CHAPTER V

RANKING, COMBINATION AND DIVERSIFICATION OF CROPS

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5.0 RANK AND ORDER OF CROPS:

To understand the relative strength of each crop of each cultivation unit (village), the crops have been arranged in the descending order of their percentage share of G.C.A. The crops occupying as little as one per cent G.C.A. share have been included in this study. To obtain their ranks, 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 small extent of the study area, no areal limit has been fixed, in the case of Weaver and Shafi who have fixed 100 acres per county, and 500 acres per Pargana, respectively. Crops of some species occupyinbg less than one per cent of 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 tuer, gram, moong, 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 ten crops of 1959-60, and nine crops of 1979-80, have been included in ranking exercise, and the first three top ranking crops of each village are taken for mapping (Figs. 4.11, and 4.12).

The ranked crops of 1959-60, have been cotton, wheat, jowar, bajri, rice, kodara, pulses, fodder, oilseeds and grass. Same crops in 1979-80 have been considered but for kodara which became insignificant by that point of time. Thus, tobacco was listed out at both points of time, and kodara at the second, owing to their insignificance.

Since the study area constitutes an important segment of the "Kanam Vibhag" - the cotton block of central Gujarat - it is not surprising if the cotton alone dominates its agricultural landscape by holding 34 to 70 per cent of the G.C.A. in as many as 38 villages (83%) and enjoying the first rank in each of them even at the first point of time. In the remaining eight villages (17%) - Chandpur Bara, Dolia, Kansagar, Kapuria, Pachakda, Panchpipla, Sindhav and Vad - wheat, which occupied second position in the previous group of villages, enjoyed first rank by holding from 42 to 66 per cent of the G.C.A. This superiority of wheat may be attributed to the Grow More Food Campaign, and incentives for food crop cultivation on the one hand and the phenomenon of water logging during the kharif season, on the other. Nevertheless, the cotton, even during the days of greater emphasis on food grain cultivation, was sweeping over approximately five times the number of villages with wheat as the first ranking crop.

Wheat stood almost uncontested as the second ranking crop in 29 villages (63%), other second ranking crops being cotton in Chandpur Bara, Dolia, Kansagar, Kapuria, Pachakda, Sindhav and Vad, having a share of 23 to 36% of G.C.A. Jowar, though not occupying a significant position, competed with wheat as a second ranking crop holding shares of G.C.A. in Chandpur Marva (26%), Runad (23%), Thanava (14%), Hamadpur Kantharia (13%), Vadadla (12%), Kaliari (8%) and Muradpur Neja (6%). Fodder, grass and rice, also stood second in rank in Panchpipla (22%), Kalak (13%) and Vanseta (10%) respectively.

Among the third ranking crops were jowar, fodder, rice, wheat, pulses, cotton and bajri. Of them jowar enjoyed the greater relative position of strength both in terms of the number of villages cultivating it, and the share of the G.C.A. devoted to it. Table 5.1 gives the relative position of each of them.

Table 5.1 shows that jowar ranked first among the third ranking crops in terms of larger number of (22) villages and larger percentage share of G.C.A. (05 to 19), followed by fodder (10 villages and 05 and 15 per cent of G.C.A.) and rice (seven villages,

and 05 to 21 per cent share of G.C.A.). Among all the 46 villages, Kundhal was the lone village with 21 per cent G.C.A. under rice. It was the all time high percentage of G.C.A. under rice in the whole area. Wheat already enjoyed the first; and second position in most of the villages; however, three villages - Hamadpur Kantharia, Chandpur Marva and Runad (all of Region I) were placed in third rank within the range of five to fourteen per cent. Pulses found third place in Khanpur Deh and Thanava with between seven and fourteen per cent of their G.C.A. Cotton and bajri had one village each and same percentage share of G.C.A.

Table--5.1

Relative Position of Strength of the Third Ranking Crops
1959-60

Crops.	Cultivating villages		% Range of GCA Share
	No.	%	
Jowar	22	48%	05 - 19
Fodder	10	22%	05 - 15
Rice	07	15%	05 - 21
Wheat	03	07%	05 - 14
Pulses	02	04%	07 - 14
Cotton	01	02%	06 - 00
Bajri	01	02%	06 - 00
	46	100%	-

Besides the first three crops mentioned above, there were pulses, bajri, jowar, grass, rice and oilseeds which were placed from fourth to ninth order in varying ranks in different villages.

In 1979-80, cotton became the first ranking crop in 45 of the 46 villages. Only in Kundhal it was placed second mainly due to its water logged area. Also in the seven formerly wheat dominated villages - Chandpur Bara, Dolia, Kansagar, Kapuria, Pachakda, Panchpipla, Sindhav and Vad - wheat gave way to cotton.

Cotton dominated the landscape occupying varying percentage of the G.C.A. of different villages from the lowest 49 per cent (as against the 34 per cent of the former year) to the highest 93 per cent (as against 73 per cent of the former year). This sweeing domination of cotton proves its dynamic character, and the radical change brought about by it in the crop landuse of the study area.

Wheat which held a significant relative position of strength as first ranking crop in eight villages and second ranking crop in 29 villages with substantially high percentage share of their G.C.A. at the first point of time was substantially reduced at the second point of time. Only one village, Kundhal, as against the eight villages of the former year, gave it the first rank, by devoting 44 per cent of its G.C.A. to it and only 20 per cent to cotton. Besides this lone example, wheat is overwhemingly subdued but in most cases (28 villages) retained its second place, occupying the share of G.C.A. between the lowest of four per cent in Degam and the highest of 35 per cent in Panchpipla. It is noted that though cotton opened better prospects of monetary gains, the traditional cultivators have not totally abandoned its cultivation, but have given accountable share of their G.C.A. to it.

Whereas in 1959-60, wheat, in some of the cases was a keen competitor of cotton, by 1979-80, several other crops emerged as the competitors of wheat. Jowar emerged in five villages, oilseeds in four, bajri in three, fodder in two and pulses, rice and grass in one each. They are placed as second ranking crops. The emergence of these crops may be attributed to hybrid seeds of jowar and bajri giving high yields in comparison to wheat and increasing demand and attractive prices of oilseeds.

Jowar, among the third ranking crop inspite of its several rivals, largely stuck to its former place. But in terms of the occupied area, its relative position seems to have been slumped down. Only 50 per cent of the total villages cultivated it on G.C.A. shares varying between three per cent in Devla and 14 per cent in Vad, as against the five per cent of Kansagar and 19 per cent

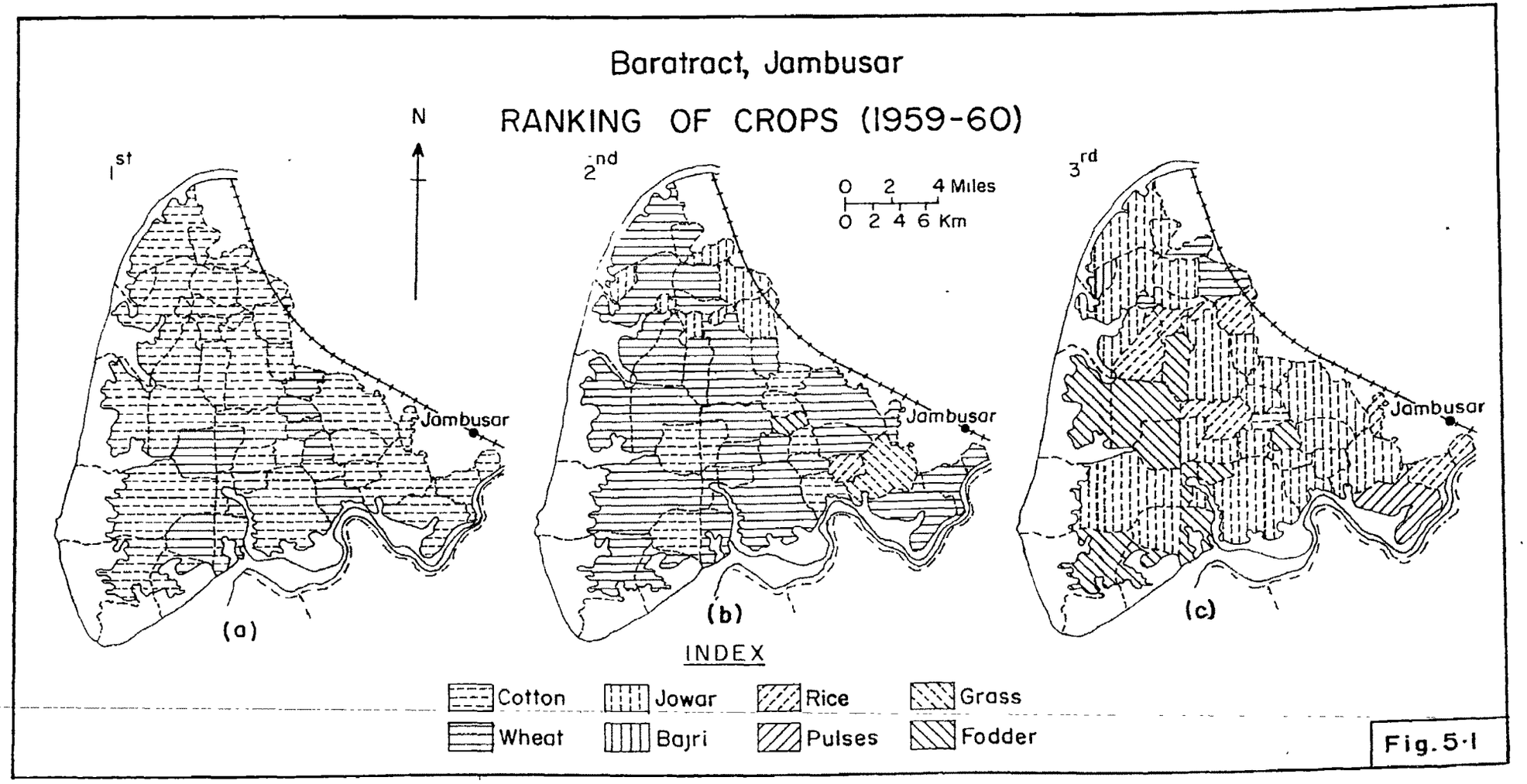

Baratract, Jambusar
RANKING OF CROPS (1959-60)
N
1st
2nd
3rd
0 2 4 Miles
0 2 4 6 Km
Jambusar
Jambusar
Jambusar
(a)
(b)
(c)
INDEX
Cotton
Jowar
Rice
Grass
Wheat
Bajri
Pulses
Fodder

Fig. 5-1

of Kimoj in the former year. Though the number of other associated crops has not much changed their G.C.A. shares have substantially changed at the second point of time over the first.

5.1 SPATIAL PATTERN OF RANK DISTRIBUTION:

In 1959-60, the first ranking crop, cotton is seen almost all through the area, with small intermittant enclaves of wheat. A block of three villages - Panchpipla, Pachakda and Vad - form one enclave in the eastern part. A block of two villages - Kansagar and Sindhav - in the mid western part forms another enclave, and two riverine villages, Dolia at the loop and Kapuria at the mouth of River Dhadhar, form individual. enclaves of wheat as the first ranking crop (Fig. 5.1 a)

The second ranking crops wheat jowar, fodder, rice and grass, have more or less the same pattern of distribution as that of the first ranking crops. However, wheat, among them is the most widely cultivated crop. Jowar makes an enclave of a block of three villages - Hamadpur Kantharia, Runad and Vadadla and two individual enclaves of the village Kaliari and Chandpur Marva. Cotton made individual enclaves at Dolia, Kansagar, Kapuria, Pachakda, Sindhav and Vad. Rice confined to a small village Vanseta. Fodder and grass made their separate enclaves in Panchpipla and Kalak respectively. The landscape has been overwhelmingly dominated by wheat (Fig. 5.1.b)

The pattern of distribution of the third ranking crops at the first point of time makes a combination of jowar, fodder, pulses, rice, wheat and cotton, but dominated by jowar. Enclaves of fodder were found in Bhadkodara, Dahri, Malpur and Sindhav in a block. Besides, each associated crop forms its separate enclave. Thus, like cotton and wheat as significant first and second ranking crops, jowar is the most significant among the third ranking crops (Fig. 5.1.c)

In 1979-80, there is a clean sweep of cotton as first ranking crop all over the area except in one village - Kundhal - the lone enclave of wheat (Fig. 5.2.a).

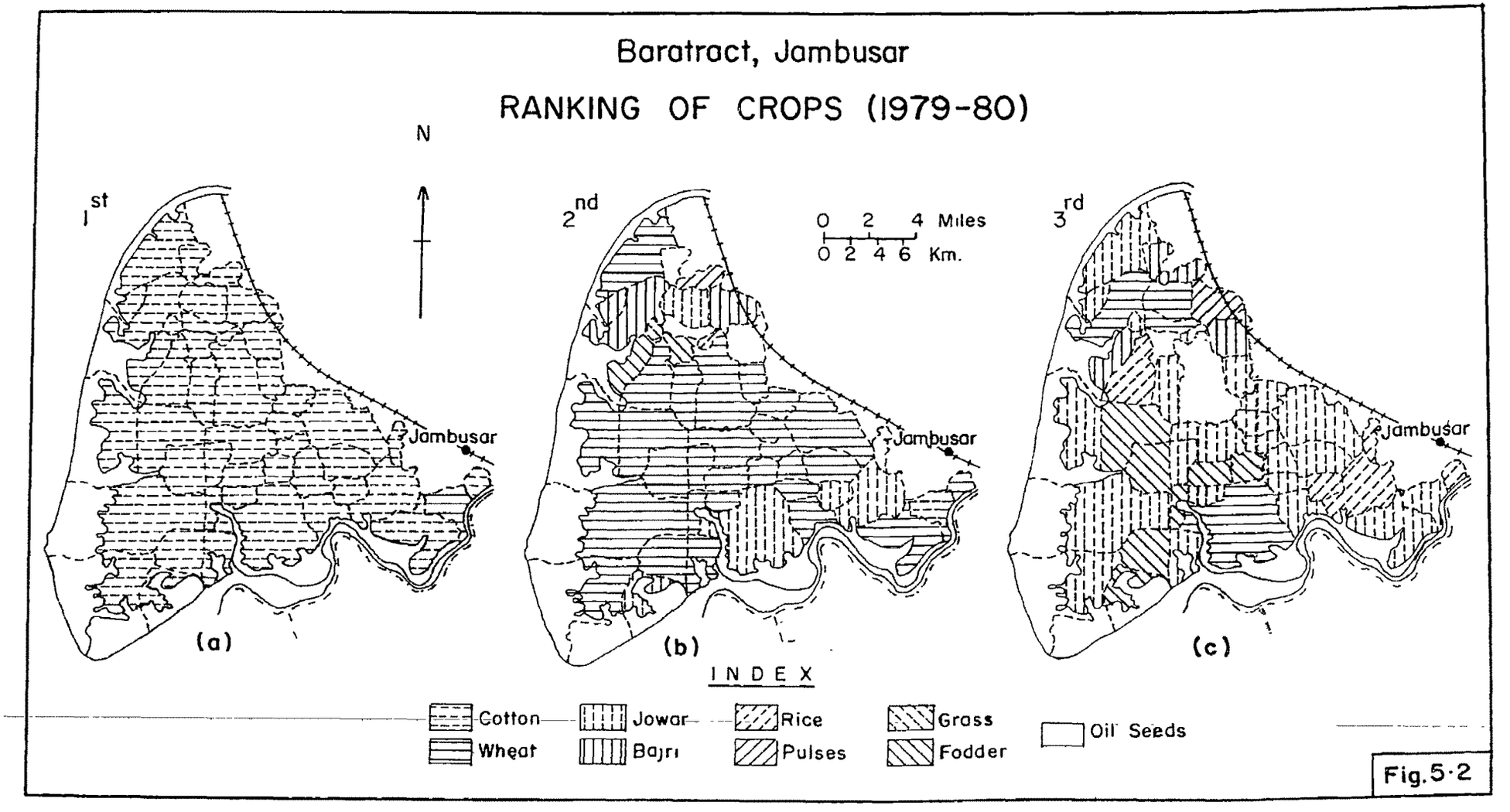

Baratract, Jambusar
RANKING OF CROPS (1979-80)
N
1st
2nd
3rd
0 2 4 Miles
0 2 4 6 Km.
Jambusar
Jambusar
Jambusar
(a)
(b)
(c)
INDEX
Cotton
Wheat
Jowar
Bajri
Rice
Pulses
Grass
Fodder
Oil Seeds

Fig.5·2

Wheat, having retained its superiority among the second ranking crops, covers most of the area, Kalak, Vanseta, Tankari, Asarsa and Kimoj were the enclaves of jowar, Kundhal on Dhadhar was of cotton, Runad of bajri, Hamadpur Kantharia of pulses, Limaj of oilseeds, and Kaliari of rice (Fig. 5.2.b)

Jowar as the third ranking crop dominated the landscape, even though, interrupted by wheat, fodder, rice, oilseeds and bajri. The next significant places, after jowar go to fodder, wheat and bajri (Fig. 5.2.c). It is seen that jowar underwent significant spatial changes as compared to previous point of time. It has been displaced from its third rank (either promoted or demoted) from Bakarpur-Timbi, Gulal, Jantran, Kalak, Kapuria, Kimoj, Salehpur Sangdi, Sigam, Singarna, Tankari, Vanseta and Zamdi; and displaced other crops like fodder, rice oilseeds, etc. from Chandpur Bara, Chandpur Marva, Dahri, Islampur, Khanpur Deh, Kundhal, Madafar, Malpur, Muradpur Neja, Nada, Panchpipla and Thanava. Similarly, wheat changed its habitat from Chandpur Marva, Hamadpur Kantharia, and Runad to Kimoj Tankari, Sigam and Salehpur Sangdi in the same relative position of strength. Oilseeds are the new entrants in the third rank, displacing jowar and rice from Jantran and Kaliari respectively.

The change in the pattern of distribution of the third ranking crops explains the entry of the less value added crops primarily for subsistence, and occasionally for commercial ends.

To sum up, cotton has been, by far, the first ranking crop of this area occasionally challenged by the important cereal-wheat, which maintained its value as the second crop with slight ups and downs. Among the first, second and third ranks cotton, wheat and jowar were the main crops at both points of time, competing for their relative positions. More or less, these three crops faced the same fate in 1979-80. Though, wheat is totally dislodged as the first ranking crop, except at Kundhal in the south-eastern corner, it retained its value as the second ranking crop, and swayed in this capacity over the large extent of the area, leaving a few enclaves for both cotton and jowar.

Among the third ranking crops jowar enjoyed the supreme relative position of strength, and dominated the largest extent of agricultural landscape of the area in 1959-60, subordinating wheat, rice, fodder, etc. Assessed on the relative position of strength, it is found obvious that C.W.J. (cotton-wheat-jowar) was the significant crop combination of that year.

In 1979-80, cotton attained the supreme position, wheat maintained its second rank in most cases, but the striking change that took place was in case of the third ranking crop. Jowar could not retain its former relative position. Its position was contested by a few other crops and wheat, which slumped from its first and second to third rank, became its contestant in a few villages; rice, bajri, fodder and oilseeds were other contestants. Thus, the former structure of three crop combination was changed from one to several eg. C.w.j., C.w.o., C.w.k. etc.

The change in the ranking of crops is the outcome of the attitude and decision making of the farmers and the capability of the land to grow them. The cost and benefit, personal preferences and market demands are other dominant considerations in this regard.

Though the range of crop ranks went upto tenth place in 1959-60 and ninth place in 1979-80, the purpose to visualise the change is served by looking only upto the third ranking crops. Others are ignored. However, it deserves mention that wheat which did not descend from the third rank in 1959-60, went down even upto eighth rank in 1979-80. Other small crops also met the same fate, but at places, oilseeds, and fodder crops have gained higher relative position with the passage of time.

5.2 CROP COMBINATION REGIONS:

Agriculture in itself involves complex functioning of a host of elements which together make it a complex system. The components of this system are crop raising, horticulture, animal husbandry etc. Each functional element exists in association, in which each lone element plays a vital role. To identify their role, their

mutual relationship and the significance of each of them becomes important objective of the students of agricultural landuse. Here an attempt is made to understand the association of crops. Weaver (1954) pointed out three reasons for the crop association and combination studies:

(a) Crop combinations are essential to an adequate understanding of crop geography.

(b) Crop combination is in itself an integrated reality that demands definition and distributional analysis, and

(c) Crop combination regions are essential for the construction of the still more complex structure of valid agricultural regions. Besides, such combination regions explain the attitude and preferential and selective abilities of the farmers; they are helpful in understanding the edaphic and agro-economic structure of the regions thus formed.

Several types of combinational studies have been introduced in the studies of agricultural geography, such as crop combination; crop livestock combination; agricultural enterprize combination etc. Some of the techniques used for such analysis are:

(1) Mean Positive Deviation Method (Panwall, 1953);
(2) Minimum Deviation Method (Weaver, 1954);
(3) Standard Deviation Method (Nelson, 1955);
(4) Quartile Method (Johnson, 1958);
(5) Modified Minimum Deviation Method (Doi, 1959);
(6) Least Squarred Deviation Method (Thomas, 1963);
(7) Minimum Positive Deviation Method (Rafiullah, 1965);
(8) Lower Limit Method (Athawle, 1966);
(9) Maximum Distance Method (Ayyar, 1969);
(10) Successive Quotient Method (Kostrowicki, 1972).

For the present study Weaver's Minimum Deviation Method has been selected. His method is the symbolic expression of the method of variance i.e.

$$S.D. = \frac{\Sigma d^2}{N}$$

When N = the number of observations(crops);)

S.D. = Standard Deviation

Σd^2 = Sum of the squared percentage of area under each selected crop.

Although Weaver's method has been widely used by the students and scholars of agricultural geography during the fiftees and sixtees, it was highly criticised and partially modified by geographers of the later period. With all its weaknesses, its following attributes attracted the present researcher to select it for the present study:

(a) It gives the association of crops in a set of combinations according to their rank and order.

(b) It gives the minimum deviation from the mean of the standard deviation, and allows to include crops holding the maximum percentage (above 90 or so) and also those holding a minimum percentage share in the G.C.A.

(c) It also reflects the reality of crop associations in relation to the local situations of the unit areas (villages).

(d) Like other methods it puts no inhibition on the inclusion of crops for working out the combinational structure on the basis of the percentage G.C.A. held by them.

(e) Inspite of its defects, it is "admirably suitable for smaller administrative units, or where there is considerable crop specialization" (Majeed, 1980 p. 67).

5.2.1 Method:

Selection of the crops and their ranking have been done according to the method discussed above (Rank Order of crops pp 168-174).

Based on the number of ranked crops of each village, their theoretical values were set, S.D. worked out, and arranged in

descending order to recognise the regions with their crop combinations, and mapped (Fig. 5.3 a and b). Thus, the regionalization of the area on the basis of crop combinations for both points of time has been done.

5.2.2 Crop Combinations:

The detailed inventory of the crop combinations for the two points of time includes 25, and 16 sets of combinations respectively (Table 5.3). Table 5.2 gives a villagewise break-up of the pattern of combinations for the two points of time:

Table - 5.2

Status and Pattern of Crop Combinations 1959-60 and 1979-80

Combinations	1959-60		1979-80		Name of crops (195960 and 1979-80
	No. of villages	%	No. of villages	%	
One - crop	02	4.35	26	56.52	Cotton
Two - crop	19	41.30	06	13.04	Cotton-wheat
Three-crop	10	21.74	-	-	Cotton-wheat-jowar
Four - crop	01	2.17	03	6.52	Cotton-wheat-jowar-pulses
Five-crop	04	8.70	02	4.35	Cotton-wheat-rice-pulses-jowar
Six-crop	-	-	01	2.17	Cotton-wheat-jowar-pulses-fodder-oilseeds.
Seven-crop	02	4.35	04	8.70	Cotton-wheat-rice-jowar-pulses-oilseeds-grass.
Eight-crops	02	4.35	04	8.70	Cotton-wheat-jowar-pulses-oilseeds-rice, etc.
Nine-crops	06	13.04	-	-	Cotton-wheat, etc.
Total:	46	100.00	46	100.00	

The table shows the distribution of nine sets of crop combination for the area at the two points of time. Cotton, however, seems to be the dominant crop of both the points of time, but overwhelming

at the latter point of time. Of the 25 combinations, 21 were dominated by cotton as the first ranking crop, and only four were dominated by wheat, while in 1979-80, all 16 combinations were dominated by it (Table 5.3).

(i) Mono-crop:

Cotton has been the only capable of forming the monocropped regions at the two points of time. In 1959-60, however, monocropping did not get much favour, and only two villages (4.35%), Kaliari and Vanseta, did have it. But in 1979-80, cotton surpassed all the significant crops of the former year, and formed a single region in as many as 26 (56.52%) villages of the area leaving only 20 villages (43.48%) for other combinations. Whereas in 1959-60, the two monocropped regions were just small enclaves enclosed by the other combinations, in 1979-80, cotton made almost a contiguous regions from Degam in the north to Nada and Tankari in the south, and three enclaves (Kalak, Nadiad and Runad) enclosed by other combinations in the eastern part of the area. Thus, the larger half of the area was dominated by cotton alone.

(ii) Two-Crop Combination:

In this combination, the crops were cotton-wheat, cotton-jowar, wheat-cotton, and wheat-fodder. Even though, ramified by the changing crops, in 1959-60, it covered as many as 19 villages (41.30%) and gave the appearance of a contiguous crop region extending from east to west and north to south, interspersed by small enclaves of other combinations. But in 1979-80, its extent decreased by three times, and only six villages (13.04%) could have it and the association was of only two crops - cotton and wheat. However, it could form a narrow elongated region sandwitched by the monocropped regions from the west, and multi-cropped regions from the east.

(iii) Three-Crop Combination:

The associated crops in this combination were cotton-wheat-jowar; fodder-grass-rice, etc. placed in order of their percentage

share of G.C.A. In most of the cases, it could form only enclaves and not contiguous regions. In 1959-60, small patches of ten units areas are seen with this combination dispersed all over the area. However, the C.W.J. combination constitutes an elongated region from Salehpur Sangdi to Gulal in the upper midland plain in the north and W.C.F. and C.W.G. together form a small region. In 1979-80, such a combination completely disappeared from the scene. (Fig. 5.3 a & b)

(iv) Four-Crop Combination:

In 1959-60, it consisted of C.J.W.P. (cotton-jowar-wheat-pulses) and made only one enclave in village Runad. But in 1979-80 it consisted of C.W.F.P., C.W.F.J. and W.C.J.P. and constituted three small enclaves in villages Singarna, Thakor-Talavdi and Kundhal.

(v) Five-Crop Combination:

In 1959-60, the region-forming crops were cotton, wheat, jowar, rice, pulses, grass and fodder, in order of their share of the respective G.C.A. In this combination cotton and wheat dominated as first and second crops and others were found changing their positions. However, no contiguity is seen; they have made four enclaves of Limaj, Degam, Bakarpur-Timbi and Khanpur Deh, dispersed from south to north. In 1979-80, the combination was almost the same, but with the replacement of grass by bajri, and two enclaves, Khanpur Deh and Dolia adjacent to each other, were constituted.

(vi) Six-Crop Combination:

In 1959-60, this combination did not exist , but in 1979-80 it made an enclave in Pachakda, in association with cotton, wheat, jowar, pulses, fodder and oilseeds.

(vii) Seven-Crop Combination:

In 1959-60, this combination, in association with cotton, wheat, rice, jowar, grass, fodder, pulses, in one and bajri replacing rice in the other, formed only two enclaves laterally opposite to each other i.e. Mahapura in the south-east, and Kapuria in

the south-west. In 1979-80, the association of the same crops as of 1959-60, with the total absence of grass and conspicuous presence of oilseeds, and bajri, formed four enclaves of Kimoj, Limaj, Shambha and Vanseta, dispersed in the eastern and northern parts of the area.

(viii) Eight-Crop Combination:

In 1959-60, with the dominance of cotton, grass and wheat, in association with jowar, rice, pulses, fodder and bajri, this combination constituted two enclaves of Kaliari and Kalak far removed from each other in the upper midland plain, and the eastern fringe. In 1979-80, almost the same crops as those of former year with oilseeds becoming more conspicuous, formed four enclaves, in which Kava, the largest, and Dahri, the second largest, were dispersed, while Vadadla and Thanava jointly made a small region.

(ix) Nine-Crop Combination:

It appeared in association with cotton, wheat, jowar, bajri, pulses, rice, fodder, grass and oilseeds in their changing relative positions in 1959-60. However, it was the third largest region-forming combination after two and three-crop combinations. It was spread over six villages, viz. Hamadpur Kantharia, Sigam, Vadadla, Muradpur Neja, Chhidra and Zamdi. Chhidra and Zamdi, Sigam and Muradpur Neja, together made two conjoined regions, while Hamadpur Kantharia, and Vadadla remained isolated enclaves.

It may be attempted to explain the variability of the combination as related with the variation of soils of the area. In 1959-60, two-crop combination is found widely distributed (41.30% of the area). But its greater part of distribution seems to have gone to Degam series, (9 of the 22 villages) to Balota Onjal series (8 of the 11 villages) and in Ankhi-Haldar series (2 of the 13 villages). It shows that larger number of crops in combination are restricted to better soils and vice versa. Three-crop combinations are found more popular in Ankhi-Haldar series, less in Regions II and III. Five-crop combinations are seen only in Degam series (3 villages), and Ankhi-Haldar (one village) series less with Degam, and the least with Balota-Onjal series. Other combinations are found scattered in all the three regions of the area.

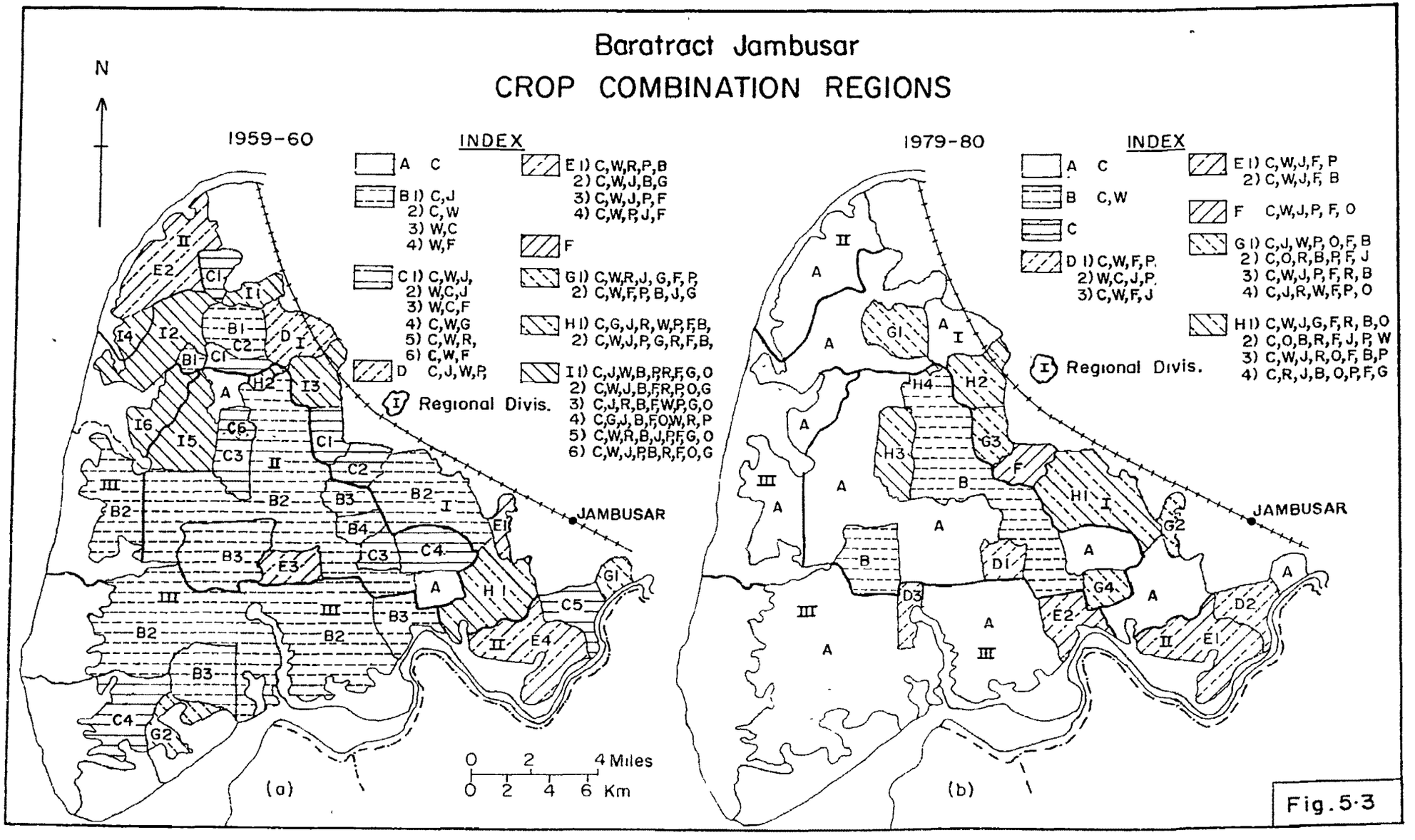

Baratract Jambusar
CROP COMBINATION REGIONS
N
1959-60
INDEX
A C
B 1) C,J
2) C,W
3) W,C
4) W,F
C 1) C,W,J,
2) W,C,J
3) W,C,F
4) C,W,G
5) C,W,R,
6) C,W,F
D C,J,W,P,
E 1) C,W,R,P,B
2) C,W,J,B,G
3) C,W,J,P,F
4) C,W,P,J,F
F
G 1) C,W,R,J, G,F,P,
2) C,W,F,P,B,J,G
H 1) C,G,J,R,W,P,F,B,
2) C,W,J,P,G,R,F,B,
I 1) C,J,W,B,P,R,F,G,O
2) C,W,J,B,F,R,P,O,G
3) C,J,R,B,F,W,P,G,O
4) C,G,J,B,F,O,W,R,P
5) C,W,R,B,J,P,F,G,O
6) C,W,J,P,B,R,F,O,G
I Regional Divis.
JAMBUSAR
0 2 4 Miles
0 2 4 6 Km
(a)
1979-80
INDEX
A C
B C,W
C
D 1) C,W,F,P,
2) W,C,J,P,
3) C,W,F,J
E 1) C,W,J,F, P
2) C,W,J,F, B
F C,W,J,P, F, O
G 1) C,J,W,P, O,F, B
2) C,O,R,B,P,F, J
3) C,W,J,P,F,R,B
4) C,J,R,W,F,P,O
H 1) C,W,J,G,F,R, B,O
2) C,O,B,R,F,J,P,W
3) C,W,J,R,O,F,B,P
4) C,R,J,B,O,P,F,G
I Regional Divis.
JAMBUSAR
(b)

Fig.5·3

5.2.3 The Change:

A comparison of the maps 5.3 a & b shows a distinct change in cropping pattern as well as in the crop combinations. In 1959-60, only two enclaves far removed from each other showed the monocropped regions, while in 1979-80, it went up 13 times covering larger half of the total area under the single crop (cotton) region making almost a mini cotton belt covering 57% of the total area. It engulfed seven villages - Chandpur Marva, Gulal, Hamadpur Kantharia, Kalak, Runad, Salehpur Sangdi and Sigam of Region-I; ten villages — Degam, Muradpur Neja, Kaliari, Chhidra, Bhadkodara, Madafar, Kansagar, Bakarpur Timbi and Mahapara- of Region II and nine villages - Asanvad, Asarsa, Devla, Islampur, Kapuria, Malpur, Nada, Tankari and Zamdi - of Region III. Rest of the combinations were spread over only 20 villages (43%) of the area. Apart from the dominance of monocropping, the six crop combination, appeared in 1979-80 against 1959-60, and the nine crop combination of that year disappeared.

It, thus, shows that a great change took over the cropping system of the area. It may, therefore, be stated, that in the event of favourable rains, as well as the prospective socio-economic conditions the concept of greater comparative advantage becomes automatically applicable in the choice of crops; and priority in choice is always given to value added crops. But the combination keeps on changing which is evidenced here, and further perceptible changes may be envisaged with the introduction of Narmada Canal Irrigation (other things being equal) in the near future.

The changes brought about in crop combinations in the area during the study period can be summarised in a tabular form (Table 5.3)

5.3 CROP DIVERSIFICATION:

5.3.1 Definitions and Methods:

Essentially, diversification is an indicator of multiplication of agricultural activities which obviously involves intense competition among various activities for space (Singh and Dhillon 1984). Definitions of diversification, more or less, give the same sense:

Table - 5.3

Crop Combinations- 1959-60 1979-80

Series	1959-60			1979-80		
	Status	Association	Villages	Status	Association	villages
A	Monocrop	Cotton	Kaliari, Vanseta (02)	Monocrop	Cotton	Asanvad, Asarsa, B.Timbi,Bhadkodra Ch.Marva, Chhidra,Degam, Devla, Gulal, H.Kantharia, Islampur, Kalak Kaliari, Kansagar,Kapuria,Madafar, Mahapura,Malpur,M.Neja, Nada,Nadiad Runad, S.Sangdi,Sigam, Tankari, Zamdi (26)
B	Two Crop 1.	Cotton-wheat	Asanvad,Bhadkodara,Devla Islampur,Jantran,Kava Madafar,Malpur, Sardarpura,Singarna Tankari, ,Thakor Talavdi (12)	Two crop	Cotton-wheat	Ch.Bara, Jantran,Panchpipla,Sardarpura Sindhav, Vad (06)
B	Two crop 2.	Cotton-Jowar	Chandpur Marva. (01)	—	—	—
B	Two crop 3.	Wheat-cotton	Dolia, Kansagar,Vad Kapuria,Sindhav(05)	—	—	—
B	Two crop 4.	Wheat-Fodder	Panchpipla (01)	—	—	—

Table 5 - 3 (contd...)

Series	1959-60				1979-80			
	Status		Association	villages	Status		Association	villages
C	Three crop	1.	Cotton-wheat-jowar	Gulal,Kimoj,S.Sanghdi Shambha(04)	—		—	-
C	" "	2.	Cotton-wheat-Rice	Kundhal (01)	—		—	-
C	" "	3.	Cotton-wheat Fodder	Dahri (01)	—		—	-
C	" "	4.	Cotton-wheat-grass.	Nada, Nadiad (02)	—		—	-
C	" "	5.	Wheat-cotton-Jowar.	Pachakda (01)	—		—	-
C	" "	6.	Wheat-Cotton Fodder	Chandpur Bara (01)	—		—	-
D	Four crop		Cotton-Jowar wheat-pulses	Runad (01)	Four crop	1.	Cotton-wheat-Fodder-pulses	Singarna (01)
	—		—	—	" "	2.	Cotton-wheat-Fodder Jowar	Thakor Talavde (01)
	—		—	—	" "	3.	Wheat-Cotton-Jowar pulses.	Kundhal (01)

Table 5-3 (Contd....)

Series	1959-60				1979-80		
	Status		Association	Villages	Status	Association	Villages
E.	Five crop	1.	Cotton-wheat-Rice-pulses Bajri	Limaj (01)	Five crop	1. Cotton-wheat jowar-fodder pulses	Khanpur Deh (01)
	" "	2.	Cotton-whear-Jowar-Bajri-Grass	Degam (01)	" "	2. Cotton-wheat Fodder-Bajri	Dolia (01)
	" "	3.	Cotton-wheat Jowar-pulses Fodder	Bakarpur Timbi(01)	—	—	—
		4.	Cotton-wheat-Pulses-Jowar Fodder	Khanpur Deh (01)	—	—	—
F	Six crop		-	-	Six crop	Cotton-wheat-Jowar pulses-Fodder-oilseeds.	Pachakda (01)
G	Seven crop	1.	Cott on-Wheat-Rice-Jowar-Grass-Fodder pulses	Mahapura (01)	Seven crop	1. Cotton-jowar-wheat-pulses-oilseeds-Fodder-Bajri	Kimoj (01)
	"	2.	Cotton-wheat-Fodder-Pulses Bajri-Jowar grass	Asarsa(01)	"	2. Cotton-oilseeds Rice-Bajri pulses-fodder Jowar	Limaj (01)

Table - 5-3 (Contd....)

Series	1959-60			1979-80)		
	Status	Association	Villages	Status	Association	Villages
	-	-	-	Seven crop	3. Cotton-wheat-jowaar Pulses-Fodder-Rice Bajri	Shambha(01)3
	-	-	-	""	4. Cotton-jowar-Rice-wheat Fodder-Pulses-oilseeds	Vanseta (01)
H.	Eight crop	1. Cotton-Grass-Jowar-Rice-Wheat-pulses-Fodder-Bajri	Kalak (01)	Eight crop	1. Cotton-wheat-Jowar-Grass Fodder-Rice-Bajri-oilseeds.	Kava (01)
	""	2. Cotton-wheat-jowar-pulses Grass-Rice-Fodder-Bajri	Kaliari (01)	"	2. Cotton-oilseeds-Bajri-Rice Fodder-Jowar-Pulses-wheat	Vadadla (01)
	-	-	-	"	3. Cotton-wheat-jowar-Rice Oilseeds-Fodder-Bajri pulses	Dahri (01)
	-	-	-	"	4. Cotton-Rice-Jowar Bajri-oilseeds-pulses-Fodder-Grass.	Thanava(01)
I.	Nine crop	1. Cotton-Jowar-Wheat-Bajri Pulses-Rice-Fodder-Grass-Oilseeds.	Hamadpur Kantharia (01)	-		-

Table 5-3 (contd.....)

Series	1959-60			1979-80		
	Status	Association of crops	villages	Status	Association of crops	Villages
I.	Nine crop	2. Cotton-Wheat-Jowar-Bajri-Fodder Rices-Pulses-Oilseeds-Grass	Sigam(01)	-	-	-
		3. Cotton-Jowar-Rice-Bajri-Fodder Wheat-Pulses-Grass-Oilseeds.	Vadadla (01)	-	-	-
		4. Cotton-Grass-Jowar-Bajri-Fodder-Oilseeds-Wheat-Rice-Pulses	Muradpur Neja (01)	-	-	-
		5. Cotton-Wheat-Rice-Bajri-Jowar Pulses-Fodder-Grass-Oilseeds.	Chhidra (01)	-	-	-
		6. Cotton-Wheat-Jowar-Pulses-Bajri-Rice-Fodder-Oilseeds-Grass.	Zamdi (01)	-	-	-
			46			46

(1) Normally the even proportion in any field of economic activity, be it industry, mining, cropping pattern, employments or livestock raising, is a rare possibility.

(2) The competitive ability particularly among the crops is not self generated, but bestowed by the cultivators according to their value in terms of the prospects of consumption, and,

(3) It is empirically proved that in no area each significant or insignificant crop occupies even proportion of space. Always, the significant crops occupy much larger and others smaller shares of G C A. This is a reality of all agricultural regions of India, and so is the case of the study area.

On these grounds, the diversification may lie between the number of crops cultivated, and the percentage or actual share of G.C.A. held by each.

Different workers have, therefore, attempted to identify and measure the patterns of crop diversification, and diversification in other fields of economic activities from different conceptual and methodological angles.

Bhatia (1965) evolved a simple formula to make an objective measurement of crop diversification. The formula is:

$$I.D = \frac{\text{Per cent of sown area under X crops}}{\text{Number of X crops}}$$

Where I D = Index of diversification.

X crop = those crops that individually occupy 10 per cent or more of cultivated area in a regional unit or village

However, in this case the lower the index, more the diversification and higher the index more the specialization.

S.P.Singh (1971) pointed out that the diversification index is closely related with the economic conditions of the cultivators. Jasbir Singh (1976) modified the Bhatia's formula, and used it for the investigation of spatial patterns of crop diversification in Haryana. His formula is:

$$I.D = \frac{\text{Percentage of total Harvested ares under n crops}}{\text{Number of n crops}}$$

Where n crops are those which individually occupy five per cent or more of the gross harvested area.

Gibbs-Martin (1962) is a useful quantitative formula for measuring the extent of diversification in the cropping pattern of the unit areas. The formula is:

$$I\ D = 1 - \frac{\Sigma x^2}{(\Sigma x)^2} \times 100$$

Where X is the percentage of total cropped area occupied by each crop.

In this method the level of diversification ranges between zero and one. Zero is complete specialization and one is complete diversification. This method was initially evolved for measuring the levels of diversification of industrties, but the method is equally fit for measuring the crop diversification. The lower values of indices give the levels of specialization, or lower levels of difersification and higher give that of higher diversification.

The present researcher has also attempted to devise a simple method to compute the indices for the purpose. The method is:

$$I.D = \frac{\Sigma X^2}{100}$$

Where X = the number of crops holding minimum one per cent and more of the G.C.A.

This method shows that higher the value of the indices, lesser is the level of diversification and vice versa. This method gives equally good results as obtained from other methods. A few examples to substantiate it are given hereunder, when compared with that of Gibbs Martin method, the results are quite similar.

The villages Kalak of Region I, Degam of Region II and Devla of Region III are selected with their cropping patterns at the two points of time. (Table - 5.4).

It is obvious that Kalak had eight crops in 1959-60 occupying varying percentage of G.C.A., with cotton having larger share and in 1979-80, it had nine crops among which cotton usurped 70 per cent of G.C.A., others reduced to negligible except jowar, rice and fodder. Thus, the eight crops of 1959-60, seem to be more diversified than the nine crops of 1979-80, because of the influence of only one crop - cotton. Thus, the first point of time had more diversified pattern of cropping in Kalak and the second was more bent towards specialization. Similarly, Degam with nine crops was more diversified in 1959-60 and with seven crops less. Devla had 5 crops in 1959-60 and was more diversified than its four crops of the second point of time. This leads to infer that, it is not the number of crops that determines the diversification, but their share of G.C.A. Even if one crop usurps a larger percentage share of the G.C.A., it influences the entire cropping pattern leading to specialization. Thus, the index of diversification, if all crops are not occupying even share; is not governed by the number of crops but by the percentage share of G.C.A. occupied by them. This statement may be substantiated by the Table 5.5.

Table 5.5 fortifies the evidence that the number of crops hardly influences the index of diversification. According to Gibbs and Martin, smaller the value of index higher is the tendency to specialization. Asanvad with four crops at the first point of time shows more diversification than its five crops at the second point of time.Similarly, Kalak is more diversified with eight and less with nine crops. Islampur, Malpur, Pachakda, show the tendency of diversification and specialization with the same number of crops. Contrary to these are the examples of Panchpipla and Vad. The former shows relatively more inclination to specialization with six crops, and more diversification with three crops. Thus, the hypothesis that the first crop or the first few crops govern the cropping pattern making it either diversified or specialized, is proved, and the concept of large number of crops, with this empirical finding is nullified.

Table - 5.4

Number of crops and their comparative Diversification Indices

			Cotton	Wheat	Jowar	Rice	Bajri	Pulses	Fodder	Oilseeds	Grass
1.	Kalak	1959-60	52	06	12	09	02	03	03	—	13
		1979-80	70	03	11	05	01	01	05	02	02
2.	Degam	1959-60	54	21	12	01	04	02	02	01	03
		1979-80	80	04	04	04	—	03	03	04	—
3.	Devla	1959-60	48	44	05	—	—	—	02	01	—
		1979-80	89	07	03	—	—	—	01	—	—

Author's method: $I.D. = \frac{\Sigma X^2}{100} \times 100$

Gibbs Martin Method: $I.D = 1 - \frac{\Sigma X^2}{(x)} \times 100$

	1959-60	No. of crops	1979-80	No. of crops	1959-60	No. of crops	1979-80	No.of crops
Kalak	31.56=32	08	50.90 = 51	09	0.68 (68)	08	0.49 (49)	09
Degam	35.36=35	09	64.74 = 65	07	0.65 (65)	09	0.35 (35)	07
Devla	42.70=43	05	79.80 = 80	04	0.57 (57)	05	0.20 (20)	04

Table -- 5.5

Number of Crops and Index of Diversification in Selected villages
1959-60 - 1979-80

Villages	1959-60			1979-80		
	No. of crops	Percentage area under 1st crop	Index	No. of crops	Percentage area under 1st crop	Index
1. Asanvad	04	C.64	51	05	C.86	25
2. Bhadkodara	04	C.58	68	03	C.90	18
3. Islampur	05	C.52	59	05	C.76	40
4. Kalak	08	C.52	68	09	C.70	49
5. Malpur	05	C.59	57	05	C.86	25
6. Pachakda	06	W.38	73	06	C.66	52
7. Panchpipla	06	W.66	51	03	C.49	61
8. Vad	06	W.62	55	05	C.56	59
9. Vanseta	08	C.70	49	08	C.61	59

Villages selected by 20% stratified random sampling.

In the present study, however, the Gibbs and Martin's (1962) method is used and the crops with one per cent and more share of the G.C.A. are considered.

5.3.2 Distribution Pattern of Diversification:

Without the use of any statistical measurement the crude data themselves show the status of diversification at the first point of time and that of specialization at the second point of time. When measured, the index of diversification for the first point of time is 66, and for the second is 56, which is less by only 15 per cent than the earlier year. It leads us to infer that the cropping pattern at the first point of time was relatively more balanced and diversified than at the second. This change took place owing to the greater significance of value added crop, cotton, at the second point of time.

Based on the obtained indices the villagewise distribution pattern of diversification is mapped (Fig. 5.4 a & b). However, the distribution of indices in five classes have been worked out on the Smith David (1977) Method. The Table 5.6 gives the villagewise pattern of its distribution.

Table 5.6 reveals that Devla, Chandpur Marva, and Bhadkodara were relatively in the low, medium and high levels of crop diversification at the first point of time, they all descended to that of very low at the second point of time. Madafar, Chhidra, Zamdi, Degam, Gulal and Nada, previously in medium and high levels descended to low level, showing greater inclination towards specialization. Asarsa, Chandpur Bara, Kalak, Mahapara, Salehpur Sangdi and Shambha from high and Runad from very high levels went down to medium. Similarly, Khanpur Deh and Kimoj descended from very high to high level.

Asanvad, Kapuria, Kansagar, Malpur and Tankari in the low level, Islampur, Kava, Nadiad, Sindhav, Singarna and Thakor-Talavdi in the medium level and Dahri, Dolia, Pachakda and Vadadla in the high level, maintained their respective levels at the second point of time also.

Table - 5.6

Villagewise Levels of Crop Diversification (1959-60 - 1979-80)

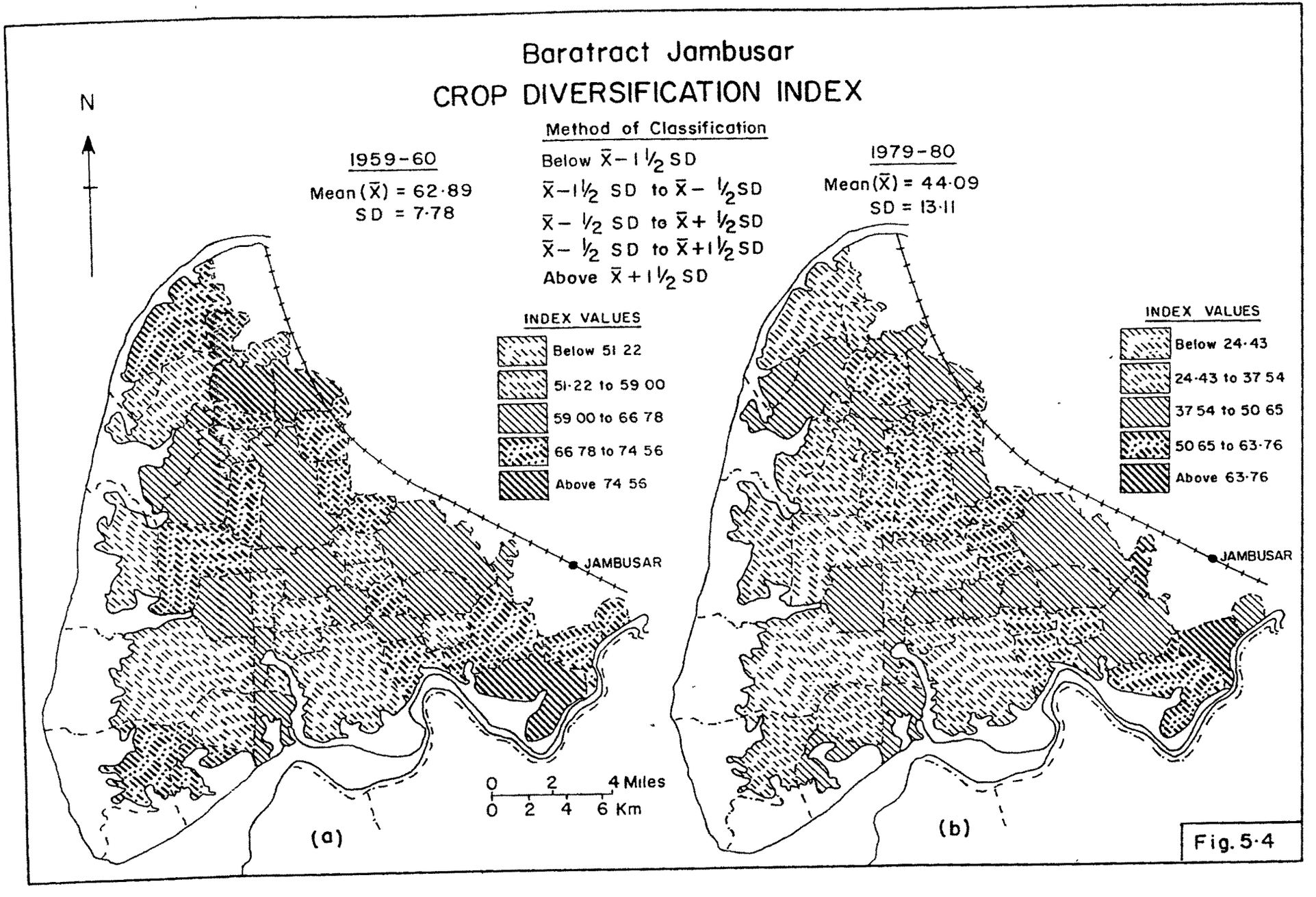
1969-60/ 1979-80 Levels of Indices	0.00	Bellow 51.00 Very low	51 - 59.00 Low	59 - 67 Medium	67 - 75 High	Above V.H. 75.00	Total
0.00		Isanpur(01)	-	-	-	-	01
Below 24.00 V.L.	-	-	Devla (01)	Chandpur Marva(01)	Bhadkodara(01)	-	03
24-38 Low	-	-	Asanvad,Kapuria,Kansagar Malpur,Tankari(05)	Madafar, Chhidra, Zamdi(03)	Degam, Gulal Nada (03)	-	11
38-51	-	Bakarpur Timbi, Kaliari(02)	Hamadpur Kantharia, Muradpur Neja, Sigam (03)	Islampur,Kava,Nadiad Sindhav,Singarna Singarna, Thakor Talavdi (06)	Asarsa,Chandpur Bara,Kalaak, Mahapura,Salehpur Sangdi,Shambha(06)	Runad (01)	18
51-64	-	Vanseta(01)	Panchpipla,Vad (02)	Jantran,Sardarpura, Thanava (03)	Dahri, Dolia, Pachakda, Vadadla (04)	Khanpur Deh Kimoj (02)	12
Above 64 Very High	-	-	-	Limaj (01)	Kundhal (01)	-	02
Total:	-	04	11	14	15	03	47

However, inspite of the ascent, or descent, or status quo the degree of diversification of the former year, have shrunk to yield place to the greater degree of specialization during the latter year. But it is not true to say that all villages have opted for specialization enmasse. A very plain explanation in this regard may be given that all those villages showing descent from their former levels have gone for greater degree of specialization or monocropping, while those having ascended from their former levels have gone for diversification even though devoting more G.C.A. share to cotton; and some of those maintaining status quo have even though, devoted relatively larger G.C.A. share to cotton, have attempted to maintain a balance between the different crops. However, their tilt is more towards specialization. For example, Asanvad had six crops at the first point of time and seven crops with very insignificant G.C.A. share in five crops at the second point of time, that reduced its diversification index value. Similar were the cases of other villages.

5.3.3 Levels of change:

No clear pattern seems to emerge as all levels seem to have interspersely distributed (Fig. 5.4 a). However, in 1959-60, the very high level of diversification was confined to Khanpur-Deh (75) on Dhadhar in the south-east, Kimoj (75) and Runad (76) on the north-eastern side. High, medium, and low levels together occupied a wide area from the south-eastern to north-western corners; and eastern to western side, with the three small patches of low level in Vanseta, Kaliari and Bakarpur Timbi.

In 1979-80, the zone of concentration of various levels has changed. More or less very low and low levels, drifted west and south staking their claim over the villages formerly in the same level and adding a few more villages of the formerly other levels. The zone of concentration of medium, high, and very high levels clearly occupied the eastern part from Khanpur Deh on Dhadhar in the south-east to Hamadpur Kantharia in the north- east and Muradpur-Neja, Chandpur Marva and Sigam in the north-west.


Baratract Jambusar
CROP DIVERSIFICATION INDEX
N
Method of Classification
Below $\bar{X} - 1\frac{1}{2}$ SD
$\bar{X} - 1\frac{1}{2}$ SD to $\bar{X} - \frac{1}{2}$ SD
$\bar{X} - \frac{1}{2}$ SD to $\bar{X} + \frac{1}{2}$ SD
$\bar{X} - \frac{1}{2}$ SD to $\bar{X} + 1\frac{1}{2}$ SD
Above $\bar{X} + 1\frac{1}{2}$ SD
1959-60
Mean ($\bar{X}$) = 62·89
SD = 7·78
INDEX VALUES
Below 51 22
51·22 to 59 00
59 00 to 66 78
66 78 to 74 56
Above 74 56
JAMBUSAR
0 2 4 Miles
0 2 4 6 Km
(a)
1979-80
Mean ($\bar{X}$) = 44·09
SD = 13·11
INDEX VALUES
Below 24·43
24·43 to 37 54
37 54 to 50 65
50 65 to 63·76
Above 63·76
JAMBUSAR
(b)
Fig. 5·4

The upgradation to very high level was also confined to eastern fringe at Kundhal on Dhadhar, and Limaj near Jambusar town (Fig. 5.4 b). A conspicuous spatial dimension of change is, thus, found for which no other factor except the disequilibrium caused by cotton, may be held responsible.

5.3.4 The Overall Change:

A comparison of the crop diversification maps (Fig. 5.4 a&b) shows that for the earlier years the indices of diversification being higher give more diversified cropping pattern. The number of crops (1% and more) varied from the minimum four to maximum ten at the first point of time; their indices of diversification ranged between 49 and 76 which is the indicator of greater degree of diversification, even though cotton was the principal crop of that year; the other crops, specially cereals, occupied substantial percentages of the G.C.A. It was more or less proportionate share of the G.C.A. by a few major crops, with narrow gap between each of them. It was consequential to higher indices almost in each region and each villages.

At the second point of time the number of crops occupying one per cent and more of the G.C.A. dropped from four to three and from ten to nine in the lower and higher ranges; and the indices also dropped significantly. It took place owing to cotton, that alone occupied much greater percentage of G.C.A. Thus, the change indicates the shift (in most cases) from multiple cropping to almost monocropping pattern.

Appendix II shows that four of 46 villages, Kaliari, Panchpipla, Vad and Vanseta, show a positive change in their C.D. index; even though the number of crops in three of them was more at the first than at the second point of time; and the fourth village had equal number of crops. However, the difference between the shares of G.C.A. occupied by each crop at the two points of time being large, gave big index values at the first and small at the second points of time. Even then their index values were higher than most of the other villages against the established pattern of decrease in the rest of the villages.

The remaining 42 villages in their negative change varied between two and seventy four per cent. They, in varying degree, moved from the diversified to more or less specialized cropping pattern.

In the regional scenario, interesting variations are observed. Region I, composed mostly of the 'Ankhi Haldar' series of soils, considered to be the best in the whole study area, shows comparatively larger levels of diversification at the two points of time. Average number of crops at both points of time were eight and seven and the average indices were 68 and 47 respectively. The indices ranged between 56 in Sigam, and 75 in Kimoj at the first; and 13 in Chandpur Marva, and 65 in Limaj at the second point of time.

The Region II, a tract mostly composed of Degam series of soils, next to the Ankhi Haldar series in quality, had on the average seven and six crops, the average index numbers were 62 and 46 and the range of indices was between 45 in Kaliari and 75 in Khanpur Deh and 18 in Bhadkodara and 72 in Kundhal respectively at the two points of time.

Region III, the tract of Balota Onjal series, shows the impression of the quality of its soil on its crop diversification pattern. The level of diversificationn is relatively less in this region than the other two. The number of crops (occupying at least one per cent of G.C.A.) did hardly exceed nine at the first; and seven at the second point of time. The average number of crops for the region comes to six and five, the average indices were 60 and 35, the range of indices was between 51 in Asanvad, and 70 in Nada, and 20 at Devla, and 58 in Dolia at the two points of time respectively.

A comparative analysis of the indices of the three micro-regions shows that each has a tilt towards lower levels of diversification at the second point of time over the first. However, a relatively subdued level of diversification in terms of the number of crops and also the index values are seen in Regions I and II whereas Region III shows relatively steep tilt towards specialization in both of them at the second point of time over the first point of time.

Although, the diversification and specializationn are the products of the changing economic environment at local, national and international levels, a few personal and geoclimatic factors do influence them. With the growing demand of cottonn in the local, national and the world market, the prices of cotton were also becoming more and more attractive, which played a vital role in the decision making, and also in the choice crops and, devotion of G.C.A. share to them.

No less weightage may be given to geoclimatic conditions, and the artificial drainage system in determining the cropping pattern. It is seen that even within the regions, varying indices existed denoting the influence of soil and terrain. In the Dhadhar flood plain a lower level of diversification is seen except at two villages, Khanpur Deh and Kundhal. The midland plains showed the positive and negative trends normally at medium to high levels but the coastal and estuarine villages have invariably shown relatively lower levels of diversification. This may be attributed to the edaphic and terrain effects. At the second point of time, the unreliable character of rain on one hand, and the artificial drainage system (Kans) on the other, including the economic factors, have drawn more or less the whole area towards specialization. However, the regional disparity in this respect could not be ruled out. If the differences in the regional averages of the indices of the two points of time are taken, it is revealed that Region III with 25.72, Region I with 21.15 and Region II with 15.95, have the disparity in their levels of diversification. The smaller the difference between the indices of the two points of time the lesser the level of specialization.

To sum up, the diversification or specialization of cropping are relative terms directly linked with agroclimatic situations and personal visualization of economic prospects. As these determinants change, the cropping pattern accordingly changes. The Government policy, however, is a factor to be reckoned with, which, above all, influences the cropping pattern of any area.