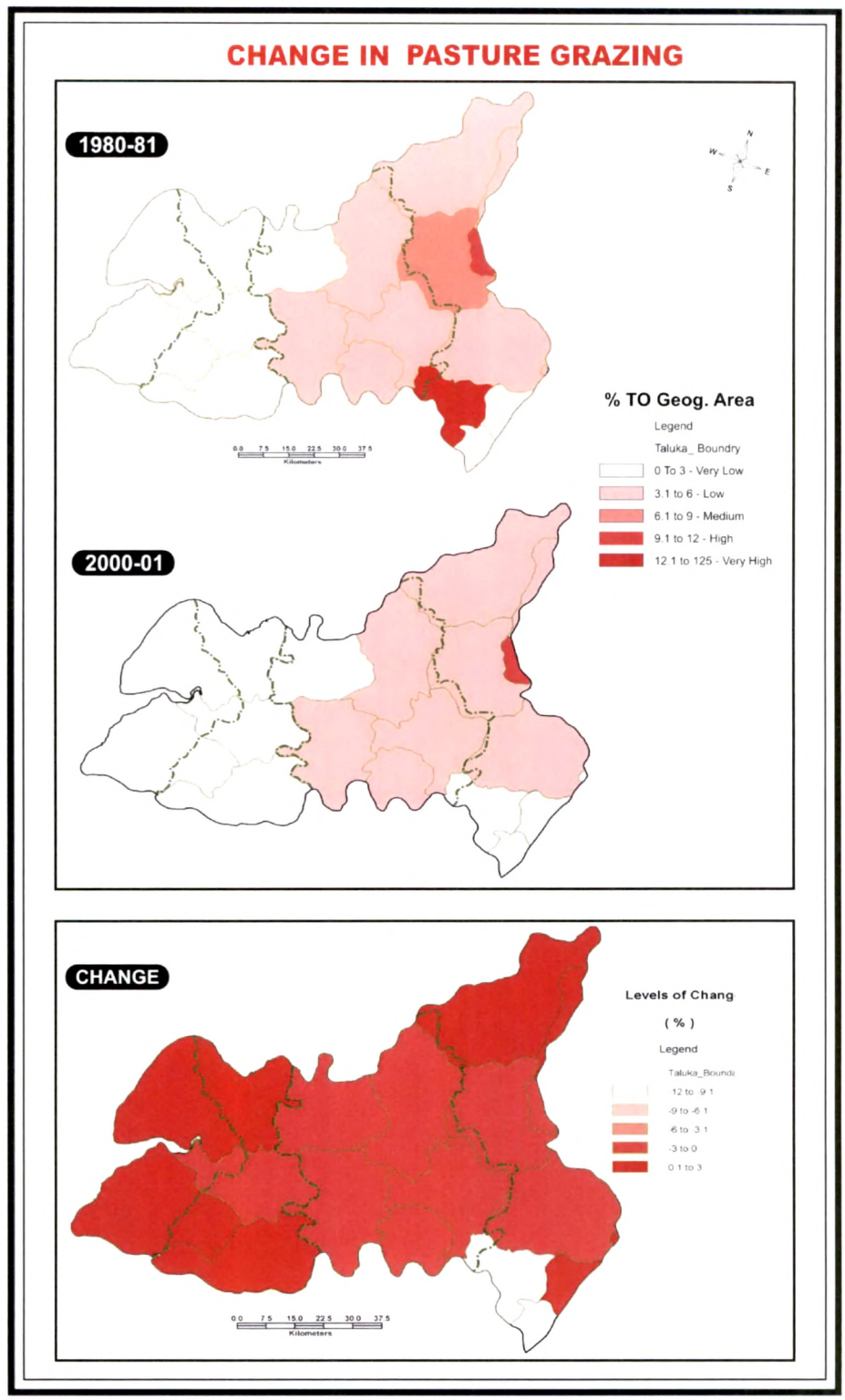

CHANGE IN PASTURE GRAZING
1980-81
% TO Geog. Area
Legend
Taluka_ Boundry
0 To 3 - Very Low
3.1 to 6 - Low
6.1 to 9 - Medium
9.1 to 12 - High
12.1 to 125 - Very High
2000-01
CHANGE
Levels of Chang
(%)
Legend
12 to 9.1
-9 to -6.1
-6 to -3.1
-3 to 0
0.1 to 3
0.0 7.5 15.0 22.5 30.0 37.5
Kilometers

Figure 8.9

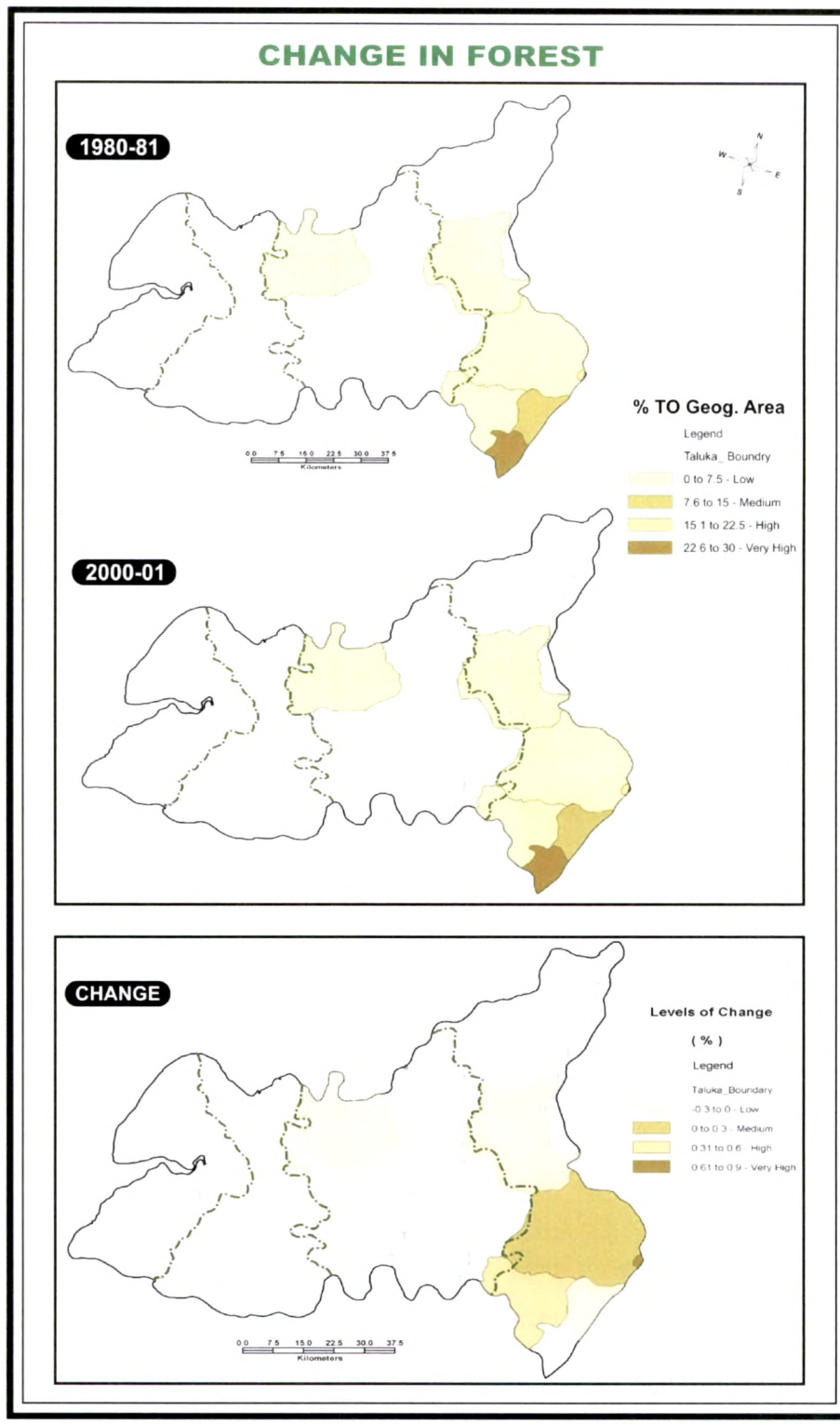

CHANGE IN FOREST
1980-81
N
W
E
S
0.0 7.5 15.0 22.5 30.0 37.5
Kilometers
% TO Geog. Area
Legend
Taluka_ Boundry
0 to 7.5 - Low
7.6 to 15 - Medium
15.1 to 22.5 - High
22.6 to 30 - Very High
2000-01
CHANGE
0.0 7.5 15.0 22.5 30.0 37.5
Kilometers
Levels of Change
(%)
Legend
Taluka_Boundary
-0.3 to 0 - Low
0 to 0.3 - Medium
0.31 to 0.6 - High
0.61 to 0.9 - Very High

Figure 8.10

8.4.3 Settlements

Pattern of human settlement varies significantly according to complex and inter-related, cultural political, economic, geographic and demographic factors (Hansen 1978). The total area under this category is 107,829 ha and 98,530 ha at two points of time. Like other categories, this is also not free from regional variation. Region II had the largest area 33,398 ha followed by 30,600 ha of region I, region III by 28036 ha and region IV by 15795 ha. By the second point of time, its area increased to 34,254 ha of region II, 28643 ha in region I, 25894 ha in region III and in region IV to 9739 ha.

8.5 CONCLUSION

To sum-up, though each category of land use shows mixed trends of change, however, on the basis of greater percentage of dynamism in the different categories, the following three trends has been observed:

(1) Positive change,

(2) Negative change, and

(3) Relatively static.

8.5.1 Positive Change

The land under agricultural use, such as N.S.A. and the land under social and cultural uses such as settlement, transportation (road, railway etc.) are the main an upward trend, categories showing positive change. In case of N.S.A. the region I, II and III showed positive change, region IV showed negative change. Thus, overall there is a greater percentage of positive

change. Lower percentage of constancy and no negative change area noted almost throughout the study area.

8.5.2 Negative Change

The uses more vulnerable to negative change have been culturable waste, wasteland, the grazing lands and settlement. A notable negative change took place in the hectareage of Kharland over the two decades. In all 483.30 ha of total Kharland area had been reclaimed. Similarly, in the other wasteland areas out of the four regions, region I, II and III show decrease and region IV shows increase. Thus, in all such uses, the percentage of decrease is much greater establishing a favourable trend towards a better utilization of the land.

8.5.3 Relatively Static

The third category includes those uses, which have greater degree of stability. It does not mean that they were not affected by either negative or positive changes. Among such uses are forest and marginal lands of Malpur in region IV and the railway lines. Thus, it establishes the fact that, other things being equal; such uses are less prone to change. However, these two are more vulnerable to both positive and negative changes. The railways may acquire more area if any some developmental programme is implemented, and forest may disappear giving way to some other economically viable use.

Finally, it may be concluded that the general land use undergoes positive, negative and mixed trends of change acceding to the changing conditions of human and economic environment of the area. But the fact to be noted is that the changes are usually sluggish and not abrupt as in case of the cropland use. It is, thus deduced that the nature of general land use change in the area is sluggish. Better economic vistas, more exploration of resources, increased supply of amenities of life to rural people, may bring more change in the existing rural land use system in the days to come.

8.6 Cropland Use

The pattern of cropland use in any area is determined by the interaction between the capabilities and drive of human force and the potentialities and endowment of nature (Rizvi S M, 1991). It varies according to the variations in the relationship between man and nature. But the cropping pattern itself is fashioned by man.

Though, cropping is the most efficient use of rural arable land in the light of the agro-climatic and edaphic conditions, the cropping pattern hardly remains uniform through time and space. It varies under the changing physical and non-physical circumstances. The cropping pattern may therefore, be defined as both "time and space sequence in a given area" (Bishm and Singh 1980).

The study area rolls under the predominant influence of nature. The pattern of cropland use here depends largely on the changing natural conditions and the decision of the farmers. However, rainfall is more or less

the governing factor here as in most other parts of the state and the country, in the absence of dependable sources of irrigation, the farming is of extensive type. Fallowing is not a common practice. The area is predominantly kharif crop growing, one where sowing starts with the advent of monsoon and the success or failure of crop depends on its regularity and certainty. It so happened in 1972 and 1974 that due to scanty and sporadic rains, most of the villages could not use even a fraction of their cropland for cultivation, and those who managed to cultivate did so on only small parts of their fields. Thus the cropping pattern in those years was totally changed; cotton, the ever-dominant crop, was superseded by jowar. On an average every alternate year brings somewhat semi-drought conditions. The year 1918, 1948, 1972 and 1974 were the worst years, as the amount of rain received were 222 mm, 173 mm, 287 mm and 257 mm respectively. 1948 is remembered as the year of severest famine.

The village level crop census for the two points of time show that there have been eleven crops grown in this area. Variation in the rank order of these crops was quite obvious. Crops are usually taken in both the seasons – Kharif (the rainy season) and Rabi (the winter season). Both types of crops in both the seasons depend on the amount of precipitation received during the growing seasons. Table 8.5 to 8.8 show the crops of both the seasons and their percentage G.C.A. at the two points of time in the four regions separately.

Kharif is the main cropping season in which most of the crops are grown. Cotton took the largest percentage with 40.80 and 39.30 at the two points of time respectively. Among the cereals, jowar the leading kharif crop followed by rice (paddy), wheat and bajra in year 80-81. There was a slight change in year 2000-01, where wheat is the leading kharif crop followed by rice, jowar and bajra. Among other crops pulses, had a significant share in the G.C.A. with 13.28 and 19.58 percentages at the two points of time respectively. While oil seeds, sugarcane, tobacco and other crops were insignificant at the first point of time, at the second point of time, these crops strengthened their position.

Rabi is not a very important cropping season, as most of the cropland remains engaged in several long duration kharif crops. However, during 1980-81 a substantial percentage (4.68% of G.C.A.) was occupied by wheat, which was third most significant crop. Rabi jowar and rabi pulses occupied small percentage to the G.C.A. By 2000-01, all Rabi crops like the other kharif crops, increased. Wheat increased by a substantial percentage (5.23%) and occupied first place. Tur, gram and other pulses have shown increase and stood second among all the crops (19.05%) after cotton.

The regional level census for 1981 and 2001 show that, majority of the crops are grown in the kharif season. Cotton and tur are the foremost kharif crops. Only one crop, viz., wheat constitutes a rabi crop.

Table 8.5: Gross Cropped Area – 1980-81

Sr. NO.	Region	Taluka	Paddy	Wheat	Jowar	Bajra	Other Cereals	Gram	Tur	Other Pulses	G'nut	Other Oil Seeds	Cotton	Sugarcane	Tobacco	Other Crops
1	I	NANDOD	1090	196	4873	1202	543	145	187	596	2045	189	8579	168	2334	2213
2		TILAKWADA	1760	286	2083	39	866	12	612	145	155	65	10604	41	3522	1786
3		NASVADI	3852	279	3180	793	2115	23	519	110	163	15	9879	27	1234	1278
4		SANKHEDA	2778	371	2657	991	1154	35	1012	417	233	46	19570	2	2697	2239
5		PAVI JETPUR	22	26	31	12	231	3	2	7	2	4	23	10	0	0
6		WAGHODIA	4393	1337	5245	952	874	409	1531	243	229	20	20520	147	2884	2747
7		SAVLI	2838	1469	4877	1292	1129	258	1375	86	189	120	21375	0	2994	1789
8		JAMBUGHODA*	39	0	38	37	565	4	2	2	36	12	19	2	0	0
9		HALOL*	134	0	575	401	5	3	20	201	9	59	790	18	0	13
10		KALOL*	234	0	831	233	34	11	23	226	44	165	1231	84	13	59
TOTAL			**17140**	**3964**	**24390**	**5952**	**7516**	**903**	**5283**	**2033**	**3105**	**695**	**92590**	**499**	**15678**	**12124**
11	II	VADODARA	3301	1689	6767	3122	592	208	7188	326	49	120	9022	117	2317	2489
12		DABHOI	5170	1414	7274	883	826	231	8088	346	85	209	25423	375	2628	2869
13		SINOR	672	286	3612	568	801	23	4425	267	33	99	13596	162	2281	1482
14		KARJAN	743	836	6843	81	581	39	15359	224	139	627	21144	512	3214	2319
15		PADRA	2890	1823	3960	4173	1309	186	7512	533	209	504	7337	312	4848	6122
TOTAL			**12776**	**6048**	**28456**	**8827**	**4109**	**687**	**42572**	**1696**	**515**	**1559**	**76522**	**1478**	**15288**	**15281**
16	III	BHARUCH	874	1317	12201	11	0	268	3711	1266	47	202	10579	34	47	2812
17		VAGRA	192	912	8135	27	13	12	1867	1231	25	56	1297	0	0	1523
18		JAMBUSAR	449	296	4051	21	37	7	3219	776	11	296	12351	12	13	1221
19		AMOD	123	241	3826	16	16	13	2291	921	0	23	6898	0	0	688
TOTAL			**1638**	**2766**	**28213**	**75**	**66**	**300**	**11088**	**4194**	**83**	**577**	**31125**	**46**	**60**	**6244**
20	IV	VAGRA	56	8481	5422	158	8	39	368	1286	3	34	4988	0	0	1551
21		JAMBUSAR	225	3399	2702	230	45	64	447	1112	9	83	13121	0	12	1676
21		AMOD	48	1400	2821	235	7	59	689	1112	0	67	8814	0	0	1744
TOTAL			**329**	**13280**	**10945**	**623**	**60**	**162**	**1504**	**3510**	**12**	**184**	**26923**	**0**	**12**	**4971**
TOTAL – (I+II+III+IV)			31883	26058	92004	15477	11751	2052	60447	11433	3715	3015	227160	2023	31038	38620

Table 8.6: Regional Cropping Pattern –1980-81

Sr. No.	Crop	Irrigated area (Hectares)	%	Unirrigated area (Hectares)	%	Total area (Hectares)	%
1	Paddy	4007	3.99	27876	6.10	31883	5.72
2	Wheat	6328	6.30	19822	4.34	26058	4.68
3	Jowar	5160	5.14	86848	19.03	92008	16.52
4	Bajra	3206	3.19	12271	2.68	15477	2.78
5	Other Cereals	709	0.70	11042	2.41	11751	2.11
6	Total Cereals	19410	19.34			177584	31.90
7	Gram	0	0	1992	0.43	1992	0.35
8	Tur	294	0.29	60153	13.18	60447	10.85
9	Other Pulses	8	0.007	11425	2.50	11433	2.05
10	Total Pulses	302	0.30		0	73932	13.28
11	Groundnut	31	0.030	3685	0.80	3715	0.66
12	Other Oil Seeds	16	0.01	2999	0.65	3015	0.54
13	Total Oil Seeds	47			1.01	6731	1.20
14	Cotton	56639	56.44	170521	37.36	227160	40.80
15	Sugarcane	2023	2.01	0	0	2023	0.36
16	Tobacco	8713	8.68	22325	4.89	31038	5.57
17	Other Crops	13201	13.15	25419	5.57	38620	6.93
	TOTAL (ALL CROPS)	**100335**	**100**	**456345**	**100**	**556680**	**100**

Table 8.7: Gross Cropped Area – 2000 - 01

Sr. NO.	Region	Taluka	Paddy	Wheat	Jowar	Bajra	Other Cereals	Gram	Tur	Other Pulses	G'nut	Other Oil Seeds	Cotton	Sugarcane	Tobacco	Other Crops
1		NANDOD	2715	1466	3071	2315	5219	289	6533	1008	613	824	16174	1631	3124	2714
2		TILAKWADA	4456	2647	1479	737	8471	10	3196	1521	5770	572	16527	0	4589	3882
3		NASVADI	2799	1880	1612	95	6218	267	5001	1211	550	237	13547	0	4128	3608
4		SANKHEDA	3856	2235	3601	980	5879	152	9898	679	2943	109	21074	141	3789	2914
5	I	PAVI JETPUR	12	23	2755	12	5	2	12	290	2	525	10	20	0	4
6		WAGHODIA	7342	1910	2721	575	7818	115	8589	177	280	75	26982	8	4589	2947
7		SAVLI	6162	2654	1974	2849	0	312	10420	227	196	231	22898	241	3561	3211
8		JAMBUGHODA*	2	13	12	13	0	0	12	0	0	8	12	0	0	0
9		HALOL*	52	216	113	112	0	0	128	0	0	28	412	0	20	55
10		KALOL*	81	412	89	98	0	0	113	2	0	13	612	0	58	289
TOTAL			**27477**	**13456**	**17427**	**7786**	**33610**	**1147**	**43902**	**5115**	**10354**	**2622**	**118248**	**2041**	**23858**	**19624**
11		VADODARA	4434	5008	1983	3461	314	235	16997	376	855	3036	17452	786	6520	4285
12	II	DABHOI	3914	2131	5556	1911	351	227	13058	349	731	2324	25543	286	4379	5511
13		SINOR	1236	1857	1613	2177	266	257	5311	169	1240	1884	15659	494	2289	2237
14		KARJAN	1463	3941	2017	1827	712	240	16180	546	824	2236	38273	5136	6812	3916
15		PADRA	3835	2860	1833	4246	545	183	18127	260	280	2504	21074	1058	7520	12514
TOTAL			**14882**	**15797**	**13002**	**13622**	**2188**	**1142**	**69673**	**1700**	**3930**	**11984**	**118001**	**7760**	**27520**	**28463**
16		BHARUCH	78	2891	3936	274	16	277	13130	1398	2	1095	28199	1828	1789	4621
17	III	VAGRA	0	4283	1764	92	4	123	4916	721	0	0	15144	0	2139	3792
18		JAMBUSAR	289	3659	2159	1562	103	506	8364	513	0	846	21770	0	2317	1788
19		AMOD	21	340	634	33	5	62	5756	389	0	2	12893	531	1005	3424
TOTAL			388	11173	8493	1961	128	968	32166	3021	2	1943	78006	2359	7250	13625
20		VAGRA	0	2625	1821	97	4	82	3453	383	0	0	10100	0	4	2190
21	IV	JAMBUSAR	152	2400	353	1037	23	291	5780	292	0	1062	12680	0	6	1351
21		AMOD	40	438	488	51	3	51	2420	221	0	0	7796	325	9	1455
TOTAL			**192**	**5463**	**2662**	**1185**	**30**	**424**	**11653**	**896**	**0**	**1062**	**30576**	**325**	**19**	**4996**
TOTAL – (I+II+III+IV)			42939	45889	41584	24554	35956	3681	157394	10732	14286	17611	344831	12485	58647	66708

Table 8.8: Regional Cropping Pattern –2000-01

Sr. No.	Crop	Irrigated area (Hectares)	%	Unirrgated area (Hectares)	%	Total area (Hectares)	%
1	Paddy	13768	5.85	29101	4.53	42939	4.892
2	Wheat	15478	6.58	30411	4.73	45889	5.23
3	Jowar	7009	2.98	34575	5.38	41584	4.74
4	Bajra	5483	2.33	19071	2.96	24554	2.79
5	Other Cereals	10077	4.28	25879	4.03	35956	4.09
6	Total Cereals	51815	22.03	139037	21.65	201983	23.02
7	Gram	347	0.14	3334	0.51	3681	0.41
8	Tur	32448	13.79	124946	19.45	157394	17.94
9	Other Pulses	835	0.35	9897	1.54	10732	1.22
10	Total Pulses	33630	14.30	138177	21.51	171807	19.58
11	Groundnut	9339	3.97	4947	0.77	14286	1.62
12	Other Oil Seeds	6494	2.76	11117	1.73	17611	2.00
13	Total Oil Seeds	15833	6.73	16064	2.50	31897	3.63
14	Cotton	92545	39.35	252286	39.28	344831	39.30
15	Sugarcane	12485	5.30	0	0	12485	1.42
16	Tobacco	12756	5.42	45888	7.14	58644	6.68
17	Other Crops	16108	6.84	50600	7.88	66708	7.60
TOTAL (ALL CROPS)		**235172**	**100**	**642122**	**100**	**877294**	**100**

8.7 Cotton

Being the segment of the Kanam Vibhag (The region of Black Cotton Soil) cotton has forever been its principal crop. The commercial value of cotton attracted the special attention of the successive governments for its proper cultivations, ever since the medieval period. When British traders came, Bharuch was a flourishing trade centre for years and noted for hand-woven fabrics prepared out of the indigenous cotton. The British gave great impetus to cotton cultivation, when they took over the sovereignty of this area after the fall of Moghal Empire (District Gazetteer, Broach, 1961, 241).

Dabhoi, Karjan, Waghodia and Jambusar were the leading Talukas in the cultivation of cotton between 1981 to 2001, Karjan showed a substantial increase because it had better requisite conditions for cotton.

As stated earlier, cotton dominated the agricultural landscape of the area with 227160 ha and 344831 ha at the two points of time. In the regional landscape also it occupied almost 50% of the cropped area. Region-I was leading with 92590 ha of the total cropped area, followed by region-II with 76522 ha, region-III with 31225 ha and region-IV with 26923 ha under this crop in 1980-81. In 2000-01, region-I maintained its top position with 118248 ha. followed by region-II with 118001 ha region-III with 78006 ha and region-IV with 30576 ha. under this crop. The sequence of regional pattern of distribution has thus, not changed in 2000-01, against 1980-81. The relative significance of cotton has thus increased in gradual order from eastern to the western part of the region.

Cotton is a highly dynamic crop of the area, marking a substantial increase of 50.80 percent during the study period (1980-81 to 200001). Similarly, it registered increase in its share to the total cropped area of each region by 27.71 percent, 54.20 percent, 150.30 percent and 13.60 percent respectively, showing a greater change in its cultivation nearer the coast than in the upland parts.

In respect of the spatial pattern of change in G.C.A. shares under cotton, all levels of positive change took place over the entire area. It therefore, shows that higher levels of mono-cropping trend. In year 80-81, cotton held only 40.80 percent of the G.C.A. (556680 ha.) leaving 59.02 percent for other crops. But after the formation of Gujarat State in 1960, several developmental policies, programmes, and plans for agriculture development were formulated, export forums were opened, incentives for better production were announced, and several measures for the improvement of seeds were taken up. These situations prompted the farmers to grow as much of this crop as possible. Thus, since 1960, the share of cotton in the G.C.A. started increasing. Even under the scanty rain condition of 1974 cotton claimed 32.44 percent of the G.C.A. and was placed next only to Jowar in the crop ranking.

In 2000-01, due to favourable rains, hopeful market prices and the drained off water-logged depressions of regions III and IV, cotton claimed the all time high, area of 3,44,831 ha. Since there had been a bitter experience of the uncertainty of the rains during the preceding years, the wide option for

the farmers was to use maximum part of the cropland during kharif season; leaving little area for the rabi crop. Since cotton was the most profitable crop in all respects and more so due to the improved varieties of seeds (Gujarat II, Gujarat 14/49, Shankar and the recent OM BT), it claimed largest share of the G.C.A. in almost all the regions leaving only 60.70 percent for the rest of the kharif and rabi crops as against 59.20 percent at the former point of time (Figure 8.11).

Following determinants have led to the overwhelming domination of cotton in the area's cropping pattern:

1. Prevailing physical conditions most suited to cotton;
2. Traditionally the area's farmers were used to growing cotton;
3. Increasing demand and attractive prices in the home and foreign market;
4. The elasticity of the rains and the drained off water-logged depressions following the construction of "Kans" (artificial drains).

8.8 Jowar

Traditionally, it is cultivated during the kharif season. Recently, the hybrid varieties have been developed to suit the conditions of both the dry and wet seasons. However, irrigation is needed for the rabi jowar. Lack of irrigation, thus, made rabi jowar unpopular in the area. Even the kharif jowar has not been enjoying a wide popularity all over the area.

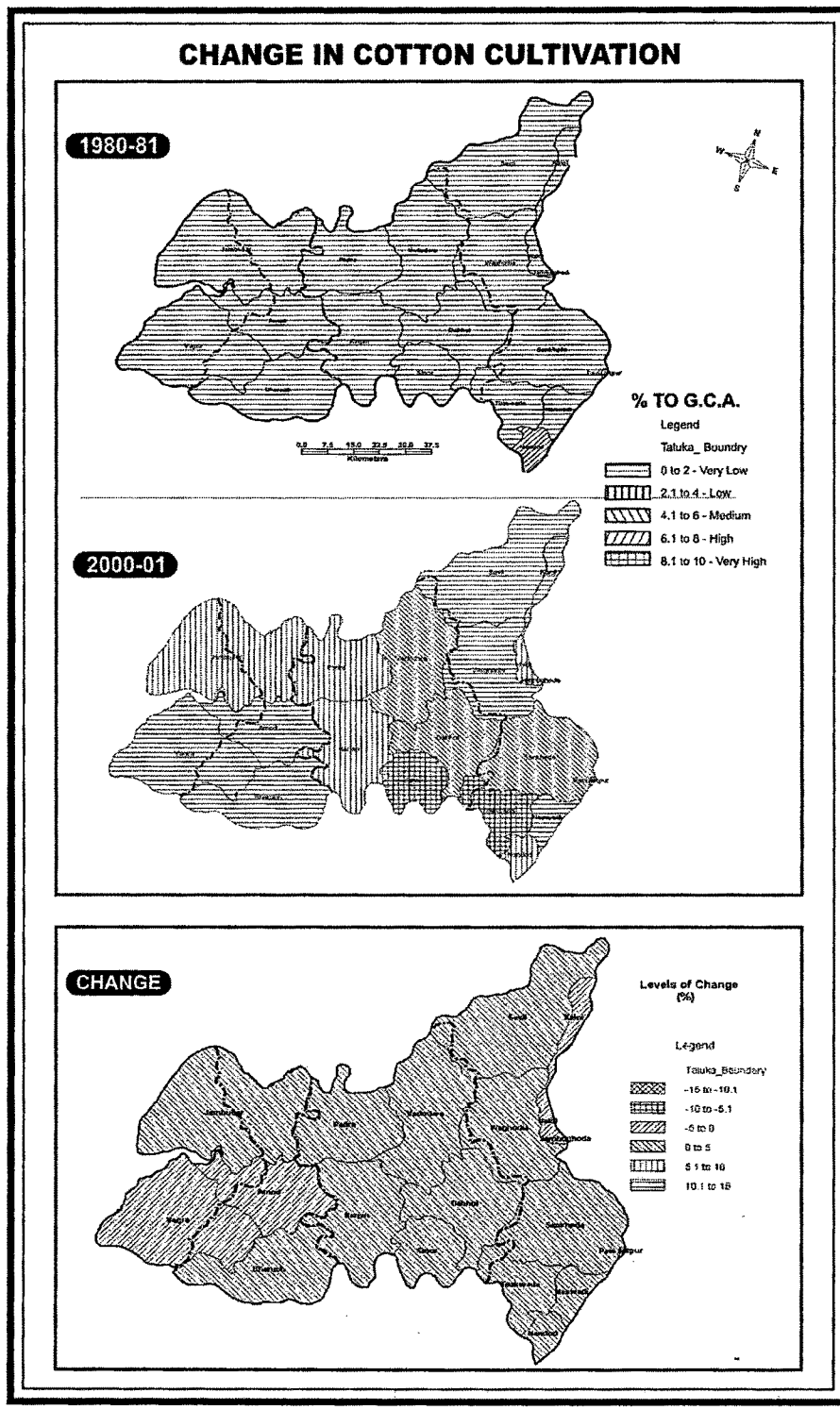

CHANGE IN COTTON CULTIVATION
1980-81
% TO G.C.A.
Legend
Taluka_ Boundry
0 to 2 - Very Low
2.1 to 4 - Low
4.1 to 6 - Medium
6.1 to 8 - High
8.1 to 10 - Very High
2000-01
CHANGE
Levels of Change (%)
Legend
Taluka_Boundary
-15 to -10.1
-10 to -5.1
-5 to 0
0 to 5
5.1 to 10
10.1 to 15

Figure 8.11

Since Jowar has the capability to withstand the semi-drought conditions, it is adopted to thrive in coarse loamy soil (goradu) and is attributed to be a crop next only to wheat in the importance among the cereals.

In 1980-81, its share in the G.C.A. of the region was 92008 ha (16.52%), which, however decreased to 41584 ha (4.74%) in 2000-01, owing to the general trend of decrease in all such crops in favour of cotton.

In varying percentage it had been grown in all the four regions. Table 8.9 to 8.16 gives the regional pattern of its distribution over two points of time.

In 1980-81, region III exceeded the other three regions in both absolute area and percentage of its total cropped area under Jowar by a wide margin of 12.71, 13.18 and 17.51 percents respectively. However, a different picture is seen in 2000-01. Region - III experienced abrupt decrease from 32.94 percent of total cropped area to 5.25 percent, region-I from 12.71 percent to 2.38 percent, region-II from 13.18 percent to 3.94 percent, and region-IV from 17.51 percent to 4.47 percent. In terms of area and percentages all the four regions have decreased their share.

A clear negative trend of change in respect of the share to G.C.A. is seen in jowar cultivation. (Figure 8.12 & 8.13)

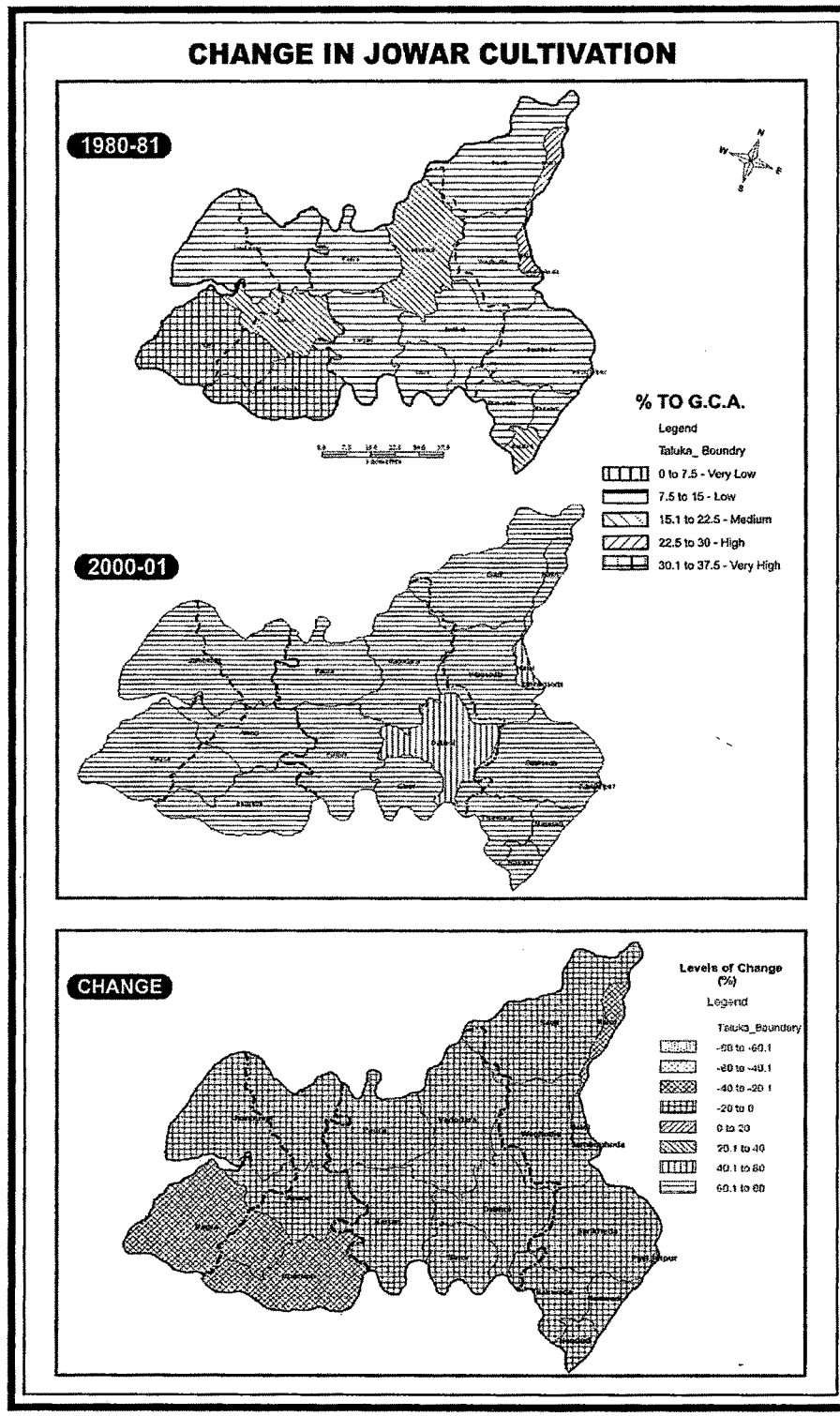

CHANGE IN JOWAR CULTIVATION
1980-81
% TO G.C.A.
Legend
Taluka_ Boundry
0 to 7.5 - Very Low
7.5 to 15 - Low
15.1 to 22.5 - Medium
22.5 to 30 - High
30.1 to 37.5 - Very High
2000-01
CHANGE
Levels of Change (%)
Legend
Taluka_Boundary
-60 to -60.1
-40 to -40.1
-40 to -20.1
-20 to 0
0 to 20
20.1 to 40
40.1 to 60
60.1 to 80

Figure 8.12

Table 8.9: Cropping Pattern in Region I - 1980-81

Sr. No.	Crop	Irrigated Area (Hectares)	%	Unirrigated Area (Hectares)	%	Total area (Hectares)	%
1	Paddy	2027	11.16	15113	8.7	17140	8.93
2	Wheat	3356	18.48	608	0.35	3964	2.07
3	Jowar	227	1.25	24163	13.9	24390	12.71
4	Bajra	1088	5.99	4864	2.8	5952	3.1
5	Other Cereals	515	2.84	7001	4.03	7516	3.92
6	Total Cereals	7213	39.72	51749	29.79	58962	30.73
7	Gram	0	0	903	0.52	903	0.47
8	Tur	2	0.01	5281	3.04	5283	2.75
9	Other Pulses	0	0	2033	1.17	2033	1.06
10	Total Pulses	2	0.01	8217	4.73	8219	4.28
11	Groundnut	31	0.17	3075	1.77	3105	1.62
12	Other Oil Seeds	0	0	695	0.4	695	0.36
13	Total Oil Seeds	31	0.17	3770	2.17	3801	1.98
14	Cotton	7141	39.32	85449	49.19	92590	48.26
15	Sugarcane	499	2.75	0	0	499	0.26
16	Tobacco	1364	7.51	14314	8.24	15678	8.17
17	Other Crops	1910	10.52	10214	5.88	12124	6.32
	TOTAL(ALL CROPS)	**18160**	**100**	**173712**	**100**	**191873**	**100**

Table 8.10: Cropping Pattern in Region II –1980-81

Sr. No.	Crop	Irrigated area (Hectares)	%	Unirrgated area (Hectares)	%	Total area (Hectares)	%
1	Paddy	1887	2.78	10889	6.9	12776	5.91
2	Wheat	1274	1.88	4774	3.02	6048	2.8
3	Jowar	3880	5.73	24576	15.57	28456	13.18
4	Bajra	2118	3.12	6709	4.25	8827	4.09
5	Other Cereals	189	0.27	3920	2.48	4109	1.9
6	Total Cereals	9348	13.78	50868	32.22	60216	27.88
7	Gram	0	0	687	0.43	687	0.31
8	Tur	261	0.38	42311	26.81	42572	19.72
9	Other Pulses	8	0.01	1688	1.06	1696	0.78
10	Total Pulses	269	0.39	44686	28.3	44955	20.81
11	Groundnut	0	0	515	0.32	515	0.23
12	Other Oil Seeds	0	0	1559	0.98	1559	0.72
13	Total Oil Seeds	0	0	2074	1.3	2074	0.95
14	Cotton	40979	60.53	35543	22.74	76522	35.45
15	Sugarcane	1478	2.18	0	0	1478	0.68
16	Tobacco	7349	10.85	7939	5.03	15288	7.08
17	Other Crops	8269	12.21	7012	10.35	15281	7.08
	TOTAL (ALL CROPS)	**67692**	**100**	**148122**	**100**	**215814**	**100**

Table 8.11: Cropping Pattern in Region III –1980-81

Sr. No.	Crop	Irrigated area (Hectares)	%	Unirrgated area (Hectares)	%	Total area (Hectares)	%
1	Paddy	93	0.78	1545	2.06	1638	1.89
2	Wheat	908	7.65	1858	2.6	2766	3.29
3	Jowar	956	8.05	27261	36.76	28213	32.94
4	Bajra	0	0	75	0.1	75	0.09
5	Other Cereals	5	0.05	61	0.08	66	0.07
6	Total Cereals		16.53		41.6	33169	38.18
7	Gram	0	0	300	0.4	300	0.35
8	Tur	31	0.26	11057	14.74	11088	12.76
9	Other Pulses	0	0	4194	5.59	4194	4.82
10	Total Pulses		0.26		20.73	15582	17.93
11	Groundnut	0	0	83	0.11	83	0.1
12	Other Oil Seeds	0	0	577	0.77	577	0.66
13	Total Oil Seeds	0	0		0.88	660	0.76
14	Cotton	7713	64.98	23412	31.21	31125	35.82
15	Sugarcane	46	0.39	0	0	46	0.05
16	Tobacco	0	0	60	0.08	60	0.07
17	Other Crops	2118	17.84	4126	5.5	6244	7.19
	TOTAL ALL CROPS	**11870**	**100**	**74609**	**100**	**86475**	**100**

Table 8.12: Cropping Pattern in Region IV –1980-81

Sr. No.	Crop	Irrigated area (Hectares)	%	Unirrgated area (Hectares)	%	Total area (Hectares)	%
1	Paddy	0	0	329	0.55	329	0.53
2	Wheat	790	30'25	12490	20.85	13280	21.24
3	Jowar	97	3.7	10848	18.11	10945	17.51
4	Bajra	0	0	623	1.04	623	1
5	Other Cereals	0	0	60	0.1	60	0.09
6	Total Cereals	887	33.95	24350	40.65	25237	40.37
7	Gram	0	0	102	0.27	162	0.26
8	Tur	0	0	1504	2.51	1504	2.41
9	Other Pulses	0	0	3510	5.86	3510	5.61
10	Total Pulses	0	0	5176	8.64	5176	8.28
11	Groundnut	0	0	12	0.02	12	0.02
12	Other Oil Seeds	16	0.61	168	0.28	184	0.29
13	Total Oil Seeds	16	0.61	180	0.3	196	0.31
14	Cotton	806	30.86	26117	43.6	26923	43.07
15	Sugarcane	0	0	0	0	0	0
16	Tobacco	0	0	12	0.02	12	0.02
17	Other Crops	904	34.58	4067	6.79	4971	7.95
	TOTAL (ALL CROPS)	**2613**	**100**	**59902**	**100**	**62515**	**100**

Table 8.13: Cropping Pattern in Region I – 2000-01

Sr. No.	Crop	Irrigated area (Hectares)	%	Unirrgated area (Hectares)	%	Total area (Hectares)	%
1	Paddy	6713	8.51	20734	8.36	27477	8.4
2	Wheat	5564	7.06	7892	3.18	13456	4.11
3	Jowar	4517	5.73	6882	2.77	7786	2.38
4	Bajra	904	1.14	12910	5.2	17427	5.33
5	Other Cereals	9369	11.88	24241	9.78	33610	10.28
6	Total Cereals	27067	34.32	72659	29.29	110857	33.93
7	Gram	79	0.1	1068	0.43	1147	0.35
8	Tur	5888	7.47	38014	15.33	43902	13.44
9	Other Pulses	460	0.58	4655	1.87	5115	1.56
10	Total Pulses	6427	8.15	43737	17.63	50164	15.35
11	Groundnut	6855	8.69	3499	1.41	10354	3.16
12	Other Oil Seeds	1297	1.64	1325	0.53	2622	0.8
13	Total Oil Seeds	8152	10.33	4824	1.94	12976	3.96
14	Cotton	31168	39.54	87080	35.13	118248	36.2
15	Sugarcane	2041	2.58	0	0	2041	0.62
16	Tobacco	1544	1.95	22314	9	23858	7.3
17	Other Crops	2410	0.05	17214	6.94	19624	6
	TOTAL (ALL CROPS)	**78809**	**100**	**247828**	**100**	**326667**	**100**

Table 8.14: Cropping Pattern in Region II – 2000-01

Sr. No.	Crop	Irrigated area (Hectares)	%	Unirrgated area (Hectares)	%	Total area (Hectares)	%
1	Paddy	7055	5.44	7787	3.89	14842	4.5
2	Wheat	8153	6.29	7644	3.82	15797	4.79
3	Jowar	2221	1.71	10781	5.38	13002	3.94
4	Bajra	4305	3.32	9317	4.65	13622	4.13
5	Other Cereals	705	0.54	1483	0.74	2188	0.66
6	Total Cereals	22439	17.3	37012	18.52	59451	18.02
7	Gram	268	0.2	874	0.43	1142	0.34
8	Tur	24231	18.7	45442	22. 7	69673	21.13
9	Other Pulses	375	0.28	1325	0.66	1700	0.51
10	Total Pulses	24874	19.18	47641	23.7	72515	21.98
11	Groundnut	2484	1.91	1446	0.72	3930	1.19
12	Other Oil Seeds	5058	3.9	6926	3.46	11984	3.63
13	Total Oil Seeds	7542	5.81	8372	4.18	15914	4.82
14	Cotton	45448	35.08	72553	36.26	118001	35.79
15	Sugarcane	7760	5.99	0	0	7760	2.35
16	Tobacco	11212	8.65	16308	8.15	27520	8.34
17	Other Crops	10259	7.91	18204	9.09	28463	8.63
	TOTAL(ALL CROPS)	**129534**	**100**	**200130**	**100**	**329664**	**100**

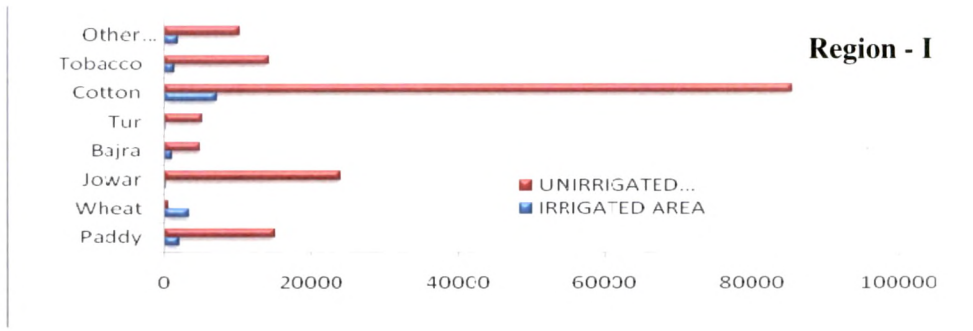
Table 8.15: Cropping Pattern in Region III – 2000-01

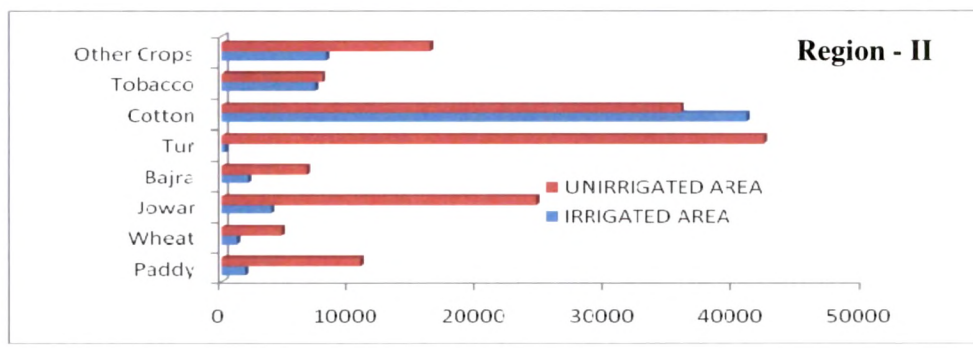
Sr. No.	Crop	Irrigated area (Hectares)	%	Unirrgated area (Hectares)	%	Total area (Hectares)	%
1	Paddy	0	0	388	0.27	388	0.24
2	Wheat	1521	7.1	9652	6.89	11173	6.91
3	Jowar	248	1.15	8245	5.88	8493	5.25
4	Bajra	170	0.79	1791	1.27	1961	1.21
5	Other Cereals	2	0.009	126	0.08	128	0.07
6	Total Cereals	1941	9.049	20202	14.39	22143	13.68
7	Gram	0	0	968	0.69	968	0.59
8	Tur	1833	8.56	30333	21.65	32166	19.91
9	Other Pulses	0	0	3021	2.15	3021	1.87
10	Total Pulses	1833	8.56	34322	24.49	36155	22.37
11	Groundnut	0	0	2	0.0014	2	0.001
12	Other Oil Seeds	86	0.4	1857	1.32	1943	1.203
13	Total Oil Seeds	86	0.4	1859	1.321	1945	1.204
14	Cotton	12857	60.05	65149	46.5	78006	48.3
15	Sugarcane	2359	11.01	0	0	2359	1.46
16	Tobacco	0	0	7250	5.17	7250	4.48
17	Other Crops	2331	10.88	11294	8.06	13625	8.43
	TOTAL (ALL CROPS)	**21407**	**100**	**140076**	**100**	**161483**	**100**

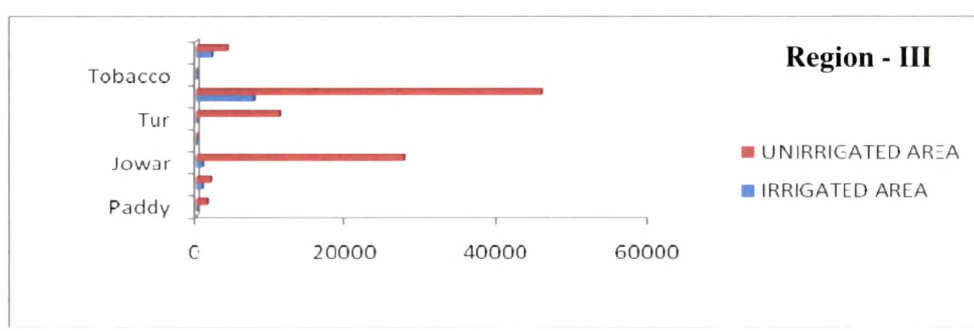
Table 8.16: Cropping Pattern in Region IV – 2000-01

Sr. No.	Crop	Irrigated area (Hectares)	%	Unirrgated area (Hectares)	%	Total area (Hectares)	%
1	Paddy	0	0	192	0.35	192	0.32
2	Wheat	240	4.42	5223	9.66	5463	9.18
3	Jowar	23	0.42	2639	4.88	2662	4.47
4	Bajra	104	1.91	1081	1.99	1185	1.99
5	Other Cereals	1	0.018	29	0.05	30	0.05
6	Total Cereals	368	6.768	9164	16.93	9532	16.01
7	Gram	0	0	424	0.78	424	0.71
8	Tur	496	9.14	11157	20.63	11653	19.59
9	Other Pulses	0	0	896	1.65	896	1.5
10	Total Pulses	496	9.14	12477	23.06	12973	21.8
11	Groundnut	0	0	0	0	0	0
12	Other Oil Seeds	53	0.97	1009	1.86	1062	1.78
13	Total Oil Seeds	53	0.97	1009	1.86	1062	178
14	Cotton	3072	56.65	27504	50.87	30576	51.4
15	Sugarcane	325	5.99	0	0	325	0.54
16	Tobacco	0	0	16	0.029	19	0.02
17	Other Crops	1108	20.43	3888	7.19	4996	8.39
	TOTAL ALL CROPS	**5422**	**100**	**54058**	**100**	**59480**	**100**

CROPPING PATTERN IN AGRO CLIMATIC REGIONS-1980-81







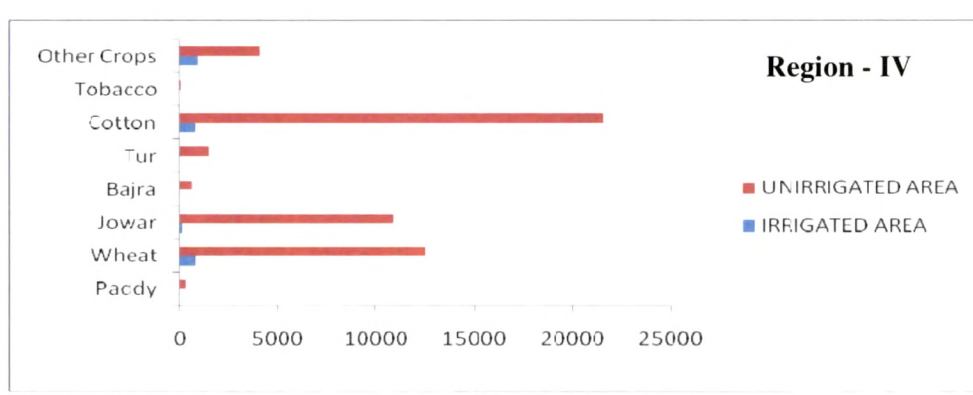
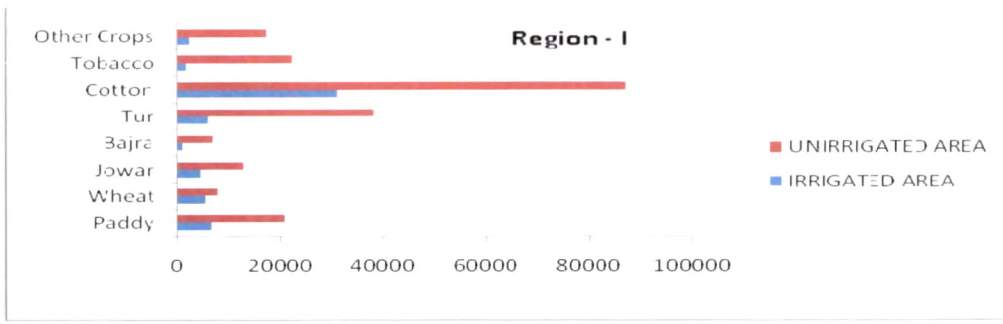
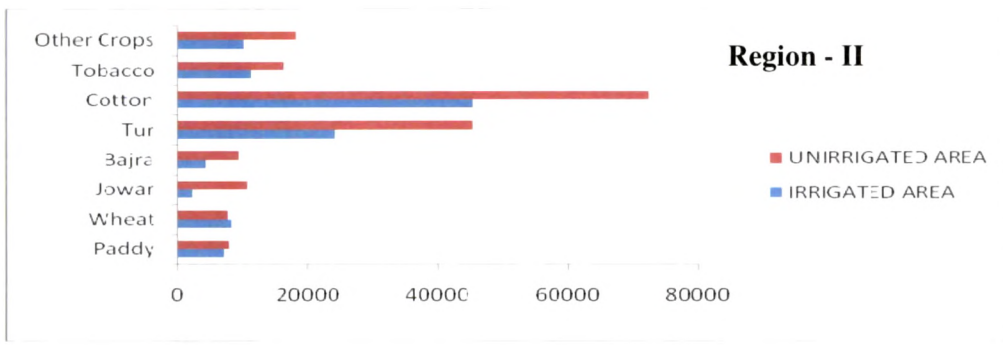
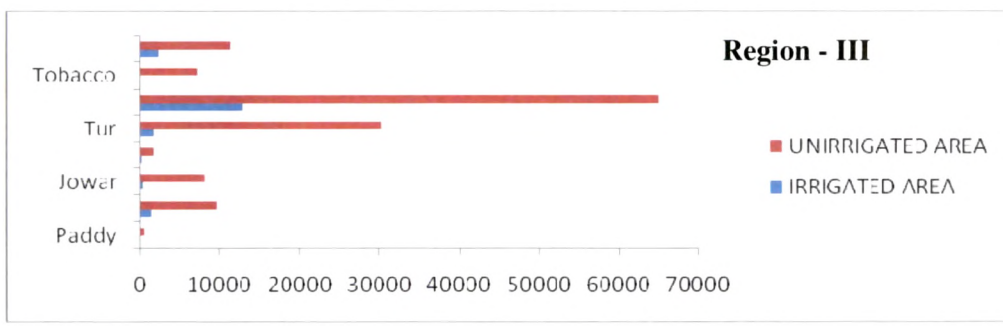


Figure 8.13

CROPPING PATTERN IN AGRO CLIMATIC REGIONS-2000-01







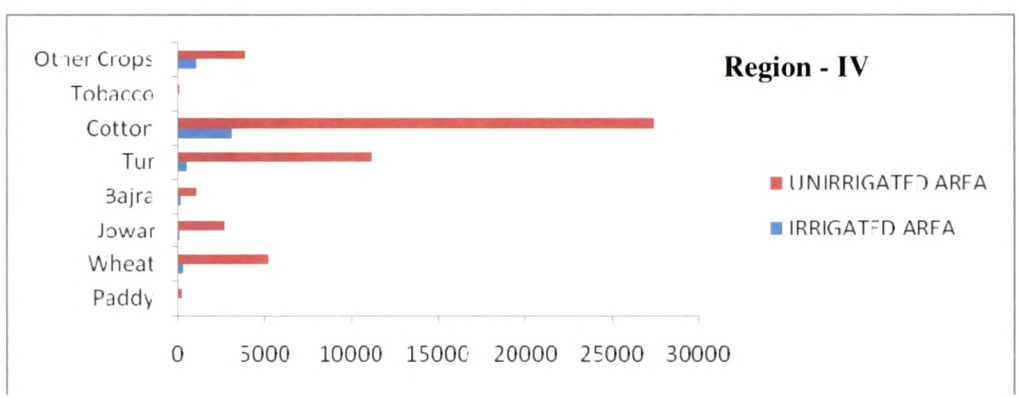


Figure 8.14

8.9 Rice

During 1980-81, rice seems to have been a significant crop. It enjoyed favorable conditions due to the presence of good fertile soil and of the depressions that were inundated during monsoon rains. Region-I and region-II ware the leading growers of this crop. In the event of fairly heavy showers during the monsoon season, the water logged depressions were supplying required water from sowing to harvesting period. But the draining-off of such water logged areas by the artificial drains has the effect of decreasing the hectareage of rice cultivation in the area.

In 1980-81, rice occupied 5.72 percent of the region's G.C.A. At the next point of time, it was reduced to only 4.89 percent of the G.C.A. Although percentage wise area under paddy declined, the total cropped are under paddy increased from 31883 ha to 42939 ha.

In the regional scenario, rice occupied the largest percentage share of the total cropped area, in 1980-81, with 8.93 (17140 ha.) in region-I followed by 5.91 percent (12776 ha.) in region-II, 1.89 (1638 ha.) in region-III and only 0.53 (329 ha.) in region-IV. Thus, rice could thrive well in the eastern part of the region as compared to the western part.

By 2000-01, a drastic change occurred in the physiography of the area i.e., the waterlogged depressions were by and large drained out by construction of the artificial drains, thus leaving little area for rice cultivation. Secondly, the cotton wave suppressed all such crops to very little significance.

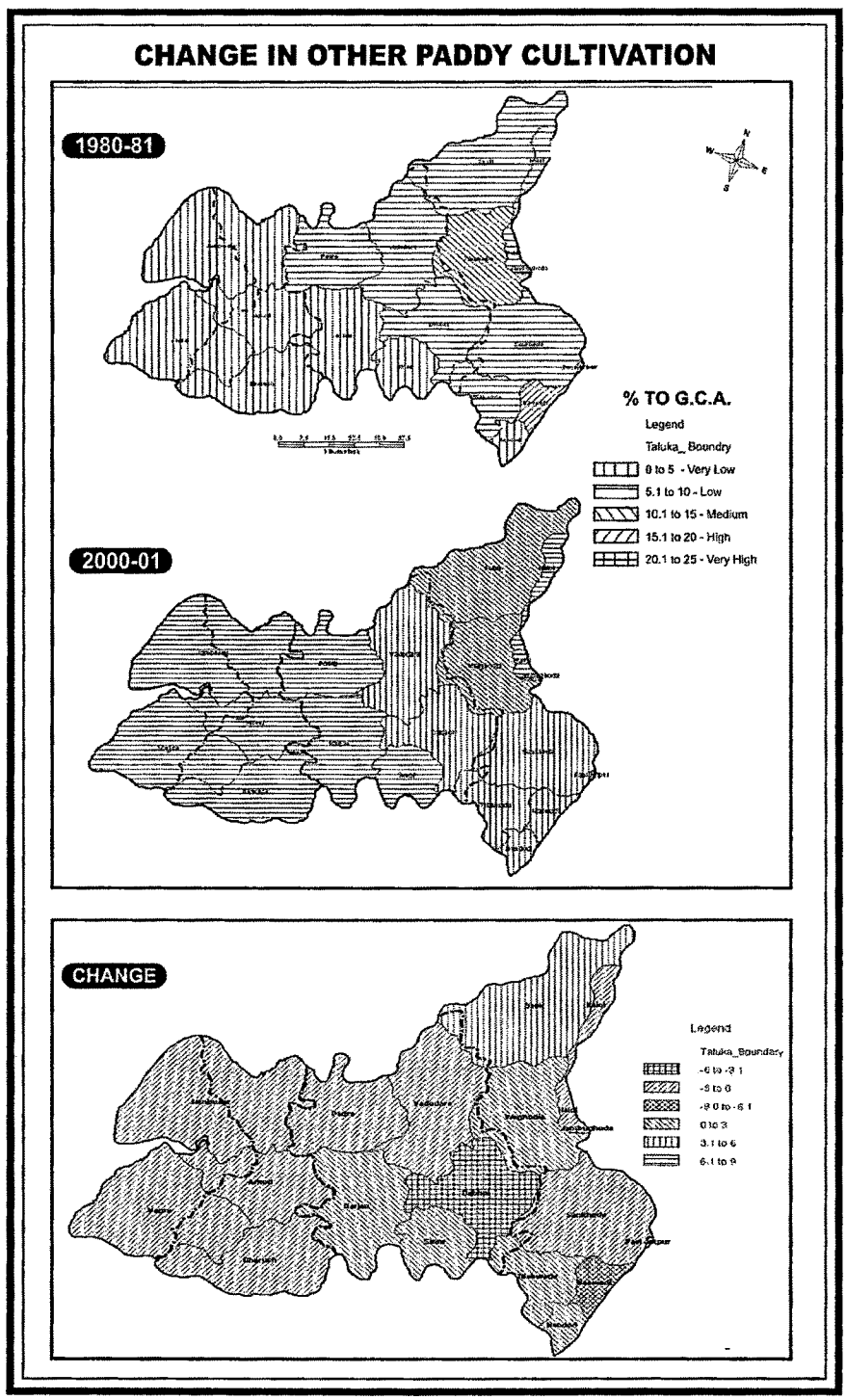

CHANGE IN OTHER PADDY CULTIVATION
1980-81
% TO G.C.A.
Legend
Taluka_ Boundry
0 to 5 - Very Low
5.1 to 10 - Low
10.1 to 15 - Medium
15.1 to 20 - High
20.1 to 25 - Very High
2000-01
CHANGE
Legend
Taluka_Boundary

Figure. 8.15

Though in sum, it suffered loss in region III and IV, but it remained by far the longest kharif cereal in region-I followed by region-II where it was the second largest kharif cereal. Its relative percentage to the G.C.A. decreased in all the four regions (8.4, 4.5, 0.24 and 0.32 respectively) (Figure. 8.14).

8.10 Bajra

Bajra is a minor Kharif crop and a food grain of the poor, but also taken by the lower middle class people. It did not gain any notable significance in the cropping pattern of the area. During 1980-81, it occupied only 2.78 percent to the G.C.A. However, it went up by a meager 0.01 percent during 2000-01. Table 8.9 to 8.16 shows the distribution and change in Bajra cultivation at the two points of times.

Like jowar, bajra has also been more significant in region-I holding 3.1 percent and 5.33 percent to the G.C.A. respectively at the two points of time. Region-II was next in order with 4.09 percent and 4.13 percent, region-III with 0.09 percent and 1.21 percent, while region-IV had 0.09 percent and 1.99 percent in the two time periods. The figures indicate an increase in all the regions by 2.23, 0.04, 1.12 and 1.9 percent respectively.

With a negligible increase to the total cropped share by 0.01 percent, it does not show that bajra could enjoy any significance in terms of its share in the total cropped area. However, it is found to be a crop of some significance in the villages of region III and IV.

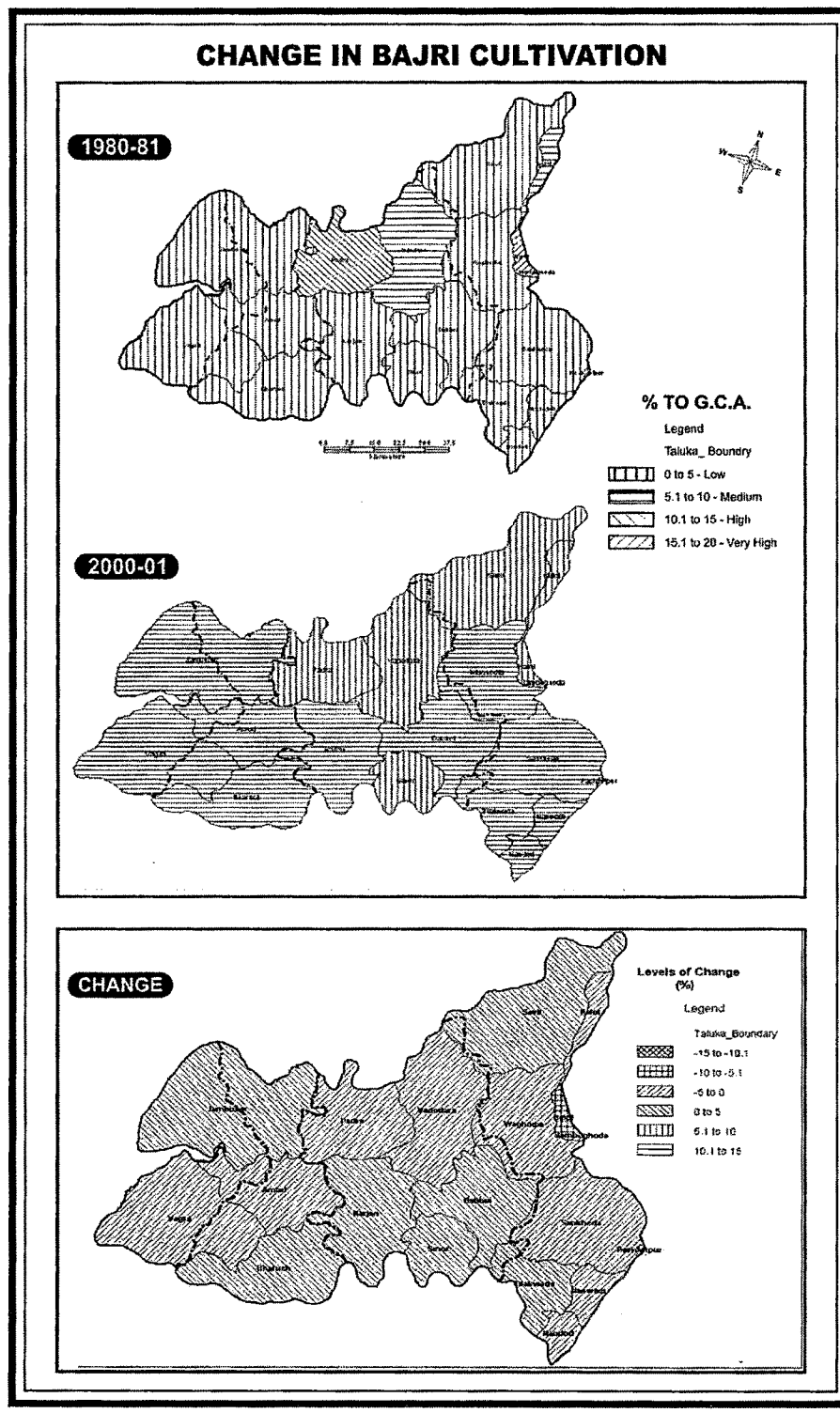

CHANGE IN BAJRI CULTIVATION
1980-81
% TO G.C.A.
Legend
Taluka_ Boundry
0 to 5 - Low
5.1 to 10 - Medium
10.1 to 15 - High
15.1 to 20 - Very High
2000-01
CHANGE
Levels of Change (%)
Legend
Taluka_Boundary

Figure 8.16

Bajra, among the kharif cereals, was the crop enjoying relatively better favour of the environment, and moved inverse to the general trend of decrease in the cereals (Figure 8.15).

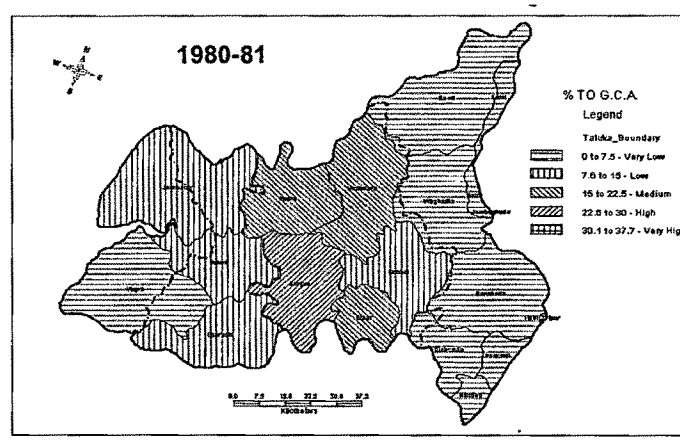
8.11 Pulses

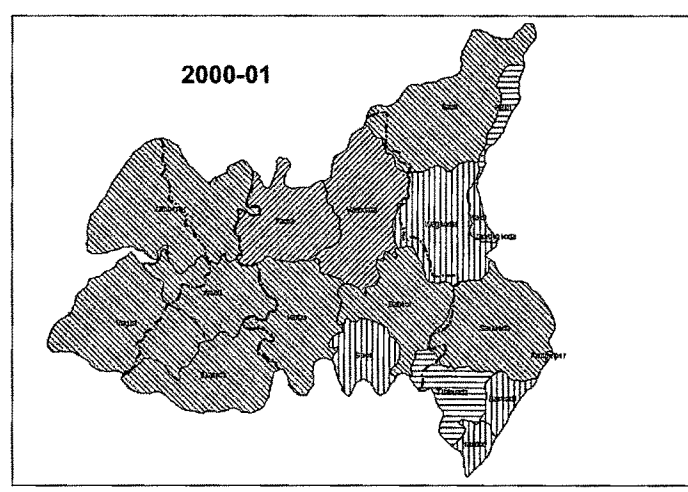
Among the pulses of the kharif season are tur, moong (Mag) urad (Adad) and gram of rabi season. Of them the principal pulse is tur, the others being quite insignificant. Thus, all the minor pulses have been assimilated with tur, which held relatively major hectareage, and are discussed under the broad head of "pulses".

Pulses seem to have been grown only for domestic use. They never occupied any substantial percentage of the total cropped area, in the area/region. However, their position was relatively very good during 1980-81, when they occupied 13.28 percent to the total cropped areas. But they still increased to 19.58 percent by 2000-01, along with the cereals and other such crops.

In case of their regional distribution, it is found that region-II, with its edaphic qualities has been relatively big grower of pulses devoting 20.81 percent to the total cropped area, at the first and 21.98 percent at the second point of time. It maintained its superiority at both the points of time. Region-I devoted 4.28 and 15.35 percent, region-III devoted 17.93 percent and 22.37 percent and region-IV devoted 2.28 percent and 21.8 percent respectively at

CHANGE IN PULSES CULTIVATION





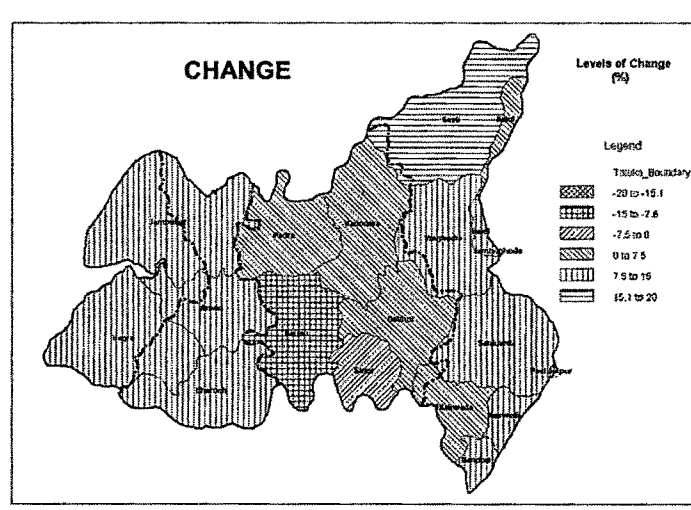


Figure 8.17

the two points of time. This itself shows the adaptability of the pulses to the local condition and the choice of the farmers (Figure. 8.17).

8.12 Oil Seeds

The principal oil seeds comprising sesamum (til) and castor (divelia). groundnuts (Magphali), are also insignificantly grown. The share of G.C.A. under each of them has been so small that they had to be aggregated to bring them under one head – Oil Seeds.

During 1980-81, the oil seeds were one of the most insignificant crops occupying only 1.20 percent to the G.C.A. of the region.

In 1980-81, the aggregated percentage share of G.C.A. under oil sees in region-I was only 1.98 percent, but it went up to 3.96 of the total cropped area in 2000-01. However inspite of the general trend of increase, they occupied only 0.95 (1980-81) and 4.82 (2000-01) percent of the total cropped area of region-II. In region III it occupied 0.76 percent and 1.20 percent and in region-IV they could occupy only 0.31 percent and 1.78 percent to, the total cropped area at the two points of time. Over all there is an increase in area under oil seed, because castor is gaining significance due to its uses in chemical industries. Moreover, it is adaptive to this environmental condition, being able to survive with low inputs of water, fertilizer, and man-hours (Figure 8.18).

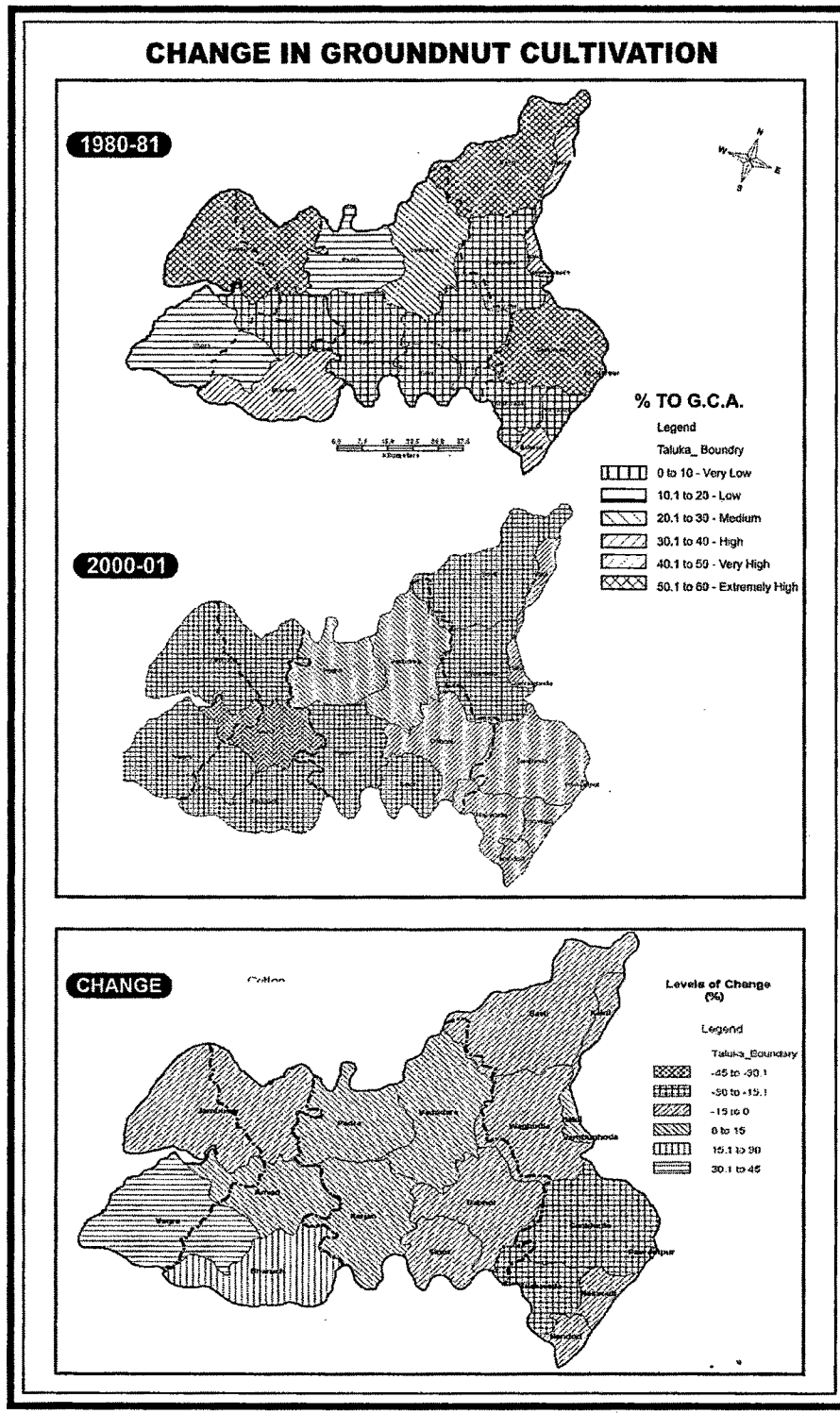

CHANGE IN GROUNDNUT CULTIVATION
1980-81
% TO G.C.A.
Legend
Taluka_ Boundry
0 to 10 - Very Low
10.1 to 20 - Low
20.1 to 30 - Medium
30.1 to 40 - High
40.1 to 50 - Very High
50.1 to 60 - Extremely High
2000-01
CHANGE
Levels of Change (%)
Legend
Taluka_Boundary
-45 to -30.1
-30 to -15.1
-15 to 0
0 to 15
15.1 to 30
30.1 to 45

Figure 8.18

8.13 Sugarcane

Among all the crops of the region, sugarcane is the most insignificant crop of this area. It is grown for domestic use, for making "Jaggery". It occupies a very insignificant share 0.36 and 1.42 percent of the total cropped area, at the two points of time.

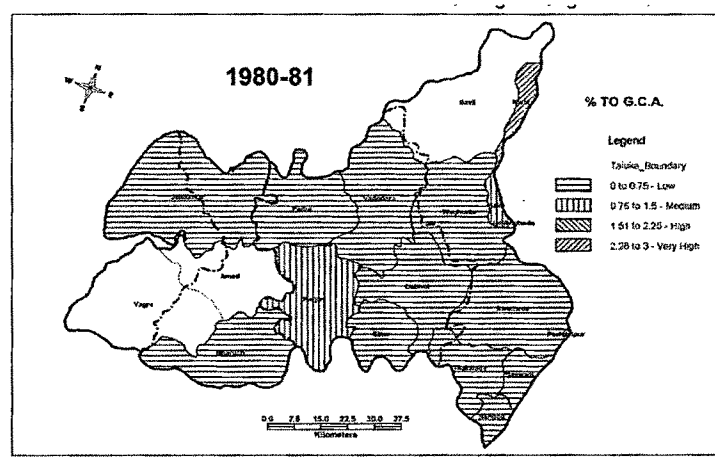
Moreover, sugarcane needs heavy irrigation and rich laterite soil for its growth. The region is devoid of good irrigation setup, but with the construction of the Narmada Canal Network, sugarcane will gain tremendous importance in terms of its share to the total cropped area in the days to come.

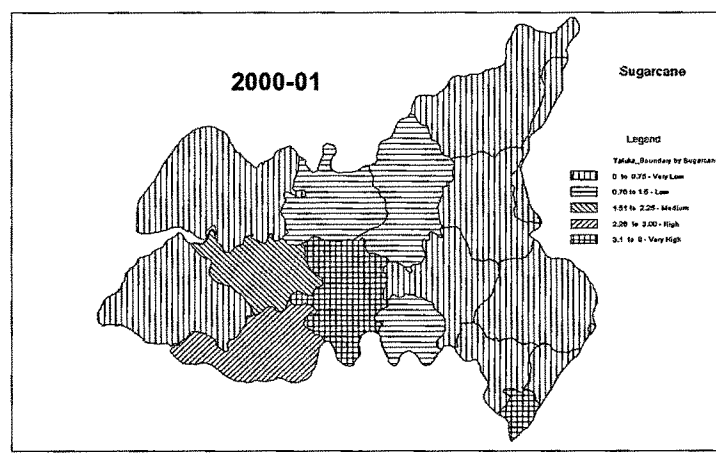
With respect to regional distribution, it is found that region-II has been a relatively bigger grower of sugarcane devoting 0.68 percent to the total cropped area at the first and 2.35 percent at the second point of time. It maintained its superiority at both the points of time. Karjan Taluka of region-II has the highest share of area under sugarcane at both the points of time. Region-I devoted 0.26 and 0.62 percent, region-II devoted 0.05 and 1.46 percent and region-IV devoted 0.02 and 0.54 percent respectively at the two points of time (Figure. 8.19).

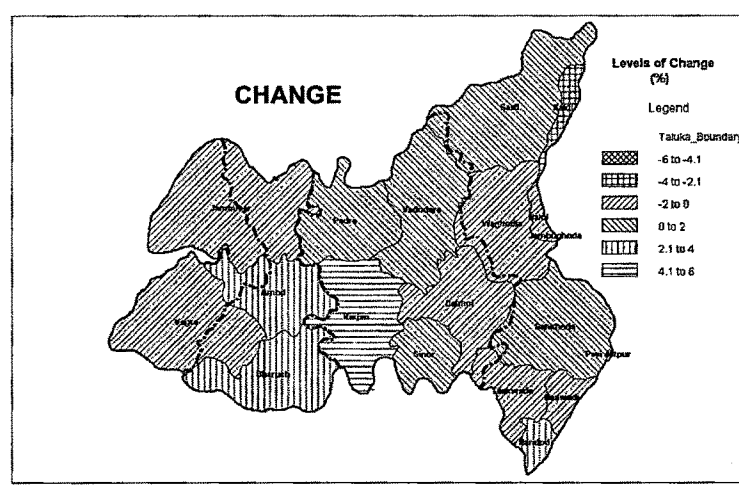
8.14 Tobacco

Tobacco is one other crop, which does not share significant area under its cultivation across the region. It is grown for domestic use for "bidi, hooka,

CHANGE IN SUGARCANE CULTIVATION







(Figure. 8.19)

cigarette and cheroot. It occupies a share of 5.57 percent and 6.68 percent to the G.C.A. respectively at the two points of time.

Dashrath village of Vadodara Taluka occupies a significant position in tobacco trade of India. Padra Taluka of Vadodara District in region-II has the highest share of area under cultivation and even production in the region.

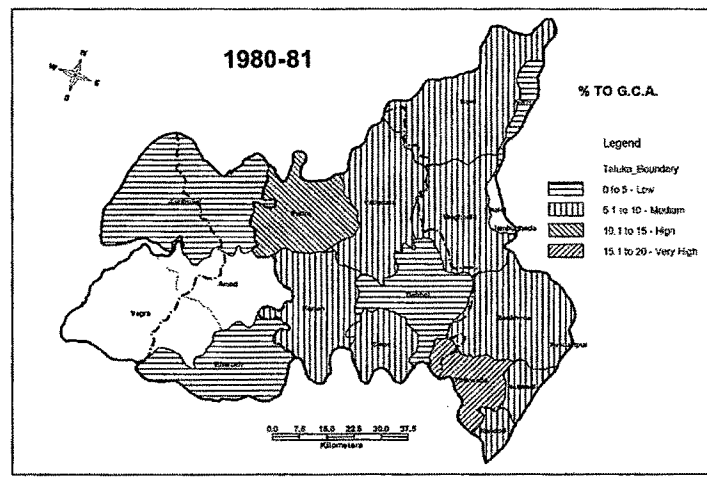
In case of their regional distribution, it is found that region-II has been the bigger grower of tobacco devoting 7.08 and 8.34 percent to the total cropped area. Followed by region-I with 7.3 and 8.17 percent at the two points of time. In region-III, the share of tobacco is 0.07 and 4.48 percent and region-IV had a share of 0.02 at both the points of time. Thus, the share of tobacco has remained unchanged in region-IV. It is an obvious fact that tobacco is not the cup of Kanam region, but of its counterpart, the Charotar region in Central Gujarat (Figure 8.20).

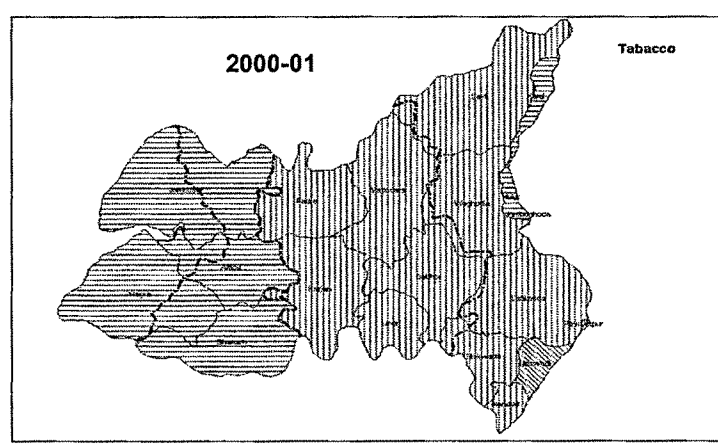
8.15 Other Crops

The other crops categories include vegetables, fruits, spices and fodder. Collectively they shared an area of 6.93 percent of the total cropped area, in 1980-81 and 7.63 percent in 2000-01.

In case of the regional distribution, it is found that region-II has been a relatively large grower of other crops devoting 7.08 percent of the total cropped area in the base year and 8.63 percent in 2000-01. Padra Taluka of Vadodara District is a leading grower of vegetables, because of vicinity to

CHANGE IN TOBACCO CULTIVATION





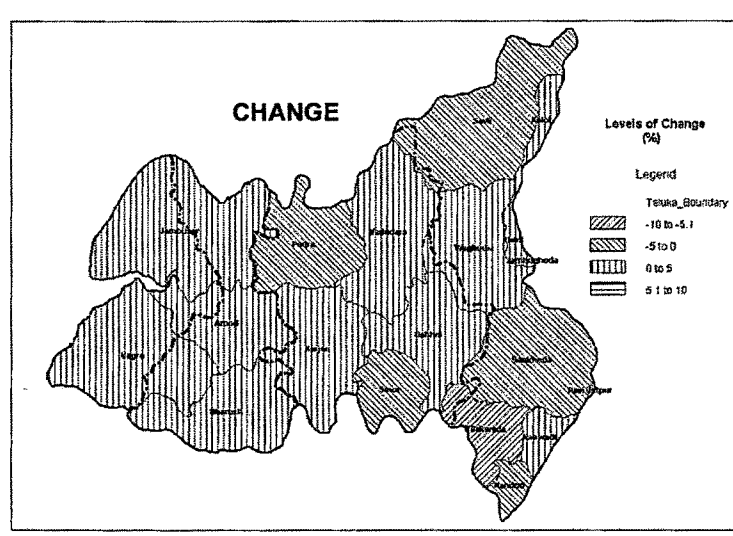


Figure: 8.20

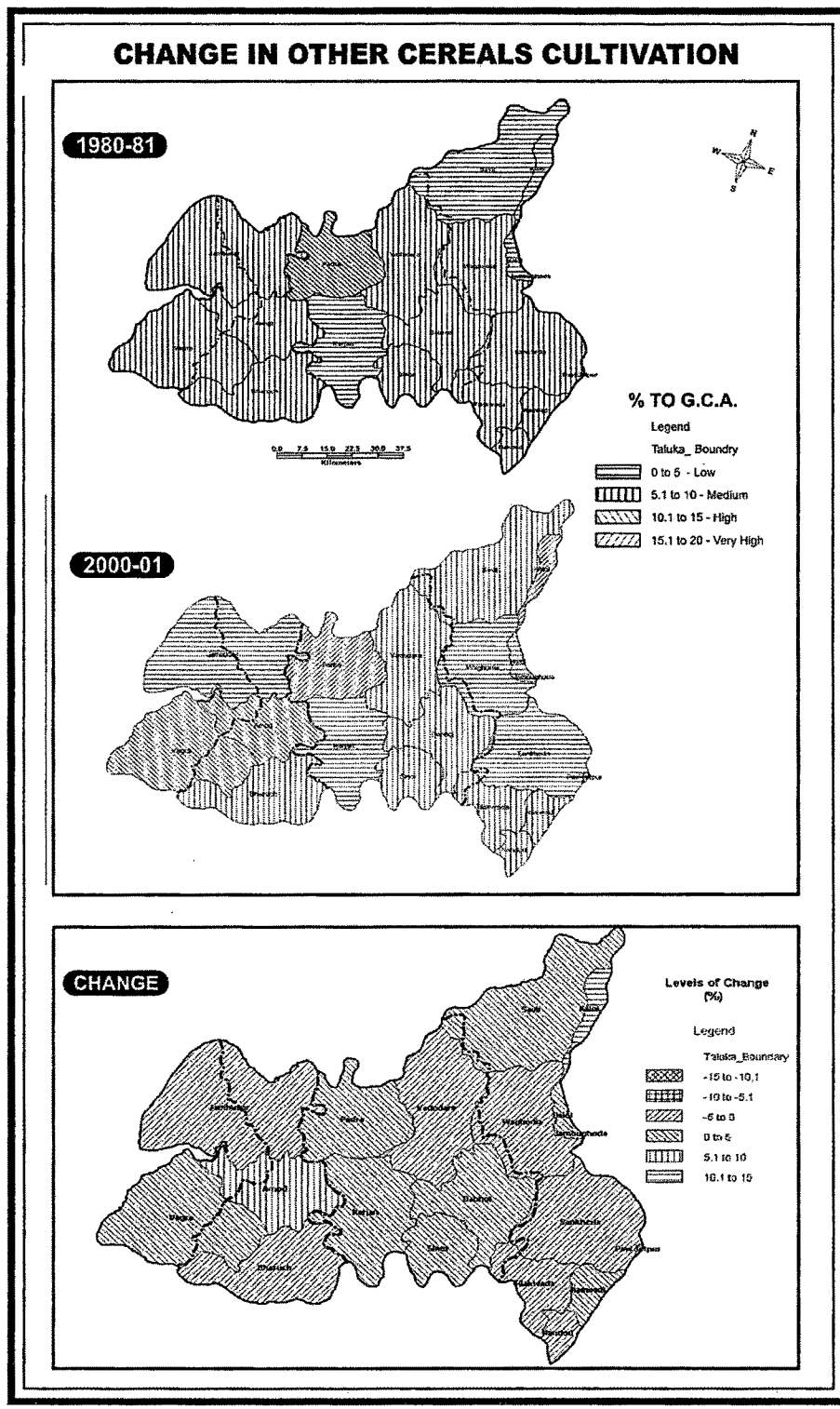

CHANGE IN OTHER CEREALS CULTIVATION
1980-81
% TO G.C.A.
Legend
Taluka_ Boundry
0 to 5 - Low
5.1 to 10 - Medium
10.1 to 15 - High
15.1 to 20 - Very High
2000-01
CHANGE
Levels of Change (%)
Legend
Taluka_Boundary
-15 to -10.1
-10 to -5.1
-5 to 0
0 to 5
5.1 to 10
10.1 to 15

Figure 8.21

Vadodara city in the form of market. Region-I devoted 6.32 percent and 6.00 percent, region-III devoted 7.19 percent and 8.43 percent and region-IV devoted 7.95 percent and 8.39 percent respectively at the two points of time (Figure 8.21)

Thus it can be seen, that slowly other crops are gaining momentum because of available market in the region.

8.16 Wheat

The most significant cereal crop grown in rabi season and the third most significant crop of the area is wheat. It always stood next jowar in the study area. In 1980-81 it held 31883 ha against 42939 ha in 2000-01 to the G.C.A.

The trend of increase of area under wheat, which set in during the first and second five years plans affected the study area as well.

Wheat being the rabi season crop, often suffered from lack of moisture owing to the absence of rains during the late October and early November. Other favouring circumstances, such as suitable clayey loam soil rich in humus, mild winter conditions and marine moist climate, are present in the study area. However, it was probably the force of the "Grow more food drive" that provided the motivation for the cultivation of wheat not only in this area but in other parts of the country as well.

In 1980-81, it occupied around 4.68 percent of the G.C.A., but in 2000-01, its share slightly increased to 5.23 percent.

Though endowed with better natural conditions, the region does not appear to be the foremost grower of wheat. In 1980-81, region-I devoted only 2.07 percent of the G.C.A. and 4.11 percent in 2000-01. Similarly, region-II devoted 2.8 percent and 4.29 percent, region-III devoted 3.29 percent and 6.91 percent and region-IV devoted 21.24 percent and 9.18 percent at both the points of time. The percentage share of wheat to the G.C.A. declined in region-IV, where as there is a positive growth in region I and III where the share of wheat to G.C.A. has increased sizeably.

Looking to the percentage share to the G.C.A. devoted to wheat in respective regions, it is found that wheat was more significant in region-IV at both points of time.

The pattern of distribution and change in wheat cultivation indicates that most of the big wheat growers remained big and the small remained small.

The overall assessment of the pattern of distribution and change of the cereals and other crops gives the impression that the importance of the commercial crop, cotton has overwhelmingly increased reducing the formerly significant crop to the lowest significance.

8.17 Overall Change in Cropland Use

The preceding analysis shows that there has been a shift of emphasis in selection of crop throughout the region, which has in essence resulted into

CHANGE IN WHEAT CULTIVATION

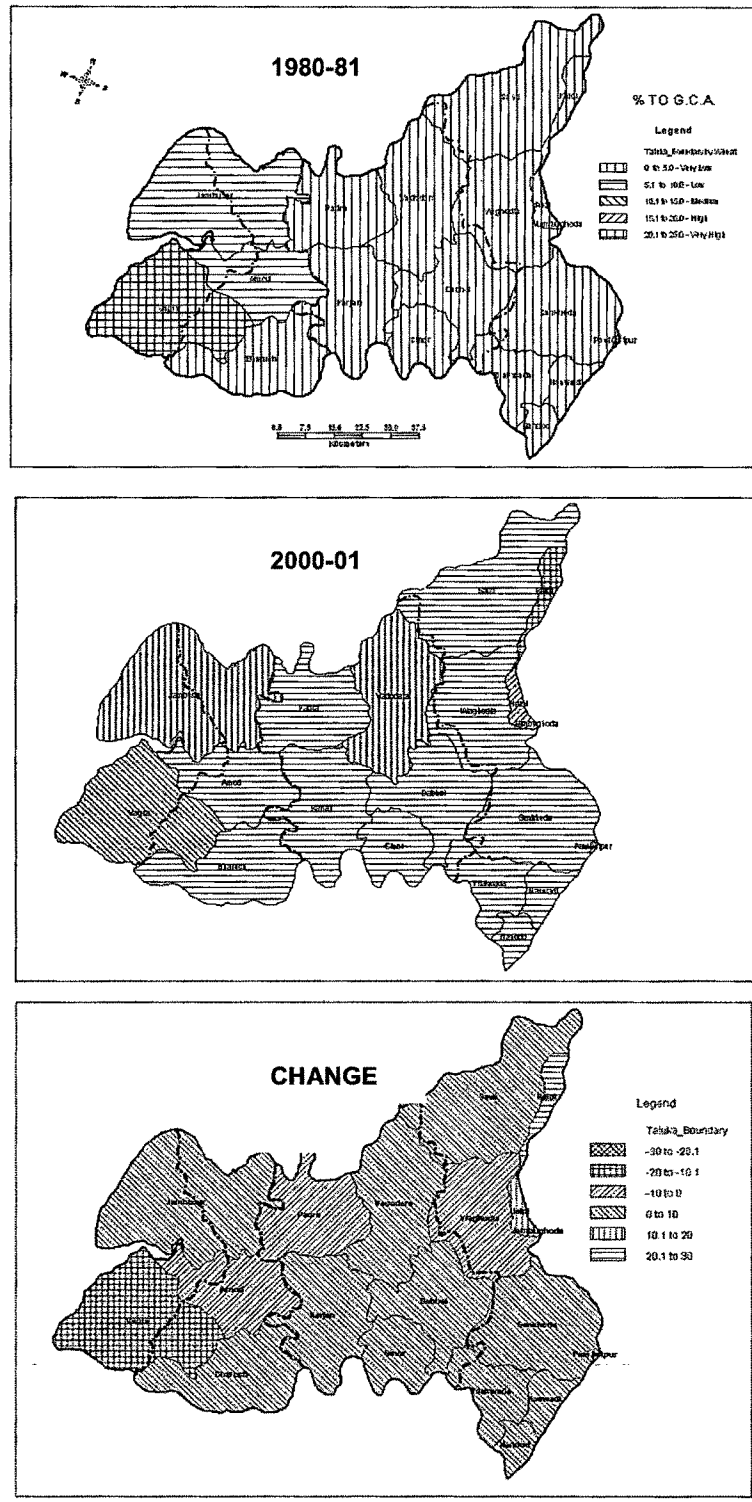


Figure 8.22

the change in the structure of the dynamic mosaic of the cropland use in the study area. This mosaic is composed of increasing and decreasing crops at the two points of time.

In respect of the total area, all the crops except jowar received the positive push and entered the list of increasing crop. As such each crop experienced either increase or decrease at regional level in 2000-01, over that of 1980-81. Of the fourteen identified crops only one viz; cotton has decreased in the share to the G.C.A., but in fact each crop has undergone positive and negative changes in different regions.

It is found that cotton is the only favoured crop having received the greatest advantage of the shift of emphasis. It got an increased share in terms of cropped area to the G.C.A. Among other crops, pulses have shown tremendous rise in cropped area.

8.18 Ranking, Combination and Diversification of Crops

To understand the relative strength of each crop of each region or taluka, the crops have been arranged in the descending order of their share to the G.C.A. The crops occupying as little as one percent of the G.C.A. share have been included in this study. To obtain their rank, they have been arranged according to their relative strength. The work is based on the lines of Weaver (1954) and Shafi (1965). However, in view of the limited study area, no areal limit has been fixed, as in the case of Weaver and Shafi who have fixed 200 acres per county and 500 acres per pargana, respectively. Crops of some species occupying less than one percent to the G.C.A. have

been grouped together to increase their group significance and to bring them to the level of being ranked. Thus, pulses like tur, gram, mong, math etc., were individually quite insignificant in terms of the area occupied by them; when added up they formed a group significant enough to be included in the ranking. Thus, altogether 10 crops of 1980-81 and 2000-01 have been included in ranking exercise, and the first three top ranking crops of each region are taken for mapping.

The ranked crops of 1980-81 and 2000-01 are paddy, wheat, jowar, bajra, pulses, oil seeds, cotton, sugarcane, tobacco, and other crops.

Since, the study area constitutes an important segment of the "Kanam Vibhag" the cotton block of Central Gujarat – it is not surprising if cotton alone dominates its agriculture landscape. By holding 35 to 51 percent to the G.C.A., in all the regions and the talukas of the region at both points of time, cotton, even during the days of greater emphasis on food grain cultivation, remains the dominant crop.

Jowar stood as second ranking crop in regions I and II, other second ranking crops being pulses in region-II and wheat in region-IV.

Among the third ranking crops were paddy, jowar, and pulses. Of them jowar enjoyed the greater relative position of strength both in terms of preference, and the share of the G.C.A. devoted to it. Jowar ranked first among the third ranking crops in terms of number of regions and percentage share to the G.C.A. In region-II and IV, jowar was ranked third where as in region-I paddy was ranked third and in region-III the pulses occupied the third rank.

Besides the first three crops mentioned above, there were, bajra, oil seeds, sugarcane, tobacco, and other crops, which were placed from fourth to tenth order in varying ranks in different regions.

In 2000-01, cotton became the first ranking crop in all the regions and all the talukas of the region. Cotton dominated the landscape occupying varying percentage of the G.C.A. of different regions. This sweeping domination of cotton proves its dynamic character, and the radical change brought about by it in the crop land-use of the study area.

Pulses, held a significant relative position of strength as second ranking crop across all the regions. It is noted that though cotton opened better prospects of monetary gains, the traditional cultivators have not totally abandoned cultivation of other crops, but have given accountable share of their G.C.A to these crops.

Where as in 1980-81, jowar was ranked second it terms of its share of the cropped area, by 2000-01, its position was taken over by pulses. The emergence of these crops may be attributed to hybrid seeds giving high yields in comparison to jowar, wheat and paddy. The increasing demand and attractive prices is one of the key reasons for the shift.

Among the third ranking crop inspite of several rivals, largely other crops (vegetables, fruits, spices etc.) stood third in region-II and III respectively, while in region-I, paddy stood third and in region-IV, wheat stood third (Figure 8.23 to 8.25).

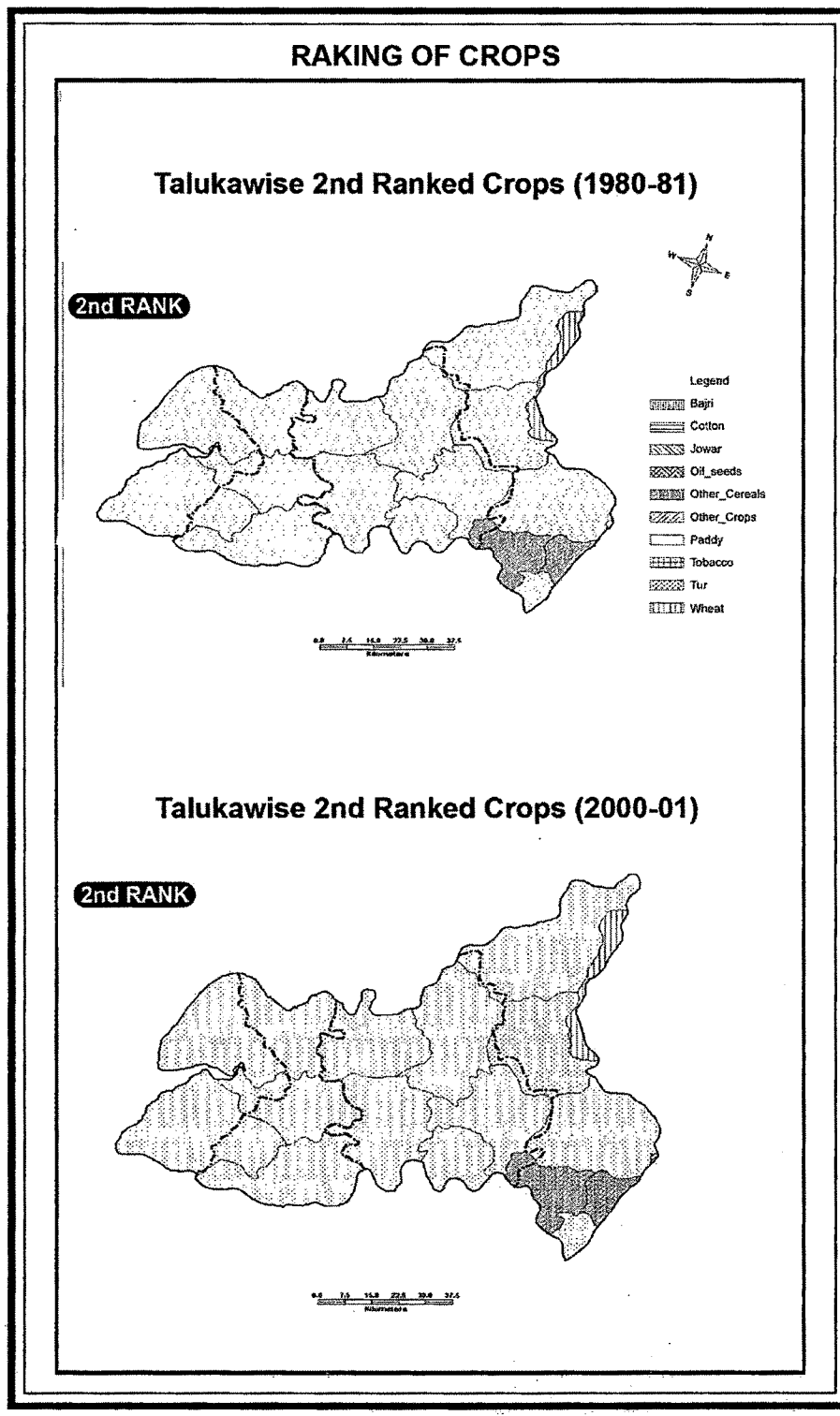

RAKING OF CROPS
Talukawise 2nd Ranked Crops (1980-81)
2nd RANK
Legend
Bajri
Cotton
Jowar
Oil_seeds
Other_Cereals
Other_Crops
Paddy
Tobacco
Tur
Wheat
Talukawise 2nd Ranked Crops (2000-01)
2nd RANK

Figure 8.23

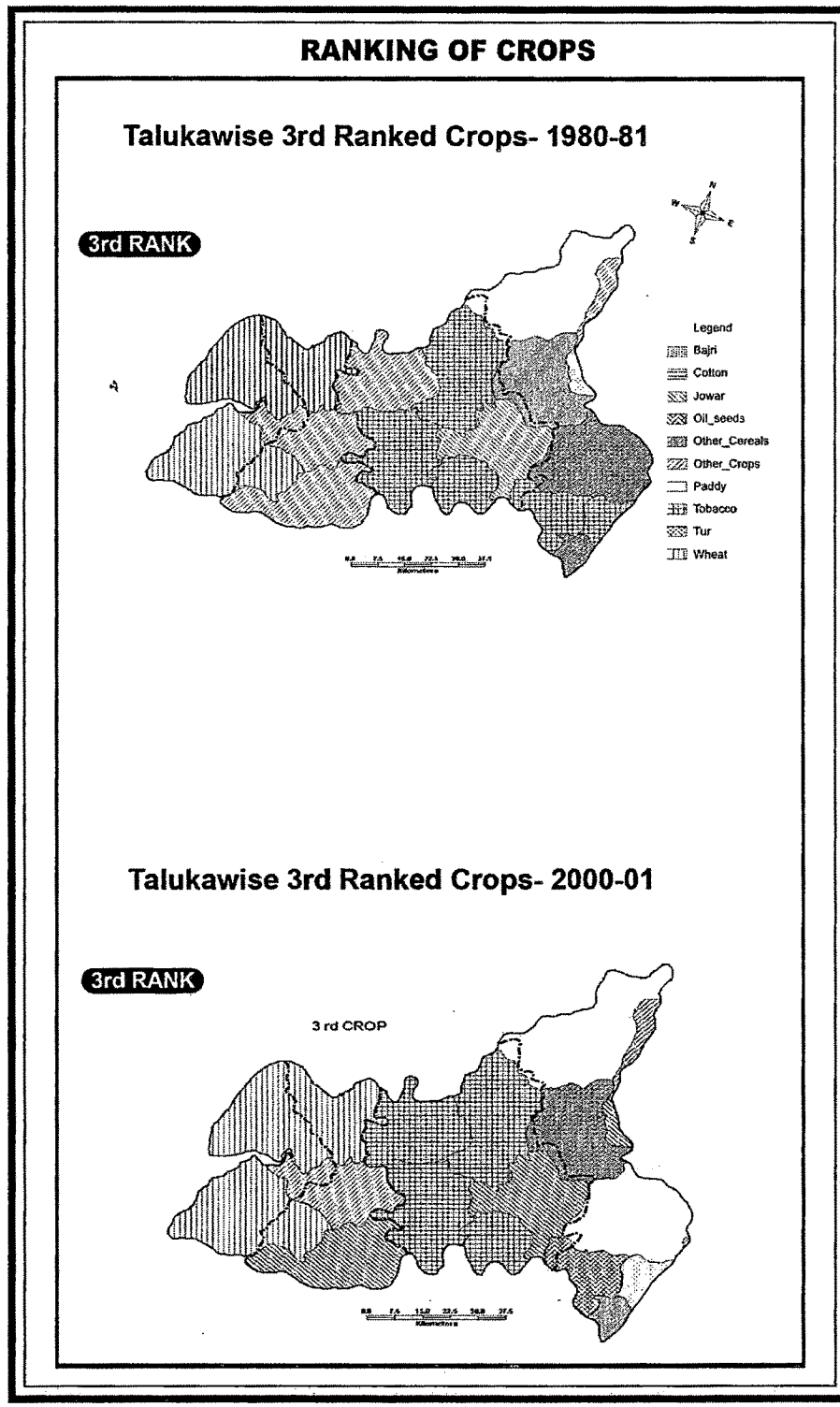

RANKING OF CROPS
Talukawise 3rd Ranked Crops- 1980-81
3rd RANK
Legend
Bajri
Cotton
Jowar
Oil_seeds
Other_Cereals
Other_Crops
Paddy
Tobacco
Tur
Wheat
Talukawise 3rd Ranked Crops- 2000-01
3rd RANK
3 rd CROP

Figure 8.24

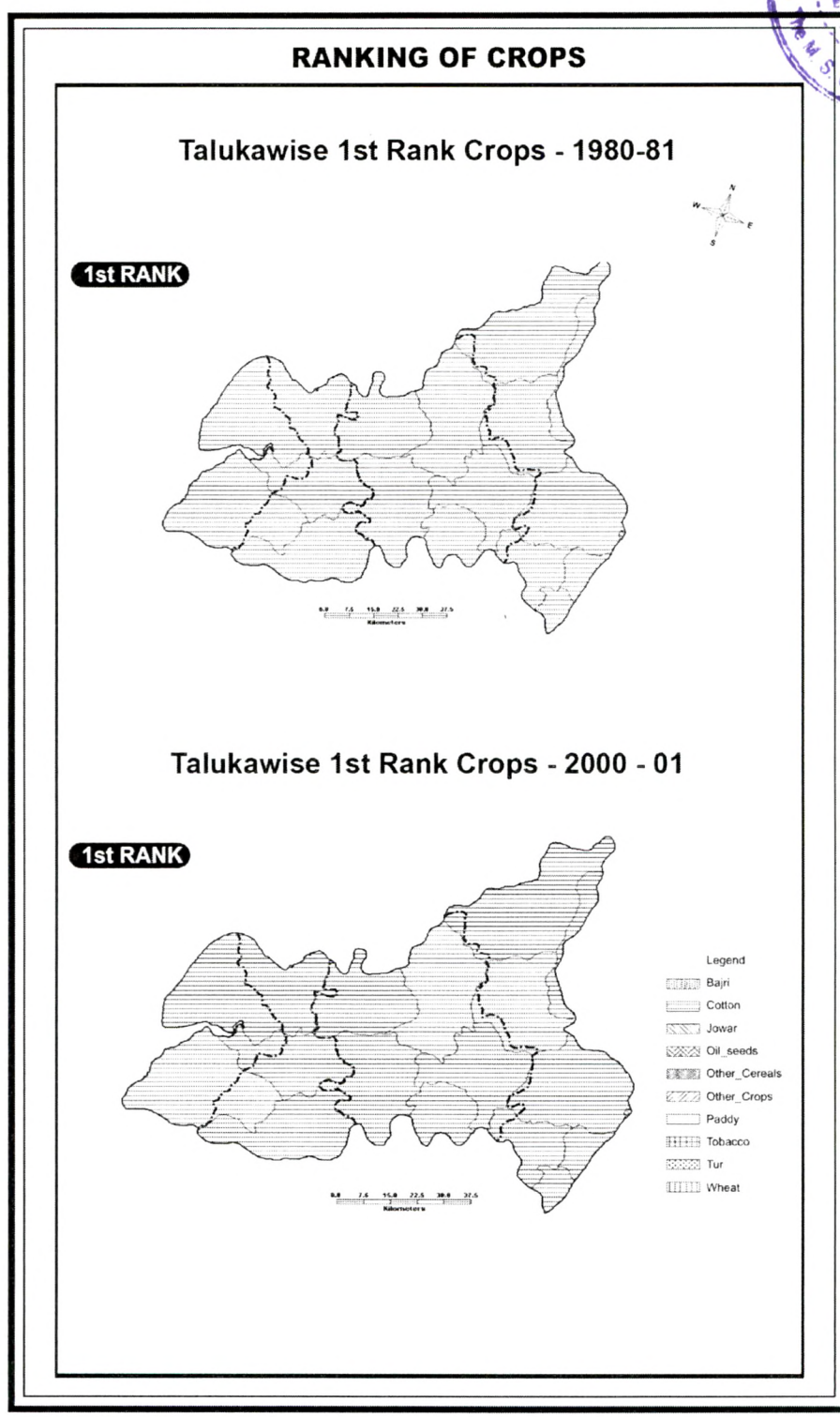


Figure 8.25

8.19 Cropping Under Canal Irrigation And Existing And Projected Crop Yield Levels

Introduction of canal irrigation from Narmada project is going to bring radical changes in an area, which is otherwise mostly a rain fed area, the cropping pattern practiced will undergo significant transformation. The rain fed crops are cultivated as irrigated crops and the low value crops are replaced with high value crops.

Wheat, cotton and sugarcane are likely to occupy prime place in the proposed cropping pattern. This is because of suitable soil conditions in various soil regions. In view of favorable export market backed by Government of India, for all round development of this crop, the area of cotton will increase with advent of Narmada water. The shift from un-irrigated to irrigated cotton crop will bring in qualitative change also, resulting into expanded area under cultivation of long and extra long cotton hybrid varieties. This is expected to increase earnings of farmers.

Paddy requires heavy moisture retentive soils and hence will remain confined to Regions I & II. In view of limited water allowance, cultivation of heavy-duty crops like sugarcane is not to be encouraged in Regions III & IV. Bajra (Pearl Millet) will occupy sizable area in Narmada Command Area. The price of these coarse cereals is as high as that of fine cereals. Jowar (Sorghum), particularly rabi, will be utilising Narmada water for assured production of the grain as well as stalks, which are used as fodder for cattle.

In view of increase of process price (market as well as support) of oil-seeds and pulses, shift is seen in these crops. Replacing low value cereals is expected. The prices of pulses are very attractive and irrigated area of three crops like mug (Mung), Chana (Gram) and Urad are expected to gain momentum.

Apart from the main crop groupings, viz food grains, oil-seeds, cotton, tobacco, sugarcane, the other crops comprising fruits, vegetable, spices and fodder crops are expected to find favour with the farmers. The area under Command Area Phase – I has been intensively industrialized. And hence area of fruits and vegetables is expected to expand rapidly. In view of expanding dairy industry and shrinking areas under pasture and grasslands, the cultivation of fodder crops is expected to expand significantly. A variety of special crops such as condiments and spices, fruits and vegetables have large global market besides the ever-increasing domestic demand. These crops hold significant potential.

The cropping change is also influenced by Government polices of export-import and trade. Majority of the farmers would like generating certain degree of commercialization as well as a supportive environment from the Government.

Irrigation will bring drastic changes in various aspects of inputs and output linkages. These linkages shall have to be appropriately tied up with transformation of the area from un-irrigated to irrigated. Multi cropping and the changes in the cropping pattern will increase demand for high yielding seeds, fertilizers, plant protection chemicals and crop loans to a great extent. This input

aspect will be required to be tied up with the concerned government departments, corporations (seed, fertilizer, pest etc), banking institutions, insurance and other agencies. Similarly appropriate steps will be required to handle the manifold increase in output of agriculture commodities. It is hoped that by the time Narmada waters are made available to these regions, the infrastructure required for transport, marketing (Agriculture Produce Marketing Committee (APMC), Multi Commodity Exchange (MCX), e-choppal web portal by Indian Tobacco Company) adequately built up in these regions and the state.

8.19 Projected Cropping In Regions I to IV in SSP Command Area Phase-I (Under Irrigated and Un-Irrigated Conditions)

Several attempts have been made to project cropping pattern in Narmada Command Area. The first attempt was made in 1982 by Tata Economic Consultancy Services, followed by in 1985 by Operation Research Group, Vadadora, in 1995 by the Sardar Patel Institute of Economic and Social Research (SPIESR), Ahmedabad and in December 2000, by Vyas Associates as a study assignment from Narmada Planning Group (NPG), Gandhinagar.

While revising the economic appraisal of the Sardar Sarovar Project, in 1995 the Sardar Patel Institute of Economic and Social Research (SPIESR), Ahmedabad, quickly reviewed the cropping pattern contemplated for working out irrigation benefits of the project in 1995. The projection by ORG (1985) and SPIESR (1995) do not have any significant difference.

8.21 Projection Methodology

Ideally, the methodology for projecting the future agriculture scenario would be to first estimate the production function for each of the crops grown in the region under consideration. This function would relate output of a particular crop to inputs like area, fertilizer (chemical and manure), irrigation, pesticides, labour, seeds and time-trend variables that can serve as substitutes for all remaining variables.

The production function has been estimated for several crops in Gujarat state as a whole by Agro-economic Research Centre, Sardar Patel University, Vallabh-Vidhya Nagar, Anand and Anand Agriculture University, Anand. It is however, not easy to derive production functions for the Narmada Command Area, or any part of it. The data on different inputs are not available with a single agency or authority / organisation. The data needs to be collected from various sources and then complied. It would not be appropriate to apply the state norms for the use of such inputs to the command area, because the agriculture scenario in Gujarat varies vastly from district to district and from region to region, for most of the crops and even more so in the command area vis -a vis the non command area. However based on the following assumptions, projections can be made for the expected cropping pattern in the Sardar Sarovar Command Area after the completion of the project:

- Between 1980-81 and 2000-01, i.e. in two decades there have been significant changes in the cropping pattern.

- The net sown area (NSA) is not likely to increase much since most of the area is already under cultivation.
- Most of the ground water potential is already exploited; hence there is little scope of exploration.
- The cultivation practices are not likely to undergo any significant shift in the further near future.
- Cotton may continue to remain the dominant crop due to soil factor, but its share may decline.
- Low volume high value crops may replace low value cereals.

The cropping pattern proposed for each of the regions is an outcome of an exercise keeping the main focus on seeing that the farmers getting the limited quantum of Narmada water (depth of 530 mm) obtain the maximum returns from it. In other words, the planned irrigation on 1.80 million ha from Narmada Project should ensure the maximum economic return to the state

In the present study, the researcher has also adopted the Spatial Decision Support Systems (S.D.S.S.) for crop predictions (Turban 1995, Lal et al,1993)

8.211 Spatial Decision Support Systems for Crop Productivity Management

Regional Productivity analysis involves evaluating spatial soil and weather variability, identifying optimum crop management practices and predicting productivity of the region under different climatic and management scenario. This

analysis can help regional planners and policy makers in delineating acreage and distribution of areas with high productivity and developing management recommendations for different crops. Lal et. al. (1993) extended the scope of applicability of site specific crop simulation models such as DSSAT (Decision Support System for Agro technology transfer) to regional planning productivity by combining their capabilities with ARC/INFO GIS Software. An interface was developed to combine DSSAT models with ARCVIEW. The simulation models predict information on yield and other crop related output for different homogeneous soil and weather data combinations, and GIS aggregates information from individual units, displays maps and presents results in tabular format for the study area / region. In the present study similar model was developed by using "GeoMedia Professional" GIS software and "SWAT" (Soil & Water Analysis Tool). The inputs for this type of study include planting date, soil maps, soil survey reports, daily precipitations, daily maximum and minimum temperatures, and solar radiations. The GIS Crop-model system can then be used to simulate crop growth and development for each polygon or field with different characteristics. The result of the study for the crops grown under rain fed conditions showed a strong spatial variation. Hence, it may be possible to capture the variability in crop yields adequately by overlaying many soil characteristics using GIS and appropriate analytical models. This helps in making decision on varying inputs use at field level for sustainable crop productivity

8.22 Existing And Projected Yield Under Irrigation in Region I To IV in SSP Command Area Phase – I

The projection of crop yields have taken into consideration various aspects like:

- Yields obtained in experiments of the National demonstration conducted on farmer's fields.
- Yield levels being obtained in similar agro-climatic situations in other parts of the State.
- Yield levels obtained in experiments conducted on irrigation demonstration farms located in the command area of medium and major irrigation projects of Gujarat.
- The yields projected on the above considerations are within achievable limits (Table. 8.17 to 8.20).

Major contributors towards additional production and their regional distribution will be as under:

- Cotton : Region - I, II, III & IV.
- Rice : Region - I & II.
- Wheat : Region - I, II, III & IV.
- Pearl Millet : Region - I, II, III & IV.
- Sorghum : Region - I, II, III & IV.
- Sugarcane : Region - II & I.
- Tobacco : Region - II.
- Tur : Region - I, II, III & IV.

- Groundnut, castor, other pulses, vegetables and fruits and fodder will have their share in the additional production.

The likely aggregate yield levels in the regions I to IV of SSP Command Area Phase – I are given in the table 8..

The highlights are summarized below:

Region I: It has deep black soil and sandy loam soils. And with suitable, sustained irrigation cotton, rice, tur and tobacco will give high return.

Region II: Comprising five Talukas of Vadadora District this region holds loamy and alluvial soil free from inherent salinity and can sustain irrigated agriculture for a long time. Increased productivity levels and higher irrigation area allocated to high value crops of cotton, tobacco, sugarcane, and vegetables and fruits are expected.

Region III: This region has deep black and Loamy soil. Cotton and tur are expected to be the main crops along with other crops. With advent of suitable irrigation, a large proportion of the region will take to wheat cultivation side by side with tur and cotton from un-irrigated to irrigated conditions. But as per the Land Irrigability classification the region falls under Class–3 and Class–4, which have severe to very severe limitation for sustained use under irrigation. Utmost care should therefore be taken while selecting the crops.

Region IV: this region has black cotton and coastal soils. Here again, traditional crops like cotton, tur (pigeon pea), and wheat will be the main crops. Due to

peculiar soil and terrain conditions, salinity in soil (particularly in lower layers), and the land irrigability classification (the region falls under Class–3, Class–4 and Class–6, the region has severe to very severe limitation and is not suitable for the sustained use under irrigation. The crop varieties requiring low water inputs, and are salinity resistant with high yield potentials and reasonably high returns like mustard, til seed (sesame seeds), sunflower, gram, coconut and dates, should be encouraged.

In all the four regions, the enhanced crop productivity levels of leading crops is expected to be accompanied by higher income. The total income would be around Rs. 13828 million per year (Base price year 2004-05). The increase in the yield of existing crops, and thereby the earnings would not only mitigate the effects of decrease in land holding, but will enhance the economy of the area in particular and of the state as a whole (Figure 21

Table 8.17: Projected Area Under Crops in Regions Ito IV in SSP Command Area – Phase I (under irrigated and unirrigated conditions)

REGIONS	UNDER IRRIGATED CONDITIONS				IN UNIRRIGATED CONDITIONS			
	I	II	III	IV	I	II	III	IV
CROPS / AREA → ↓	In '000 ha				In '000 ha			
RICE	23.5	37.0	1.0	4.8	-	-	6.0	1.5
WHEAT	20.0	41.0	12.0	6.0	-	-	-	-
JOWAR (K+R)	5.1	5.0	4.5	2.0	5.0	12.0	9.0	2.1
BAJRI (K+R)	9.0	7.0	3.0	1.0	6.0	6.0	5.5	1.0
TUR (pigeon pea)	6.8	6.0	5.0	1.0	1.0	1.5	-	-
OTHER PULSES	4.0	0.5	2.0	1.0	2.0	2.0	2.2	1.0
GROUNDNUT	3.5	10.0	0. 5	-	-	-	-	-
MUSTARD	1.5	3.1	0.1	-	-	-	-	-
CASTOR	0.5	7.0	2.0	1.0	-	-	-	-
OTHER OILSEEDS	0.5	1.0	0.6	-	-	-	-	-
SUGARCANE	1.4	4.5	1.0	0.5	-	-	-	-
COTTON	44.0	52.0	25.0	7.5	36.0	18.3	14.5	11.0
TABACCO	10.0	16.3	-	-	2.0	1.5	-	-
FRUITS	5.0	5.0	2.0	0.5	-	-	-	-
VEGETABLES	5.4	11.8	4.0	0.3	-	-	-	-
SPICES	0.5	1.5	0.5	0.1	-	-	-	-
FODDER	2.5	4.0	3.0	0.5	-	-	-	-
TOTAL	143.2	212.7	66.2	23.2	52.0	41.3	37.2	16.58

Table

Table 8.18: Total And Additional Production Of Crops/Crop Groups Across The Regions Of SSP Command – Phase – I (Irrigated)

CROP / CROP GROUP	REGION I		REGION II		REGION III		REGION IV	
	Total	Additional	Total	Additional	Total	Additional	Total	Additional
	PRODUCTION IN '000 TONNES							
RICE	105.7	84.8	185.0	156.2	4.1	3.2	27.3	21.2
WHEAT	80.0	37.0	180.4	86.0	48.0	38.4	14.4	9.6
SORGHUM	14.3	13.8	15.0	12.1	13.5	9.4	5.0	3.2
PEARL MILLET	25.6	13.7	21.0	15.8	9.0	6.2	2.6	1.7
TUR (pigeon pea)	10.8	6.7	10.8	2.9	8.5	5.6	1.7	1.2
OTHER PULSES	5.6	3.7	0.7	0.5	2.8	2.0	1.2	0.8
GROUNDNUT	8.7	5.4	25.0	10.7	1.2	0.6	-	-
MUSTARD	2.2	0.4	5.0	1.0	0.2	0.1	-	-
CASTOR	1.0	0.4	15.9	2.6	4.6	0.8	4.6	2.7
OTHER OILSEEDS	0.6	0.4	1.2	0.9	0.7	0.5	-	-
SUGARCANE	140.0	46.1	459.0	144.0	85.0	31.4	-	-
COTTON	96.8	60.5	114.4	57.2	56.2	40.9	15.0	10.4
TABACCO	28.0	16.0	48.0	19.7	-	-	-	-
FRUITS	100.0	53.5	100.0	17.8	36.0	3.1	1.5	0.3
VEGETABLES	100.0	40.4	220.0	81.8	72.0	12.0	4.5	0.9
SPICES	0.6	0.3	1.8	1.1	0.6	0.2	0.1	00
FODDER	75.0	12.5	120.0	20.0	90.0	15.0	15.0	25
TOTAL		.						

Table 8.19: Total and Additional Production of Crops/Crop Groups Across the Regions Of SSP Command Area

Phase I (*Un Irrigated)*

CROP / CROP GROUP	REGION I		REGION II		REGION III		REGION IV	
	Total	Additional	Total	Additional	Total	Additional	Total	Additional
	PRODUCTION IN '000 TONNES							
RICE	-	-	-	-	4.3	0.7	1.2	0.3
WHEAT	-	-	-	-	-	-	-	-
JOWAR	5.7	1.6	9.7	2.8	9.2	2.6	2.1	0.6
BAJRI	7.6	1.3	4.8	0.9	5.6	0.9	1.0	0.1
OTHER CEREALS	-	307	-	-	-	-	-	-
TUR (pigeon pea)	0.8	0.2	2.3	0.4	-	-	-	-
OTHER PULSES	1.1	0.2	1.2	0.2	1.0	0.1	-	-
GROUNDNUT	-	-	-	-	-	-	-	-
CASTOR	-	-	-	-	-	-	-	-
OTHER OILSEED	-	-	-	-	-	-	0.4	0.1
COTTON	2.7	7.8	10.3	2..9	6.8	1.4	5.8	1.6
TABACCO	2.9	0.5	3.2	-	-	-	-	-
FODDER	-	-	-	-	-	-	-	-
TOTAL								

Table 8.20: EXISTING AND PROJECTED YIELDS (IRRIGATED) BY REGIONS

EXISTING AND PROJECTED YIELDS (IRRIGATED) BY REGIONS								
↓**CROP / YIELD →**	REGION 1		REGION 2		REGION 3		REGION 4	
	E	P	E	P	E	P	E	P
	Kg / ha							
RICE	892	4500	764	5000	877	4100	877	3900
WHEAT	2148	4000	2302	4400	801	4000	801	2400
JOWAR	815	2800	578	3000	919	3000	919	2500
BAJRI	1331	2850	740	3000	917	3000	917	2600
OTHER CEREALS	333	2800	-	3200	-	2800	-	2500
TUR (pigeon pea)	675	1800	1307	1800	585	1700	585	1750
OTHER PULSES	462	1400	500	1400	400	1400	400	1200
GROUNDNUT	1255	2500	1426	2500	1174	2400	1174	2500
MUSTARD	1200	1500	1286	1600	1000	1600	1000	1500
CASTOR	1238	2000	1895	2274	1929	2315	1929	2315
OTHER OILSEED	409	1250	368	1250	316	1200	-	1200
SUGARCANE	67.08	100.00	70.00	102.0	53.57	85.00	53.60	85.00
COTTON	854	2200	1099	2200	615	2250	615	2000
TABACCO	1202	2800	1769	3000	1500	2500	-	2200
FRUITS	9.30	20.00	16.43	20.00	16.43	18.00	12.00	15.00
VEGETABLES	11.92	20.00	13.82	22.00	15.00	18.00	12.00	15.00
SPICES	540	1200	444	1200	854	1200	854	1000
FODDER	25.00	30.00	28.00	30.00	25.00	30.00	25.00	30.00
E = EXISTING P = PROJECTED								
YIELD OF SUGARCANE AS CANE, FRUIT, VEGETABLES AND FODDER ARE IN Tones / ha								

Table 8.21: PRICE OF CROPS (Rs. Million)								
REGION ▶	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**
CROP GROUP ▶	**IRRIGATED**				**UN IRRIGATED**			
RICE	954	1765	36	238	-	-	8	3
WHEAT	308	718	320	80	-	-	-	-
JOWAR	366	99	77	26	13	23	21	5
BAJRI	97	112	44	12	9	7	7	1
TUR (pigeon pea)	127	56	106	22	3	7	-	-
OTHER PULSES	66	8	35	14	3	4	2	-
GROUNDNUT	58	144	8	-	-	-	-	-
MUSTARD	7	14	1	-	-	-	-	-
CASTOR	6	44	13	6	-	-	-	-
OTHER OILSEED	10	81	13	-	-	-	-	1
SUGARCANE	59	184	40	20	-	-	-	-
COTTON	1437	1360	971	247	151	57	26	32
TABACCO	399	493	-	-	12	13	-	-
FRUITS	348	116	20	2		-	-	-
VEGETABLES	182	368	54	4		-	-	-
SPICES	11	37	8	-		-	-	-
FODDER	7	11	9	2		-	-	-
TOTAL FOR REGION	**4442**		**1755**	**673**	**191**	**111**	**64**	**42**
TOTAL FOR PHASE I	**12420**				**408**			
TOTAL FOR PHASE I	**(Rs. Million) 12828**							

8.23 SUMMARY AND CONCLUSION:

Change is one of the laws of nature. However, it hardly occurs without a relevant cause. The nature of change, therefore, depends on the nature of cause. The two major forces, namely, nature and man, either individually (in case of nature) or interacting with each other produce change in terrestrial environment. Environment is one that is most affected by either individual or due to joint actions.

In the course of study on the dynamics of environment in SSP-Command Area Phase-I, a host of factors have been found to be operative. The following are factors taken to be the most significant:

Physical Factors	(A)	Topography
	(B)	Climate
	(C)	Soil
	(D)	Land Holding Size
Man-made Factors	(A)	Artificial Drains
	(B)	Check-dam
Socio-economic Factors	(A)	Population
	(B)	Production / Yield
	(C)	Prices.
Technological	(A)	Farm Implements / Tractors etc.
	(B)	H.Y.V. seed and Fertilizers / pest
Political	(A)	Government Policies and Programme.

Physical Factors

Among many aspects of the environment or its change, the significance of physical factors cannot be ignored. Though, their influence,

with the advancement of technology, is declining in most parts of the developed world, they have yet a strong control in most of the developing countries; which contribute much to the shaping the behaviour and life-style of the people.

(A) Topography

As explained in earlier pages, the study area presents a landscape of a very gently rolling plain rising about 280m from the east to about 10m on the west periphery. At places, it is almost completely flat, at other places shallow depressions are liable to be inundated during heavy spells of monsoon. Such depression have, far long been a retarding factor in cropland use during kharif season. Besides these depressions, estuaries of the river Mahi, Dhadhar and Narmada, and several backwater creeks from the Gulf and the three rivers have been the pronounced features. The marshes swamps and the Kharlands are the other features, which have affected land use in the area in various ways.

A few significant factors have been responsible possible for such physiographic and structural changes are (1) discharge of sediments by Mahi, Dhadhar and Narmada rivers during their spate; (2) the upraised silt deposits in the Gulf bed and (3) the Kadana and Vanakbori Dams over river Mahi which effectively checked the perennial flow and stalled the erosive action, causing deposition of heavy layers of salt at the estuary of Mahi and also in to the eastern coastal water of the Gulf of Khambat. The lands thus emerged have not been put to any specific use during the study period.

However, they can be put to optimum use in the future. The increasing salinity levels of water, especially in the coastal belt, have seriously affected region III and IV. Region II is partially effected. Because of this Padra taluka of Vadodara district has started facing salinity ingression problem.

(B) Climate

Of all the environmental factors responsible for changes in land use in general and cropland use in particular, climate, specially it significant component, rainfall plays the role of catalyst. On the one hand, rain water functions as the washing agent for the reclaimed hectareage of the Kharland and on the other it allows the growth of grass for the pastureland and is the moisture supplier for the cultivated land. The erratic nature of rainfall, its variation in space and time, are the most crucial factors in the development of a region. For the survival and growth of the Indian agriculture economy, it is said that "Indian economy is a gamble with the monsoon". The rain determines the extent and hectareage of cultivation in the country as a whole, and in the unprivileged (lacking in irrigation) areas in particular. However, the climate is that control which accounts for at least 50% of the variability of crop yields over a series of years (Sinha, 1959). The study area comes in the latter group where the rainfall has almost been the determining factor in general, but more so for the cropland use. Besides, the rains are the most important influencing factor for the location of settlements, and even the density and distribution of population. The prime source of drinking water, ever since the area was inhabited, has been the rainwater stored in tanks. In

case, the tank lost the storing capacity, the villages had to be abandoned. e.g. Chandpur, Marva and Isanpor. The influence of rainfall may be seen on the cropland use over a period of two decades.

It is seen that as long as the amount of rain received is around 500 mm, which is minimum essential for cultivation, the G.C.A. ranges between 57 to 74 percent, divided among different crops. But as the rainfall went below 500 mm (in year 1948, 1972, 1974 respectively) the G.C.A. went down to only 21 percent, which is very low. A unique change in cropping pattern is also noticed. For example jowar, which always ranged between two and three percent of G.C.A. in the regions, earlier occupied 16.52 percent, the second largest share ever enjoyed by it. It brought down even the most popular crop, cotton to 39.30 percent. Thus, any abnormality in the rains upsets the established cropping pattern. Thus, the significance of rain factor as the catalyst of change cannot be underestimated.

The year of deficient rains have shown that greater percentage of land is left as fallow – which is not a usual practice.

However, it is also seen that regular and sufficient rains is most cases helped to increase the N.S.A. But rainfall alone may not be considered responsible for the change having taken place in the cropland use of the area.

Sometimes the scarcity of drinking water due to less or no rains forces enmasse out migration of the people with their animal and belongings. The desertion due to unavailability of drinking water has led to change in the

whole land use system in some villages like Nada, Chandrapur, Isanpor etc. in region-III and IV, especially during the summer. The situation is acute, when there is no drinking water source as in region III and IV where the ground water is brackish. Moreover, the drinking water that is supplied to this village by GWSSB (Gujarat State Water Supply and Sewerage Board) from their pumping station at Janor (Taluka – Ankleshwar, District Bharuch) is very erratic in summer, sometimes available only once a week.

Since the subtarranean water is brackish the source of irrigation is absent. At times the tube-well water is used in emergency conditions, to save the drying crops. Farmers reported that the tubewell water increases the salinity of the topsoil, which is a strong reason for less use of this water. This factor further reinforces the significance of rainfall in land use especially in the regions III and IV.

Dependence on rainfall is a hampering factor for the adoption of innovative measures in agriculture. In the area of dependable source of irrigation in the state, as in Kheda and Surat districts, modern methods have been widely adopted. In Surat district, almost a complete replacement of cotton by sugarcane has taken place. Bharuch district and particularly the study area, represents with most of the old traditions, and cotton continues to be the principal crop. However, the hybrid seeds, developed for dry farming are widely used, but the restricted use of chemical fertilizers is due to the rain factor. So, the innovations for assuring better economic gains are yet to be adopted as these are subject to availability of dependable source of irrigation.

(C) Soil

The importance of soils in the rural economic environment cannot be underrated. But, to reckon them as the catalyst for land use change, may not be reasonable unless any conspicuous change in the soil themselves takes place. It is found that the soils are identified on the basis of crops normally cultivated on them. e.g. the alluvial loan soils for wheat, jowar, bajra etc., the black cotton soil and 'Besen' for cotton. But often wheat is sown in black soils and gives desired yield (other things being equal) and similarly other crops are also cultivated, which shows that there is no need to strictly follow these associations, the soil-crop association would change, once irrigation facility of Narmada water is available. Therefore, it may be said that soils have a role as a catalyst of change in the cropping patterns in the Narmada command area phase-I.

(D) Land Holding

The land holding size is found to decrease in all parts of the study region. This fact may be considered as contributing to the declining yield of crops. The reduction in the size of landholdings is particularly noticeable in Regions III and IV. The increasing salinity ingress has been partially responsible for this trend. Thus, the area and yield of crops have been adversely affected by the decreasing size of land holdings (Table 8.22)

Man-made Factors

(A) Artificial Drains

Though an artificial feature, the 'Kans' function as the natural drainage channels. A network of such drains has been constructed in the area. The need to construct them was to provide outlet to the waterlogged areas. Some of them are joined with the village tanks, and serve as feeder channels, and some are joined with the main drains, while a few meet the creeks they have brought about some change both in the general and the cropland use. However, one adverse effect, though not of big magnitude, is that it introduced soil erosion to the almost flat adjoining areas.

On the basis of the significant change brought about by these drains, at both physical and economic fronts, they may well be taken as the catalyst of land use change for some villages of the regions. '

Table 8.22 Land Holding In Region I to IV in SSP Command Area Phase-I

LAND HOLDING	AGRO-CLIMATIC REGION			
	I	II	III	IV
Average Land holding size (Ha), 1981.	2.91	2.86	4.03	4.19
Average Land holding size (Ha), 1991.	2.35	2.26	3.23	3.48
Average Land holding size (Ha), 2001.	2.23	2.09	3.23	2.93
Percentage holding 1981, below 2 Ha.	50.8	53.8	44.3	42.8
Percentage holding 1991, below 2 Ha.	60.35	55.4	51.86	48.12
Percentage holding 2001, below 2 Ha	63.31	56.1	59.23	55.83
Percentage holding 1981, more than 2 Ha.	49.2	46.2	55.7	57.2
Percentage holding 1991, more than 2 Ha.	39.65	44.6	48.14	55.88
Percentage holding 2001, more than 2 Ha.	38.13	43.38	41.11	44.63

(B) Check-dam (Bundh):

Another artificial features added to the physical geography assumption the higher lands of the east to the coastal margins on the west are the check dams lying in both continuous and discrete forms. These dams have checked the tidal ingression in region-IV, and have turned as much as 13 percent of the total geographical area of region-IV, in to "Kharland" along the coast and the estuaries of Dhadhar, and Mahi rivers. These dams have helped to reclaim some amount of Kharland. By 2000-01, some villages had reclaimed varying hectareage of their Kharland for both cultivation and salt extraction purposes.

Socio-economic Factors

(A) Population

Use of the land depends on the human population. For the fulfillment of his basic needs of food, clothing, shelter, and other needs as education, health services and so on, man has to look at the land. In the process both general and cropland uses are subjected to change along with the change in number, distribution density and other characteristics of population. As population increases, there is corresponding change in the intensity of use in different functions of the land as already noted in section 8.3 of this chapter. Therefore, the characteristics and needs of the population act as significant catalysts for change.

(B) Production / Yield

It is a variable phenomenon varying with the agro-climatic circumstances. Table 8.23 gives the yield of the major 10 crops at both points of time under study.

In 1980-81, cotton gave the lowest per hectare yield and wheat gave the highest, as at that time "Desi" – strain of cotton giving low yield and the variety of wheat giving good yield under dry conditions, were grown. Cotton held 35 to 51 percent (regional level) of total G.C.A. By 2000-01, various experiments on hybridization of cotton yielded the 14/69, - Gujarat Shankar, Gujarat II strains which proved most suitable to the conditions of the area. Among the latest is the BT-Cotton. This gave highest average yield of (233 kg/ha) and also occupied the largest share of G.C.A., while wheat yield decreased in regions III and IV and there was no significant increase in regions I and II, due to hybrid seeds requiring more water and fertilizer could not be supplied due to natural constraints. Thus, the area under wheat dropped in region IV and there is a marginal increase in area in regions I, II and III. The yield of jowar has increased, except in region III. This has been possible, due to the hybrid seeds suited to the condition of the area. The yield of bajra has decreased across all the regions. The yield which is itself a dependent factors, may, however, be taken to be influencing the cropland use. Thus ability to adopt improved technology can be a factor in bringing about changes in cropland use. Conversely non-availability of modern

technology for improved agriculture practices, can affect the cropping patterns, and hence, also, the cropland use

(C) Prices

Prices deeply affect the selectivity of the crops. A better reward of labour and hard work is the natural desire of all workers and farmers. Prices may be taken to be highly influential in changing cropping pattern of any area. So has been the case in the study area. The ever increasing price line, and also the average per hectare yield made cotton and tur the most popular crop.

Prices of cotton show ever-increasing trends and so is the area under it. When cotton's G.C.A. share dropped to an all time low (35.79%), but prices soared to even higher than that of wheat the area under the crops showed an inverse relation. Bajri probably was least affected by the prices, as its area did not increased with its rising prices. The case of oil seed is different. The prices also excelled with increase in area under cultivation across all the regions. The prices of pulses and their area show proportionate relationship. In recent times the prices of pulses are at an all time high in comparison to any crops.

Table 8.23: Average Yield Per Unit Area (kg per ha)

YEAR	Rice	Wheat	Jowar	Bajra	Other Cereals	Tur	Oil Seed	Cotton	Sugarcane	Tobacco
	REGION – I									
1980-81	278	1640	978	1675	1482	2434	1425	191	6230	1181
2000-01	1211	1741	991	1373	1221	2634	1551	211	6338	938
REGION - II										
1980-81	611	2131	1383	1477	1321	2631	596	204	4625	1301
2000-01	781	2114	975	1027	1381	3011	785	233	7246	1418
REGION - III										
1980-81	579	2652	1671	2265	1850	1636	2278	138	7130	1641
2000-01	3000	1500	1000	1000	1300	1700	2300	200	1000	210
REGION - IV										
1980-81	300	2460	1051	794	1210	1308	902	100	7500	1805
2000-01	743	1470	1430	775	900	1332	2058	122	45	280

Source: Directorate of Agriculture, Gandhinagar & Market Yard Price of Vadadora and Bharuch.

This review suggests that other things being equal, the rising prices largely influence value based and market oriented crops. The farmers base their decision for preferences on the price trends and accordingly give priority to the crops. Since cotton has been the all time principal crop of this area, with increasing demand of cotton in the markets at home as well as abroad, its prices have shown a regular ascent, and so also its hectareage except in years 1948, 1972, and 1974. Continuous swell in the area under cotton along with its ever-soaring prices led to a shrinkage in area under other crops, thus pushing up their prices. The area under other crops as well as their price tend to fluctuate according to change in supply and demand.

Table 8.24: Price and Percentage Area Under Selected Crops (Price / % of Area (GCA)

Year	Region		Rice	Wheat	Jowar	Bajra	Oil Seed	Pulses	Cotton
1980-81	I	PRICE	2.60	1.90	1.40	1.50	12	5	4.14
		%-G.C.A.	8.93	2.07	12.71	3.1	1.98	4.28	48.26
2000-01		PRICE	12.20	9.20	7.10	6.80	26	19.10	22
		%-G.C.A.	8.4	4.11	2.35	4.13	3.96	15.35	36.2
1980-81	II	PRICE	2.60	1.90	1.40	1.50	12	5	4.14
		%-G.C.A.	5.91	2.8	13.18	4.9	0.95	20.8	35.45
2000-01		PRICE	12.20	9.20	7.10	6.80	26	19.10	22
		%-G.C.A.	4.5	4.79	3.94	4.13	4.82	21.98	35.79
1980-81	III	PRICE	2.70	2.18	1.50	1.50	12.80	5	4.12
		%-G.C.A.	1.89	3.29	32.94	0.09	0.76	17.93	35.82
2000-01		PRICE	12.03	9.18	7.10	6.80	26	20	22.10
		%-G.C.A.	0.24	6.91	5.25	1.21	1.20	22.37	48.3
1980-81	IV	PRICE	2.70	2.18	1.50	1.50	12.80	5	4.12
		%-G.C.A.	0.53	21.24	17.51	1	0.31	8.23	43.07
2000-01		PRICE	12.03	9.18	7.10	6.80	26	20	22.10
		%-G.C.A.	0.32	9.18	4.47	1.99	1.78	21.8	51.4

Source: Directorate of Agriculture, Gandhinagar & Market Yard Price of Vadadora and Bharuch.

It may thus be concluded that ever-rising prices of cotton have played the role of a catalyst of change in the cropping pattern of the area during the period under study (Table 8.24)

Technological Innovations

The scientific and technological developments have so widely been diffused that not a single land use type seems to have remained unaffected. The mechanical devices, the H.Y.V., the chemical fertilizers, pesticides etc., have, in varying measures changed the agricultural scenario. However,

disparity in their distribution cannot be ruled out. The study area is one of those where, due to the physico-economic conditions, the innovations could not be widely adopted. It has been noted that only a few (about 2 to 3 percent) farmers could manage to have tractors, while the rest of the agricultural community works with the old and traditional means, viz., wooden ploughs or the new iron ploughs which are slowly getting popular.

(A) Farm Implements / Tractors

Tractors are used by the affluent farmer. This factor had only limited impact on agricultural output during the study period. The ratio of the beneficiary villages and tractors is very low.

(B) H.Y.V. seed and Fertilizers / Pest

A shift from the traditional varieties of seeds to H.Y. Vs is commonly found in all the villages. Even prior to 1980-81 the hybrid seeds of cotton had been widely used. From Vijay strain to Digvijay, from Digvijay to various hybrid strains viz., Desi hybrid-7, Gujarat hybrid 13, Gujarat 14 – 49, hybrid 4, 6, Valaraxmi and Gujarat 11, Shankar, and the BT are the strains adopted from time to time. But of all of them Gujarat 14 – 49, Gujarat 11 and Shankar Kapas – have been found most adapted to the edaphic and climatic conditions of the area. Other conditions being equal, these strains give on out tons of 500 to 500 kg or more per ha.

In case of wheat, the former Davdkhani, and later the Mexican wheat were replaced by the hybrid varieties of Arnej, Gujarat wheat-1, Gujarat wheat – 89 (G.W.1 and G.W.89 and also G.W.120). Since these varieties

need ample water and fertilizers, late October rain of around 2 to 3 inches (50-75 mm) may assure a good harvest. The uncertainty of rains, have been a major reason for the user cultivation of wheat. Wheat had been the second most important food crop.

The hybrid jowar seeds introduced in this area are C.S.H.5 and 6 among others. If rains favor, and required amount of manures and chemical fertilizer are supplied, these strains give a high yield between 2000-2500 kg per ha. But under the prevailing environmental conditions of the study area its average yield ranged between 900 to1 600 kg per ha.

The hybrid verities of Tur (Pigeon Pea – Carjams Indicus) are T.15-15, B.D.2, Pusa Ageti, etc. The first two are late maturing and the last one is early maturing variety. Their estimated yield is 4500 to 5000 kg per ha. However, under the prevailing conditions of the area they touch the mark of 2500 to 3000 kg if not infected by pests.

The hybrid sesamum and castor, though not very popular in this area, can give 600-700 kg/ha. and 1300-1500 kg/ha, respectively. But they could not gain much favour in the triangular competition between oil seeds, cotton, tur and wheat.

Political

(A) Government Policies and Programmes

Recognizing the importance of agriculture as a vital sector of the economy, large-scale efforts, both by Central and State Governments have been made since the inception of planning for development in the country.

Gujarat as a separate state did not exist during the first Plan and for more than half of the second Plan period. The approach adopted in the first phase of agricultural development (1951-59) can be regarded as general and broad based (Pathak, Desai and Patel, 1979, p.217). The important programmes implemented during this period included the "grow more food" campaign and the community development and extension programmes. These programmes covered a wide range of activities such as minor irrigation land development and soil conservation along with improvement in agricultural practices and improved modern inputs. Of them, the land development programme was implemented in the area, but could materialize only after the formation of Gujarat as a separate state.

The general policy framework for the development of agriculture in Gujarat broadly corresponded to the general pattern for the country. The basic objectives of the various plan documents of the state

(1) To evolve an institutional framework.

(2) To make provisions for the necessary social and economic overheads which constitute the core foundations for any development efforts.

(3) To direct public and private resources for development of agriculture.

(4) To evolve and to introduce measures for improved agricultural practices.

(5) To change the basic attitude and values of the people so as to bring about a change in their traditional outlook. Besides these objectives,

the documents of the state plan including the perspective plan emphasized certain specific objectives.

(a) Achievement of self-reliance in grains.

(b) Attaining greater importance in commercial crops.

(c) Development of sources of minor irrigation, and other irrigation facilities.

(d) Evolving suitable dry farming technologies and systematic programmes for the development of drought prone areas.

(e) Implementing suitable integrated command area development programmes for medium and major irrigation project, where in Narmada project is given special thrust or attention, which as per Government records is said to be "Life line of Gujarat".

Efforts were made to implement these programmes in each agriculture region of the state. However, the study area could not enjoy the benefits of all the developmental programmes. The basic objectives seem to have been achieved, but the specific objectives could not be mat. The analyzing of conditions prevailing in 1980-81, shows that the stress at the point of time was laid on objectives a, b and d, mentioned above. But objectives, c and e were not executed. Hence, minor irrigation works and integrated command area development programme failed to materialize. By 2000-01, however, the objectives b and c received greater emphasis where the commercial crop – cotton – attained an all time high percentage of the G.C.A. and dry farming technologies were implemented to achieve greater success out of the given

potential of agricultural productivity of the area. The H.Y.V. seeds, the improved techniques and improved implements have been introduced and minor irrigation schemes like Panam Dev and Danorra irrigation works became vital sources of irrigation in region I of the study area.

What emerges from this discussion is that the hybrid seeds, besides those for cotton, could not achieve the desired responses in this area even though they contain the potential for attractive yields. It is only cotton, which relegated all other crops by covering 51.4 percent of the G.C.A. in region IV in 1981 to share only 36.2 percent (region II) in 2001. This two distinct aspects of agriculture of the area have emerged over the two decades, one is the specialization in commercial crop (cotton), the other is generalization in subsistence crop (wheat, jowar, tur etc.). It very clearly proves that agriculture is governed by the law of supply and demand (Ilbery, 1985).

Various factors have by now, been discussed, and as such each of them are seen to have played their part in the dynamics of general and crop land use. It is now attempted to assess as to which of them have played the dominant role as a catalyst.

The changes in physical landscape of the area i.e. (1) the reclamation of the Kharland, (2) construction of check dams especially along the Gulf of Khambat coast and the creeks to check the tidal ingress, (3) the construction of artificial drains to drain off the waterlogged depressions mostly in region III and IV in the central and southern parts of the area, and (4) irrigation

schemes in region I – Panam, Dev and Dannora irrigation Projects have been main catalysts for the changing land use in the study area.

Fluctuations in the amount of rainfall do influence decision making, and selection of strategies. But in normal conditions, a host of other factors combined influence the cropland use.

A glance over the past provides some rational clues regarding this issue. .... Prior to 1980-81, the country was facing an acute crisis of food, the rapid growth of population and sluggish growth of agriculture. By means of definite policies implemented through Five Year Plans, all regions of the country had to grow more food crops (under 'grow more food' drive). Thus the ratio between the food and non-food crops was approximately 3:4.

To conclude, it is established that the changes in general land use have taken place by rational and value based planning of the administrative organs, such as the State Government, the Taluka Panchayats and the Kharland Board. In all these agencies, the decision-making is highly influenced by the concept of economic gain. Thus human element is the foremost catalyst of change in the general land use.

In the cropland use, the geo-economic determinism and at times the socio-personal determinism along with various changing situations, and innovations, seem to have influenced the selection of crops and the hectarage devoted to them. it has been observed that the changing situations of the physical environment, viz., rainfall, very adversely affected the

cropping. But the people of the area, managed to use their cropland between zero to 70 percent or more.

This enterprising and the risk taking attribute as highlighted by the "Game's Theory" is seen only in the human element.

It is the interaction of physical and human factors that determines the pattern of agricultural land use in the changing circumstances. Thus the varying factors discussed above viz., the innovations, the market prices etc., are the supportive factors to the decision-making for the cropland use. The economic determinism, therefore, cannot be ignored.

"Thus, man himself, above all, is the most dominant catalyst of change in the pattern of general and cropland use".

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LAND USE

FIELD MADE READY ?

FARMER PLOUGHING FIELD
BEFORE MONSOON

CULTIVABLE WASTE (VILLAGE KALLAR)

INUNDATION OF KHARLAND BY
INGRESH OF SEA WATER

SOIL SALINITY

ONGC GEG UNIT (VILLAGE NADA)

SILTING OF GULF OF CAMBAY OFF THE
ESTUARY NEAR DAHEGAM

CROP LAND

JOWAR

PADDY