Chapter VII

MEASUREMENT OF AGRICULTURAL PRODUCTIVITY

Productivity as defined in agricultural geography means output per unit of input or per unit of area respectively, and the improvement in agricultural productivity is generally the result of a more efficient use of the factors of production, viz. environment, arable land, labour, capital and the like. Productivity, is a difficult theme, both in concept and in terms of measurement of its level. Therefore, any definition that is adopted is bound to suffer from certain weaknesses. It is important to remember, however, that productivity is a physical rather than a value concept, which describes the relationship between the output and the major inputs like land, labour and capital. The regional differences in agricultural productivity are the result partly of natural advantages of abiotic environment (soils and climate) and partly of farming efficiency as controlled by cultural ecology. Farming efficiency refers to the properties and qualities of various inputs and the manner in which they are combined and put to use for production. Increases in agricultural productivity is largely related to the choice of inputs, and their relative quantities, and the techniques and the skill with which they are used in the production processes.

The level of agricultural productivity or performance, as a concept, means the degree to which the economic, cultural, technical and organizational variables (i.e. the man-made frame) are able to exploit the abiotic resources of the area for agricultural production (Jasbir Singh, 1979). The regional variations in physical output from the soils are the result partly of natural circumstances and partly of human manipulations of the land resources. The regional differences in yields per unit area indicate the magnitude and the direction of the inter-play of a multitude of factors. Furthermore, the level of agricultural productivity or performance is a dynamic concept, as any modification in physical factors and improvement in non-physical bases of farming effect *agriculturaproductkunde* per hectare.

The method of mapping of spatio-temporal characteristics of the level of agricultural productivity provides a rational base for future orientation in agricultural planning. The

pattern of change in level of agricultural productivity in relative terms is a reliable index of the agricultural development in the past. Besides, it can be used as an effective measure for delimiting the areas where even agrarian development could not bring about significant changes and modifications in the crop structure and agricultural production, and which may thereby be termed as *weaker areas* or *area of poverty*.

Measuring the independent control of land, labour and capital on agricultural productivity is extremely difficult because they are complementary rather than isolated aspects. Thus a measure of land productivity, for example, output per hectare would not necessarily be an indicator of land potential, but rather a measure of collective utilization of land, labour and capital. In the same way, labour productivity, for example, output per adult-male unit farm work force or man-days is also a reflection of innate land potentiality and the degree of capital investment. Capital productivity means output per unit of input in monetary values but land and labour efficiency ultimately needs methods which can assess the output and input ratio, and the input should include land, labour and capital.

a) Approaches of the study

Several techniques adopted for computing efficiency in level of agricultural productivity per unit area per unit of time, or per unit of farm work force, etc. are detailed below:

1. Assessing the value of agricultural production per unit area
2. Measuring production per unit of farm labour or man-hour
3. Determining output in relation to input, or output-input ratio and profitability of farming measured in terms of the return for the sum total of human efforts or paid-out-cost in relation to the output (Khusro, 1964)
4. Expressing production of agriculture in terms of grain equivalents per head of population (Buck, 1967; E. de Vries, 1967; Clark and Haswell, 1967)
5. Considering output per unit area or yields per hectare after grading them in ranking order, thereby deriving the ranking coefficient (Kendall, 1939; Stamp, 1960; Shafi, 1960)
6. Giving weightage to the ranking order of the output per unit area with the percentage share under each crop (Sapre and Deshpande, 1964; Bhatia, 1967)
7. Using the carrying capacity of land in terms of population (Stamp, 1958, 1967)
8. Determining an index of productivity (Enyedi, 1964; Shafi, 1972, 1974)
9. Calculating the index number of agricultural efficiency by expressing the per unit area carrying capacity (in terms of population) of the component enumeration unit as a percentage of the per unit area carrying capacity for the entire region (Jasbir Singh, 1972, 1974)
10. Computing the crop yield and concentration indices ranking coefficient (Jasbir Singh, 1976)
11. Involving the area, production and price of each cultivated crop in each of the constituent areal unit of the region, and then relating the out-turn in terms of money of the unit to the corresponding productivity of the region (Hussian, 1976)

12. Delimiting agricultural productivity by computing the intensity and spread indices of three variables, i.e. (i) yield, (ii) grain equivalents, and (iii) cropping system (Singh, V. R., 1979)

Of these, the first three techniques seem to require such statistics as are not readily available and even easily accessible in most of the underdeveloped and developing countries of the world. Technique (3), however, has little validity in a subsistence farm economy where (i) foodgrains dominate and constitute 75 to 85 per cent of all agricultural production, (ii) the major output is retained for domestic consumption, and (iii) most of the inputs are provided by the farmer.

Technique (4) which advocates measuring agricultural progress in terms of grain equivalent per head of population was used for the first time by Buck in 1967. He realized that in a subsistence agricultural economy as in China, productivity expressed in terms of monetary value has no meaning because the crops may be grown for local domestic consumption, and only a small portion of it may be sold for cash. To him, therefore, the natural unit for measuring the level of agricultural productivity in such a community appeared to be the conversion of kilograms of agricultural products into grain equivalents. He considered all grains to be equal in food value. He converted agricultural products other than food grains into grain equivalents according to the local market price at which they are exchanged against food grains which are grown predominantly in a locality.

Technique (5), which works on the basis of hectare-yield statistics of crops, indicates the efficiency of agriculture more adequately. The spatial variation in physical output from land is the result of combinations of natural environment and human activities. Kendall (1939) developed method of determining agricultural efficiency based on output per unit area and devised a system of ranking coefficient.

Sapre and Deshpande (1964) introduced technique (6). They have, in fact, modified the ranking coefficient approach by giving weightage to the area under different crops. They have used the weighted average of ranks instead of the simple average of ranks. The weighted ranks of various crops are proportionate to the percentage of cropland under

each crop. The weighted average of ranks seems to have an inherent weakness which arises from not taking into account the harvested regional strength of crops.

The technique (7) of carrying capacity of land (in terms of population) was suggested by Stamp (1958) in his Presidential Address to the International Geographical Congress at Rio de Janerio in 1956. Stamp (1960) has opined, making some allowances for quality, that higher the output per unit area, greater is the efficiency of the farmer. He had taken into account, first, a standard nutrition unit, this is, to what extent food and land are required to support one average human being and to produce that much amount of food respectively; second, the caloric value of some leading food crops since 90 percent of the world population depends upon food grains. In this approach the production of crops is converted into calories, which then can be used to measure the optimum carrying capacity of land in terms of population. In a sense the carrying capacity is a measure of farming efficiency.

While discussing geographical types of agriculture, Enyedi (1964) devised technique (8) for determining an index of productivity coefficient. Enyedi's formula of productivity index is:

$$\text{Productivity Index} = \frac{Y}{Y_n} \div \frac{T}{T_n}$$

Where Y is the total production of the selected crop in unit area,

Y_n is the total production of the same crop on national scale,

T is the total cropped area of the unit area, and

T_n is the total cropped area at national scale.

Enyedi's technique is appreciable in the sense that it determines the productivity index of an area with reference to national level. However, the technique does not consider that in certain cases the productivity index is influenced by the magnitude of the area under a particular individual crop. Besides, when the district yield is less than the national yield, its productivity index is higher than the national level.

Technique (9) is a modified form of technique (7) and is considered most useful for measuring agricultural efficiency. In those parts of the world which suffer from food

shortage, what matters most in many countries is the actual amount of food produced. After making some allowances for the quality of production (i.e. to change the crop production into caloric values) and the usages and the wastages in the form of seed, cattle feed, storage losses, etc. it can be inferred that higher the caloric output per unit area greater is the carrying capacity of land in terms of population and hence the efficiency of farming. The carrying capacity of agricultural areas, i.e. their maximum caloric return from the soils can be considered as their index of efficiency. The variations in caloric productivity per unit area are the result of differential interaction between the combination of environmental conditions and the combination of human activities.

Technique (10) introduced by Jasbir Singh, (1976) in order to assess the regional differences in the levels of food production and to delimit the weaker areas from the point of view of agricultural production is enough to focus attention only on the important food crops of a region or a country lying in the Oriental World since they are the dominant, primary and secondary crops in terms of agricultural land occupancy. The average food crop yields and proportions of these crops in the total harvested area have been used as twin-elements for measuring the index of the level of food production. For an objective measurement of the level of agricultural productivity, the relative crop yield and concentration indices arranged in ranking order and computed into average ranking coefficients, would give a measure which one may call the crop yield and concentration indices ranking coefficient. The procedure may be explained as follows:

$$Y_i = \frac{Y_{ae}}{Y_{ar}} \times 100$$

Where Y_i is the crop yield index,

Y_{ae} is the average yield per hectare of crop 'a' in the component enumeration unit,

Y_{ar} is the average yield of the crop 'a' in the entire region or country

$$C_i = \frac{P_{ae}}{P_{ar}} \times 100$$

Where C_i is the crop concentration index,

P_{ae} is the percentage strength of crop 'a' in the total harvested are in the component enumeration unit, and

P_{ar} is the percentage strength of crop 'a' in the total harvested area in the entire region or country

The crop yield and concentration indices thus derived for all the regional units and the crops are ranked separately. Yield and concentration ranks for individual crops are added and thereafter divided by 2, thus giving the crop yield and concentration indices ranking coefficient. The equation is :

$$\text{Crop yield and concentration indices Ranking coefficient for crop 'a'} = \frac{\text{Crop yield index ranking of crop 'a} + \text{Crop concentration index ranking of crop 'a'}}{2}$$

The result thus derived will give us an idea of the level of agricultural productivity: the lower the ranking co-efficient, the higher the level of agricultural productivity and vice versa.

Technique (11), put forth by Hussain (1976) for establishing agricultural productivity of the Sutlej-Ganga plains of India, converted the agricultural production into money value of a regional unit in proportion to the whole region. This approach revealed that other things remaining the same, higher the return in terms of value in money, greater is the productivity of land. However, because of variations in crop, combinations and crop prices, this approach suffered in its application in the global perspective.

Singh V. R. (1979), too, advocated approach (12) with which he tried to present a two-dimensional picture of agricultural productivity consisting of intensity and spread. Intensity and spread of three variables, namely, (i) yield, (ii) grain equivalents, and (iii) cropping systems have been taken into consideration to formulate agricultural productivity regions. Logically, this approach seems equally reliable and dependable, but a long chain of formulae makes the procedure excruciatingly lengthy involving enormous and cumbersome calculations. Moreover, this technique does not mirror the agricultural productivity of an area. Rather, two separate maps for intensity and spread have to be

drawn, and thereafter they have to be superimposed for identifying the categories, so subjectivity and personal bias may inadvertently enter into one's inferences at this stage.

To conclude, the techniques for measuring agricultural productivity, efficiency or performance levels should present useful tools for generalizing the overall performance of an area at a given point of time and may possibly be between two points of time to find out dynamic trends in it. Such techniques should have wide applicability so as to comprehend the level of agricultural development. Regional imbalances in farm production obviously call for an intensive effort on the farm so that per unit area yield disparities might be narrowed down.

An analysis of spatial patterns of levels of agricultural productivity is significant for several reasons, the major ones of which may be identified as follows:

1. The overall picture does not, however, give the exact idea of the regional differences in the agricultural production and, that for proper understanding of the situation regional studies are indispensable; and here the regional imbalances in the levels of agricultural productivity have to be recognized.

2. In the age of specialization there is an urgent need to synthesize the two subjects of geography and agriculture for well guided and sound agricultural planning and implementation of package programmes in a country where farming is the mainstay of a large proportion of population and food shortage clouds are always hovering.

3. It may have to be recognized that the impact of the new strategy varies from one regional unit to another, depending on the variable combinations of physical environs and socio-economic, cultural and human circumstances.

4. A survey of spatial differences in the levels of agricultural productivity or efficiency may be useful for differentiating areas whose performances are poor in comparison with other, in spite of the new agricultural strategy.

5. It may help in the delimitation of agricultural production typologies, or areas of prosperity, parity and poverty.

Finally, the geography of agricultural productivity may attempt, first, to map, describe, and interpret the regional imbalances in levels of productivity; second, to demarcate areas with relatively poor performances, and third, since any agricultural revolution rests on capricious nature, it must be reduced either by following irrigation agriculture or dry farming technology. Such attempts will suggest for the acceleration of farm production future agricultural programmes will have to be made flexible and re-examined, re-adjusted and re-cast from time to time in the light of past experiences and accomplishments in the field of agricultural productivity.

b) Measurement of Agricultural Productivity

Our basic idea in this section is to find the regional disparity in productivity amongst the blocks and regions for individual crop. So through this analysis we intend to identify the regions whose yield for individual crops are high. In the previous section we have seen the latest techniques of measuring agricultural productivity wherein population is used as a parameter; but with the objective of identifying regional variation in productivity, inclusion of population as a parameter is felt unwarranted.

We have seen that Enyedi's method attempt to find productivity index using the relation

$$\text{Productivity Index} = \frac{Y}{Y_n} \div \frac{T}{T_n}$$

Where: Y is the total production of the selected crop in unit area,

Y_n is the total production of the same crop on national scale

T is the total cropped area of the unit area, and

T_n is the total cropped area at national scale.

But it is felt that considering the total area of each crop for the block and district is misguiding. We should rather use the relevant area for each crop at the block and region level; so, in our analysis we have modified Enyedi's technique for determining an index of productivity co-efficient, which is discussed below.

Methodology

Productivity index has been calculated using the relation

$$\text{Productivity Index} = \frac{Y}{Y_n} \div \frac{A}{A_n}$$

Where Y, is the total production of the selected crop in the block/region.

Y_n is the total production of the same crop at district level.

A is the total cropped area of the particular crop in the block/region.

A_n total crop area for the same crop at district level

For the purpose of ignoring the fluctuation of the individual years for productivity of individual blocks we have considered the average area and average production in our analysis (Appendix-VII.i to VII.xiii). To gauge the change in productivity over the period we have divided the entire period 1993-1994 to 2000-01 into Period I (1993-94) and Period II (2000-01). We then calculated the productivity index for individual crop for both the periods (Appendix-VII.xiv & VII.xv). We have found that the productivity index varies between 0.12 (Jute- Kaliachak in Period-II) and 6.43 (Jute-Bamongola in Period-II). To enable comparative analysis across blocks it was felt to classify the productivity indices into 5 classes, viz. Very Low (V.L.), Low (L), 'Medium' (M), High (H), and 'Very High' (V.H.).

Table-7.1 shows the ranges in which these productivity indices have been classified

Table: 7.1 Categorization of Productivity Indices

Category	Value
Very Low	Less than 0.9
Low	0.9-1
Medium	1-1.1
High	1.1-1.2
Very High	Grater than 1.2

Thus we are able to identify the level of productivity index for individual crops at block/region level for Period-I and Period-II as discussed above and classify into 5 classes and have plotted Map 7.1 to 7.13. These maps provides the snapshots of the variation in the productivity at the block / region level and also the pattern of change in the productivity.

Cereals: Map 7.1 to 7.4 which analyses the productivity for aus, aman, boro and wheat respectiely shows some interesting pattern.

Aus: It is found that in general the productivity of aus in the blocks of Diara region are comparatively higher than other blocks. Moreover the productivity in Harishchandrapur-I, English-Bazar, Manikchak and Kaliachak-I have increased over the years to 'Very High' level. It is interesting to note that the productivity for Harishchandrapur-II, Chanchal-I, Chanchal-II, Ratua-II, Bamongola and Habibpur have fallen. This change at the block level has resulted in a decline in the productivity for 'Tal' in Period-II over Period-I and increase from 'Low' to 'High' in Diara region over the same period.

Aman: The peculiarity of productivity level of aman in the district and block level is that while in Period-I the level of productivity was 'Low' for all blocks except Ratua-I, Gazole Manikchak with 'Medium' productivity, in Period II there is a wide variation in the productivity levels as Kaliachak-I has become a 'Very High' productive block with Gazole and Habibpur showing 'high' productivity. The productivity of the English Bazar blocks of the district in Period-II has sharply fallen. Aman which happens to be the prime crop of the district requires more attention and thereby increased productivity is expected. The appalling situation of the district is explained by decreasing productivity of aman in many blocks. At region level the direction of productivity change is found to be different, while for 'Tal' the productivity declined from 'Low' to 'Very Low'. Barind maintained its productivity level while Diara's productivity increased from 'Low' to 'High'. This single crop is able to explain that Diara region is improving with higher productivity.

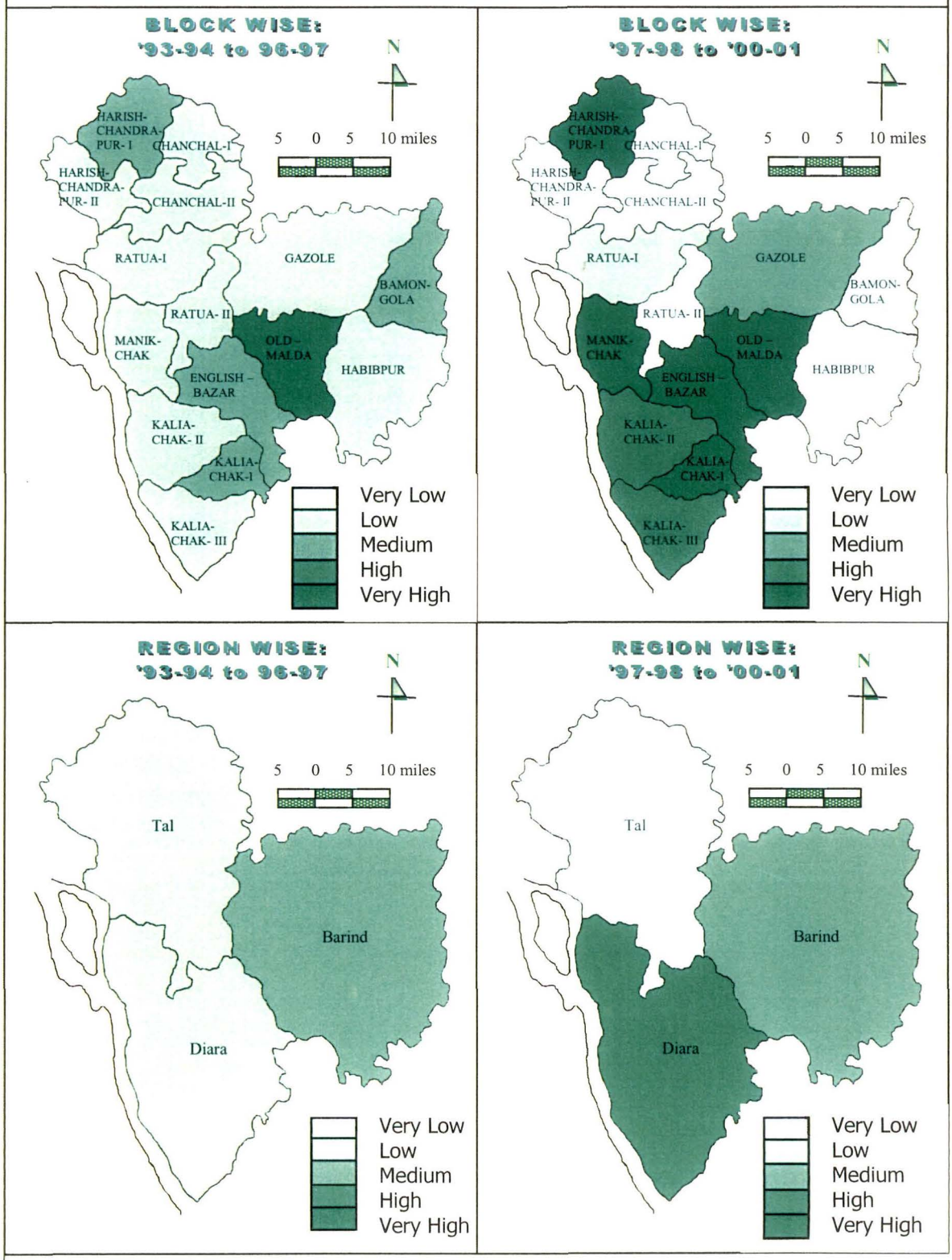
Boro: The other major crop of the district has shown varied productivity levels in Period-II while 'Medium' productivity level in Period-I with an exception in Manikchak ('Low') and Habibpur ('Very Low'). In Period-II Harishchandrapur-II and English Bazar have increased their productivity to 'Very High' level while Gazole has improved its productivity to 'Medium'. But, it is alarming to find the productivity of Ratua-I, Old-Malda, Bamongola, Manikchak, Kaliachak-I, Kaliachak-II and Kaliachak-III to be declining.

At region level Tal and Barind maintained their 'Medium' and 'Low' productivity level respectively over the years whereas Diara's productivity have declined from 'Medium' to 'Very Low' level.

Wheat: Like other cereals wheat also shows the similar pattern of uniform 'Medium' Productivity level in Period-I while varied productivity level in Period-II. Harishchandrapur, English Bazar and Kaliachak-III are the blocks where the productivity increased sharply while for the blocks of Barind region wheat productivity is on the decline. Wheat, a winter crop which requires irrigation facility, is not supported in the Barind region as the region's irrigation facility is not adequate. At region level even Tal shows a decline in productivity.

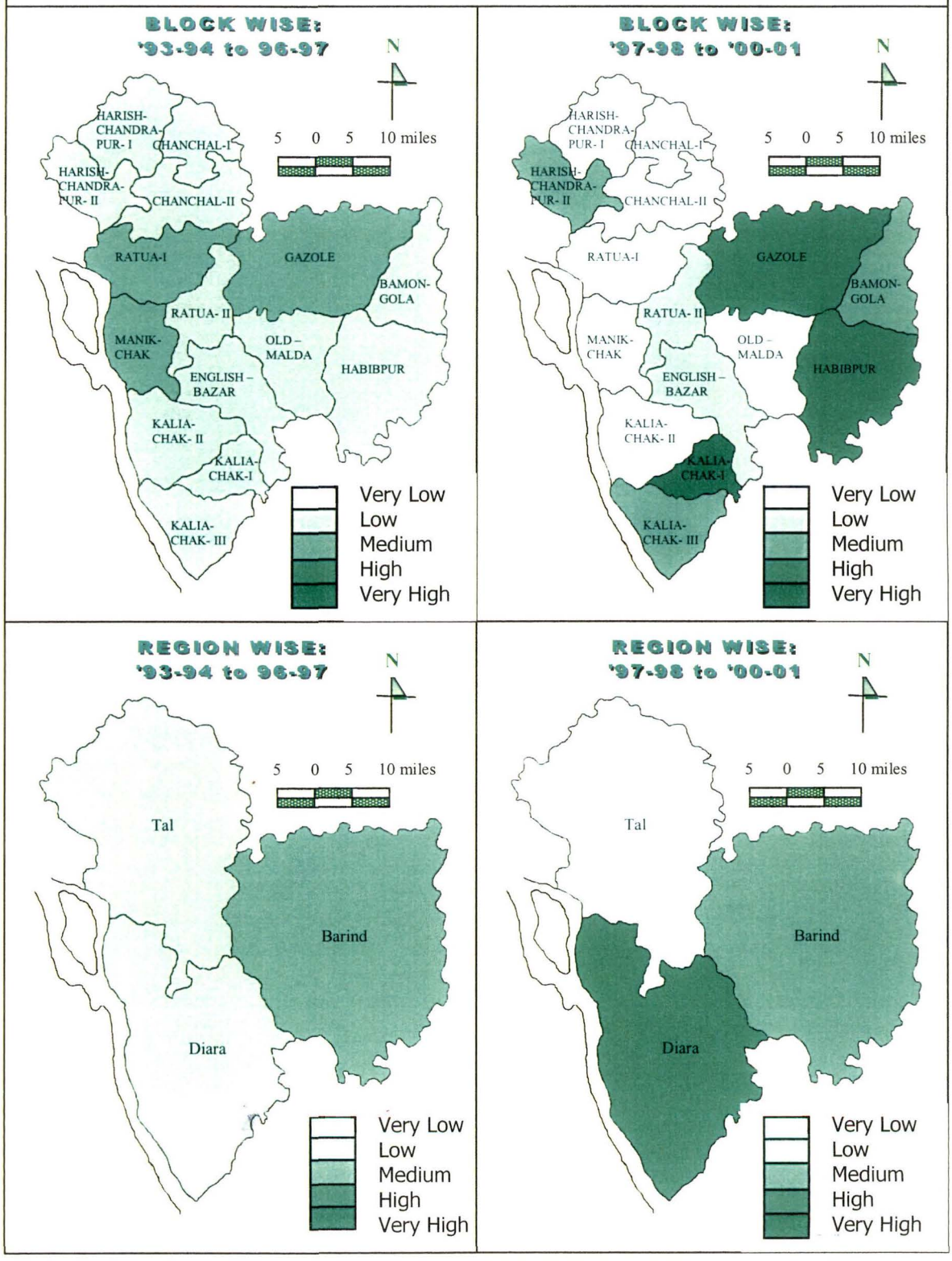
Map No: 7.1

CROP PRODUCTIVITY INDEX: AUS



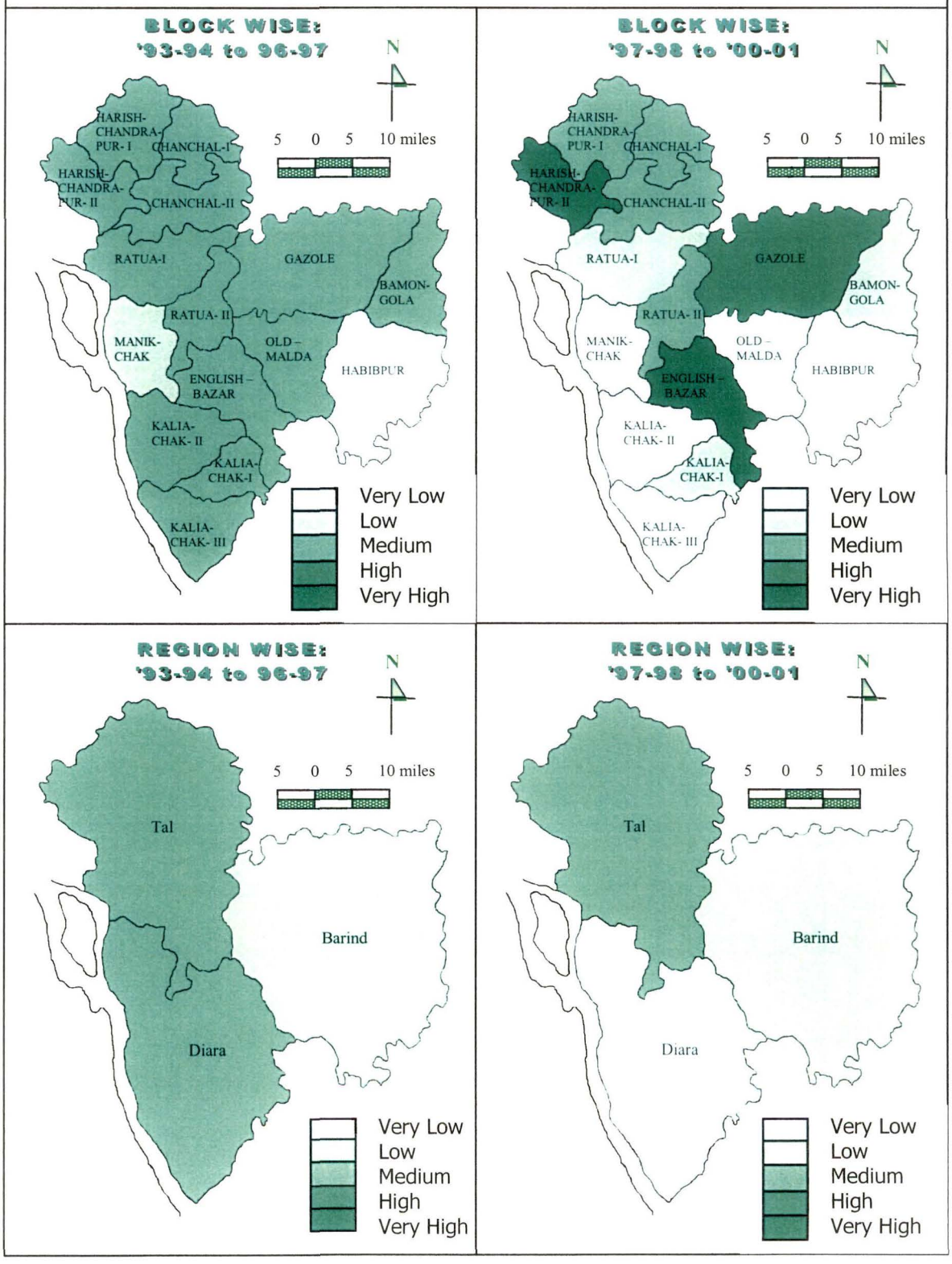
Map No: 7.2

CROP PRODUCTIVITY INDEX: AMAN



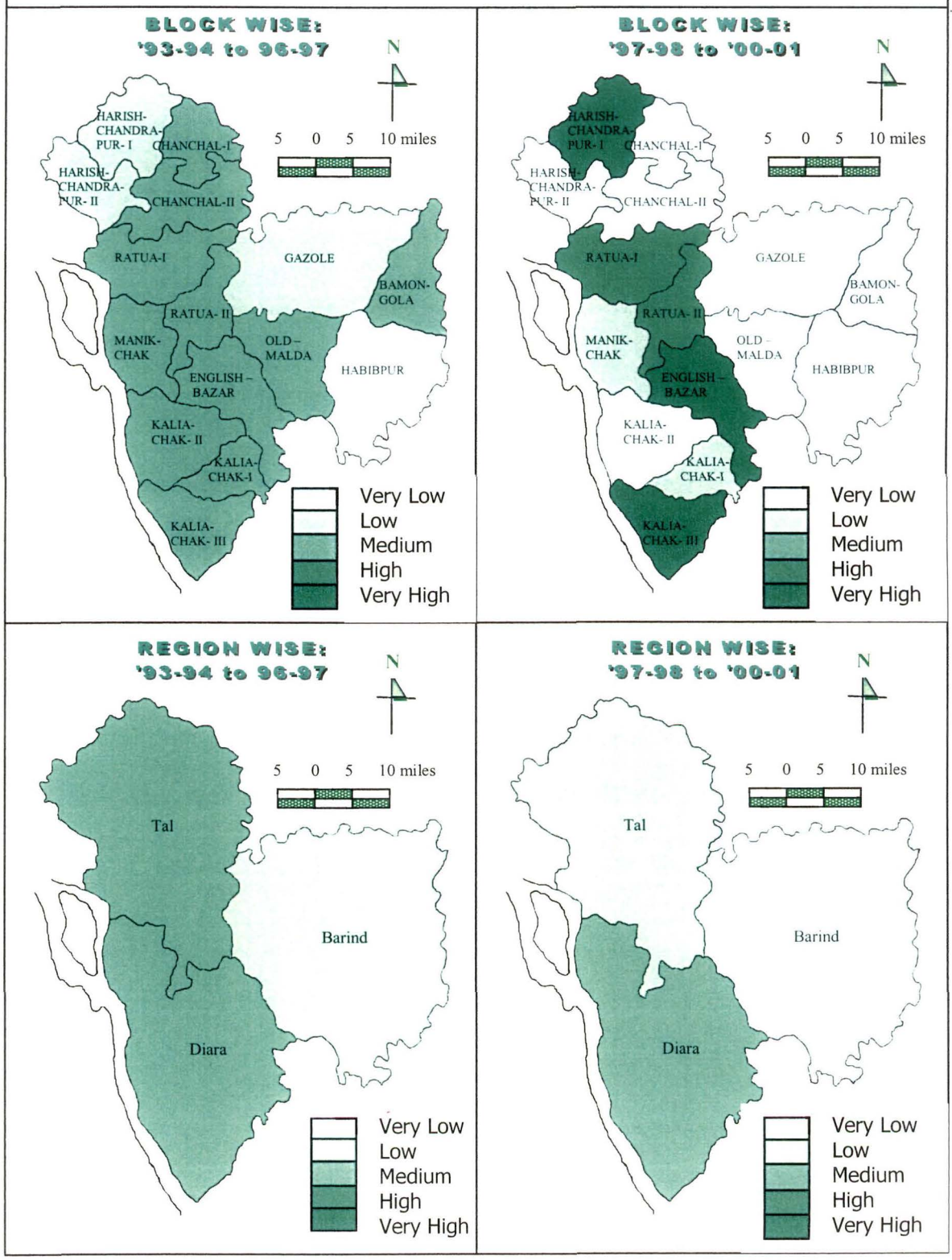
Map No: 7.3

CROP PRODUCTIVITY INDEX: BORO



Map No: 7.4

CROP PRODUCTIVITY INDEX: WHEAT



Pulses: Map 7.5 to 7.8 analyses the productivity for arhar, kalai, gram and lentil individually. The findings are discussed here.

Arhar: For arhar the general level of agricultural productivity during Period-I is 'Low' while in Period-II is 'Very Low'. The block standing out during the two Periods are: Period-I: Harishchandrapur-II, 'Very High'; Old-Malda, 'Medium'; Period-II Gazole and Kaliachak-III, 'Very High'. Thus barring these two blocks the general trend gives an indication that there is a change in agricultural productivity of arhar is distinct. This productivity fall happens along with a decline in area under cultivation of arhar, as discussed in Chapter-V.

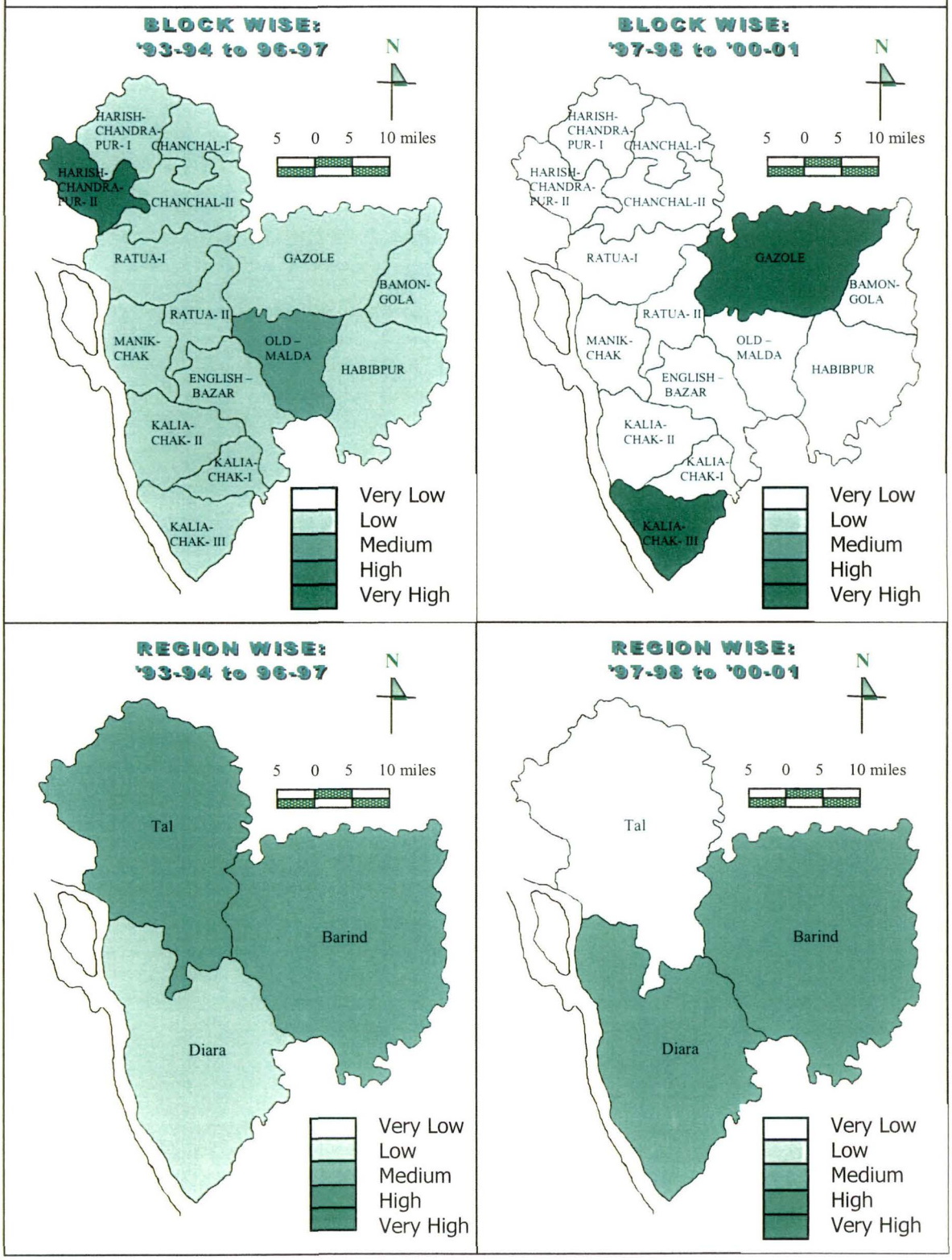
Kalai: The level of crop productivity for kalai matches the regional demarcation as in Period-II, Tal region is found to have 'Very Low' productivity, Barind 'Very High' productivity while Diara 'High' productivity. This regional variation was not at all evident in Period-I where all the blocks, except Harishchandrapur-I, were having 'Medium' productivity. This productivity pattern provides an indication of potential of kalai cultivation in Barind region. But this potential needs to be studied along with area under cultivation as kalai is not found as a significant crop in the Barind region (Findings of Chapter- V)

Gram: In case of gram the productivity and its pattern are similar to that of cereals. In Period-I the blocks are having 'Low' productivity level. Against this in Period-II the blocks show varied productivity levels. Harishchandrapur-I, Habibpur and Kaliachak-III are the blocks wherein productivity has increased significantly. But the rise of productivity in Habibpur is unable to resist the decline in productivity of Barind region as a whole as other there blocks viz. Gazole, Bamongola and Old-Malda slide to 'Very Low' level.

Lentil: the productivity of Lentil across blocks in Period I is comparatively more uniform than Period II. In Period I while Old Malda is having 'Very High' productivity, Ratua I, Bamongola, Kaliachak II show 'Low' productivity and English Bazar and Kaliachak I have 'Very Low' productivity. Others have 'Medium' productivity. In Period II, Ratua II and Kaliachak II have graduated to have 'Very High' productivity. The productivity of Old Malda has sharply dropped to 'Very Low' level. At regional level Tal shows a moderate increase in productivity over the years, while Barind's productivity has fallen.

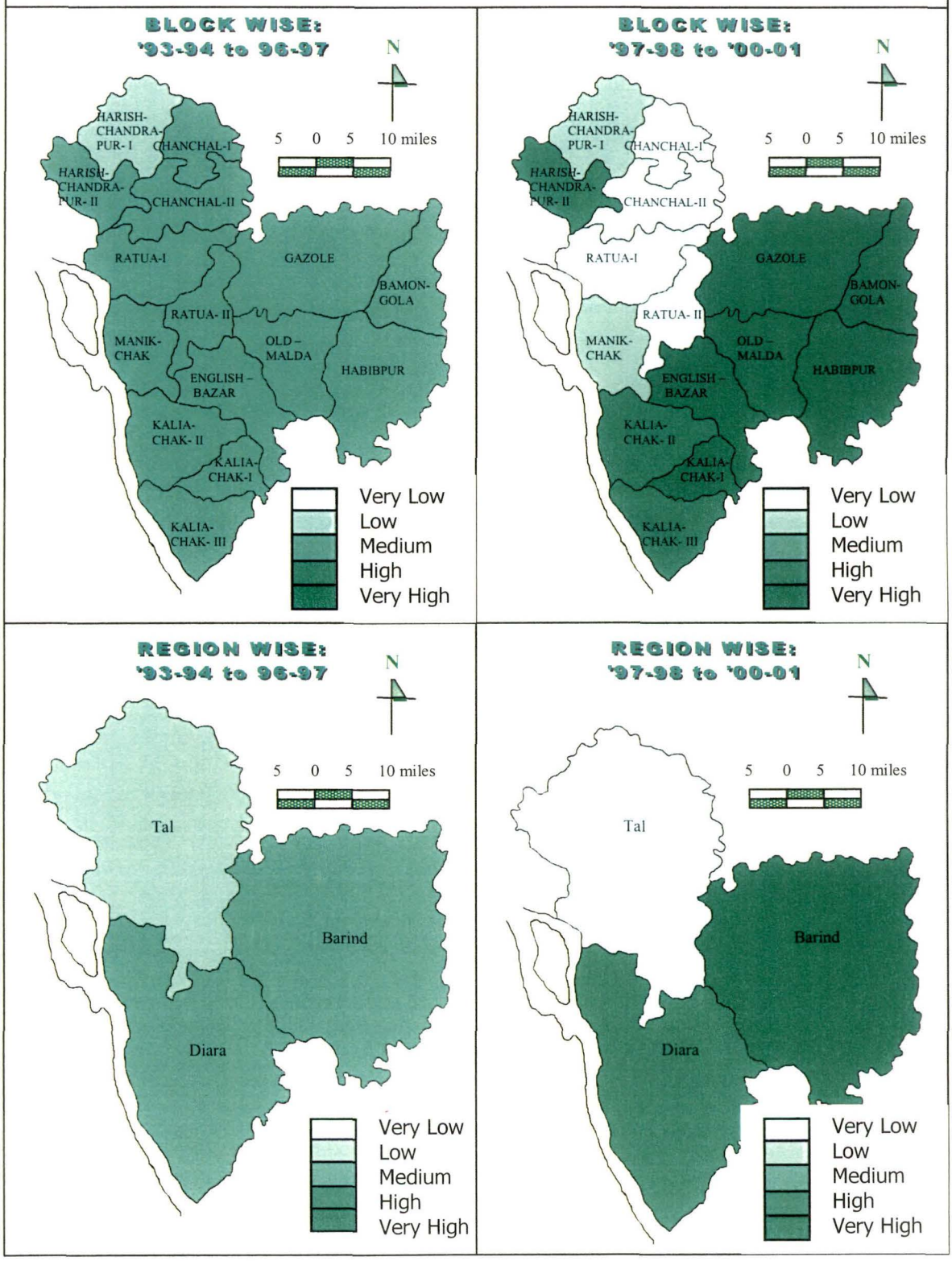
Map No: 7.5

CROP PRODUCTIVITY INDEX: ARHAR



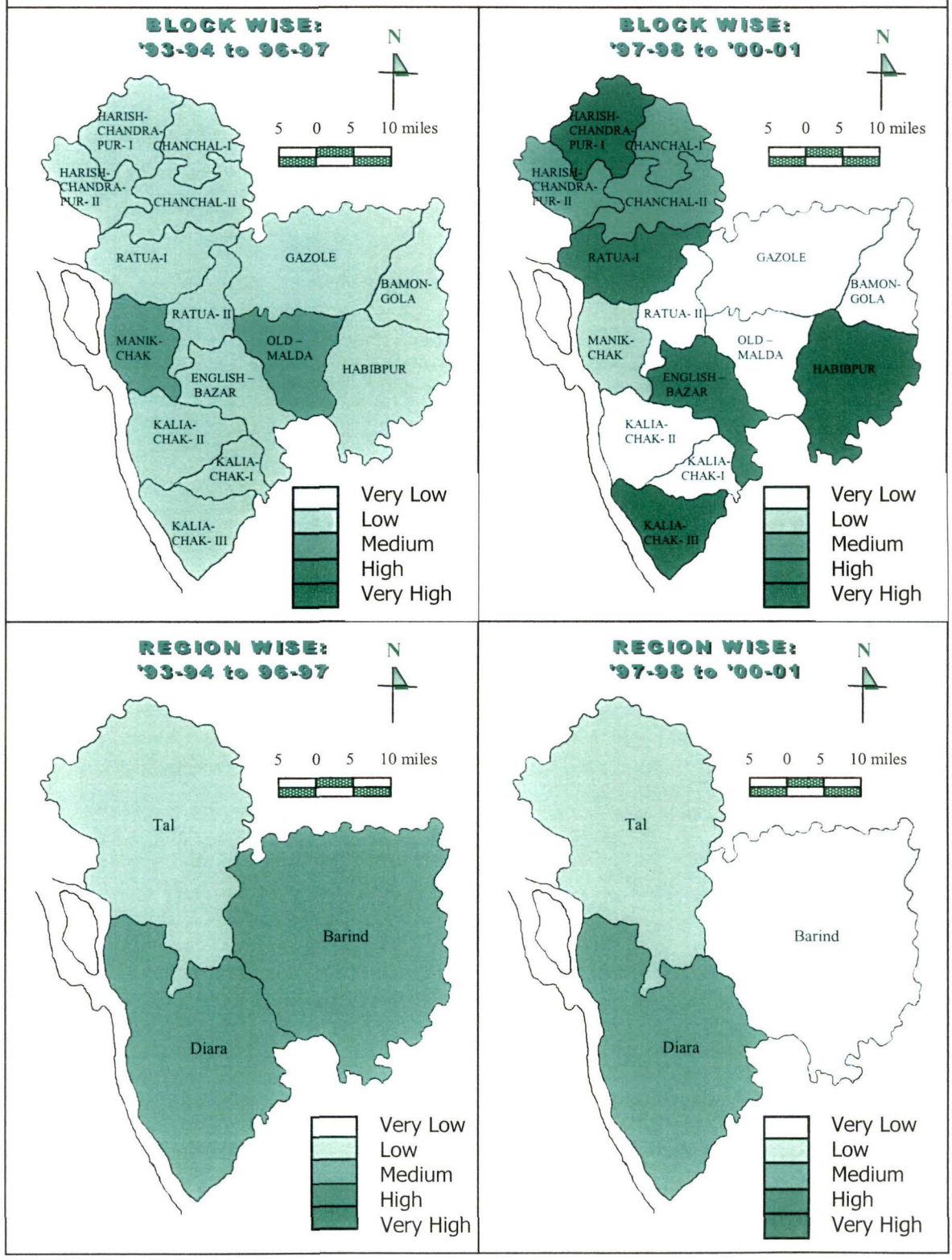
Map No: 7.8

CROP PRODUCTIVITY INDEX: KALAI



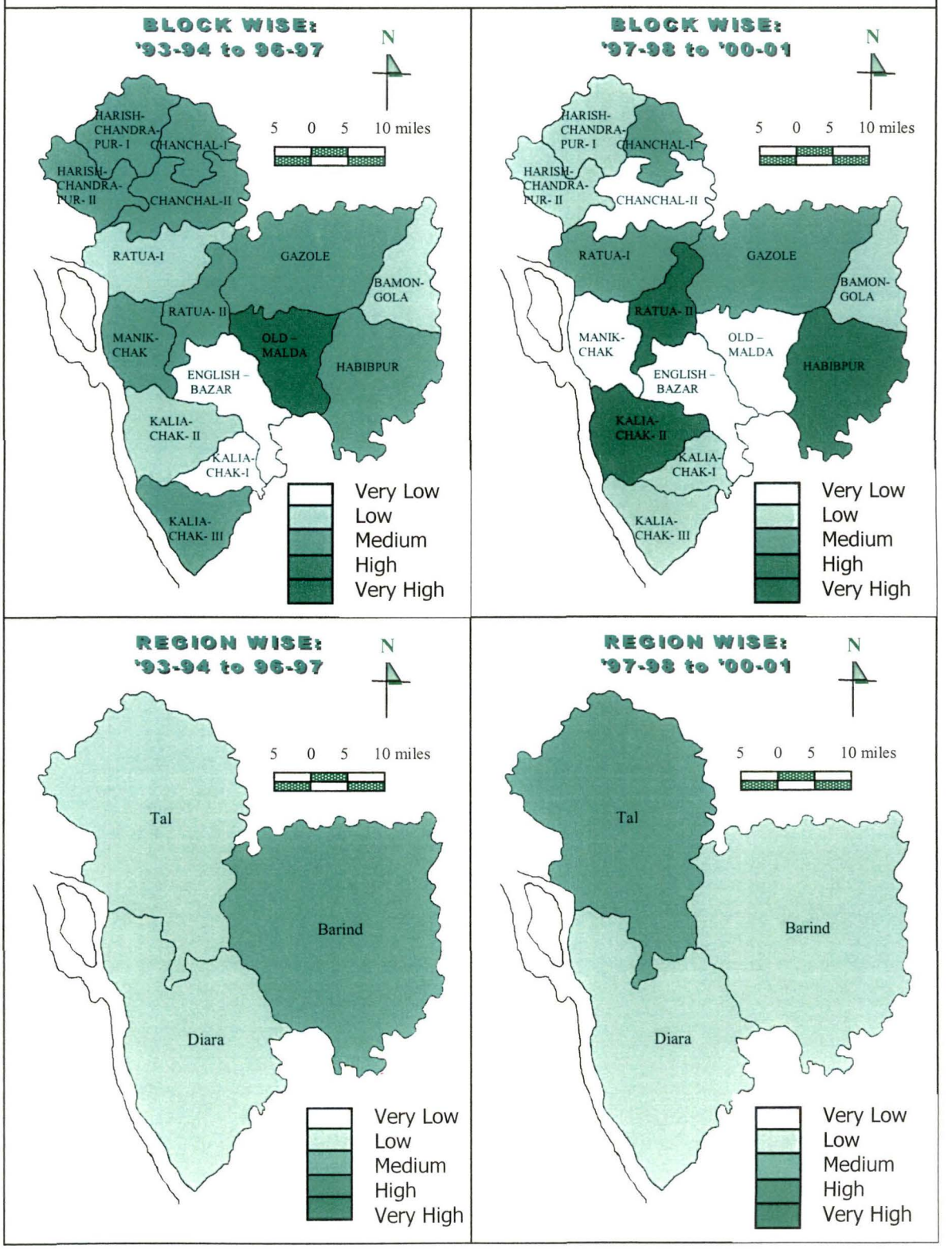
Map No: 7.7

CROP PRODUCTIVITY INDEX: GRAM



Map No: 7.8

CROP PRODUCTIVITY INDEX: LENTIL



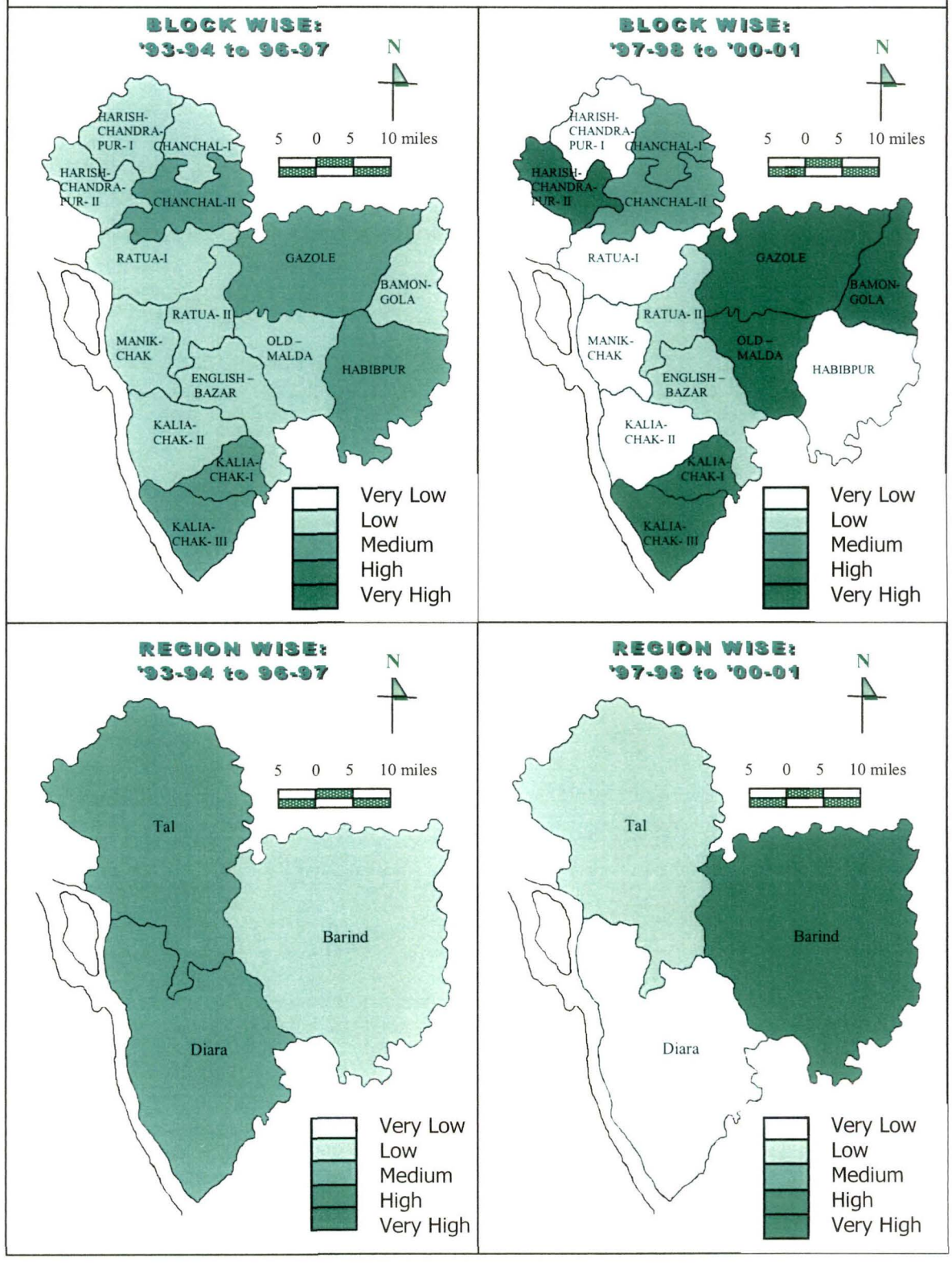
Oil seeds: Map 7.9 and 7.10 show the variation of the productivity level of mustard and linseed, respectively at block and region level.

Mustard: Mustard shows a definite regional pattern of Productivity level in Period II. Eastern blocks of Gazole, Bamongola and Old Malda have increased their productivity index to 'Very High' level while in western blocks viz. Ratua I, Manikchak and Kaliachak II, the productivity has fallen to 'Very Low' level. This shift has caused Barind's productivity to increase to 'High' level while Diara's productivity has fallen to 'Very Low' level.

Linseed: Linseed productivity is found to be low in maximum number of blocks in Period-I with exception of Chanchal-II ''Very High''; Kaliachak-II 'Very Low' So the disparity was not so pronounced in Period-I. In period-II the blocks of Diara region and Old-Malda have progress substantially to 'Very High' productivity level. This is in contrast to the fall in productivity of the central belt consisting of Ratua-I, Ratua-II, Gazole, Bamongola and Manikchak.

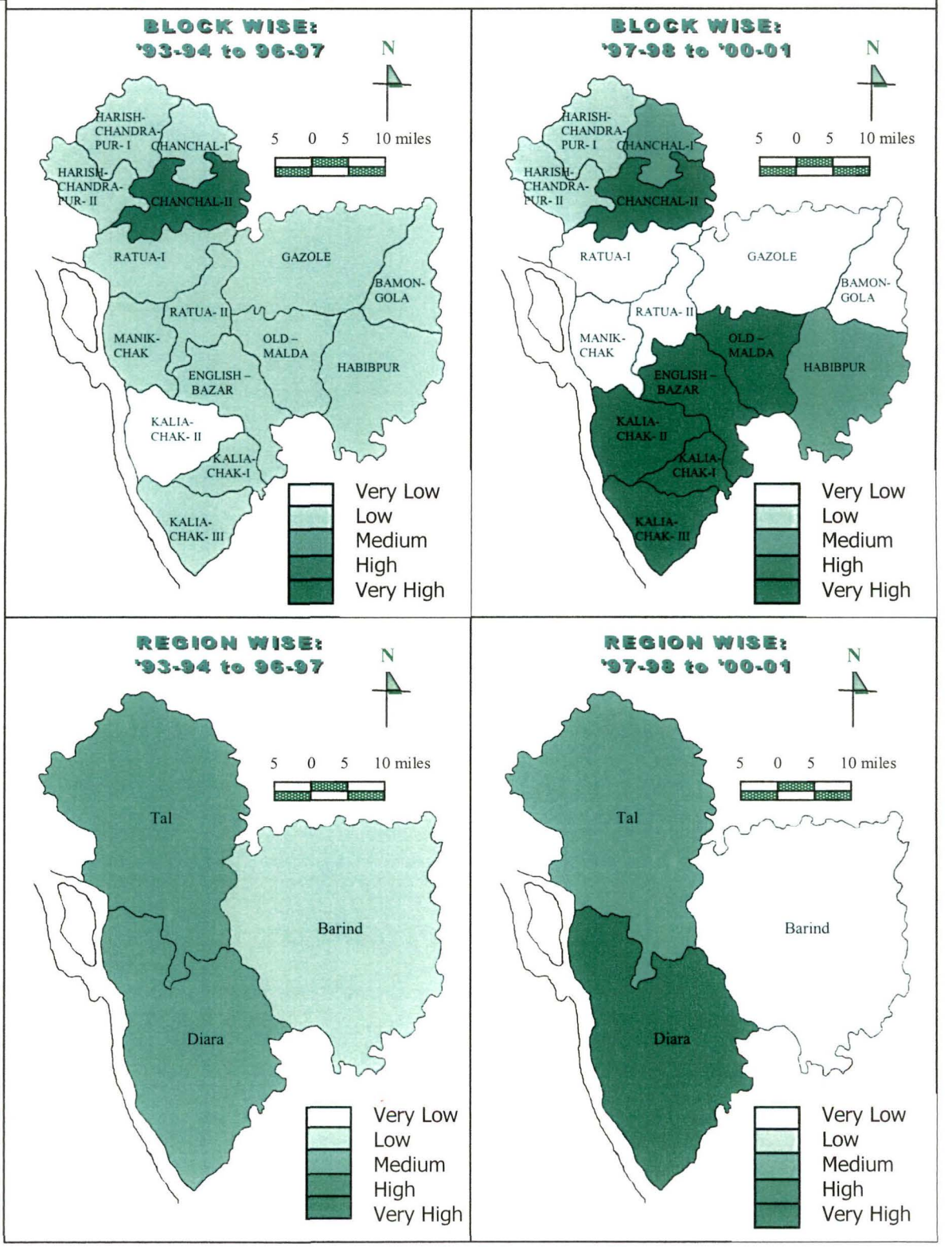
Map No: 7.9

CROP PRODUCTIVITY INDEX: MUSTARD



Map No: 7.10

CROP PRODUCTIVITY INDEX: LINSEED



Cash Crop: Map 7.11 to 7.13 provides an illustration of the productivity level of potato, mango and jute for the period 1993-94 to 1996-97 and 1997-98 to 2000-01 at the block and region level.

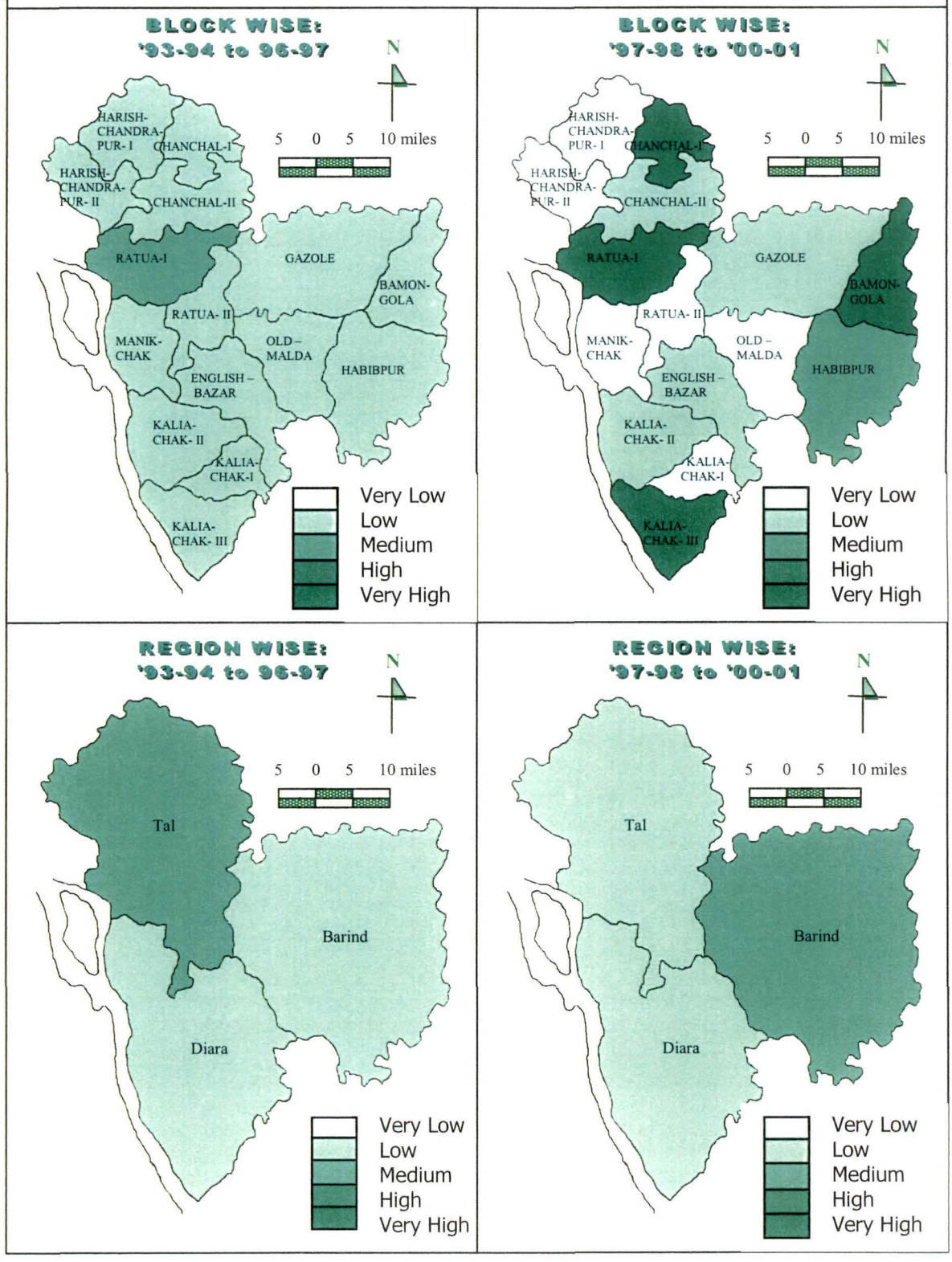
Potato: In Potato too the pattern of diversity is similar to that of the other crops as in the Period-I the blocks were having 'Low' productivity with the only exception of Ratua-I, Bamongola and Kaliachak-III have graduated to 'Very High' level of productivity while Harishchandrapur-I, Harishchandrapur-II, Ratua-II, Old-Malda Manikchak and Kaliachak-I have failed to 'Very Low' productivity levels (Map 7.11 to 7.13). At regional level there is a minor change in productivity has fallen from 'Medium' to 'Low' while for Barind reason from 'Low' to 'Medium'.

Mango: For mango cultivation through productivity analysis shows Bamongola having high productivity in mango but as mango is not a major crop, this increase in productivity is not meaningful. In the blocks where mango is a significant crop productivity of mango has increased in Ratua-I, English Bazar, Kaliachak-II while decreased in Kaliachak-I. At region level the productivity has remain unchanged for Diara, the main mango culvating region.

Jute: In blocks where jute is significant crop viz. Harishchandrapur-I , Chanchal-I, Chanchal-II, Ratua-I, Ratua-II and Manikchak, there is a variation of productivity and different changing pattern while in Harishchandrapur-I and Ratua-I the productivity has decline. For Chanchal-II it has increased to ''Very High'' level, but when we compare the regional pattern we find that main jute-cultivating region Tal productivity has decreased from ''Medium'' to 'Low'. In Barind region the productivity has increased from 'Very Low' to ''Very High'' over the period which signifies that the region has a potential for jute if cultivated extensively.

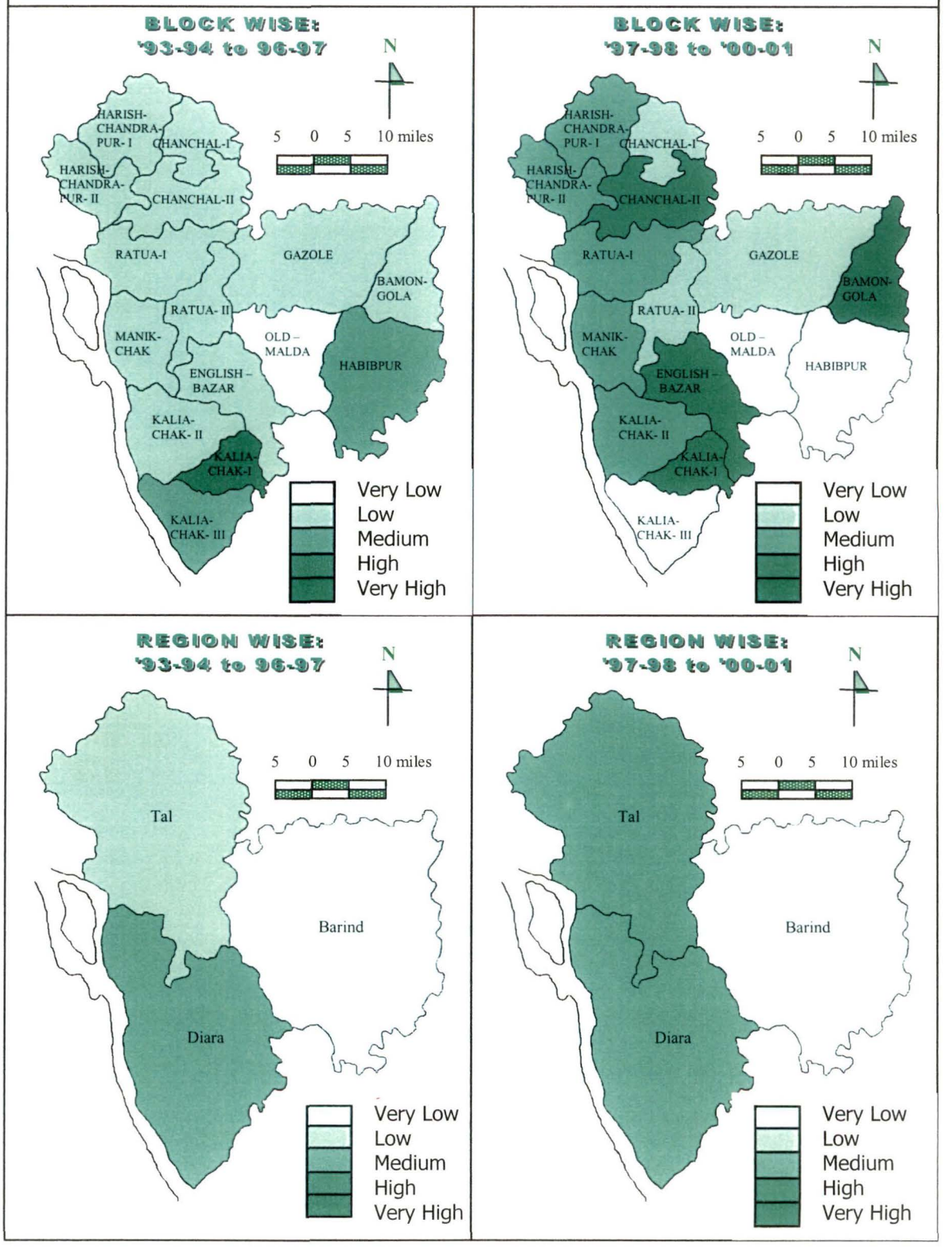
Map No: 7.11

CROP PRODUCTIVITY INDEX: POTATO



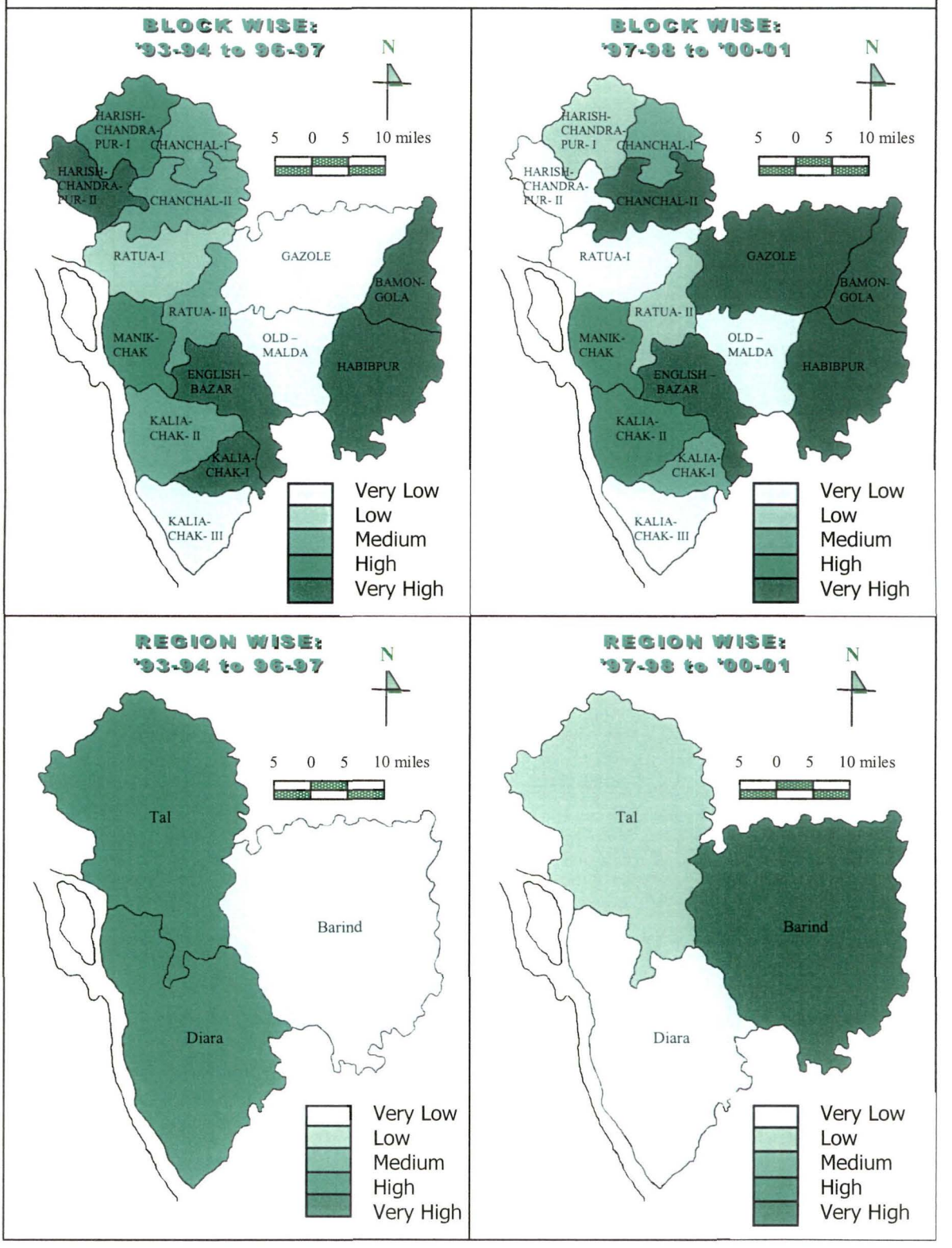
Map No: 7.12

CROP PRODUCTIVITY INDEX: MANGO



Map No: 7.13

CROP PRODUCTIVITY INDEX: JUTE



In the above sub-section of productivity analysis we have basically found that the level of productivity was comparatively uniform in Period-I but in Period-II the difference in productivity amongst blocks significant. Some of the blocks have increased their productivity to ''Very High'' high level while in many it has fallen 'Very Low' level. This gives an indication that there is a specialization happening in the blocks depending on the physical and non-physical character the blocks now have specialized in certain crops. It is to be noted that the analysis shows the level of productivity for all blocks with out considering the actual acreage for individual crops so many a times some insignificant crop for any particular block shows dramatic change. This is to be considered as an indication of the potential of the block for that particular block.

c. Present Growth Trends

After analyzing the crop wise productivity of different blocks in Malda in this section we attempt to analyze the productivity growth trend in the district. For this we considered the published yield data (Appendix-VII.xvi to VII.xxvi). The yield data for arhar and gram are not available for the required period. To analyse the productivity trend we can analyse the productivity index (calculated in the previous section) across the years. But it is felt that these analyses will be misleading as even if the productivity of a particular block is increasing but if the rate of increase is less than that of Malda's increase then the productivity index is likely to fall. Similarly on the declining phase we can have an increasing crop productivity index for any particular block if its decline is comparatively less than the rate of decline of the district. This misleading analysis can have serious policy implication so it is not attempted here.

While scanning the data we find that though there is variation in the yield of any particular crop for a block over the years but for any particular year the yield is similar for many crops like kalai, lentil, potato and jute to some extent. So it is felt one can question the validity of the data for these crops. Moreover for linseed there is no trend data available. So the trend analysis of productivity is restricted to only six crops viz. aus, aman, boro, wheat, mustard and mango.

We are unable to show the trend at region level or at crop group level as the yield data is not additive. As the yield data is not comparable across crop so it can be normalized. But as our objective is to find the trend of productivity and not to compare across crops, we prefer to do the analysis with absolute values. The following figures show the trend of area under cash crop for the individual blocks, Fig-7.1 for aus, Fig-7.2 for aman, Fig-7.3 for boro, Fig-7.4 for wheat, Fig-7.5 for mustard and Fig-7.6 for mango.

Fig 7.1 Block Wise Trend of Yield : Aus (1993-94 to 2000-01)

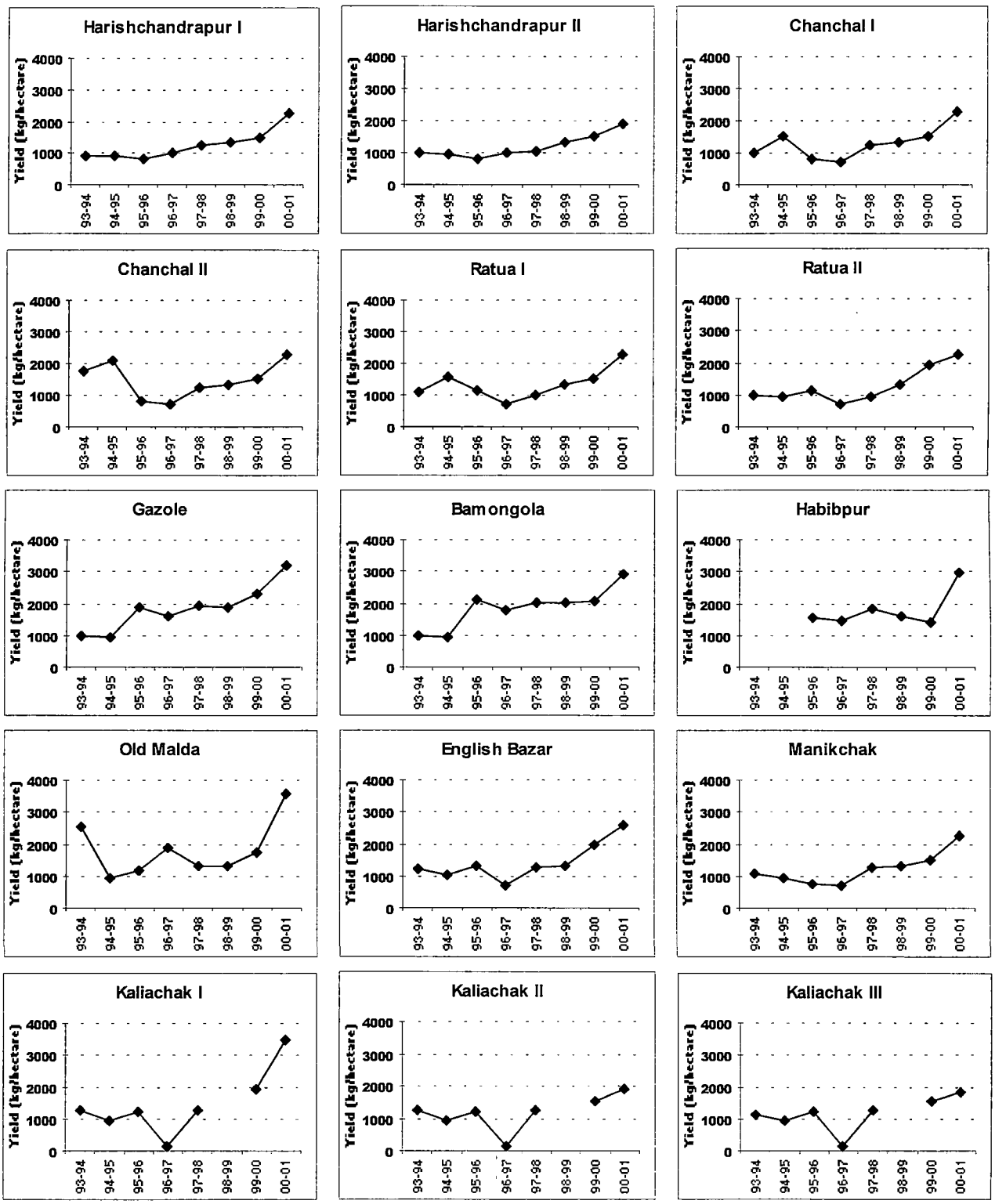


Fig 7.2 Block Wise Trend of Yield : Aman (1993-94 to 2000-01)

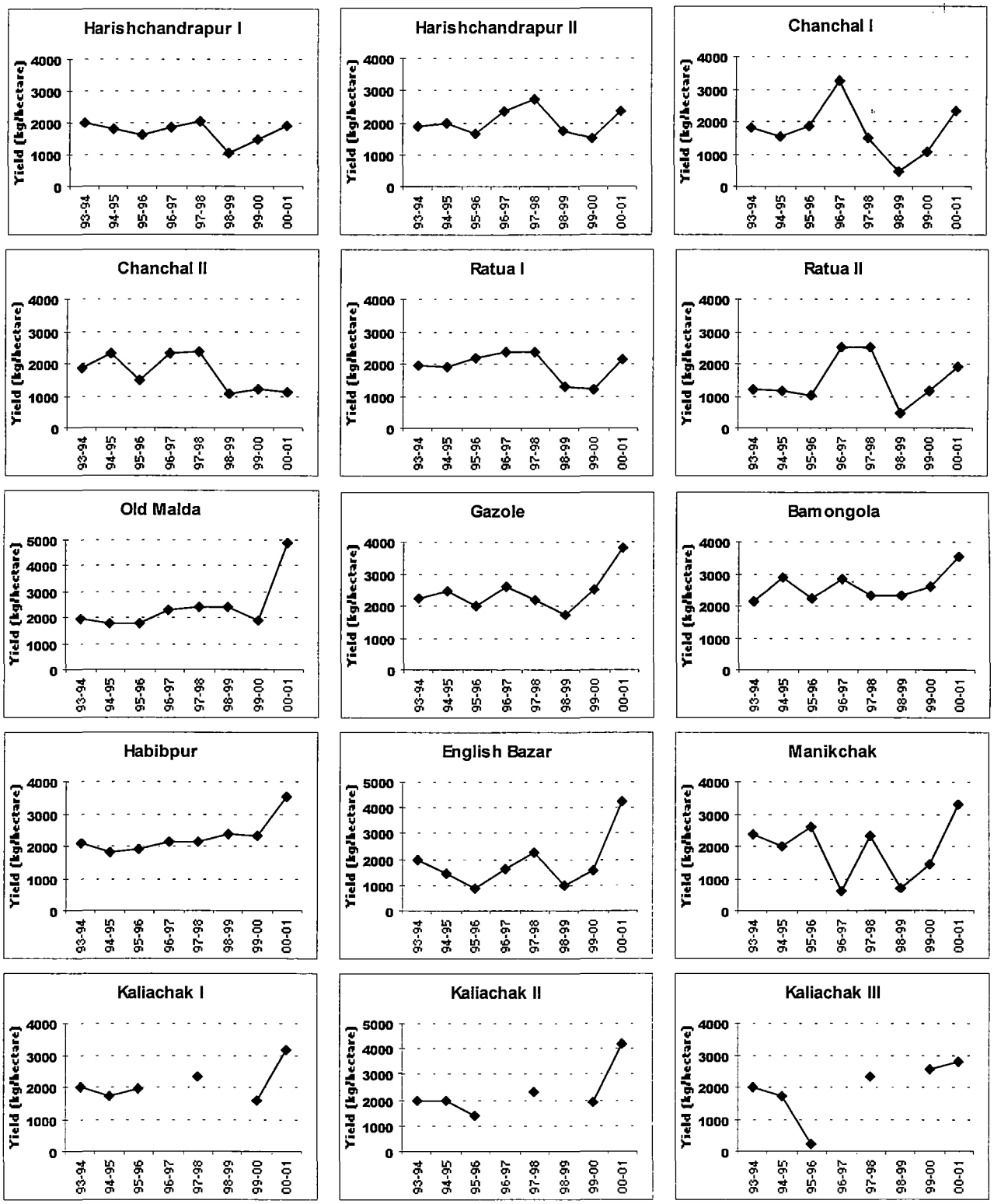


Fig 7.3 Block Wise Trend of Yield : Boro (1993-94 to 2000-01)

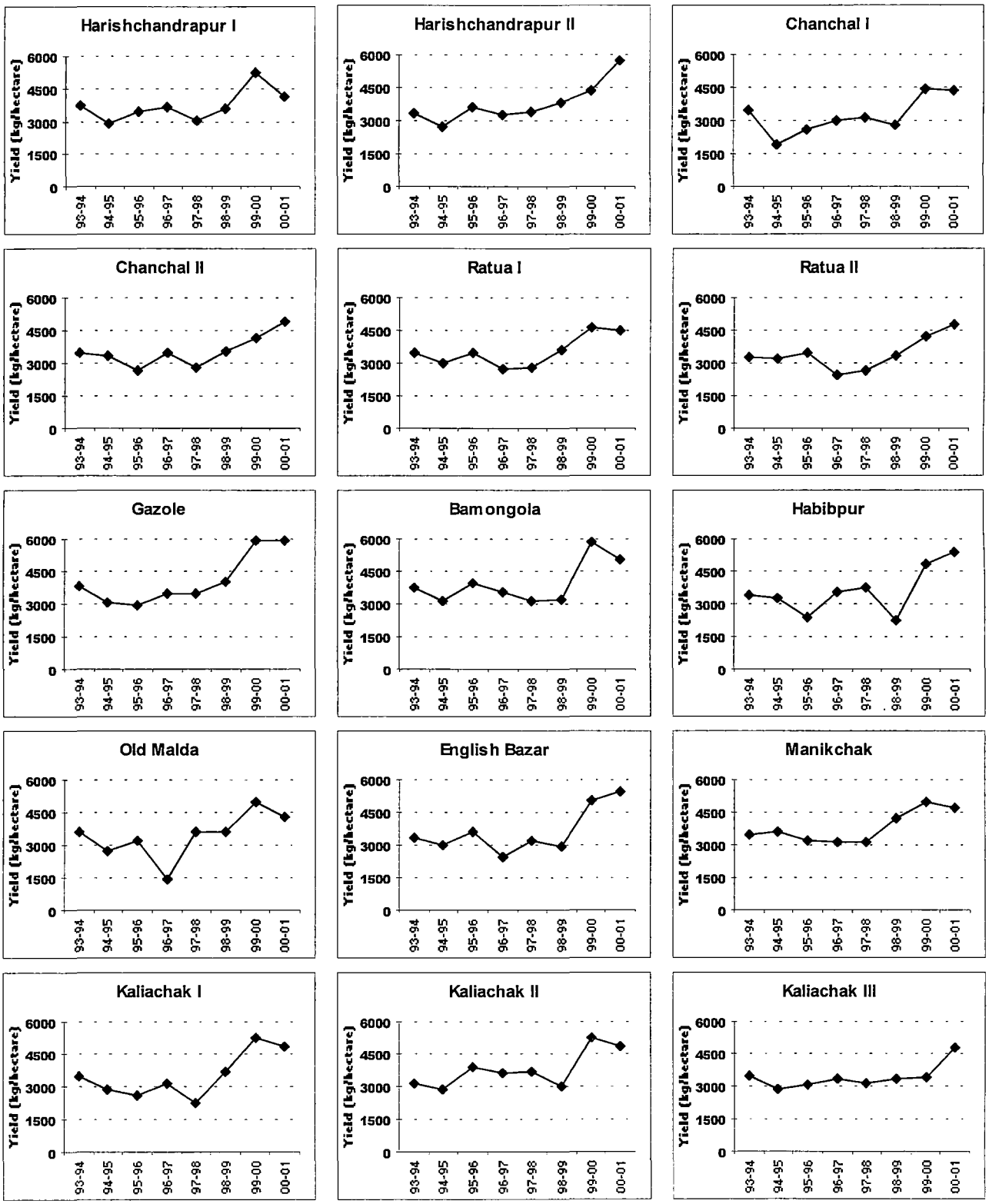


Fig 7.4 Block Wise Trend of Yield : Wheat (1993-94 to 2000-01)

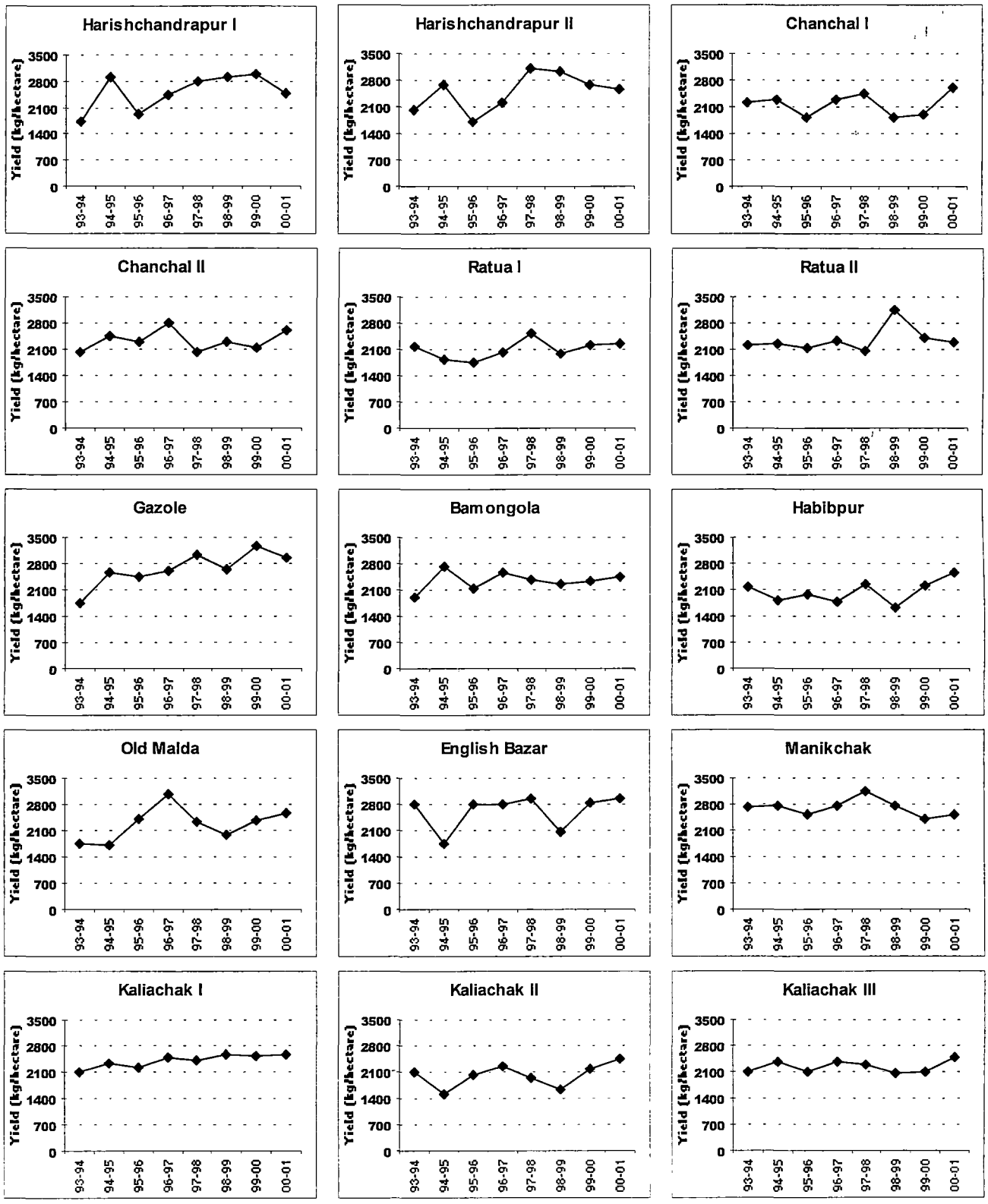


Fig 7.5 Block Wise Trend of Yield : Mustard (1993-94 to 2000-01)

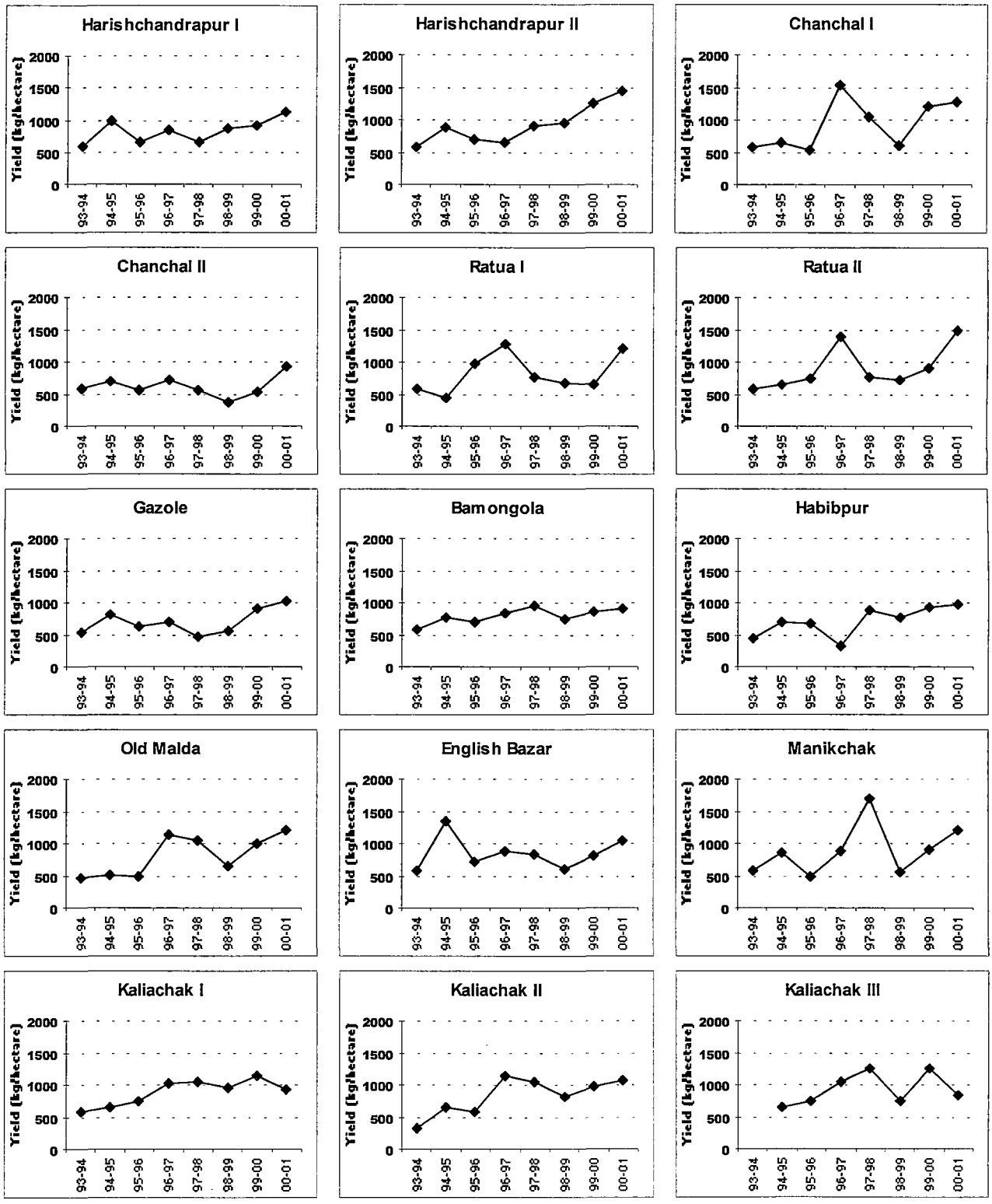
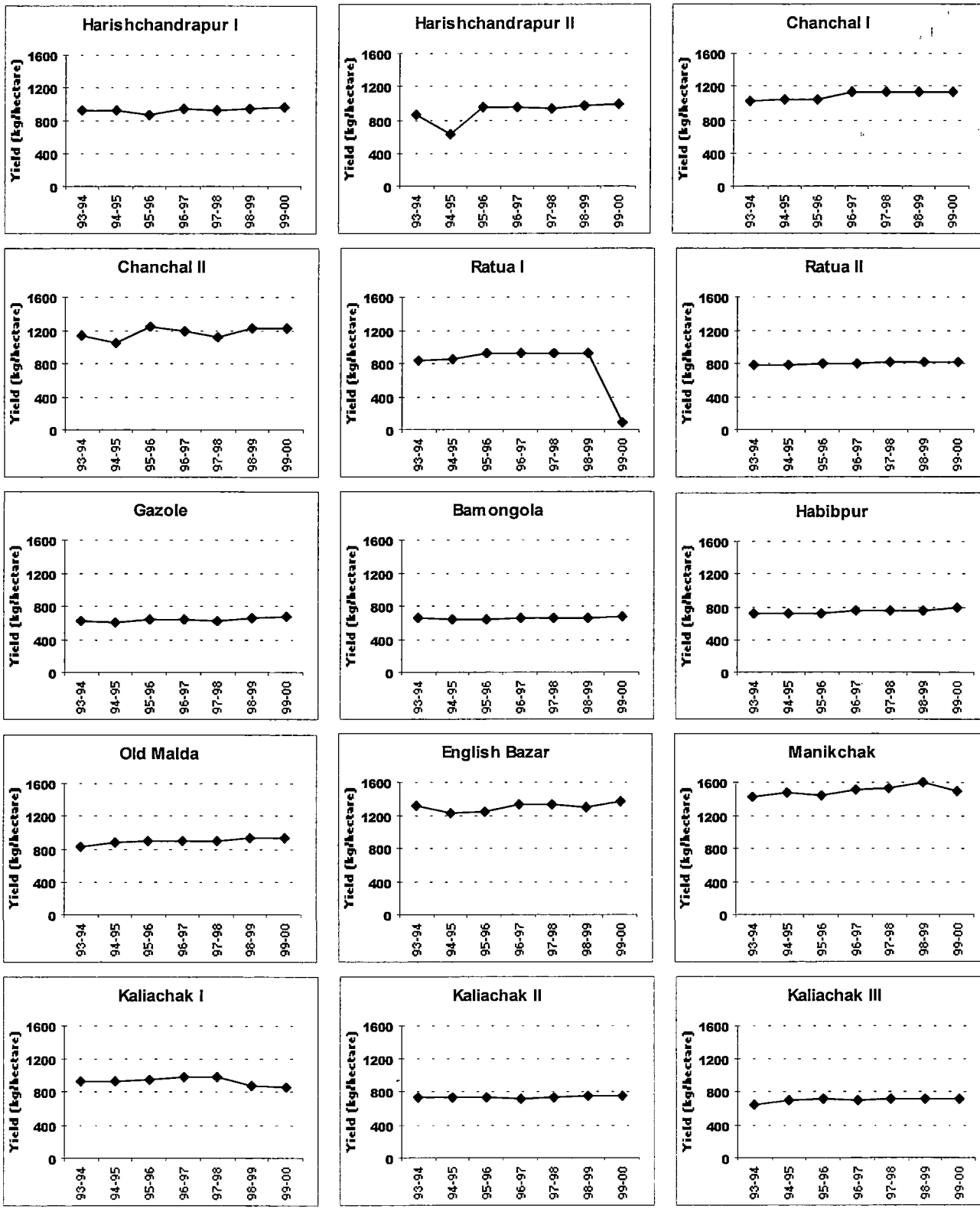


Fig 7.6 Block Wise Trend of Yield : Mango (1993-94 to 1999-00)



From the Fig 7.1 we find that the yield has increased for aus the most. Continuous growth is observed in some of the blocks but in majority of the blocks the growth rate is fluctuating.

In case of aman wide fluctuation is observed (Fig 7.2) but the over all change does not look significant. In the year 2000-01 all the blocks except Chanchal-II show considerable rise in yield.

There is a moderate rise in yield of boro in the district (Fig 7.3); but overall growth rate do not vary much amongst the blocks. The pattern of the trend lines looks similar for the blocks.

Yield of wheat have increased over the years marginally but annual fluctuation is observed across the blocks (fig 7.4).

For mustard yield growth is significantly different across the blocks as in some we find CARG of 10 percent plus where in others below 5 percent (Fig 7.5). Here too annual fluctuation of yield is observed.

For mango the yield trend line for all the blocks are flat with minor exceptions (Fig 7.6).

Thus we find for major crops cultivated in Malda, there is an overall increase in yield over the years. But, this analysis do not provide the complete picture of yield growth as we are unable to comment on the level of significance of these growth rates and thereby we are not in a position to comment on the future prospect of these crops at individual block level.

For the purpose of analysing the significance of yield trend of six crops identified we have used the time series data for 8 years (1993-94 to 2000-01) of these crops of Malda viz. aus, aman, boro, wheat, mustard, and mango.

The exponential function $Y=AB^t$ was fitted to the data to compute the compound growth rates. Compound growth rate (r) =(Antilog b) 1* 100. The compound growth rates were tested for their significance by the students 't' test.

The co-efficient (eg. 0.126) given in the table to explain trend growth can be interpreted as 12.6 compounded annual growth. The t-stat provides the idea of the significance of the individual coefficients.

Result and Discussion: The regression was performed for individual blocks and the results are provided here.

Table 7.2 provides the growth rate and the significance level for the individual crops under cereals.

Table 7.2 Growth Trend of Cereals: Block wise (1993-94 to 2000-01)

	Aus		Aman		Boro		Wheat	
	co-efficient	t-stat	co-efficient	t-stat	co-efficient	t-stat	co-efficient	t-stat
Harishchandrapur I	0.126	5.3	-0.031	-0.9	0.044	1.7	0.049	1.7
Harishchandrapur II	0.101	4.2	0.006	0.2	0.075	3.6	0.045	1.5
Chanchal I	0.091	1.8	-0.061	-0.6	0.071	2.0	0.004	0.2
Chanchal II	0.026	0.4	-0.093	-2.2	0.050	1.9	0.009	0.5
Ratua I	0.068	1.4	-0.038	-1.0	0.050	1.9	0.021	1.1
Ratua II	0.119	2.9	0.008	0.1	0.048	1.5	0.020	1.0
Gazole	0.152	5.5	0.039	1.1	0.087	3.1	0.063	3.4
Bamongola	0.136	3.9	0.035	1.5	0.053	1.6	0.012	0.7
Habibpur	0.086	1.4	0.066	3.1	0.059	1.3	0.020	0.9
Old Malda	0.066	1.0	0.092	2.3	0.064	1.1	0.042	1.5
English Bazar	0.108	2.3	0.079	1.0	0.067	1.8	0.023	0.7
Manikchak	0.117	2.9	-0.022	-0.2	0.053	2.5	-0.009	-0.7
Kaliachak I	0.159	0.9	0.040	1.0	0.071	1.8	0.026	4.4
Kaliachak II	0.089	0.6	0.083	1.7	0.062	2.4	0.027	1.1
Kaliachak III	0.094	0.6	0.136	0.9	0.037	1.8	0.006	0.5

PS: shaded co-efficients are significant at 5% level of confidence

Aus:

The trend in general for the productivity of aus is that of an increase. Over the years 1993-94 to 2000-01 the yield of aus have increased in all blocks but with varying intensity. The maximum growth has been attained by Kaliachak I of 15.9 percent but using t-stat value we find that this growth is not significant. Significant growth is achieved in Harishchandrapur I (12.6 percent), Harishchandrapur II (10.1 percent), Ratua II (11.9 percent), Gazole (15.2 percent), Bamongola (13.6 percent), English Bazar (10.8 percent) and Manikchak (11.7 percent). Thus we find significant growth in seven blocks of Malda. This significant growth may look impressive but on further probe it is found that aus is not a major crop other than English Bazar, Manikchak and Kaliachak II.

Aman:

The yield growth rate of aman, the principal crop of the district is likely to determine the effectiveness of various policies of the Govt. implemented in the district. The trend of aman yield varies within the district . The blocks of Tal region in general show a declining trend while the blocks of Barind and Diara clock moderate growth. But of the 15 blocks the CARG is significant for only 3 blocks: Chanchal II, Habibpur and Old Malda. While Chanchal II registers a decline of 9.3 percent the significant growth of 6.6 percent in Habibpur and 9.2 percent in Old Malda have policy implications. These two blocks of Barind have 70.7 percent and 39.3 percent of gross cropped area under aman cultivation and are mono cropped and three cropped region respectively. So yield increase of the principal crop is the only way for these blocks to prosper, without any support for crop diversification.

Boro:

In general the district shows growth in boro yield. This variety of paddy which is totally dependent on irrigation facility, registering a yield growth implies that the district in general responds to the irrigation support. Harishchandrapur II (7.5 percent), Chanchal I (7.1 percent), Gazole (8.7 percent), Manikchak (percent 5.3), Kaliachak II (6.2 percent) are the blocks which registered significant growth during the period of analysis. Other than Gazole boro is a major crop in all the above-mentioned blocks. So an increase in the yield of boro is likely to have grater impact on overall prosperity.

Wheat:

The yield growth of wheat in the blocks of Malda is quite low. Gazole and Kaliachak I are the only two blocks to have registered significant growth. The cause of growth in these two blocks is different, as while in Gazole wheat is not a major crop, in Kaliachak I, wheat is most important. So the growth in the Gazole is basically because of an erratic growth pattern with 9.2 percentage of area under wheat cultivation while in Kaliachak-I better irrigation facility have brought about the marginal growth.

Mustard:

There is a general increasing trend of yield of mustard in the blocks of Malda. The growth rate varies between 0.7 percent of Chanchal II to 13.3 percent of Kaliachak II but significant growth rates are observed in Harishchandrapur II (11.2 percent), Ratua-II (9.2 percent), Bamongola (4.8 percent), Habibpur (9.9 percent), Old Malda (13.0 percent), Kaliachak-I (8.2 percent) and Kaliachak-II (13.3 percent). But amongst the blocks where mustard occupies more than 10 percent share of gross cropped area insignificant growth in Chanchal-I, Gazole, English Bazar, Kaliachak-III is a cause of worry as though these blocks show growth but we can not comment with confidence that the growth is likely to follow in years to come as presently it follows an erratic growth path.

Mango:

The yield of mango in the district is marginally increasing in all the major blocks. Among the blocks where mango's share is more than 10 percent of gross cropped area, Manikchak and Kaliachak II show significant growth of 1.3 percent and 0.7 percent respectively. For the other two blocks of English Bazar and Kaliachak I, the growth or decline is not significant. For Mango we do not expect dramatic change of yield, as these are orchard-based product with age of trees ranging from 4 to 30 years.

Table 7.3 Growth Trend of Mustard and Mango: Block wise (1993-94 to 2000-01)

	Mustard		Mango*	
	co-efficient	t-stat	co-efficient	t-stat
Harishchandrapur I	0.058	1.9	0.007	1.3
Harishchandrapur II	0.112	4.2	0.043	1.7
Chanchal I	0.103	1.8	0.019	4.8
Chanchal II	0.007	0.2	0.015	1.5
Ratua I	0.065	1.2	0.020	4.0
Ratua II	0.092	2.1	0.009	5.7
Gazole	0.051	1.2	0.014	3.1
Bamongola	0.048	2.7	0.006	3.4
Habibpur	0.099	2.0	0.015	5.9
Old Malda	0.130	2.9	0.018	4.1
English Bazar	0.013	0.3	0.011	1.4
Manikchak	0.078	1.2	0.013	2.6
Kaliachak I	0.082	3.5	-0.011	-1.0
Kaliachak II	0.133	3.0	0.007	3.2
Kaliachak III	0.052	1.0	0.016	3.2

PS: shaded co-efficients are significant at 5% level of confidence

* for the period 1993-94 to 1999-00

To conclude this chapter we find that the agricultural productivity for the district is different among the blocks and is changing. In the early 90's the productivity differential among the blocks were less pronounced than the 2nd half. In the late 90's we find while some of the blocks have increased their productivity others slide. This is in conjunction with the specialization that is happening in the agricultural scenario of Malda district.

In general the yield trend of 5 major crops viz. aus, aman, boro, wheat and mustard are increasing while for mango is stable. Yield growth rate is minimum for aus and for the primary crop of the district, aman, a moderate growth is observed. This has a policy implication as for the betterment of the agricultural profile of the district, aman yield needs to be improved along with the improvement of yield of other crops.