CHAPTER - III

-:- IMPACT OF IRRIGATION -:-

INTRODUCTION :

In the preceding two chapters the physical, social bases of irrigation and the existing pattern of irrigation have been examined respectively in the region. The present chapter attempts to highlight the impact of irrigation, particularly, an agricultural productivity, fertilizer consumption, mechanization and irrigated cropping pattern.

For this study, 15 sample villages out of 81 have been selected (Fig.3.1-A) each of which represents an area including some number of villages called 'zone'. Jasbir Singh's method is used to measure agricultural productivity in the region. The matrix analysis is used to correlate the the irrigation, agricultural productivity, fertilizer and mechanization. The spatio-temporal changes in irrigated crops have also been highlighted to represent impact of irrigation.

1. IRRIGATION AND AGRICULTURAL PRODUCTIVITY :

Agriculture has always occupied an important place in Indian economy. The proportion of cultivable land per man has been decreased considerably during the recent past. The increase in crop production is a must in India since the areal spread of crop land has almost reached to it's saturation limit (Vidyanath,1985). It needs, therefore, to improve the agricultural productivity. Agricultural productivity is a measure of overall

performance of a region which is quite useful in planning the developmental programmes in rural areas.

The erratic nature of rainfall affects badly on agricultural productivity in the region. Generally, the crop needs optimum quantity of water for higher yields and irrigation plays a significant role in enhancing the yield of crops. Besides this, it ensures assured water supply in the areas where crops are victimised by scarcity conditions. There is significant scope of increasing the net area under cultivation by growing more than one crop on the same hectare with the help of irrigation which indeed, is the main plank of our agricultural strategy in all the five year plans (Swaminathan,1980).

Agricultural productivity is a function of various factors like physical, socio-economic, technical and organizational. The level of agricultural productivity, as a concept, means the degree to which the economic, cultural technical and organizational variables are able to exploit the abiotic resources of the area for agricultural production (Singh,J.1984). The agricultural productivity is also defined as 'the level of existing performance of a unit of land which differentiate from one area to another (Mohammad Ali,1978). The differntials in productivity per unit area is determined partly by soil types and climate and partly by the farming techniques.

Agricultural productivity is a dynamic concept. It is dynamic in its spatio-temporal perspectives. The development of irrigation facilities, mechanization, use of fertilizers and high yielding varieties of seeds, adoptions of other components of new technology leads to variations in agricultural efficiency per unit of time and space.

Being an interdisciplinary study, many scholars from different fields like economics, agriculture, geography etc., have evolved different methods to measure the agricultural productivity. The ranking co-efficient of principle crops for a unit of area was used in analysing and estimating the agricultural productivity, by Kendall (1939). This method was further applied by Stamp (1952) for measuring the agricultural efficiency in India. Shafi (1960), in India, did similar work on U.P. Spare and Deshpande (1964) refined Kendall's method to some extent. Bhatia (1965) further modified this method.

Singh (1979) has taken into account the yield of crops and their areal spread. Shinde and Jadhav (1979) and Dr.M.Hussain (1976) calculated the agricultural productivity of Maharashtra plateau and Sutlej-Ganga plains respectively in terms of money value of crop production. Sharma and Coutinho (1976), Vidyanath (1985) have also suggested the new methods of measuring agricultural productivity.

In the present study, two important irrigated crops i.e. sugarcane and wheat are considered as they are dominant

in terms of their areal extent. Sugarcane is the most important cash crop of the region covering more than 65 percent of the irrigated area. Being an annual crop, it requires adequate supply of water almost throughout the year. Following sugarcane, wheat is the next important crop (22 percent) which needs irrigation because the rainfall during winter is very scanty (4.2 percent). An attempt has been made to compute the productivity indices of both crops in the present analysis. The main objective is to examine the spatio-temporal patterns of crop productivity and correlate them to the patterns of irrigation intensity. It is, therefore, proposed to formulate the hypothesis that irrigation influences crop productivity favourably.

In the present analysis, the dominant irrigated crops, in terms of their land occupance, have been considered, viz. sugarcane and wheat. In order to assess agricultural productivity, Jasbir Singh's method (1972) of 'crop yield and crop concentration indices ranking coefficient' has been employed. The statistical procedure of this method is as follows :-

i) <u>Crop Yield Indix</u> :

$$Yi = \frac{Ya}{Yr} \times 100$$

Where, Yi = Crop yield index

Ya = The average yield per hectare of crop 'a' in a zone

Yr = The average yield per hectare of crop 'a' in the region

ii) Crop Concentration Index :

$$Ci = \frac{Aau}{Cu} \div \frac{Tar}{Cr} \times 100$$

Where, Ci = Crop concentration index

Aau = Area under 'a' crop in a zone

Cu = Total cropped area in a zone

Tar = Area under 'a' crop in the region

Cr = Total cropped area in region

iii) Ranking coefficient :

Crop yield and crop concentration indices for all the zones are ranked separately. Now, the two ranks are added and divided by 'n' (two crops) to find out the ranking co-efficient for each crop.

$$\text{Indices of ranking co-efficient for crop 'a'} = \frac{\text{Yield index of crop 'a'} + \text{Crop concentration index of crop 'a'}}{\text{'n'}}$$

The values, thus obtained, indicate that the lower is the ranking co-efficient, the higher is the level of agricultural production and vice-versa.

This method leads to identify the zones of each crop where they are grown and delimit regions of different levels of productivity. As such, the ranking co-efficients for individual

crops are derived and further arranged in ascending order. The co-efficients are grouped into five categories, i.e. very high, high, moderate, low and very low. These are, however, summerised into three classes i.e. high, moderate and low. Further, overall ranking co-efficients have been derived by adding the ranking co-efficients for the two crops selected for each zone and divided by 'n' (number of crops selected). The results, thus derived, are mapped. These maps are correlated with intensity of irrigation (Fig.2.4-A) by interpolation method to examine the impact of irrigation.

Spatial pattern of sugarcane productivity :

The sugarcane covers only 6.95 percent of the net area sown. Neverthless it occupies major portion (65.75 percent) of the irrigated area. The interpolation of figure 2.4-A and figure 3.2-A clearly points out that the levels of agricultural productivity and the levels of irrigation development are correlated to each other.

Fig. 3.2A highlights the fact that the level of sugarcane productivity is high to very high (ranking coefficient below 5) in those areas where sugarcane concentration as well as irrigation development is significant. The ranking co-efficient of sugarcane productivity in the region, as a whole, has been found to be 7.97, which means that the zones of Nitavade, Karambali, Darwad and Akurde registers the high level of sugarcane productivity where the ranking co-efficients ranges between

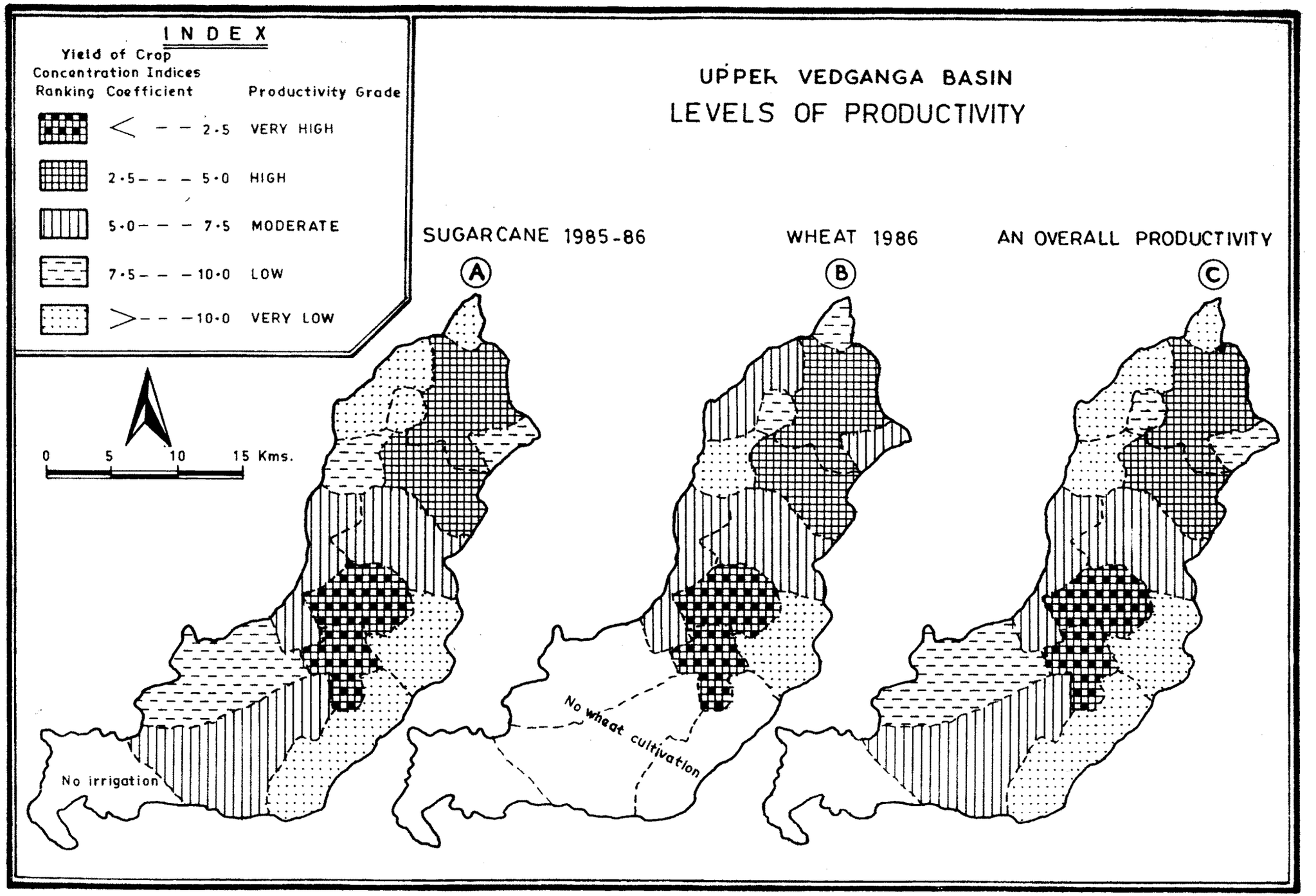
INDEX
Yield of Crop
Concentration Indices
Ranking Coefficient
Productivity Grade
< - - 2·5 VERY HIGH
2·5- - - 5·0 HIGH
5·0- - - 7·5 MODERATE
7·5- - - 10·0 LOW
> - - - 10·0 VERY LOW
UPPER VEDGANGA BASIN
LEVELS OF PRODUCTIVITY
SUGARCANE 1985-86
WHEAT 1986
AN OVERALL PRODUCTIVITY
A
B
C
0 5 10 15 Kms.
No irrigation
No wheat cultivation

Fig. 3·2

1 to 3. The average sugarcane yield per hectare in these zones is above 60 tons as compared to the region's average of 43.66 tons.

The moderate productivity is found in the zones of Patgaon, Madur and Khedage. In this category the intensity of irrigation is also moderate which ranges between 8-16 percent. The average sugarcane yield per hectare (38 tons) is restricted due to soil constraints and rugged topography.

The rest of the region, particularly the northern and southern hilly tract, presents low sugarcane productivity (28 tons) where the intensity of irrigation is below 8 percent. The low productivity is affected by poor soils, hilly terrain and scarcity of water during summer months. In the far east, in Mudhal zone, the productivity is hampered by low rainfall and poor development of water resources.

Spatial pattern of wheat productivity :

Wheat is a rabi crop in this region which is grown after the harvest of rice. It covers only 2.32 percent of the cultivated area and 22 percent of the total irrigated area. In the western part of Upper Vedganga basin, comprising the zones of Patgaon, Palyachahuda and Anturli, the wheat cultivation is absent due to unfavourable climatic conditions and poor development of irrigation facilities.

Wheat productivity zones follow almost the same to the sugarcane productivity patterns in the region (Fig.3.2-B).

The region's average yield per hectare of wheat is 7.49 quintals. Along the river valley, the wheat productivity is high due to availability of lift irrigation, fertile soils. Away from the river valley, however, the productivity is found to be decreased.

Nitavade and Karambali zone experiences productivity more as two and half times than the region's average. The another high productivity region, consisting Akurde and Darwad zones, has the productivity double to the region's average.

The moderate and low productivity zones are noted to southern and northern hill zones of the region. The region is sloppy, infertile where the raning co-efficient moves above 7.5.

Temporal changes in sugarcane and wheat productivity :

Despite the spatial changes, the region experiences the temporal disparities in crop production. Table 3.1 shows that there is 12.82 percent increase in irrigated area from 1960-61 to 1985-86. Though the area under sugarcane is comparatively more in 1960-61, the yield per hectare is increased by 17.66 tons from 1960-61.

TABLE 3.1 : Irrigated area and production of crops (1960-86).

Year	Total irrigated Area (hect.)	Sugarcane		Wheat	
		Area hect.	Yield per hect. (tons)	Area hect.	Yield per hect. (quintals)
1960-61	1714	1529	26.00	125	6.00
1985-86	2218	1455	43.66	490	7.49

SOURCE : Compiled by the Author, 1986-87.

The irrigated area under wheat is increased by 11 percent in 1985-86 whereas sugarcane recorded 61 percent increase in its productivity due to assured irrigation made available through K.T.Weirs. The increase in yield per hect., during these years, is mainly because of high frequency of irrigation which again has facilitated the high use of fertilizers and good quality of seeds.

Overall productivity pattern :

The overall productivity of crops is grouped into five categories (Fig.3.2-C). These are summerised into three classes i.e. high, moderate and low. The ranking co-efficient of overall productivity ranges from 1.5 at Karambali to 12.12 at Padkhambe. The average ranking co-efficient for the region is 7.49. The regional disparities therein are well reflected in the levels of irrigation development (Fig.2.4-A).

High productivity region :

It consists of the zones of Nitavade, Karambali, Darwad and Akurde with the ranking co-efficient below 5. Comparatively this part is agriculturally developed as it possesses favourable attributes like fertile soils, irrigation facilities and familarity of farmers with new techniques.

Moderate productivity region :

Moderate productivity is found where there is moderate development of irrigation facilities. The zones of Madur,

Patagaon and Khedage lies in this region where ranking coefficients vary from 5 to 7.5. This zone has relatively less fertile soils and scarcity of water during dry periods.

Low productivity region :

The zones lying to the north and south and far east of the region have experienced low level of agricultural productivity. Of the fifteen zone it includes seven showing the index value of above 7.5. Padkhambe zone has witnessed lowest productivity (12.12) in the region. This region has rugged topography, sloppy lands, coarse laterite soils and moreover lack of irrigation. This part has remained as a 'weaker and agriculturally backward' region in Upper Vedganga basin.

2. IRRIGATION AND FERTILIZER CONSUMPTION :

The application of fertilizer to agricultural land has become a common phenomenon during the recent past. This has boosted up the agricultural productivity considerably. Fertilizer is land saving as well as labour saving input and its land augmenting character has attracted much attention (Jadhav and Shinde,1979). The per hectare consumption of fertilizers is a fair representation of the regional resources like resource endowment and infra-structural facilities in agricultural sector (Sharma,P.V.1974). In fact the adoption of improved agricultural practices like HYV seeds, chemical fertilizers are closely associated with irrigation facilities.

An attempt has been made in this study to assess the impact of irrigation on fertilizer consumption. Obviously, it would be worthwhile to formulate the hypothesis as 'irrigation promotes the use of fertilizers in the region'.

It is observed through the field work, undertaken by the author that the use of fertilizers is very high in case of irrigated crops as compared to rainfed crops. Sugarcane, being a dominant crop of all irrigated crops, the fertilizer consumption of it is considered as a representative. In the present study, an attempt is made to analyse the spatial pattern of fertilizer consumption per 100 hectares of irrigated land. The data of fertilizer consumption per hectare in each sample village is obtained through intensive fieldwork. The data, thus obtained, were analysed with the help of following formula to calculate the index values of fertilizer consumption per unit area.

$$If = \frac{Zf}{Rf} \times 100$$

Where, If = Index of fertilizer consumption

Zf = Fertilizer consumption per 100 hectares of irrigated area in 'a' zone

Rf = Fertilizer consumption per 100 hectares of irrigated area in the region

The indices, thus obtained, were arranged in ascending order and designated the respective zones as low, moderate, high and very high on the basis of their fertilizer consumption. The map showing the spatial pattern of fertilizer consumption is superimposed on the map showing the intensity of irrigation (Fig.2.4-A) and further the relationship is observed.

Spatial pattern of fertilizer consumption :

The average fertilizer consumption for the region is 118.33 tons per 100 hectares of irrigated land. The consumption within the region varies between 70 to 210 tons per 100 hectares of irrigated area. Fig.3.3-A shows the spatial pattern of fertilizer consumption in 1985-86. The figure clearly points out that the fertilizer consumption is far from even in the study region. Such regional disparity may be attributed to the physical, social and economic conditions. It is also evident from the superimposition of Figs.2.4-A and 3.3-A that there is high positive correlationship between these two variables. The entire region is grouped into three levels of fertilizer consumption. They are :-

1) Region of low consumption :-

This category includes the only zone Palyachahuda where the intensity of irrigation is also low (below 8 percent). The fertilizer consumption per 100 hectares of irrigated land here is 70 tons. The hilly terrain, water scarcity, poor economic

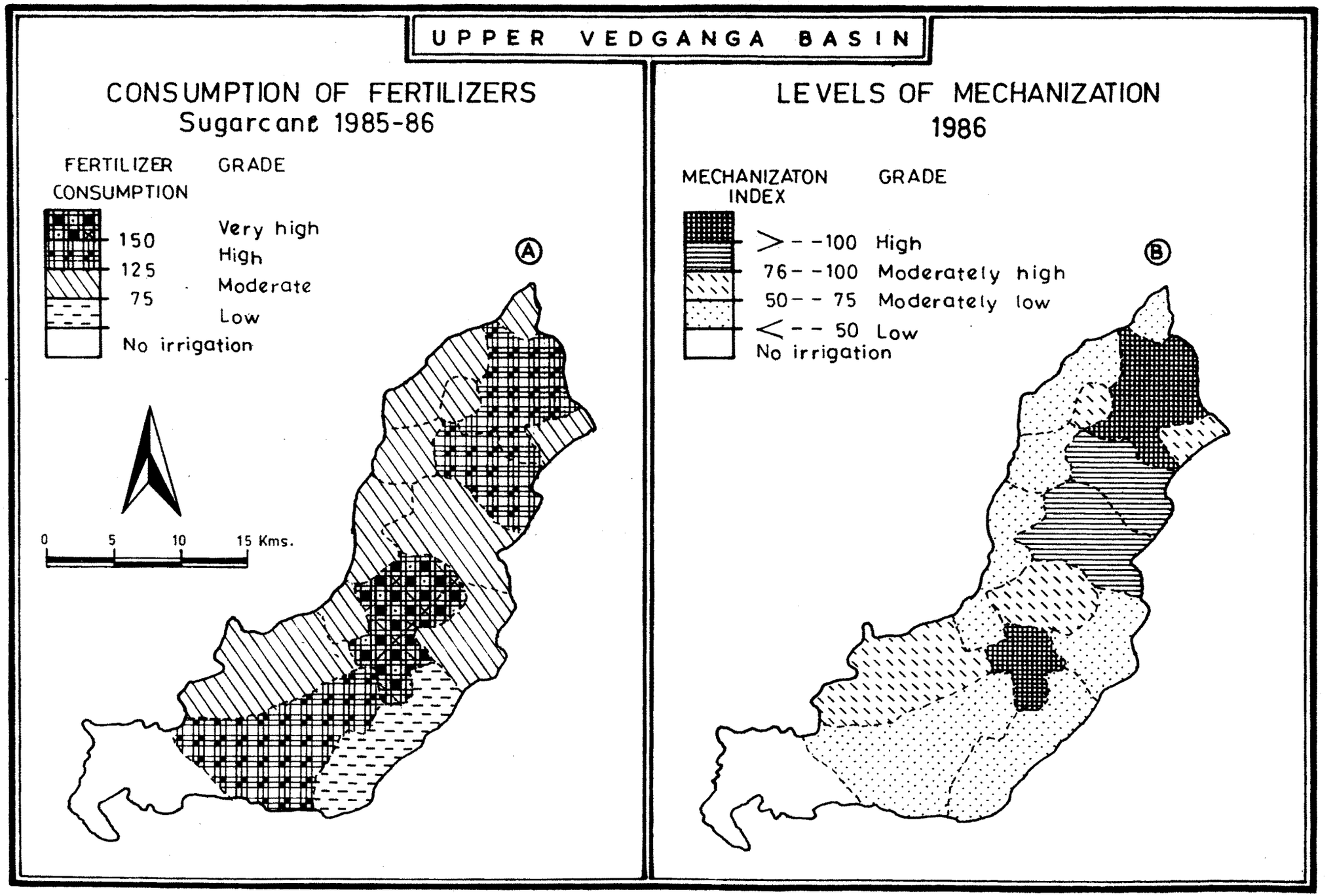
UPPER VEDGANGA BASIN
CONSUMPTION OF FERTILIZERS
Sugarcane 1985-86
FERTILIZER CONSUMPTION
GRADE
150
125
75
Very high
High
Moderate
Low
No irrigation
A
0
5
10
15 Kms.
LEVELS OF MECHANIZATION
1986
MECHANIZATON INDEX
GRADE
> - -100 High
76- -100 Moderately high
50- - 75 Moderately low
< - - 50 Low
No irrigation
B

Fig. 3·3

conditions of the farmers have resulted into low consumption level of fertilizers in this zone. This region may be called as 'Weaker zone' in regards to fertilizer consumption.

ii) Region of moderate consumption :-

Out of fifteen, this category consists of nine zones, Viz. Mudal, Tikewadi, Ambavane, Hedvade, Khedage, Minche (Kr.), Madur, Padkhambe and Anturli. The index values of fertilizer consumption range from 75 to 125. The region has moderate intensity of irrigation(8 to 16 percent) and moderate fertilizer consumption ranging between 90 to 140 tons per 100 hectares of irrigated land. Though, the zones except Madur and Anturli have low irrigation development, the consumption is moderate because these zones are characterised by other sources of irrigation which are almost perennial. Madur zone faces the problem of water scarcity. The river water is not permitted to lift in summer months in this zone because the water in the river is used for drinking purpose to taluka place Gargoti. The physiographic limitations and poor soils have resulted the moderate consumption of fertilizers in this region.

iii) Region of high consumption :-

This region comprises the zones of Darwad, Akurde,, Nitavade, Karambali and Patagaon. These zones are located along the river valley (Fig.3.3-A). The intensity of

irrigation here is above 16 percent except Patgaon. The fertilizer per 100 hectares of irrigated land is above 140 tons when the zonal average is 170 tons. The consumption is quite high in Karambali (210 tons). Though the intensity of irrigation is low in Patgaon, whatever water for irrigation is available there, is adequate encouraging the farmers to use fertilizers. High to very high intensity of irrigation, presence of alluvial soils have caused to high consumption of fertilizers in this region.

3. IRRIGATION AND MECHANIZATION :

The developments in irrigation are always regarded as stimulant to modernise agriculture. Such modernization takes place only when the farmers can afford themselves to invest in the process of development of agriculture. The ability of farmer to invest in agricultural sector has been determined by irrigation as it promotes income level. Mechanization of agriculture is the essential characteristic of irrigated areas. An assured irrigation, therefore, paves the way for mechanization. Mechanization here refers to the available number of modern implements in the form of tractors, electric pumps, oil engines etc. Thus, mechanization indicates the use of inanimate power in agriculture.

Agricultural mechanization is one of the most important indicators of agricultural development which, in turn, reflects the social, economic background of the region (Rajapati Ram,1979).

Any region moves fast towards modernization with the adoption of mechanization in agriculture. The adoption of different machines in agriculture are closely associated with irrigation facilities. It is a common belief theat Indian farmers can increase their agricultural production to a considerable extent by adopting most of the agricultural innovations if they are supplied with adequate and assured irrigation facilities (Mohammad and Majeet, 1979).

In the succeeding analysis an attempt has been made to examine the spatial pattern of the levels of mechanization and correlate it with irrigation. This would certainly reveal the fact that how irrigation is instrumental to enhance mechanization. It is, therefore, proposed to formulate hypothesis as 'irrigation influences the level of mechanization and it is positively correlated to mechanization.

In the present study, tractors, electric motors 'EM) and oil engines (OE) have been taken into consideration in measuring the level of mechanization. The data pertaining to the number of tractors, EM and OE in each zone is collected and the index values for each machine in each zone are obtained with the help of following formula :-

$$Ia = = \frac{Za}{Ra} \times 100$$

Where, Ia = Index of 'a' machine

Za = The number of 'a' machine per 100 hectares of irrigated land in a zone

Ra = The number of 'a' machine for per 100 hectares of irrigated area in the region

The indices, thus, are obtained for each machine for fifteen zones. The composite index of mechanization is then derived by adding the three indices and dividing them by the number i.e. three. The indices were arranged in ascending order and the emerging respective zones were designated as low, moderately low, moderately high and high. The map, showing the levels of mechanization is then superimposed on the map showing the intensity of irrigation to find out the relationship. This has enabled the author to assess the impact of irrigation on mechanization.

Spatial pattern of levels of Mechanization :

Fig.3.3-B, indicates that there is heterogenety in the levels of mechanization in the region. The superimposition of Fig.2.4-A and 3.3-B clearly indicates that the level of mechanization corresponds with the pattern of irrigation intensity. The levels of mechanization are shown spatially and grouped into four categories.

Region of low level of mechanization :

This category comprises the area of hill ranges in the north, south and west. It includes zones of Patagaon,

Palyachahuda, Pakhambe, Khedge, Tikewadi, Mudal and Hedvade. This region records, low intensity of irrigation (below 8 percent), poor soils, sloppy and hilly topography putting the limits to irrigation developments which in turn has resulted into low level of mechanization.

Region of moderately low mechanization :

The mechanization index value in this category ranges between 50 to 75. Anturli, Nitavade, Ambavane and Minche (Kr.) zones cover this category. Except Nitavade, all other zones have low irrigation intensity (below 8%), but still they fall in this category because Minche (Kr.) and Ambavane zone have dominant well irrigation. Besides this, Anturli zone is characterized by a large number of small farmers who have set pumps independantly on the river side. This has led to increase the number of machines despite the low proportion of the irrigated area. The reverse is the case of Nitavade where the machines of lifting water are less in number but having high H.P., irrigate quite extensive lands.

Region of moderately high mechanization :

This covers the zones of Akurde and Madur. In this region intensity of irrigation is moderate and the index values range between 76 to 100.

Region of high mechanization :

This region falls into Karambali and Darwad where the intensity of irrigation is moderate to high (above 16 percent).

This region possesses comparatively extensive plain and fertile land, assured water supply which again has resulted into high productivity of crops. Due to this people earn more and they can offord to have machines of their own.

SUMMARY :

The above discussions reveals that the region marks regional disparities in agricultural productivity, use of fertilizers and in the level of mechanization. The study also indicates that these three aspects are closely related to the irrigation facilities in the region.

Irrigation plays a vital role in enhancing the crop yield. The indices dipicted on map show spatial variation of agricultural productivity, following the pattern of intensity of irrigation. The fertile river plains, endowed with substantial irrigation facilities, have recorded sustained level of agricultural productivity. This, however, affected adversely away from the river course due to declining intensity of irrigation, coarseness of soils and rugged nature of topography. Thus, the productivity zones are parallel to river course and corresponds with irrigation facilities. Apart from this, the crop yields within the river valley vary spatially according to the frequency of irrigation..

The discussion of fertilizer consumption reveals that the high and very high use of fertilizers is confined to the

areas having high intensity of irrigation, particularly to the main valley areas of the region. Towards the north, south and far east the consumption declines significantly where the intensity of irrigation is also less. In Madur and Padkhambe the available sources of irrigation are seasonal in nature which have resulted into moderate and low consumption respectively.

It is evident from the analysis of irrigation and mechanization that the high level of mechanization is confined to the areas having high intensity of irrigation which includes the valley area. The low level of mechanization is observed in the west, north and south due to low development of irrigation facilities, resulted from adverse topographic conditions and inadequate water availability.

4. CORRELATION ANALYSIS :

The index values pertaining to intensity of irrigation, consumption of fertilizers, agricultural productivity and mechanization were calculated for fifteen zones in the region. Based on these indices the correlation matrix is attempted here by using the Pearson's Co-efficient correlation (r) formula as -

$$r = \left\{ xy - \frac{\Sigma x \ \Sigma y}{N} \right\} \Big/ \sqrt{\frac{\Sigma x^2 - (\Sigma x)^2}{n}} \ \sqrt{\frac{\Sigma y^2 - (\Sigma y)^2}{n}}$$

Where, X = Independent variable

Y = Dependent variable

N = Number of observation

The following indicators were selected to work out the correlation matrix :

X1 = Intensity of irrigation

X2 = Consumption of fertilizers

X3 = Agricultural productivity

X4 = Mechanization index

X5 = Mean annual rainfall (mm)

TABLE 3.2 : Correlation Matrix.

	X_1	X_2	X_3	X_4	X_5
X1	1.00	0.81	0.86	0.83	- 0.28
X_2		1.00	0.91	0.36	+ 0.21
X_3			1.00	0.01	- 0.02
X_4				1.00	- 0.40
X_5					1.00

SOURCE : Compiled by the author, 1986.

Although soil happens to be influencing variable, the same has not been analysed here due to lack of relevent data.

Correlation matrix was, therefore, obtained for the above indicators which shows the broad relationships among themselves. The high, medium and low classes of relationship are considered here which range as 0.60, 0.30 - 0.60 and 0.30 'r' values respectively (Table 3.2).

1) Correlation of intensity of irrigation (X1) with other variables :

Table 3.2, indicates that there is high positive correlationship with fertilizer (+0.81), agricultural productivity (+0.86) and mechanization (+0.83). It is obvious that the increases in the intensity of irrigation corresponds with the increase in fertilizers use, agricultural productivity and mechanization. But irrigation intensity is negatively correlated with rainfall (-0.28). This is true because of the fact that the region, with high amount of rainfall, in the north, south and the west, experiences low intensity of irrigation due to poor soils and hilly terrain. Along the river valley and in the eastern plains, however, there is remarkable decrease in rainfall with high irrigation intensity due to comparatively rich soils, gentle sloppy land and substantial water availability within the river course.

2) Correlation of fertilizer consumption (X2) with other variables :

Table 3.2, also reveals that the fertilizer consumption is positively related to the other inputs. The highest correlation

(0.91) is found between fertilizer and agricultural productivity. Mechanisation is developed in the irrigated areas where the fertilizer consumption is high which shows medium positive relationship (0.36). The relationship of fertilizer with rainfall is low (0.21). Due to rugged topography, poor soils and low development of irrigation, the fertilizer consumption is less in the hilly tract of the west, north and south.

3) Correlationship of agricultural productivity (X3) with other variables :

As already discussed that there is high positive relationship of agricultural productivity with irrigation, fertilizer and mechanization. The productivity has considerably low positive relationship (0.01) with mechanization. It may be attributed to the practice of traditional nature of agriculture. The ample human and animal power is available which is widely used for various agricultural operations resulting into less scope for mechanizations. Rainfall and productivity show negative relationship (-0.02). It may be due to the fact that other variables like soil may affect productivity which is not taken into consideration in this study.

4) Correlation of mechanization (X4) with Other variables :

The mechanization, as already discussed, shows high positive correlationship with the irrigation but medium with

fertilizer and low with agricultural productivity. But it is negatively correlated (-0.40) with rainfall. This may be attributed to sustained purchasing power of farmers in irrigated tracts. The mechanization is highly concentrated in the irrigated parts of the region. In the western, northern and southern hilly tract, the mechanization has less importance though the rainfall is high. Thus, increasing production and income level of farmers in the irrigated tracts has led to promote mechanization.

SUMMARY :

The above study reveals the following facts. There is high positive relationship of irrigation with fertilizer, agricultural productivity and mechanization. The agricultural productivity shows high level relationship with fertilizer, irrigation and very low with that of mechanization. Rainfall is negatively correlated with irrigation, productivity and mechanization. It has low positive relationship with fertilizers.

5. IRRIGATION AND CROPPING PATTERN :

Although agriculture is the main stay of our economy, it is not developed at modern and commercial scale. The country, therefore, needs sound agricultural planning. Agricultural planning cannot be formulated without proper diagnosis of the agricultural characteristics like cropping pattern (Tripathi, 1986).

The cropping pattern denotes the raising of crops in a particular set of time. It is a dynamic phenomenon which changes according to the adoption of new technology. Indeed, no cropping pattern is good for all times to come (Husain, 1979) because the requirements of the society changes which many times compeled to change the existing cropping pattern.

Irrigation is one of the inputs which has dominant impact on cropping pattern. Irrigation acts as an agent in the process of speedy dynamism in cropping pattern. In the present study, the author has attempted the spatial dynamism in cropping pattern occured due to irrigation for the period of 1961-63 to 1983-85. It is proposed to formulate the hypothesis as 'irrigation is instrumental in bringing about the changes in cropping pattern'. In order to test this the analysis for two periods (1961-63 and 1983-85) has been considered.

The distribution of rainfall determines the extent to which a particular crop requires irrigation. In the region under study the kharif crops deserve less irrigation because of the availability of sufficient quantom of rainfall during the kharif season. Almost all rabi crops, more or less, depend on irrigation. Sugarcane, wheat, maize, jowar, gram, vegetables are the main irrigated crops of the region. Of these, sugarcane is a yearly crop and the remaining are rabi crops. The sugarcane, wheat are the dominant crops which at present share more than 80%

of the irrigated area. Besides this, the behavioural nature of the farmer is another variable which influences the cropping pattern. The farmers in irrigated tracts have proved their innovative qualities which cause the change in cropping pattern.

Villagewise data regarding area under sugarcane, rice, groundnut for the above period were collected from village revenue office. The villagewise data, however, for wheat and other irrigated crops for the above period were not available. Wheat being a second ranking irrigated crop, following sugarcane, the author has generated the data through field work. The study also presents analytical account of individual crops in general cropping pattern and irrigated cropping so as to study the direction and extent of change in cropping pattern.

Temporal change in cropping pattern :

Table 3.3 shows the changes in general cropping pattern during the period 1961-63 to 1983-85, the percentages of land under different crops and the temporal change in the cultivated area of individual crops.

The net area sown during the period 1961-63 to 1983-85 has been increased by 1070 hectares. The total cropped area during the same period has also been increased from 20,234 hectares to 21,883 hectares respectively. It may be attributed to the fact that the irrigation has played an important role in the horizontal as well as verticle expansion of crop land in the region.

TABLE 3.3. : Major crops and their percentage to net area sown.

Sr. No.	Crop	1961-63		1983-85		Volume of change
		Area (hect)	% to NAS	Area (hect)	% to NAS	
1	Rice	7,867	39.32	8,710	41.31	+ 2.00
2	Nachani	3,454	17.26	3,653	17.32	+ 0.06
3	Jowar	358	1.79	873	4.14	+ 2.35
4	Wheat	125	0.62	490	2.32	+ 1.70
5	Other cereals	2,114	10.56	2,247	10.65	+ 0.09
6	Pulses	110	0.54	119	0.56	+ 0.02
7	Sugarcane	1,529	7.64	1,455	6.90	- 0.74
8	Oil seeds	921	4.60	1,216	5.76	+ 1.17
9	Non-food crops	3,756	18.77	3,120	14.80	- 3.96

SOURCE : Village revenue records and compiled by the author - 1986.

The general cropping pattern reflects a typical example of underdeveloped agricultural economy where the food crops dominates the cultivated area. Rice dominates the entire region and covers 38.88 percent of the total cropped area in 1961-63. In 1983-85 its area has been increased by 10.71 percent. During the same period the area under jowar, wheat, oilseeds has

increased by 144 percent, 292 percent and 32 percent respectively. The crops like nachani and other cereals including sava, vari etc. which are commercially least important show negligible increase i.e. + 0.06 and + 0.09 percent respectively.

Temporal change in irrigated cropping pattern :

Along with the change in rainfed cropping pattern, the change has been occurred in irrigated cropping pattern too during the period of investigation.

TABLE 3.4 : Irrigated crop landuse.

Crop	1961-63		1983-85		Volume of change
	Area (hect)	% to NAI	Area (hect)	% to NAI	
Sugarcane	1,529	89.20	1,455	65.60	- 23.60
Wheat	125	7.30	490	20.10	+ 12.80
Other crops	60	3.50	273	12.30	+ 08.80
Total	1,714	100.00	2,218	100.00	-

SOURCE : Village revenue records and compiled by the Author, 1986.

Table 3.4, indicates that there is 29.40 percent increase in the total irrigated area during the period under investigation. The same period has witnessed surprising decrease in the area under sugarcane which show - 23.6 percent volume of change. On the other hand, wheat and other irrigated crops particularly jowar

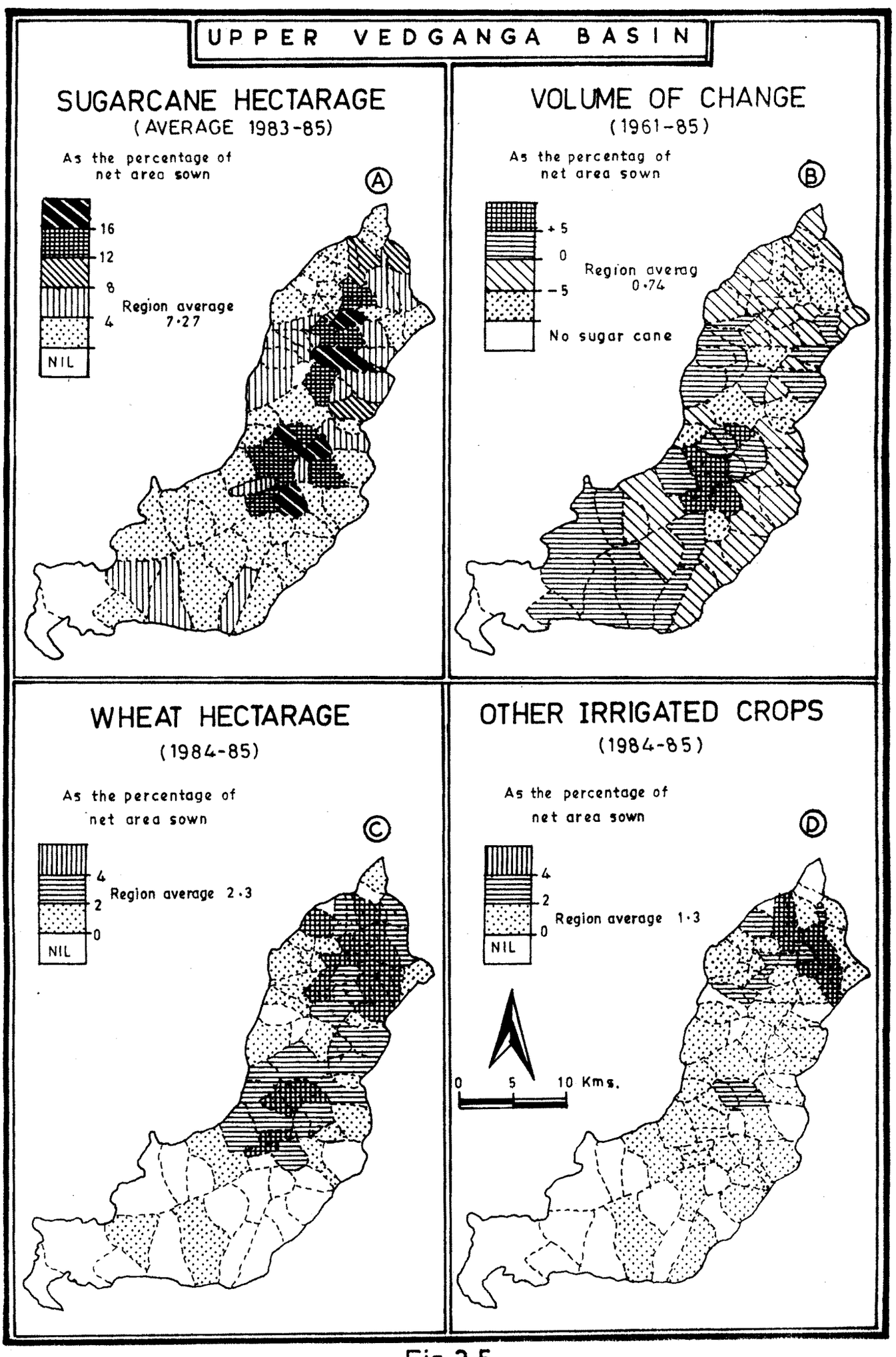
UPPER VEDGANGA BASIN
SUGARCANE HECTARAGE
(AVERAGE 1983-85)
As the percentage of net area sown
A
16
12
8
4
NIL
Region average 7·27
VOLUME OF CHANGE
(1961-85)
As the percentag of net area sown
B
+5
0
−5
Region averag 0·74
No sugar cane
WHEAT HECTARAGE
(1984-85)
As the percentage of net area sown
C
4
2
0
NIL
Region average 2·3
OTHER IRRIGATED CROPS
(1984-85)
As the percentage of net area sown
D
4
2
0
NIL
Region average 1·3
0
5
10 Kms.

Fig. 3·5

locally known as 'Shalu', gram, vegetables, show remarkable increase in their cultivation, registering + 12.8 and + 8.8 percent change respectively. It may be because of the scarcity of water during summer months for the cultivation of sugarcane. The farmers, therefore, have been turning towards the cultivation of irrigated rabi crops.

Spatial change in cropping pattern :

The cropping pattern, both rainfed and irrigated has been changed not only in time but in space too. The spatial dynamism in major irrigated crops is observed as follows.

1. Sugarcane :

The sugarcane, a single dominant crop in the region, occupies 6.95 percent of the net area sown. However, its spatial distribution has been changed during the period under investigation (Fig.3.5-B). The lower part of Upper Vedganga Valley has very high (above 16) to high (8-16) percent area under sugarcane in 1961-63. The same region experiences below 0.1 to - 5 percent volume of change in 1983-85. This is a traditional cane cultivation zone and due to scarcity of water, the farmers, recently have turned towards irrigated rabi crops. Another thing is that though the hectargge under sugarcane is decreased, the farmers have improved the sugarcane productivity. For example, instead of growing one hectare of sugarcane with low yields in the past, the farmers today are growing 1/3 hect. of sugarcane with high yields (Table 3.1).

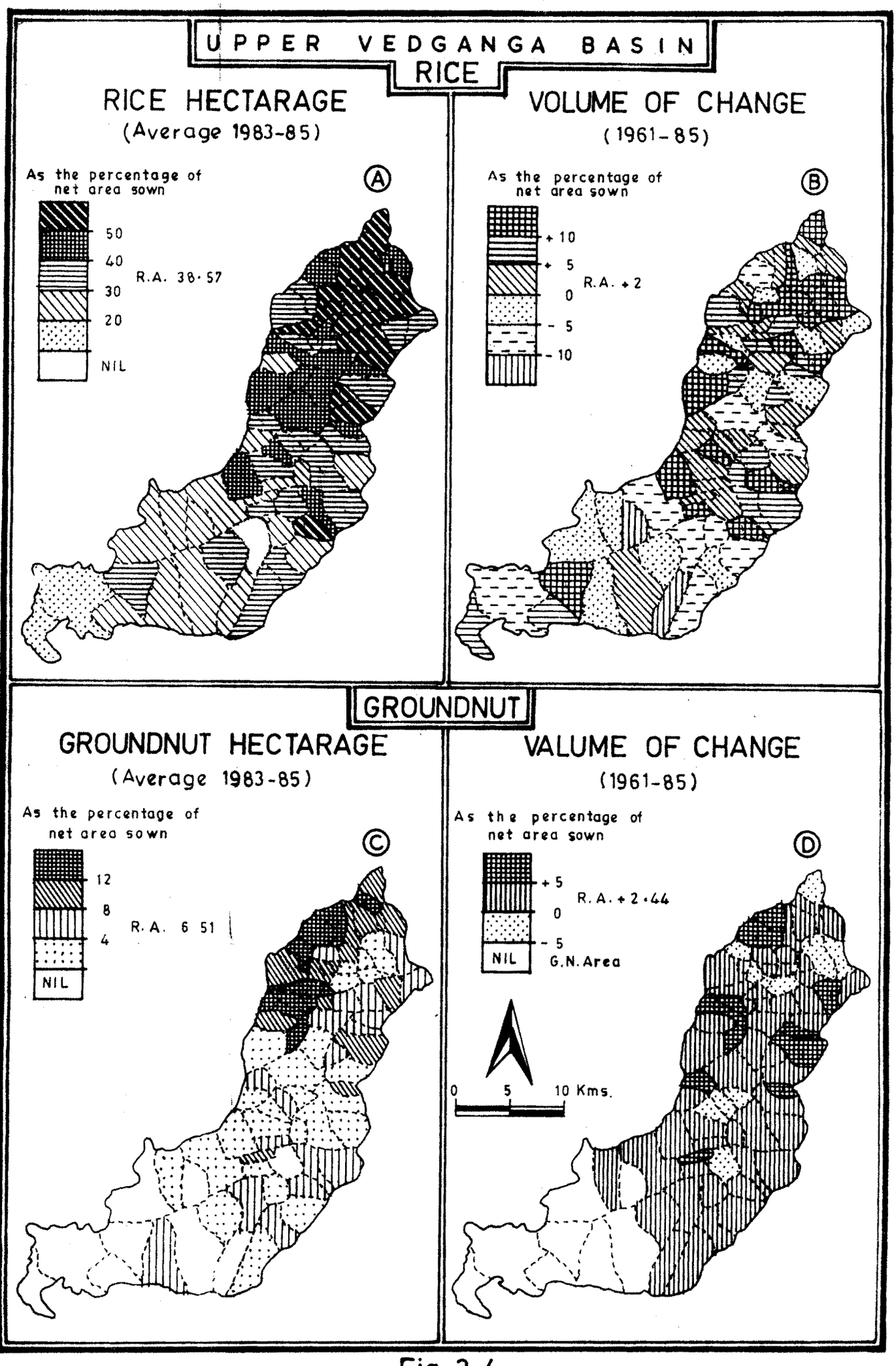
UPPER VEDGANGA BASIN
RICE
RICE HECTARAGE
(Average 1983-85)
As the percentage of net area sown
A
50
40
30
20
NIL
R.A. 38·57
VOLUME OF CHANGE
(1961-85)
As the percentage of net area sown
B
+ 10
+ 5
0
- 5
- 10
R.A. + 2
GROUNDNUT
GROUNDNUT HECTARAGE
(Average 1983-85)
As the percentage of net area sown
C
12
8
4
NIL
R.A. 6 51
VALUME OF CHANGE
(1961-85)
As the percentage of net area sown
D
+ 5
0
- 5
NIL
R.A. + 2·44
G.N. Area
0
5
10 Kms.

Fig. 3·4

In the middle part of the valley, 6 villages had moderate percent (8-12) of area uhder sugarcane in 1961-63 when it registered the volume of change above 0.1 and somewhere above 5 percent (Fig.3.5-B). This zone is newly coming up as irrigated part due to the construction of K.T. Weirs. There are small villages like Shivadav, Anturli, Mani, Chivale, Hanamante which had no sugarcane cultivation during 1961-63. These, however, experienced 0.1 to 5 percent volume of change for the period of investigation. Thus, agriculturally backward region, is also taking advantages of water resources and growing sugarcane today.

2. Wheat :

Wheat, a rabi crop, is a second ranking irrigated crop of the region. As the villagewise data of area under wheat, for the period 1961-63, is not available, the volume of change has not been attempted. But Table 3.1 and Fig.3.5-C clearly points out that there is remarkable growth in wheat cultivation.

The decrease in sugarcane hectarage (Fig.3.5-B), increase in rice hectarage (Fig.3.4-B), increase in groundnut hectarage (Fig.3.4-D), increase in jowar hectarage (volume of change + 2.35 percent) have mostly resulted into the steady growth in wheat cultivation. In the earthern part of the region much of the area under sugarcane in 1961-63 is replaced by the rainfed crops which again is used for wheat and other irrigated crops.

This situation is existed due to the scarcity of wheat in summer months. Secondly, the high yielding varieties of rice, jowar and groundnut give good yields to the farmers and on the same piece of land the wheat is cultivated as a rabi crop which requires less quantom of irrigated water as compared to sugarcane.

The same is true in case of other irrigated crops (Fig.3.5-D). The area under these crops is highly concentrated in the eastern part of Upper Vedganga Valley. The other parts of the region show 0.1 to 2 percent area under these crops. The area under these crops accounts for 273 hectares in 1983-85 but it was only 60 hectares in 1961-63 (Table 3.4). It is observed that the shift from cereals and even sugarcane to wheat and other irrigated crops is remarkable in the region.

SUMMARY :

The study reveals that there is spatio-temporal change in the irrigated cropping pattern. Irrigation is responsible in bringing about this change. The traditional cane cultivation is reducing and the irrigated rabi crops are covering more hectarage in the region due to the scarcity of water. The dominancy of sugarcane area in the east is shifted to the west due to good water resources and irrigation facilities while the irrigated rabi crops are concentrated in eastern portion of the region. The emphasis on rabi irrigated crops has, therefore, shown upward trend in the region.

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