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# Essence of Crop Diversification: A Study of West Bengal Agriculture

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## ABSTRACT

This study deals with the study of the diversification of agricultural activities of the West Bengal, one of the leading agricultural state in India. Using the Minhas and Parikh substitution and expansion effects methodology this study revealed that the cropping pattern in West Bengal in terms of allocation of acreage had been skewed towards food grain. However, during the last fifteen to twenty years some important crops (*boro* rice, potato, oilseeds, especially mustard) emerged as the main crop for the farmers. The cropping pattern turned against pulses, coarse cereals and sugarcane. It was also found that in the cropping pattern changes the expansion effect could explain 54.69% of the gross cropped area and the remaining 45.31% of the gross cropped area was due to the substitution effect.

**Key words:** Cropping pattern, agricultural growth rates, expansion effect, substitution effect

## INTRODUCTION

Growth in agricultural production and income can broadly arise from two sources, viz. expansion of land area put to agricultural use and/or more productive utilization of existing cultivable land area. However, the first possibility appears to be exhausted in the state of West Bengal due to population growth and increasing demand for land for non-agricultural uses and thus, the second source is increasingly assuming greater importance in enhancing agricultural production (Ghosh and Kuri, 2005). The possibility of increasing agricultural output can be understood under the following agrarian packages:

- Institutional change in the farming sector
- Increase in the cropping intensity of land
- Shift in the cropping pattern in favour of crops with higher productivity
- Improvement in the technique of cultivation

These four factors, however, inter-related with each other. Institutional changes become necessary to create favourable conditions for agricultural growth, when the institutional arrangements in agriculture are not in shape to provide farmers with the right incentives and opportunities like economical land holding size, inequitable tenurial arrangements, indebtedness and lack of access to credit and other inputs. Measures such as land reform can go a long way to remove obstacles to agricultural growth and West Bengal has achieved a notable success in this sphere during the last two decades. But these measures alone would raise agricultural productivity only to a certain level. For sustained agricultural growth in the long run, institutional changes are to be followed by improvements in the techniques of cultivation. The second means of having a larger volume of agricultural production from the given land resource of an economy is the increase in the cropping intensity.

Moreover, crop diversification leads to a movement of low-value agriculture to high-value agriculture and this is an important way to enhance agricultural output. Cropping pattern implies the proportion of area under different crops at a point of time. A change in cropping pattern or crop diversification implies a change in the proportion of area under different crops. The cropping pattern in an area depends mostly up on agro-climatic, technical and institutional factors (Vaidyanathan, 1992). More precisely, the cropping pattern is governed by the law of comparative advantage in relation to agro-climatic conditions (De, 2002). In West Bengal, we find that the conditions of soil and climate are, in general, favourable to food grain production and so; food grain crops dominate the cropping pattern of the state. Within the crop sub-sector the change of cropping pattern is basically the results of the adoption of new crops and the intensification of cultivation through multiple cropping. More precisely, changes in cropping pattern over time are also function of changes in the extent and quality of irrigation and the relative costs of and return to competing crops and crop combinations (De, 2002, 2003). Moreover, with the application of technical innovation (like introduction of new HYV seeds technology), institutional reforms of extension facilities (provision of irrigation facilities, better support services through government extension agencies), there can be a yield rate induced cropping pattern change. Obviously, farmers will go in favour of those crops for which the yield levels are high and have reasonable market demand for crops. Under these circumstances, this study deals with the behavior of cropping pattern changes of West Bengal over the period of 1970-71 to 2004-05 both at the state as well as district levels.

The specific objectives of the study are:

- To explore the nature of the changes in the crop diversification or specialization at the district level
- To explore the nature of cropping pattern changes in the state over the period under study by decomposing output changes in terms of substitution effect and expansion effect

## MATERIALS AND METHODS

**Data sources:** No primary data have been generated in this study. The whole study is based on the secondary data collected from various issues of Statistical Abstract and Economic Review of West Bengal, published by the Bureau of Applied Economics and Statistics, Government of West Bengal. The study has been conducted for the time period 1970-71 to 2004-05.

**Methodology:** The nature of crop diversification is first examined through changes in allocation of land towards the cultivation of different crops grown in different seasons over the years. Inter-crop variations are also considered in contrast to the explaining acreage allocation. To study the extent of diversification, various methods are available in the literature. The most commonly used methods are Herphindal index and Theil's entropy index. Herphindal index is defined as:

$$HI = 1 - \sum_{i=1}^{n} p_i^2$$

Where:

$p_i$ = Proportion of area under ith crop

$$p_i = \frac{A_i}{\sum_{i=1}^{n} A_i}$$

Where:

$A_i$ = Area under ith crop and

$\sum A_i$ = Total cropped area

The value of H-index varies between zero to one. It is one in case of perfect specialization and zero in case of perfect diversification.

Crop concentration means the variation in the density of crops in an area or region at a given point/period of time. The concentration of a crop in an area largely depends on its terrain, temperature, moisture, price and income, social factors, government policy, type of soils and many others. The most commonly method to study crop concentration is the location quotient method. We can write location quotient method of crop concentration algebraically as:

$$LQ = \frac{\frac{A_{ij}}{A_j}}{\frac{\sum_{i-1}^{n} A_{ij}}{\sum_{j} A_j}}$$

Where:

$A_{ij}$ = Gross cropped area under ith crop in jth district

$A_j$ = Gross cropped area in jth district

$\sum_{i-1}^{n} A_{ij}$ = Gross cropped area under ith crop in the state and

$\sum_{j} A_j$ = Gross cropped area of the state

By using this location quotient method crop concentration index is estimated. When the index value is greater than unity, the component areal unit accounts for a share greater than it would have had if the distribution were uniform in the entire region and therefore, the areal unit has a concentration of great agricultural significance.

Average annual exponential rates of growth of area, production and yield under different crops is estimated by fitting regressions of the type $Y = \alpha+\beta t$ (Y= value of the dependent variables area, production and yield of crops and t is the time in years) (Boyce, 1987). Here, $\alpha$ and $\beta$ are the parameters of the model. The coefficient $\beta$ represents the growth rate of Y. The trend equations are fitted by the ordinary least squares OLS method for the period 1970-71 to 2004-05.

Once the rates of growth and the change in the rates of growth of acreage of different crops are known, then the substitution effect and expansion effect can be considered easily. For a given GCA, the substitution effect is defined as the relative decline in area under some crops and the

compensating increase in area of the substitutable crops. On the other hand, the expansion effect is defined as the expansion of GCA. First of all to ensure whether the area under any crop has been changed due to the inter-crop shift of area or because of change in the total area under cultivation, a simple elasticity method is defined.

The elasticity measure defined by Venkataramanan and Prahladachar (1980) is given as:

$$\text{Cropped area} - \text{gross cropped elasitiy (E)} = \frac{\%\ \text{Change in the growth of area under crop}}{\%\ \text{Change in GCA}}$$

The value of E under each crop is calculated to identify the crops that have a gain in area from other crops and those who lose area to the former. If E is found to be greater than unity for any crop then it can be said that the area under that crop has increased due to both substitution effect and expansion effect. On the other hand, if E<0 for any crop, then it can be easily asserted that the crop has lost area to crops having elasticity greater than unity. However, if the value of E is such that 0<E<1, it is difficult to say whether the rise in area is due to expansion of area or due to substitution effect. In this case, it can only be said that the area of the crop has increased at a rate less than that of GCA.

## RESULTS AND DISCUSSION

There are numerous research works on the agriculture of West Bengal. However, most of the research works have emphasized on the growth pattern of the agricultural sector of the state. Boyce (1987), Saha and Swaminathan (1994), Sanyal *et al.* (1998), Chattopadhyay and Das (2000) and Ghosh and Kuri (2007) all have studied on the growth pattern of the West Bengal agriculture. De (2003), Ghosh and Kuri (2005), Majumdar and Basu (2005), Sanyal *et al.* (1998) and Sharma (2005) have studied on the issue of crop diversification of the agriculture of the state.

Majumdar and Basu (2005) pointed out that to enhance the growth rate of the agriculture of the state, the cropping pattern of the state needs to be diversified towards the high value crops. According to Sanyal *et al.* (1998), the cropping pattern in most of the districts has noticeably changed in favour of high-value non-food grain crops such as potato, oilseeds and other non-food grain rabi crops. They have clearly pointed out that the ill-defined land rights and lack of accessibility to institutional credit were the main reasons for the sluggish growth of private investment in agriculture in the first three decades of post-Independence period. Not only that small farm's cropping pattern was no longer confined to labour intensive crops alone; rather it tended to change in response to market forces (Sanyal *et al.*, 1998).

Thus, the issue of crop diversification has become very crucial in the agriculture of West Bengal especially after the mid nineties when the growth rate of total agricultural output as well as the production growth rates of major important crops have started declining. The main reason of slowing down the output growth rates of major crops was the falling yield growth rates as the area expansion of became hardly possible in West Bengal. The ultimate source of increasing total agricultural output remains the favourable change in the crop mix of the agriculture sector of the state. A change in the cropping pattern of the state can go a long way to counter the deceleration trends in West Bengal. More specifically, a shift in the crop diversification towards the

high value crops can become a handy solution of the slowing down the pace of agricultural growth of the state (De, 2003; Sharma, 2005). During the post-Green Revolution period (particularly after 1970) cropping pattern in West Bengal has changed in favour of high remunerative crops at the cost of the lower value crops (Bhalla and Singh, 1997; De, 2002). The analysis reveals that during the period 1970-71 to 1994-95, the area and production of *boro* rice, potato and mustard have increased rapidly and the development of irrigation and technology in other fields are the main factors behind the relatively rapid expansion of cultivation of the above mentioned crops. The farmers prefer that combination of crops from which they can derive maximum possible net revenue at least possible risk, if there is no dearth of essential factors of cultivation of those crops (De, 2003).

Mruthyunjaya and Kumar (1989) have found that during the period 1972 to 1983, in West Bengal, paddy and total oilseeds are the two crops which gained area allocation under gross cropped area GCA and there have been declined in area allocation under total pulses both in absolute and relative terms. Area under paddy and wheat has continually increased in many states including West Bengal at cost of coarse cereals, millets, pulses and cotton. Technological support, price support and infrastructural support (which includes markets and irrigation, subsistence requirements, lesser price, yield risks etc.) are the main reasons for paddy and wheat dominated cropping pattern of the country.

Sau and Pathak (2007) have shown that there is an increasing extent of crop diversification following economic reforms. The area under fruits and vegetables recorded a substantial increase during the period 1997-98 to 2004-05.

The Aggregate Cropping Pattern and its Changes: At the beginning of our study period (1970-71) in West Bengal the scenario of cropping pattern was that out of the GCA of 7152 thousand ha, 5454.3 thousand ha were under total cereals (Table 1) and thus, contributing 76.326% of the GCA. Among cereals, rice was cultivated in major parts of the area. Clearly, the area under rice was 4955.6 thousand ha or 69.26% of the gross cropped area and the area under wheat was only 5.04% of the GCA. The area under total pulses was 9.36% of the GCA. Thus, total food grain, which is the sum of total cereals and total pulses, occupied more than 85% of the GCA. This shows clearly that the food grain crops dominated the cropping pattern of the state in 1970-71. More specifically, a total domination by rice in the aggregate cropping pattern of West Bengal. The area under mustard and rapeseed was 108.2 thousand ha and the area under linseed was only 43.6 thousand ha. The total oilseed covered an area of 168.1 thousand ha or only 2.23% of the GCA. Jute, which was a favourable crop to the farmers, covered 407.1 thousand ha or only 5.7% of the GCA. Only 1 per cent of the GCA was under potato cultivation (65.1 thousand ha). The percentage shares of GCA under cotton, tobacco, sugarcane, chillies, ginger etc were very small.

The gross cropped area of the state increased to 7661.60 thousand ha in 1980-81 from 7152 thousand ha in 1970-71. The area under cereals was increased from 5454.3 to 5575.5 thousand ha. There was also an upward shift in the area under rice from 4955.6 thousand ha to 5176.2 thousand ha. However, there was a downward shift in the relative area allocation under rice from 69.29 to 67.55% of the GCA. The area under total pulses declined from 669.5 thousand to 524.3 thousand ha that is, a relative decline in the area from 9.36 to 6.84% of the GCA. In total, the area under

Table 1: Cropping pattern changes in West Bengal during 1970-71 to 2004-05 (000 ha)

| Crops | 1970-71 | 1980-81 | 1990-91 | 2004-05 |
|---|---|---|---|---|
| Aus | 799.20 (11.17) | 615.10 (8.03) | 610.30 (7.05) | 339.75 (3.52) |
| Aman | 3969.90 (55.51) | 4214.60 (55.01) | 4306.50 (49.72) | 4126.71 (42.71) |
| Boro | 186.50 (2.61) | 346.50 (4.52) | 896.10 (10.34) | 1390.15 (14.39) |
| Rice | 4955.60 (69.29) | 5176.20 (67.56) | 5812.90 (67.10) | 5856.61 (60.62) |
| Wheat | 360.20 (5.04) | 283.00 (3.69) | 269.10 (3.11) | 425.72 (4.41) |
| Other cereals | 139.50 (1.94) | 116.30 (1.52) | 99.80 (1.15) | 14.97 (0.15) |
| Total cereals | 5454.30 (76.26) | 5575.50 (72.77) | 6181.80 (71.36) | 6297.30 (65.18) |
| Gram | 155.10 (2.17) | 96.20 (1.26) | 25.60 (0.30) | 46.49 (0.48) |
| Arhar | 25.80 (0.36) | 22.60 (0.29) | 5.80 (0.07) | 3.36 (0.03) |
| Other pulses | 488.60 (6.83) | 405.50 (5.29) | 282.20 (3.26) | 193.00 (2.00) |
| Total pulses | 669.50 (9.36) | 524.30 (6.84) | 314.00 (3.62) | 242.85 (2.51) |
| Food grain | 6123.80 (85.62) | 6099.80 (79.62) | 6495.40 (74.98) | 6540.15 (67.69 |
| Rape and mustard | 108.20 (1.51) | 131.10 (1.71) | 378.10 (4.36) | 452.00 (4.68) |
| Linseed | 43.60 (0.61) | 67.80 (0.88) | 8.50 (0.10) | 8.90 (0.09) |
| Til | 10.30 (0.14) | 108.10 (1.41) | 99.30 (1.15) | 111.90 (1.16) |
| Total oilseeds | 168.10 (2.35) | 317.40 (4.14) | 513.20 (5.92) | 685.05 (7.09) |
| Jute | 407.10 (5.69) | 610.40 (7.97) | 500.20 (5.77) | 620.42 (6.42) |
| Mesta | 66.30 (0.93) | 44.40 (0.58) | 9.10 (0.11) | 10.17 (0.11) |
| Cotton | 1.30 (0.02) | 0.20 (0.003) | 0.10 (0.001) | 0.8 (0.008) |
| Total fibre | 476.40 (6.66) | 656.90 (8.57) | 511.40 (5.90) | 634.11 (6.56) |
| Tea | 88.50 (1.24) | 94.00 (1.23) | 101.20 (1.17) | 109.70 (1.14) |
| Sugarcane | 38.30 (0.54) | 14.30 (0.19) | 12.20 (0.14) | 16.90 (0.17) |
| Tobacco | 10.10 (0.14) | 18.90 (0.25) | 12.70 (0.15) | 13.00 (0.13) |
| Potato | 65.10 (0.91) | 115.60 (1.51) | 194.50 (2.25) | 308.43 (3.19) |
| Chillies | 8.00 (0.11) | 24.80 (0.32) | 48.80 (0.56) | 60.47 (0.63) |
| Ginger | 1.50 (0.02) | 2.90 (0.04) | 5.30 (0.06) | 9.41 (0.10) |
| Total cropped area | 6979.8 | 7344.6 | 7894.7 | 8377.22 |
| Gross cropped area (GCA) | 7152 | 7661.6 | 8662.28 | 9661.325 |

Bureau of applied economics and statistics (West Bengal)

food grain crops also declined from 6123.8 to 6099.80 thousand ha, registering a relative fall from 85.62 to 79.62% of the GCA. All the oilseeds crops experienced an upward shift in their area coverage. Especially, the area under til increased from 10.3 thousand ha to 108.1 thousand ha, that is, a jump of over 10 times. Among other non-food grain crops jute, tea, potato, tobacco, chillies and ginger witnessed an increase in their area coverage. However, there were declines in the cultivation areas of *mesta*a cotton and sugarcane.

The GCA in the state increased to 8662.28 thousand ha in 1990-91 from 7661.60 thousand ha in 1980-81. The area under rice rose to 5812.9 thousand ha but its share in GCA remained the same as in 1980-81. The same was the case for total cereals. However, the area under total pulses declined from 524.3 thousand ha to 314.6 thousand ha, registering a decline in relative area allocation from 6.84 to 3.62%. Again, though the area under total food grain increased in absolute terms, its importance in the relative area allocation continued to fall. The area under rape and mustard increased from 131.1 to 378.1 thousand ha. But the relative area allocation under total oilseeds rose marginally from 4.14 to 5.92 per cent, because the absolute area under linseed declined significantly from 67.8 thousand ha in 1980-81 to 8.5 thousand ha in 1990-91. The area under jute and *mesta* declined drastically. As a result, the area under total fiber declined from

656.9 to 511.4 thousand ha. Tea, potato, chillies and ginger, all witnessed an increase in their respective area coverage in absolute terms. But their relative position in the GCA did not change to any significant extent.

The increase in the area of total cereals shows an interesting trend at the end of the study period. Though the absolute area under total cereals increased from 6181.8 thousand ha to 6297.30 thousand ha and its relative area allocation in the GCA declined from 71.36% in 1990.91 to 65.18% in 2004-05. This is mainly because of the fall in the area under other cereals crops from 99.86 thousand ha in 1990-91 to 14.97 thousand ha in 2004-05. However, the area under total cereals rose marginally in 2004-05 and its relative share to GCA became 65.18% (6297.3 thousand ha). An interesting intra rice area change took place in this decade. Though the area under both *aus* and *aman* declined in absolute terms, the absolute area under *boro* rice increased remarkably. There was an increase in the area under wheat from 269.1 thousand ha to 425.72 thousand ha. Thus, wheat improved its position in the relative area allocation in the GCA (from 3.11 to 4.67%). Total pulses also registered a downfall in its area from 314 to 242.85 thousand ha (3.62 to 2.51%).

Obviously, the area under food grain crops witnessed a decline from 74.98 to 67.69% of the GCA. There was a marginal improvement in the area under total oilseeds (5.92 to 7.09%), mainly due to the increase in the area under rape and mustard from 378.1 thousand ha to 452 thousand ha. The area under total fibre rose from 511.40 to 634.11 thousand ha, i.e., from 5.9 to 6.56% of GCA. Sugarcane experienced a continuous fall in its area during the period 1970-71 to 1990-91. However, during 2004-05, area under sugarcane increased from 12.2 thousand ha to 17 thousand ha. Potato, chillies, ginger, tea all continued to improve their respective percentile figure in respect of GCA.

Thus, during the 35 years under review, the GCA in West Bengal increased by 2509.325 thousand ha from 7152 to 9661.325 thousand ha over the period 1970-71 to 2004-05. The increase in rice area was 901.01 thousand ha, that is, its share in the gross cropped area increase was 35.91%. The share of rape and mustard acreage expansion in GCA increase was 13.70%. The, respective figures for wheat, jute, potato and chillies were 2.61, 8.50, 9.7 and 2.09%, respectively.

**Measures of concentration/diversification: Herfindal index:** The broad pattern of change in cropping pattern among different crops and crop groups can be viewed using the Herfindal's index. The Herfindal's indices were formed for various crop groups and were presented in the following figures. Four measures of the crop concentration/diversification are employed in this chapter. First, we measure CRD = $S_{ie max2}/S_i$ which is simply the concentration ratio of the top two food grain crops (rice and wheat). This measures the absolute concentration into few dominant crops. In addition to this, the concentration ratio of non-food grain cash crops among GCA (CRNF) and the sum of rice and wheat among food grain crops (CRRW) are also measured. And the crop concentration of sugarcane among non-food grain cash crops (CRSN) is also measured. The measure CRD (Fig. 1) shows that the share of these two crops in the GCA has been declining continuously over the years. However, Fig. 2 indicates that the relative area coverage of rice and wheat among total food grain area increases over the time. Among the total cropped area the share of non-food grain crops has been sharply increasing over the period of study (Fig. 3). Among the non-food grain crops the relative area coverage of sugarcane has declined very rapidly and on the contrary the relative area coverage of potato, oilseeds and jute has increased significantly (Fig. 4).

The cropping pattern changes at the districts of West Bengal are analyzed with the help of Herfindal's index; while the specific crop concentration in each district is also examined using

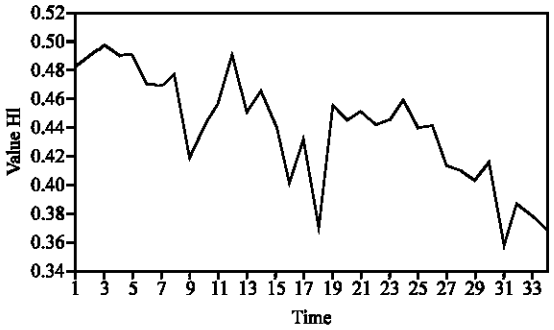


Fig. 1: Crop Composition Index for rice plus wheat in GCA

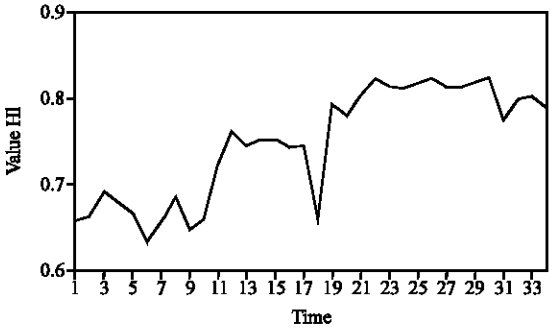


Fig. 2: Crop composition index for rice and wheat among food grain crops

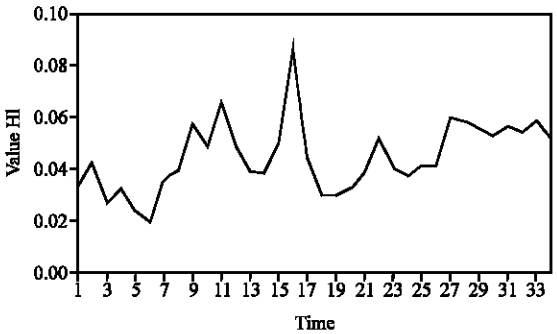


Fig. 3: Crop Composition for non-food grain cash crops among GCA

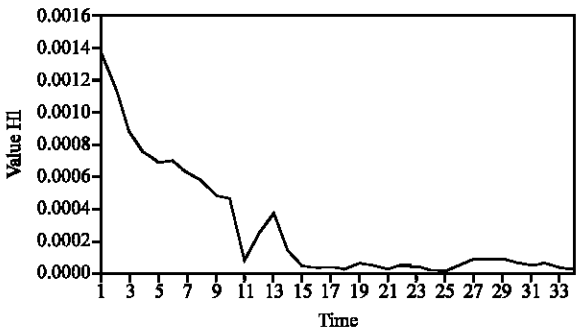


Fig. 4: Crop Composition index for sugarcane in total non-food grain area

Table 2: Herfindal indices of crop diversification in the districts of West Bengal

| Districts | 1970-71 to 1972-73 | 1980-81 to 1982-83 | 1990-91 to 1992-93 | 2002-03 to 2004-05 |
|---|---|---|---|---|
| Burdwan | 0.447046 | 0.451998 | 0.354853 | 0.308771 |
| Birbhun | 0.404933 | 0.558101 | 0.451138 | 0.374734 |
| Bankura | 0.530033 | 0.616401 | 0.44467 | 0.426353 |
| Midnapur | 0.547707 | 0.567456 | 0.401684 | 0.333887 |
| Howrah | 0.453939 | 0.422594 | 0.312999 | 0.276231 |
| Hooghly | 0.293613 | 0.284483 | 0.240202 | 0.216166 |
| 24 Pargana | 0.498585 | 0.464026 | 0.410005 | 0.301096 |
| Nadia | 0.166043 | 0.129269 | 0.117529 | 0.102609 |
| Murshidabad | 0.154427 | 0.144391 | 0.145644 | 0.135013 |
| Dinajpur | 0.270857 | 0.278453 | 0.325341 | 0.231396 |
| Malda | 0.513039 | 0.524224 | 0.519643 | 0.485166 |
| Jalpaiguri | 0.275346 | 0.23906 | 0.218861 | 0.126001 |
| Cooch Behar | 0.29553 | 0.286581 | 0.284304 | 0.244563 |
| Darjiling | 0.141352 | 0.141328 | 0.112184 | 0.050726 |
| Purulia | 0.632713 | 0.685191 | 0.619696 | 0.658523 |
| West Bengal | 0.315714 | 0.327538 | 0.282261 | 0.240207 |

Calculated from statistical abstracts of West Bengal, various issues

location quotient method of crop concentration. The value Herfindal's index is calculated for four time periods during the whole period of study. The specific time periods are 1970-71 to 1972-73, 1980-81 to 1982-83, 1990-91 to 1992-93 and 2002-03 to 2004-05. The Herfindal's indices for each districts is shown in the Table 2.

From the above Table 2, it is clear that during the period 1970-71 to 1972-73 Bankura, Midnapur, Malda, Purulia and 24 Pargana are highly specialized districts with H-index greater than 0.5. In the same period Hooghly, Nadia, Murshidabad, Dinajpur, Jalpaiguri, Cooch Behar and Darjiling are highly diversified districts with value of H-index less than 0.30. In the second period, five districts viz. Birbhum, Bankura, Midnapur, Malda and Purulia have H-index greater than 0.5 (i.e., highly specialized) whereas Hooghly, Nadia, Murshidabad, Dinajpur, Jalpaiguri, Cooch Behar and Darjiling are least specialized (i.e., more crop diversification) districts. During the movement from the first to second period Birbhum district has shown the tendency of specialization with the increasing area under rice cultivation. In the third period (1990-91 to 1992-93) only two districts viz. Malda and Purulia are highly specialized districts (H Index>0.5). And Hooghly, Nadia, Murshidabad, Jalpaiguri, Darjiling are least specialized districts. In this period, in all the districts H-index value has been declined. The same trend of H-index is found during the final period (2002-03 to 2004-05). In the final period, in all the districts except Purulia the H-index is found to decline. Darjiling is seen to be the more diversified district in the state with H-index value of 0.05. Thus, it is evident that in districts of West Bengal, crop diversification is taking place. All districts except Purulia are experiencing increased diversification. The average value of H-Index for all districts was 0.3157 in first period and it has reduced to 0.2402 in the final period. So, a larger number of districts are experiencing crop diversification.

From the crop concentration Table 3, it is clear that in those districts where diversification is taking place, mostly the area shares of non-food grain crops viz., *til*, mustard, potato are going up at the cost of other food grain crops mainly rice. In the first period, the area shares under paddy of three highly diversified districts (Darjiling, Nadia and Murshidabad) are 35.51, 45.45 and 46.16%, respectively, lower than all other districts. In final period, in the highly diversified district,

Table 3: Crop concentration index of five major crops in the districts of West Bengal during 1970-71to 2004-05

| | 1970-71 to 1972-73 | | 1980-81 to 1982-83 | | 1990-91 to 1992-93 | | 2002-03 to 2004-05 |
|---|---|---|---|---|---|---|---|
| **Burdwan** | | | | | | | |
| Potato | 2.410 | Potato | 2.540 | Potato | 1.958 | Potato | 1.595 |
| Rice | 1.185 | Mustard | 2.061 | Mustard | 1.492 | Rice | 1.231 |
| Wheat | 0.884 | Rice | 1.143 | Rice | 1.138 | Mustard | 1.190 |
| Jute | 0.378 | Wheat | 0.435 | Jute | 0.304 | Jute | 0.281 |
| Mustard | 0.372 | Jute | 0.339 | Wheat | 0.127 | Wheat | 0.131 |
| **Birbhum** | | | | | | | |
| Wheat | 2.099 | Gram | 2.060 | Mustard | 1.843 | Gram | 3.910 |
| Gram | 1.319 | Mustard | 1.930 | Gram | 1.480 | Mustard | 1.529 |
| Potato | 1.086 | Wheat | 1.201 | Rice | 1.109 | Wheat | 1.219 |
| Rice | 1.037 | Rice | 1.153 | Wheat | 0.788 | Rice | 1.203 |
| Mustard | 0.391 | Potato | 0.939 | Potato | 0.637 | Potato | 0.649 |
| **Bankura** | | | | | | | |
| Rice | 1.178 | Rice | 1.244 | Potato | 1.299 | Wheat | 1.783 |
| Wheat | 1.046 | Potato | 0.952 | Rice | 1.186 | Potato | 1.258 |
| Potato | 0.671 | Wheat | 0.658 | Mustard | 0.794 | Rice | 1.241 |
| Mustard | 0.447 | Mustard | 0.597 | Til | 0.746 | Til | 0.438 |
| Til | 0.070 | Til | 0.226 | Wheat | 0.505 | Mustard | 0.374 |
| **Midnapur** | | | | | | | |
| Rice | 1.237 | Rice | 1.254 | Rice | 1.217 | Rice | 1.230 |
| Wheat | 0.353 | Potato | 0.378 | Til | 1.053 | Til | 0.901 |
| Potato | 0.280 | Wheat | 0.218 | Potato | 0.544 | Potato | 0.417 |
| Mustard | 0.220 | Til | 0.195 | Mustard | 0.417 | Mustard | 0.353 |
| Til | 0.047 | Mustard | 0.161 | Wheat | 0.136 | Wheat | 0.219 |
| **Howrah** | | | | | | | |
| Potato | 1.637 | Til | 2.802 | Til | 7.529 | Til | 1.795 |
| Til | 1.220 | Potato | 1.138 | Rice | 1.169 | Potato | 1.399 |
| Rice | 1.102 | Rice | 1.071 | Potato | 0.720 | Rice | 1.206 |
| Jute | 0.493 | Jute | 0.582 | Jute | 0.282 | Jute | 0.446 |
| Wheat | 0.478 | Wheat | 0.148 | Wheat | 0.032 | Wheat | 0.050 |
| **Hooghly** | | | | | | | |
| Potato | 5.452 | Potato | 6.148 | Til | 17.328 | Til | 6.342 |
| Jute | 1.384 | Til | 5.521 | Potato | 5.802 | Potato | 5.10 |
| Til | 1.139 | Jute | 1.152 | Jute | 1.089 | Jute | 0.987 |
| Rice | 1.034 | Rice | 0.962 | Rice | 0.913 | Rice | 0.954 |
| Wheat | 0.957 | Wheat | 0.537 | Wheat | 0.107 | Wheat | 0.032 |
| **24 Pargana** | | | | | | | |
| Rice | 1.110 | Rice | 1.101 | Rice | 1.101 | Rice | 1.303 |
| Jute | 1.076 | Jute | 0.971 | Mustard | 0.811 | Jute | 0.867 |
| Mustard | 0.626 | Mustard | 0.848 | Jute | 0.659 | Mustard | 0.802 |
| Wheat | 0.401 | Potato | 0.356 | Wheat | 0.302 | Potato | 0.303 |
| Potato | 0.389 | Wheat | 0.300 | Potato | 0.212 | Wheat | 0.285 |
| **Nadia** | | | | | | | |
| Gram | 4.831 | Gram | 3.611 | Gram | 4.150 | Gram | 3.835 |
| Jute | 2.783 | Jute | 3.142 | Jute | 3.142 | Jute | 2.452 |
| Mustard | 1.838 | Mustard | 2.536 | Wheat | 1.961 | Mustard | 1.853 |
| Wheat | 1.634 | Wheat | 2.166 | Mustard | 1.853 | Wheat | 1.589 |
| Rice | 0.655 | Rice | 0.608 | Rice | 0.624 | Rice | 0.639 |

Table 3: Continued

| | 1970-71 to 1972-73 | | 1980-81 to 1982-83 | | 1990-91 to 1992-93 | | 2002-03 to 2004-05 |
|---|---|---|---|---|---|---|---|
| **Murshidabad** | | | | | | | |
| Gram | 2.743 | Wheat | 3.462 | Wheat | 3.938 | Wheat | 3.310 |
| Wheat | 2.424 | Gram | 3.049 | Gram | 3.049 | Jute | 2.377 |
| Jute | 1.818 | Mustard | 1.816 | Jute | 2.202 | Gram | 2.314 |
| Mustard | 1.610 | Jute | 1.642 | Mustard | 1.143 | Mustard | 1.598 |
| Rice | 0.666 | Rice | 0.669 | Rice | 0.713 | Rice | 0.698 |
| **Dinajpur** | | | | | | | |
| Mesta | 4.352 | Mesta | 2.701 | Mesta | 4.511 | Mesta | 6.186 |
| Mustard | 2.305 | Mustard | 1.837 | Mustard | 1.773 | Mustard | 1.554 |
| Jute | 1.576 | Jute | 1.485 | Jute | 1.440 | Jute | 1.499 |
| Wheat | 1.101 | Wheat | 1.433 | Wheat | 1.308 | Wheat | 1.451 |
| Rice | 0.967 | Rice | 1.023 | Rice | 1.023 | Rice | 0.986 |
| **Malda** | | | | | | | |
| Mustard | 2.266 | Gram | 4.090 | Gram | 3.552 | Gram | 3.520 |
| Gram | 1.976 | Wheat | 1.427 | Wheat | 2.593 | Wheat | 2.608 |
| Wheat | 1.293 | Mustard | 1.219 | Mustard | 1.280 | Mustard | 1.793 |
| Jute | 0.901 | Jute | 1.016 | Jute | 0.955 | Jute | 0.945 |
| Rice | 0.730 | Rice | 0.796 | Rice | 0.783 | Rice | 0.774 |
| **Jalpaiguri** | | | | | | | |
| Mustard | 1.316 | Mustard | 1.064 | Wheat | 0.883 | Wheat | 0.918 |
| Rice | 0.972 | Rice | 0.886 | Rice | 0.865 | Rice | 0.748 |
| Wheat | 0.407 | Wheat | 0.525 | Mustard | 0.369 | Mustard | 0.253 |
| Jute | 0.004 | Jute | 0.008 | Jute | 0.006 | Jute | 0.005 |
| Tea | 0.001 | Tea | 0.002 | Tea | 0.002 | Tea | 0.001 |
| **Cooch Behar** | | | | | | | |
| Tobacco | 13.262 | Tobacco | 14.116 | Tobacco | 13.968 | Tobacco | 14.521 |
| Mustard | 1.551 | Jute | 2.172 | Jute | 2.408 | Jute | 2.285 |
| Rice | 1.056 | Rice | 1.005 | Rice | 1.019 | Wheat | 1.154 |
| Jute | 0.877 | Mustard | 0.994 | Wheat | 0.971 | Rice | 0.928 |
| Wheat | 0.530 | Wheat | 0.783 | Mustard | 0.292 | Mustard | 0.457 |
| **Darjiling** | | | | | | | |
| Tea | 13.435 | Tea | 16.895 | Tea | 10.176 | Tea | 5.765 |
| Potato | 2.219 | Potato | 2.017 | Potato | 1.473 | Potato | 1.226 |
| Rice | 0.512 | Rice | 0.434 | Wheat | 0.708 | Wheat | 0.383 |
| Wheat | 0.193 | Wheat | 0.403 | Rice | 0.448 | Rice | 0.333 |
| Jute | 0.001 | Jute | 0.002 | Jute | 0.001 | Jute | 0.001 |
| **Purulia** | | | | | | | |
| Arhar | 1.749 | Arhar | 1.397 | Arhar | 4.603 | Arhar | 7.375 |
| Rice | 1.170 | Rice | 1.219 | Til | 1.386 | Rice | 1.336 |
| Wheat | 0.567 | Maize | 0.323 | Rice | 1.205 | Til | 0.695 |
| Maize | 0.422 | Til | 0.180 | Maize | 0.604 | Maize | 0.477 |
| Til | 0.108 | Wheat | 0.115 | Wheat | 0.123 | Wheat | 0.264 |

Calculated from Statistical Abstracts of West Bengal, various issues

i.e., Darjiling the area share under Paddy was 20.43%. Thus, when diversification is taking place, the area under the major dominant crops are going to be declined (i.e., this will be clear from crop concentration analysis).

In Burdwan district, which is known as rice bowl of West Bengal, during first period, the five most concentrated crops are (a) potato (b) rice (c) wheat (d) jute and (e) mustard. In second period

mustard's concentration is increased and the concentration of wheat is reduced. During the final period potato, rice and mustard remain the main concentrating crops of the farmers. In case of Birbhum district, the five mostly concentrated crops are (a) wheat, (b) gram, (c) potato, (d) rice and (e) mustard. Over the period the concentration index of gram has increased significantly. During the final period the five mostly concentrated crops are (a) gram, (b) mustard, (c) wheat, (d) rice and (e) potato. In case of Bankura district during the early period the five most concentrated crops were (a) rice, (b) wheat, (c) potato, (d) mustard and (e) *til*. During the entire period of 35 years no new crop emerged among the top five most concentrated crops; only there happened a little change in the ordering of the crops. A similar picture is seen in Midnapur district also where rice remains as the most concentrated crops throughout the whole study period. However, the concentration index of *til* has improved significantly from 0.047 to 0.901. In Howrah district during the initial period the five most concentrated crops were (a) potato, (b) *til*, (c) rice, (d) jute and (e) wheat with potato is at the top with a index value of 1.637. Here as the time progresses *til* emerged as the most concentrated crops. During the third sub-period (1990-91 to 1992-93) the concentration index of til even gone up to 7.529. However, the index falls to 1.795 during the final sub-period; still it remains the most concentrated crop of the district. The concentration indices of other crops did not change to any significant extent. Hooghly is found to be one of the most diversified districts of the state. In this district the five most concentrated crops are (a) potato, (b) jute, (c) *til*, (d) rice and (e) wheat with an extremely high concentration index of potato (5.452). Hooghly is the leading potato producing district of the state and it produces more than 30 per cent potato production of the state. Here also *til* emerged as the most concentrated crop at the end of the study period with a concentration index of 6.342. In 24 Pargana, a moderately diversified district, the five most concentrated crops are (a) rice, (b) jute, (c) mustard, (d) wheat and (e) potato. Any significant changes did not found to occur either in the ordering of the crops or in the concentration indices of the crops. Rice remains to be the most concentrated crop followed by jute, mustard, potato and wheat. Nadia and Murshidabad are the two districts of the state where crops diversification is seen to a large extent. In both these two districts five most concentrated crops are (a) gram, (b) jute, (c) mustard, (d) wheat, (e) rice. Potato which is an important cash crop of the farmers of West Bengal is not seen among the five most concentrated crops of the both these two districts. In both districts rice is at the bottom of the five most concentrated crops with the concentration index not exceeding 1. The concentration indices of all other crops are greater than unity. In Dinajpur district the five most concentrated crops are (a) *mesta,* (b) mustard, (c) jute and (e) rice. The concentration index of rice is 4.352. The concentration index of all other crops except is greater than unity. Over the entire period in this particular district no other crops has emerged among the top five crops. Even the ordering of the existing top five crops did not change. However, the concentration index of *mesta* increased significantly to 6.186 at the end of the period. The district is the leading producer of *mesta* in the state and produces 68.72% of the total *mesta* production of the state during 2004-05. The Cooch Behar district being the leading producer of tobacco shows a heavy concentration towards tobacco.

In both districts rice is at the bottom of the five most concentrated crops with the concentration index not exceeding 1. The concentration indices of all other crops are greater than unity. In Dinajpur district the five most concentrated crops are (a) *mesta,* (b) mustard, (c) jute and (e) rice. The concentration index of rice is 4.352. The concentration index of all other crops except is greater than unity. Over the entire period in this particular district no other crops has emerged among the top five crops. Even the ordering of the existing top five crops did not change. However, the concentration index of *mesta* increased significantly to 6.186 at the end of the period. The district

is the leading producer of *mesta* in the state and produces 68.72% of the total *mesta* production of the state during 2004-05. The Cooch Behar district being the leading producer of tobacco shows a heavy concentration towards tobacco. The concentration index of tobacco remains very high throughout the entire period of study. In Jalpaiguri district five most concentrated crops are (a) mustard, (b) rice, (c) wheat, (d) jute and (e) tea. Only mustard has index value of grater than unity. At the end of study period wheat becomes the most concentrated crop of the district and no single crop has concentration index of greater than unity. The hill district of north Bengal i.e., Darjiling shows a heavy concentration towards tea, with the index value of more than 13.435. However, the index reduced to 5.765 at the end of the study period. Potato is only other single crops whose index value is greater than unity. Other most concentrated crops are wheat, rice and jute. In Purulia, the least diversified district of the state, the five most concentrated crops are (a) *arhar*, (b) rice, (c) wheat, (d) maize and (e) *til*. Rice and *arhar* both have index value of greater than unity. In fact, the concentration of *arhar* has continuously increased over the years. The concentration index of *arhar* during the final period is 7.375. During this final period rice is another crop whose concentration index is greater than unity.

**The decomposition of production changes: Area effect and yield effect:** The cropping pattern in West Bengal shows a bias towards food grain crops (especially, rice). However, there is found to be a gradual change in the cropping pattern in favour of non-food grain crops over time, though the food grain crops still dominate the cropping pattern of the state. Crop yield is the major component of agricultural production and acts as the main driving force behind cropping pattern. Its changes have a direct impact on the changing cropping pattern growth. In absolute terms there has been a significant growth in yield rates of most of the food grain crops. As we know that the yield rate (Y) is defined as the ratio of total production (P) and total area (A). Thus, the exponential growth rate of production would be the sum total of the exponential growth rates of area and yield. The trend rates of growth of area, production and yield show that the output rate of growth is influenced less by the rate of growth of the area and more by the rate of growth of yield in the state (Ghosh and Kuri, 2007). Since, the exponential growth rate of output is the sum total of growth rate of area and that of yield, the increase in production under different crops can be decomposed in to area and yield components (Table 3). During our study period (1970-71 to 2004-05) total rice production was increased by 8522.24 thousand tones, out of which 1567 thousand tones was increased because of the expansion of the area under rice cultivation and remaining 6955.24 thousand tones due to an increase in yield growth rate. Total cereals production was increased by 8681.17 thousand tones, out of which 85 per cent increment came from the yield effect and 15% from area effect. During the entire period of study, total food grain production was increased by 8515.51 thousand tones. Of this increment in the food grain production, 7951.98 thousand tones came from the yield effect and only 563.53 thousand tones from the area effect. Among food grain crops, the yield effect was found to be negative only in case of *arhar* whose area effect is also negative. In case of total pulses, the negative area effect overshadowed the positive yield effect and eventually led to a fall in output. The output of all types of pulses declined mainly due to the reduction in the area under cultivation and not because of the yield effect. If we go through the table carefully we find that the yield effects of most of the crops are positive. However, the area effects of a number of important crops (small millets, gram, *arhar*, pulses etc.) are negative. Interestingly, in spite of a positive yield effect, the negative area effect led to a fall in *aus* rice output. In case of *boro* rice cultivation, the area effect (3459.21) was much higher than the positive

yield effect (294.85) and the yield effect (4744.13) of *aman* rice was much higher than the positive area effect (214.75). This implies that in rice cultivation there is a shift from *aus* to *boro* cultivation. And among food grain crops, there is a cropping pattern change in favour of rice cultivation. The area under *boro* rice was increased mainly due to irrigation facilities provided by the government in several districts of the state. Again among non-food grain crops; potato, *til* and chillies are the crops having favourable shifts in the cropping pattern. Thus, we see that there is a change in the cropping pattern of the state. The traditional food grain crops are being substituted by the commercial cash crops. However, the cropping pattern is still found to have a bias towards the production of food grain crops in general and rice in particular.

**Cropped area-gross cropped area elasticity and cropping pattern changes in West Bengal:** The cropping pattern change can also be analyzed more clearly with the help of 'cropped area gross cropped area elasticity' (E) (Venkataramanan and Prohaladachar, 1980). We categorize the crops according to the value of E into three categories. Category I include those crops for which the value of E is greater than unity. Category II includes those crops for which the value of E lies between zero and unity and lastly, category III includes those crops for which the value of E is found to be negative. From Table 4, it is found that is found that *boro* rice, mustard, *til*, total

Table 4: The decomposition of the total increase in output in terms of area effect, yield effect and the crop area-gross cropped area elasticity under crops in West Bengal during 1970-71 to 2004-05

| Crops | Area effect ('000 tones) | Yield effect ('000 tones) | Total increase in output ('000 tones) | Increase in area ('000 ha) | 'E' |
|---|---|---|---|---|---|
| Aus | -1581.79 | 1772.59 | -190.8 | -459.45 | E<0 |
| Aman | 214.75 | 4744.13 | 4958.88 | 156.81 | 0< E<1 |
| Boro | 3459.21 | 294.85 | 3754.06 | 1203.65 | E>1 |
| Rice | 1566.99 | 6955.25 | 8522.14 | 900.61 | 0 < E<1 |
| Wheat | -241.42 | 123.73 | 117.69 | 65.72 | 0 < E<1 |
| Other cereals | -199.94 | 171.54 | -28.4 | -90.3 | E<0 |
| Total cereals | 1211.51 | 7026.78 | 8681.17 | 843 | 0 < E<1 |
| Gram | -68.06 | 12.6 | -55.32 | -108.51 | E<0 |
| Arhar | -18.09 | -0.53 | -18.62 | -22.64 | E<0 |
| Other pulses | -146.58 | 61.58 | -85 | -291 | E<0 |
| Total pulses | -210.75 | 51.95 | -158.8 | -395 | E<0 |
| Food grain | 563.53 | 7951.98 | 8515.51 | 487.96 | 0 < E<1 |
| Rapeand mustard | 250.84 | 132.9 | 383.74 | 343.8 | E>1 |
| Linseeds | -10.6 | 0.9 | -9.6 | -35.4 | E<0 |
| Til | 65.69 | 18.31 | 84 | 99.7 | E>1 |
| Total oilseeds | 352.79 | 239.75 | 592.54 | 516.95 | E>1 |
| Jute | 1980.02 | 3703.1 | 5683.12 | 213.32 | E>1 |
| Mesta | -384.89 | 99.71 | -285.19 | -55.83 | E<0 |
| Total fibre | 1453.27 | 3944.59 | 5397.87 | 157.71 | 0 < E<1 |
| Sugarcane | -1975.82 | 1153.45 | -822.37 | -21.1 | E<0 |
| Tobacco | 0.77 | 0.83 | 1.6 | 3 | 0 < E<1 |
| Potato | 4796.83 | 1906.81 | 6703.64 | 246.43 | E>1 |
| Chillies | 57.79 | 2.26 | 60.05 | 52.47 | E>1 |
| Ginger | 13.83 | 3.29 | 17.12 | 7.9 | E>1 |

Author's calculation based on bureau of applied economics and statistics data

oilseeds and jute, potato, chillies and ginger form category I. Under category II come *aman* rice, total rice, wheat, total cereals, total food grain, total fibre and tobacco.

And lastly category III includes *aus*, other cereals (all cereals crops excluding rice and wheat), gram, *arhar*, other pulses (all pulse crops excluding gram and *arhar*), total pulses, linseeds, mesta and sugarcane. Though the expansion of area under the crops of category II and I is found to be higher than the decline in area under the third category of crops, there is a clear indication of crop substitution. However, only marginal crops were substituted for major crops in West Bengal during the period under study and the cropping pattern was found to be favourable towards food grain crops.

**Cropping pattern changes: Substitution and expansion effects:** The total change in the cropping pattern is the result of both substitution and expansion effect. For a given gross cropped area, substitution effect is defined as the relative decline in the area under some crops and the compensating increase in the area of the substitutable crops. The expansion effect, on the other hand, is defined as the increase in the gross cropped area. The changing cropping pattern in West Bengal during 1970-71 to 2004-05 is terms of substitution effect and expansion effect is examined in Table 5.

We see that area under *aus* rice, other cereals, gram, *arhar*, other pulses, *mesta*, linseeds and sugarcane declined by 1084.23 thousand ha, respectively. On the other hand, the area under *aman*, *boro*, wheat, *til*, mustard, jute, tobacco, potato, chillies and ginger was increased by 2392.80 thousand ha. Thus, the expansion effect alone led to an increase of area under these crops by (2392.80-1084.23) or 1308.57 thousand ha.

Therefore, the empirical evidence suggests that the both expansion effect and substitution effect were important driving forces behind the cropping pattern changes in West Bengal. The substitution effect alone could explain 45.31% of the change in gross cropped area and the remaining 54.69% of the gross cropped area was due to the expansion effect

Interestingly, even though the area under aus rice declined by 459.45 thousand ha, the area under total rice increased by 900.61 thousand ha. This is mainly because of the fact that the area increase in *boro* cultivation (by 1203.65 thousand ha during the entire period) overshadowed the

Table 5: Cropping pattern changes in west bengal: substitution and expansion effect 1970-71 to 2004-05

| Crop | Substitution effect ('000 ha) | Crop | Substitution and expansion effect ('000 ha) |
|---|---|---|---|
| Aus | -459.45 | Aman | 156.81 |
| Other cereals | -90.3 | Boro | 1203.65 |
| Gram | -108.51 | Wheat | 65.72 |
| Arhar | -22.64 | Food items | 1426.18 |
| Other pulses | -291 | Til | 99.7 |
| Food items | -971.9 | Mustard | 343.8 |
| Linseeds | -35.4 | Jute | 213.32 |
| Mesta | -55.83 | Tobacco | 3.0 |
| Sugarcane | -21.1 | Potato | 246.43 |
| Non-food items | -112.33 | Chillies | 52.47 |
| | | Ginger | 7.9 |
| | | Non-food items | 966.62 |

Author's calculation based on BAES data

corresponding decline in the area under the *aus* rice cultivation. This may imply that there is a significant improvement in irrigation facilities, as *boro* is a summer crop.

Thus, there was a significant change in the cropping pattern of the state. The areas under non-food grain crops like oilseeds, jute, chillies, potato etc. have increased significantly. There is an indication of the shift from food grain crops to non-food grain commercial cash crops. However, in spite of a decline in total pulses area; food grain crops occupy the first position. Among food grain crops, cereals crops have occupied the first place with the largest contribution from rice. Among non-food grain crops; oilseeds, jute, chillies, potato, tea etc have become the major crops of the state.

## CONCLUSION AND RECOMMENDATIONS

In short, the findings can be summarized as follows: the main focus of this study was on the cropping pattern changes in the agricultural scenario of the state of West Bengal. The cropping pattern changes are analyzed in terms of crop concentration index measured by Herfindal index and cropped area- gross cropped area elasticity. From the overall analysis it is clear that the cropping pattern in West Bengal in terms of allocation of acreage has been skewed towards food grain. However, during the last fifteen to twenty years some important crops (*boro* rice, potato, oilseeds, especially mustard) emerged as the main crop for the farmers. The cropping pattern turned against pulses, coarse cereals and sugarcane. However, during the last decade it regained some of its earlier position. From the district level analysis it has been found that Hooghly, Nadia, Murshidabd, Dinajpur, Jalpaiguri, Cooch Behar and Darjling are the most diversified districts of the state. Burdwan, Birbhum, Howrah, 24 Pargana are moderately diversified districts whereas Midnapur, Malda and Purulia are the least diversified districts of the state. Hooghly, a diversified district, shows a very high concentration towards potato cultivation. Similarly in Nadia district there is a high concentration of gram. Dinajpur, Cooch Behar and Darjiling are the three districts where *mesta*, tobacco and tea are highly concentrated in respective districts.

Again a very important intra-rice crop substitution happened in West Bengal. The area under *aus* rice has declined continuously while the area under *boro* rice has increased significantly. It is also found that in the cropping pattern changes the expansion effect could explain 54.69% of the gross cropped area and the remaining 45.31% of the gross cropped area was due to the substitution effect. In the cropping pattern scenario of West Bengal, though the non-food grain crops like oilseeds, potato, chillies etc. have been gradually replacing the food grain crops, the cropping pattern of the state is still food grain dominated.

## REFERENCES

Bhalla, G.S. and G. Singh, 1997. Recent developments in Indian agriculture: A state level analysis. Econ. Political Weekly, 32: A2-A18.

Boyce, J.K., 1987. Agrarian Impasse in Bengal: Institutional Constraints to Technological Change. Oxford University Press, Oxford and New York.

Chattopadhyay, A.K and P.S. Das, 2000. Estimation of growth rate: A critical analysis with reference to West Bengal agriculture. Indian J. Agric. Econ., 55: 116-135.

De, U.K., 2002. Economics of Crop Diversification. Akansha Publishing House, New Delhi.

De, U.K., 2003. Changing cropping system in theory and practice: An economic insight into the agrarian West Bengal. Indian J. Agric. Econ., 58: 64-83.

Ghosh, B.K. and P.K. Kuri, 2005. Changes in cropping pattern in West Bengal during 1970-71 to 2000-01. IASSI Q., 24: 39-56.

Ghosh, B.K. and P.K. Kuri, 2007. Agricultural growth in West Bengal from 1970-71 to 2003-04: A decomposition analysis. ICFAI J. Agric. Econ., 4: 30-46.

Majumdar, K. and P. Basu, 2005. Growth decomposition of foodgrains output in west Bengal: A district level study. Indian J. Agric. Econ., 60: 220-234.

Mruthyunjaya and P. Kumar, 1989. Crop economics and cropping pattern changes. Econ. Political Weekly, 24: A159-A161.

Saha, A. and M. Swaminathan, 1994. Agricultural growth in West Bengal in the 1980s: A disaggregation by districts and crops. Econ. Political Weekly, 29: A-8-A-8.

Sanyal, M.K., P.K. Biswas and S. Bardhan, 1998. Institutional change and output growth in west Bengal agriculture: End of impasse. Econ. Political Weekly, 33: 2979-2986.

Sau, S. and S. Pathak, 2007. Diversification of agriculture-rationale and determinants-a study with special reference to West Bengal. Indian J. Regional Sci., 39: 140-149.

Sharma, H.R., 2005. Agricultural development and crop diversification in Himachal Pradesh: Understanding the patterns, processes, determinants and lessons. Indian J. Agric. Econ., 60: 71-93.

Vaidyanathan, A., 1992. Instability in agriculture: Extent, causes and consequences: A review article. Indian Econ. Rev., 27: 211-222.

Venkataramanan, L.S. and M. Prahladachar, 1980. Growth rates and cropping pattern changes in agriculture in six states: 1950 to 1975. Indian J. Agric. Econ., 35: 1-4.