

Technological Change and its Impact on the Crop Economy of West Bengal

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ABSTRACT

The present study examines the change in crop profile and cropping pattern and its impact on the crop economy of West Bengal due to technological change in agrarian production from late eighties to 2002-03 with the help of primary and secondary data through simple tabular as well as growth analysis. The present study is devoted to identify the factors that have been operative in changing crop-mix and cropping pattern during the period. By using simple correlation analysis the movement of area under different crops over time has been explained and it is found that no transfer of area has been brought about to wheat from its competing crops in both the periods i.e. late sixties to late eighties and late eighties to 2002-03. Rather both the area under wheat and its competing crops have been increasing simultaneously (excepting gram) over the entire period. By using same correlation analysis it is also revealed that neither the relative price nor the relative profitability has played the pivotal role in explaining the area expansion of wheat and its competing crops. Continuous expansion of area under summer rice over the entire period and the decline in area under autumn rice and winter rice in the later phase have also not been explained by relative profitability consideration. It is the consumption demand for cereal of farm and non-farm people which has played the pivotal role in changing crop-mix and cropping pattern in both the periods. In a small farm dominated agricultural economy of West Bengal the consumption demand of cereal has been continuously increasing and to meet the increasing consumption demand in the first instance more and more land have been allocated to the production of summer rice and wheat. For Bengali people rice is the principal staple cereal. In rural areas the use of wheat as staple cereal was not notable in pre-HYV era. With the inflationary upsurge from late sixties onwards and thereby severe erosion of the purchasing power the wheat as a cheaper staple cereal has come up as a staple cereal by substituting rice. With narrowing the gap of price differences between rice and wheat the preference of rice to wheat and in effect, dwindling in wheat area is visualized. The meeting of consumption demand having been satisfied the surplus land is devoted to raise paying crops like vegetables and chilli in order to increase farm income. The continuous increase in area under irrigation and evolving of high yielding short duration rice varieties

through research have played an important role in the process of observed reallocation of land with the twin objectives to meet self-consumption demand of cereal and increasing farm income.

Keywords:

Technological change, Cropping pattern, crop profile, area movement, price movement, relative profitability, consumption demand

INTRODUCTION:

A spectacular change has been experienced in the crop economy of West Bengal since late sixties with the introduction of HYV technology in crop production. The HYV technology introduced in the country in general and in West Bengal in particular during late sixties was centered around the cereal crops particularly rice and wheat. Improvement of yield per unit area through introduction of HYV technology in case of maize and small millets is not found notable. Production technology of other crops namely jute, potato, pulses, oilseeds, vegetable and spice crops were recorded by and large unchanged till late eighties or early nineties as has been noticed in crop production front of West Bengal. From early nineties production technology of pulse, oilseed, jute, sugarcane and potato has got a remarkable change which has been reflected in the improvement of yield per unit area of these crops. The production technology of vegetable and spice crops is recorded a great leap since late eighties and more particularly early nineties due to introduction of hybrid technology in the production of vegetable crops. One may, therefore, reasonably demarcate the entire period extending from late sixties to 2002-03 into two phases. The first phase extending from late sixties to late eighties is marked as a period of technological change in cereal production and the second phase extending from late eighties onward as period of technological change in oilseed and pulse and more particularly in vegetable and spice crops. The present study purports to examine the change in crop profile and cropping pattern and its impact on the crop economy of West Bengal due to technological change in agrarian production in the second phase i.e. late eighties to 2002-03.

METHODOLOGY

The study is principally based on secondary data, both cross sectional and time series. Data on area, production and yield rate of the principal crops in West Bengal have been drawn upon from Socio-Economic and Evaluation Branch, Directorate of Agriculture, Govt. of West Bengal and Bureau of Applied Economics and Statistics, Govt. of West Bengal. Data on wholesale prices of wheat and rice have been collected from Ministry of Food and Supply, Directorate of Economics and Statistics, Government of West Bengal. Simple tabular as well as growth analysis have been adopted in the present study. Primary data, quantitative as well as qualitative, have also been used in the present study and was collected by interviewing the selected sample respondents with the help of suitably designed schedule and questionnaire in 2003-04. For the present study the district 'Cooch Behar' of West Bengal has been selected purposively to gather information. The objective of the study keeping in view two clusters of villages, one agriculturally developed (Cluster I: advanced villages) and the other agriculturally backward (cluster II: backward villages), have been selected where the extent of irrigated area, power supply, distance from the nearest wholesale market, medical facility have been taken into account as the important infrastructural facility in distinguishing developed / advanced villages from backward villages. Considering those developmental parameters two clusters of villages consisting of three villages in each cluster have been selected. Eighty farm households have been selected from each cluster following simple random sampling without replacement with probability proportional to size (household).

There are four concepts of cost, namely, cost A_1 , cost A_2 , cost B and cost C which has been widely used in farm management and other cost studies conducted in India. The cash and kind expenses (or out of pocket expenses) actually incurred by an owner operator is defined as Cost A_1 . Thus, this cost includes the cash and kind expenditure incurred on hired human labour, owned and hired bullock labour, farm produced or purchased seeds, farm produced or purchased manures, fertilizers, micronutrients, insecticides and fungicides, irrigation, land revenue and cesses, depreciation on non-land fixed capital, interest on working capital, and interest on crop loans.

The concept of prime cost has been adopted in this study which has already been used by Panse, V.G. and Bokil, S.D. (1966) and also by the Madras Report for the Triennium 1954-55 to 1956-57. In conformity with Madras Report and authors noted above, prime cost in the present study designated as cost D (Krishnaji, 1975) has been defined as the cost incurred on account of total labour input, seed, manures and fertilizers, repairs and depreciation of implements and machinery, and irrigation charges. Panse and Bokil also justify the use of this

concept for the principal reason that it represents the physical requirements in the production of a crop. It is not identical with cost A_1 as used in farm management studies. Therefore, Cost D mentioned above can be defined as Cost A_1 considered in the present study exclusive of land revenue and cesses plus the imputed value of family labour.

CHANGES IN CROPS AND CROPPING PATTERN IN THE SECOND PHASE: 1987-88 TO 2002-03.

Upswing of area growth of summer rice initiated in late sixties onward has been maintained monotonically in the second period as well with an annual growth of 5.11 per cent over the entire period (Table 5) and that in three subsequent sub-periods with growth rate of 3.09, 2.43 and 2.22 per cent respectively (Table 2). And in effect area under summer rice has grown from 661 thousand hectares in late eighties to 1421 thousand hectares in 2002-03. Similarly, dwindling the area of autumn rice as noticed from early eighties was maintained although and arrived at the figure 648 thousand hectares in early eighties and 394 thousand hectares in 2002-03 with a negative growth of 3.76 per cent per annum. In contrary to the first period, the increasing trend of area under winter rice (though very feeble) is turned into declining trend during the second period particularly from early nineties as revealed from Table 2 and Table 5. But it is important to note that the upswing or downswing of area in case of winter rice is very feeble in contrast to a remarkable change in area as noticed for summer rice and autumn rice. As a consequence, share of crop to net cropped area (NCA) has changed from 12.23 to 26.23 per cent for summer rice, 10.71 to 7.27 per cent for autumn rice, and from 75.29 to 73.23 per cent for winter rice over the period extending from late eighties to 2002-03. In the second period as in the first period an increasing trend in area under wheat with inter-year fluctuation is recorded. But higher rate of area growth (2.44 as against 1.16 per cent per annum) with relatively less inter year fluctuation is noticed over the second period (Table 5). As in the first period area under pulse crops is registered a declining trend in the second period also with a negative average annual growth of 2.64 per cent and as a consequence its area has further come down from 379 thousand hectares in late eighties to 255 thousand hectares in 2002-03. But the contrasting feature is that area under food grain crops, despite dwindling of area under autumn rice, winter rice, and pulse crops, has increased with an annual growth of 0.29 per cent as against its decline in the first period with a growth rate of 0.15 per cent.

Area of oilseed crops in general and that of rape and mustard in particular is noticed a great leap from early eighties and therefrom an increasing trend is maintained

over the second period with average annual growth of 0.40 and 0.20 per cent respectively (Table 8 and Table 5). Area under potato as observed an increasing trend with inter-year fluctuation in the first period is recorded a continuous increase with annual growth of 4.36 per cent over the second period. It is remarkable to note the magnitude of hike of area under potato from about 79 thousand hectares in late sixties, beginning of HYV era, to about 164

thousand hectares at the end of first period and thereafter a further hike to 316 thousand hectares in 2002-03. Area under jute is also noted an increasing trend in second period also with an annual growth of 3.04 per cent. Area under sugarcane in the second period though has increased in contrast to that of first period but could never touch to the level recorded at the beginning of HYV era.

Table 1: Average Area of Major Cereal Crops in West Bengal

| Major cereal crops | Average Area ('000 ha) | | | | | | | | |
|--------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| | Triennium ending 1962-63 | Triennium ending 1967-68 | Triennium ending 1972-73 | Triennium ending 1977-78 | Triennium ending 1982-83 | Triennium ending 1987-88 | Triennium ending 1992-93 | Triennium ending 1997-98 | Triennium ending 2002-03 |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Autumn rice | 568.6 (10.37) | 658.6 (11.97) | 807.9 (14.79) | 830.0 (14.96) | 648.5 (11.77) | 578.9 (10.71) | 561.1 (10.27) | 465.1 (8.51) | 393.8 (7.27) |
| Winter rice | 3892.9 (70.99) | 3975.2 (72.26) | 3946.3 (72.24) | 4233.0 (76.30) | 4104.7 (74.52) | 4069.9 (75.29) | 4284.1 (78.41) | 4278.5 (78.31) | 3967.4 (73.23) |
| Summer rice | 28.9 (0.53) | 37.5 (0.68) | 251.2 (4.60) | 289.1 (5.21) | 329.3 (5.98) | 661.3 (12.23) | 897.1 (16.42) | 1141.1 (20.89) | 1421.0 (26.23) |
| Wheat | 43.1 (0.80) | 58.5 (1.06) | 383.6 (7.02) | 521.6 (9.40) | 254.4 (4.62) | 359.0 (6.64) | 263.1 (4.82) | 355.4 (6.50) | 421.8 (7.78) |
| Major Cereals | 4533.5 (82.68) | 4729.8 (85.98) | 5389.1 (98.64) | 5873.7 (105.88) | 5337.0 (96.90) | 5669.1 (104.87) | 6005.4 (109.92) | 6240.2 (114.22) | 6204.0 (114.52) |

Figures in parentheses indicate percentage of the net cropped area.

Table 2: Annual Growth Rate of Area of Major Cereal Crops in West Bengal.

| Major cereal crops | Growth rate (in per cent) of average area | | | | | | | |
|--------------------|--|--|--|--|--|--|--|--|
| | Triennium ending 1962-63 to triennium ending 1967-68 | Triennium ending 1967-68 to triennium ending 1972-73 | Triennium ending 1972-73 to triennium ending 1977-78 | Triennium ending 1977-78 to triennium ending 1982-83 | Triennium ending 1982-83 to triennium ending 1987-88 | Triennium ending 1987-88 to triennium ending 1992-93 | Triennium ending 1992-93 to triennium ending 1997-98 | Triennium ending 1997-98 to triennium ending 2002-03 |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Autumn rice | 1.47 | 2.06 | 0.26 | -2.43 | -1.13 | -0.31 | -1.85 | -1.65 |
| Winter rice | 0.21 | -0.07 | 0.70 | -0.31 | -0.09 | 0.51 | -0.01 | -0.75 |
| Summer rice | 2.65 | 20.94 | 1.42 | 1.31 | 7.22 | 3.09 | 2.43 | 2.22 |
| Wheat | 3.10 | 20.69 | 3.12 | -6.93 | 3.50 | -3.05 | 3.05 | 1.73 |
| Major cereals | 0.42 | 1.31 | 0.86 | -0.95 | 0.60 | 0.58 | 0.38 | -0.06 |

Table 3: Annual Growth Rate of Area of Pulse and Oilseed Crops in West Bengal.

| Pulse and Oilseed Crops | Growth rate (in per cent) of average area | | | | | | | |
|-------------------------|--|--|--|--|--|--|--|--|
| | Triennium ending 1962-63 to triennium ending 1967-68 | Triennium ending 1967-68 to triennium ending 1972-73 | Triennium ending 1972-73 to triennium ending 1977-78 | Triennium ending 1977-78 to triennium ending 1982-83 | Triennium ending 1982-83 to triennium ending 1987-88 | Triennium ending 1987-88 to triennium ending 1992-93 | Triennium ending 1992-93 to triennium ending 1997-98 | Triennium ending 1997-98 to triennium ending 2002-03 |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Kharif Pulses | 6.11 | -3.36 | -2.45 | 5.58 | 1.13 | 2.32 | -0.37 | -3.15 |
| Rabi Pulses | -1.01 | -1.35 | -0.18 | -3.54 | -1.97 | -5.16 | -2.19 | 2.03 |

| | | | | | | | | |
|-----------------------|-------|-------|-------|-------|-------|-------|-------|-------|
| Total Pulses | -0.16 | -2.23 | 0.53 | -3.40 | -1.71 | -2.76 | -2.47 | 1.35 |
| Total Foodgrain crops | 0.29 | 0.89 | 0.69 | -1.06 | 0.42 | 0.36 | 0.23 | -0.02 |
| Rape & Mustard | 0.60 | -0.22 | -1.62 | 5.83 | 6.89 | 2.70 | -1.93 | 2.80 |
| Total Oilseeds | 0.01 | 0.66 | 1.22 | 6.15 | 3.00 | 1.51 | -0.60 | 1.58 |

Table 4: Annual Growth Rate of Area of Other Principal Crops in West Bengal.

| Other Principal Crops | Growth rate (in per cent) of average area | | | | | | | |
|-----------------------|--|--|--|--|--|--|--|--|
| | Triennium ending 1962-63 to triennium ending | Triennium ending 1967-68 to triennium ending | Triennium ending 1972-73 to triennium ending | Triennium ending 1977-78 to triennium ending | Triennium ending 1982-83 to triennium ending | Triennium ending 1987-88 to triennium ending | Triennium ending 1992-93 to triennium ending | Triennium ending 1997-98 to triennium ending |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Jute | 1.87 | -0.97 | 0.15 | 2.17 | 0.72 | -0.64 | 1.27 | 0.67 |
| Sugarcane | -1.58 | 0.90 | -1.44 | -2.74 | -6.14 | 2.03 | 4.32 | -0.50 |
| Potato | 3.09 | -1.15 | 5.33 | -0.06 | 3.40 | 2.74 | 2.86 | 1.06 |

Table 5: Annual Compound Growth Rate (ACGR) (in per cent) of Area Trend of Principal Crops in West Bengal.

| Principal crops | First Period (1968-69 to 1986-87) | | Second Period (1987-88 to 2002-03) | |
|---------------------|-----------------------------------|---------------------|------------------------------------|---------------------|
| | ACGR | R ² | ACGR | R ² |
| (1) | (2) | (3) | (4) | (5) |
| Autumn rice | -2.29** (0.0044) | 0.6075 [6.2707] | -3.76** (0.0026) | 0.9329 [1.2944] |
| Winter rice | 0.14** (0.0017) | 0.0373 [3.7804] | -0.32** (0.0022) | 0.1265 [3.5443] |
| Summer rice | 7.57** (0.0132) | 0.6733 [14.0690] | 5.11** (0.0042) | 0.9156 [2.0512] |
| Wheat | 1.16** (0.0161) | 0.0297 [31.5952] | 2.44** (0.0067) | 0.4905 [8.1596] |
| Total Major Cereals | 0.23** (0.002) | 0.0699 [4.5624] | 0.49** (0.0014) | 0.4608 [1.8380] |
| Jute | 2.87** (0.0069) | 0.5119 [10.7842] | 3.04** (0.0041) | 0.7979 [3.1278] |
| Sugarcane | -5.28** (0.009) | 0.6560 [10.7453] | 4.77** (0.014) | 0.4644 [16.5487] |
| Potato | 5.33** (0.0063) | 0.8178 [5.6216] | 4.36** (0.0037) | 0.9099 [1.8922] |
| Kharif Pulses | 0.46** (0.0138) | 0.0065 [30.2165] | -3.40** (0.0061) | 0.6777 [6.3595] |
| Rabi Pulses | -4.14** (0.0063) | 0.7074 [7.5021] | -3.53** (0.0086) | 0.5370 [10.9044] |
| Total Pulses | -3.78** (0.0043) | 0.8108 [4.3387] | -2.64** (0.0065) | 0.5360 [8.3344] |
| Total Foodgrains | -0.15** (0.0018) | 0.0380 [4.2760] | 0.29** (0.0012) | 0.2863 [1.8768] |
| Rape & Mustard | 5.28** (0.0107) | 0.5981 [17.1419] | 0.20** (0.0055) | 0.0098 [9.7101] |
| Total Oilseeds | 6.12** (0.0061) | 0.8595 [5.1793] | 0.40** (0.004) | 0.0661 [7.1137] |

| | | | | |
|----------------|---------------------|--------------------|--------------------|--------------------|
| Total Chillies | 10.71** (0.0054) | 0.9619 [2.0890] | 2.46** (0.0026) | 0.8662 [1.6152] |
|----------------|---------------------|--------------------|--------------------|--------------------|

Figures in first bracket indicate Standard Error (SE) of Annual Compound Growth Rate.

Figures in third bracket indicate instability index.

** Significant at 1 per cent level of significance

Table 6: Annual Compound Growth Rate (ACGR) (in per cent) of Yield Trend of Principal Crops in West Bengal

| Principal crops | First Period (1968-69 to 1986-87) | | Second Period (1987-88 to 2002-03) | |
|---------------------|--------------------------------------|---------------------|---------------------------------------|---------------------|
| | ACGR | R ² | ACGR | R ² |
| (1) | (2) | (3) | (4) | (5) |
| Autumn rice | 0.58** (0.0053) | 0.0665 [12.1705] | 2.91** (0.0047) | 0.7373 [3.8820] |
| Winter rice | 0.89** (0.0055) | 0.1341 [11.6171] | 2.00** (0.0038) | 0.6660 [3.8608] |
| Summer rice | -0.02** (0.0036) | 0.0002 [8.2843] | 0.36** (0.0026) | 0.1208 [4.3941] |
| Wheat | -0.14** (0.0061) | 0.0034 [13.9376] | 2.07** (0.0086) | 0.2958 [10.1910] |
| Total Major Cereals | 1.15** (0.0046) | 0.2678 [9.1525] | 1.77** (0.0035) | 0.6480 [3.6883] |
| Jute | 1.94** (0.0047) | 0.5057 [7.0588] | 2.12** (0.0020) | 0.8834 [1.1435] |
| Sugarcane | 0.40** (0.0035) | 0.0733 [7.6010] | 1.17** (0.0065) | 0.1916 [10.0668] |
| Potato | 3.49** (0.0039) | 0.8272 [3.5953] | 0.42** (0.0048) | 0.0507 [8.4816] |
| Kharif Pulses | -0.58** (0.0048) | 0.0768 [11.0193] | 0.81** (0.0083) | 0.0643 [13.7784] |
| Rabi Pulses | 0.35** (0.0042) | 0.0405 [9.2591] | 0.68** (0.0052) | 0.1105 [9.1156] |
| Total Pulses | 0.34** (0.0036) | 0.0487 [8.1036] | 0.81** (0.0038) | 0.2427 [6.0658] |
| Total Foodgrains | 1.36** (0.0045) | 0.3511 [8.4888] | 2.17** (0.0021) | 0.8789 [1.2972] |
| Rape & Mustard | 3.34** (0.0067) | 0.5979 [9.6829] | -0.39** (0.0049) | 0.0428 [8.7339] |
| Total Oilseeds | 2.75** (0.0052) | 0.6262 [7.5018] | -0.02** (0.0035) | 0.0003 [6.4920] |
| Total Chillies | -0.85** (0.0040) | 0.2078 [8.3574] | 1.74** (0.0022) | 0.8123 [1.7355] |

Figures in first bracket indicate Standard Error (SE) of Annual Compound Growth Rate.

Figures in third bracket indicate instability index.

** Significant at 1 per cent level of significance

Table 7: Average Yield Rate of Major Cereal Crops in West Bengal.

| Major cereal crops | Average Yield Rate (Kg/ha) | | | | | | | | |
|--------------------|----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| | Triennium ending 1962-63 | Triennium ending 1967-68 | Triennium ending 1972-73 | Triennium ending 1977-78 | Triennium ending 1982-83 | Triennium ending 1987-88 | Triennium ending 1992-93 | Triennium ending 1997-98 | Triennium ending 2002-03 |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |

| | | | | | | | | | |
|---------------|------|------|------|------|------|------|------|------|------|
| Autumn rice | 777 | 812 | 1102 | 876 | 930 | 1097 | 1604 | 1707 | 1966 |
| Winter rice | 1134 | 1101 | 1140 | 1231 | 1131 | 1461 | 1792 | 1955 | 2235 |
| Summer rice | 1124 | 1666 | 2917 | 2879 | 2541 | 3012 | 3010 | 3003 | 3086 |
| Wheat | 702 | 858 | 2153 | 2093 | 1923 | 1945 | 2122 | 2227 | 2298 |
| Major Cereals | 1085 | 1062 | 1289 | 1338 | 1231 | 1635 | 1971 | 2144 | 2417 |

Table 8: Average Area of Major Pulses and Oilseeds in West Bengal.

| Major pulses and oilseeds | Average area ('000 ha) | | | | | | | | | |
|---------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--|
| | Triennium ending 1962-63 | Triennium ending 1967-68 | Triennium ending 1972-73 | Triennium ending 1977-78 | Triennium ending 1982-83 | Triennium ending 1987-88 | Triennium ending 1992-93 | Triennium ending 1997-98 | Triennium ending 2002-03 | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | |
| Kharif pulses | 31.5 (0.57) | 57.0 (1.03) | 40.5 (0.74) | 31.6 (0.57) | 54.4 (0.98) | 60.9 (1.13) | 76.6 (1.40) | 73.8 (1.35) | 53.6 (0.99) | |
| Rabi pulses | 543.5 (9.91) | 491.0 (8.92) | 428.5 (7.84) | 420.8 (7.58) | 293.4 (5.33) | 240.4 (4.45) | 141.5 (2.59) | 113.4 (2.07) | 138.7 (2.56) | |
| Total pulses | 769.5 (14.03) | 757.5 (13.77) | 604.1 (11.06) | 637.0 (11.48) | 450.6 (8.18) | 379.1 (7.01) | 286.6 (5.24) | 223.1 (4.08) | 255.1 (4.71) | |
| Total foodgrains | 5447.5 (99.35) | 5606.0 (101.91) | 6128.3 (112.18) | 6562.2 (118.29) | 5898.8 (107.10) | 6151.6 (113.79) | 6377.6 (116.73) | 6526.7 (119.47) | 6513.0 (120.22) | |
| Rape & Mustard | 99.8 (1.82) | 105.9 (1.92) | 103.6 (1.90) | 88.0 (1.59) | 155.1 (2.81) | 302.1 (5.59) | 394.5 (7.22) | 324.7 (5.94) | 427.9 (7.90) | |
| Total oilseeds | 156.5 (2.85) | 156.7 (2.85) | 167.4 (3.06) | 189.0 (3.41) | 343.3 (6.23) | 461.4 (8.53) | 536.2 (9.81) | 504.6 (9.24) | 590.4 (10.90) | |

Figures in parentheses indicate percentage of the net cropped area.

Table 9: Average Area of Other Principal Crops in West Bengal.

| Other principal crops | Average Area ('000 ha) | | | | | | | | | |
|-----------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--|
| | Triennium ending 1962-63 | Triennium ending 1967-68 | Triennium ending 1972-73 | Triennium ending 1977-78 | Triennium ending 1982-83 | Triennium ending 1987-88 | Triennium ending 1992-93 | Triennium ending 1997-98 | Triennium ending 2002-03 | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | |
| Jute | 377.3 (6.88) | 454.2 (8.25) | 411.8 (7.54) | 418.0 (7.53) | 518.4 (9.41) | 557.0 (10.30) | 522.3 (9.56) | 592.5 (10.84) | 633.6 (11.70) | |
| Sugar-Cane (Gur) | 37.3 (0.68) | 31.8 (0.58) | 34.8 (0.64) | 30.1 (0.54) | 22.8 (0.41) | 12.1 (0.22) | 14.8 (0.27) | 22.6 (0.41) | 21.5 (0.40) | |
| Potato | 58.1 (1.06) | 78.8 (1.43) | 70.2 (1.28) | 118.0 (2.13) | 117.3 (2.13) | 163.8 (3.03) | 214.7 (3.93) | 284.7 (5.21) | 316.3 (5.84) | |

Figures in parentheses indicate percentage of the net cropped area.

Table 10: Average Area of Vegetable and Spice Crops in West Bengal.

| Vegetable & Spice Crops | Average area ('000 ha) | | | | | | | | | |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--|
| | Triennium ending 1962-63 | Triennium ending 1967-68 | Triennium ending 1972-73 | Triennium ending 1977-78 | Triennium ending 1982-83 | Triennium ending 1987-88 | Triennium ending 1992-93 | Triennium ending 1997-98 | Triennium ending 2002-03 | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | |
| Brinjal (Winter + Rainy) | NA | NA | NA | NA | NA | NA | NA | NA | 119.4 (2.20) | |

| | | | | | | | | | |
|---|---------------|---------------|---------------|----------------|----------------|----------------|----------------|----------------|-----------------|
| Cucurbit (Summer + Rainy) | NA | NA | NA | NA | NA | NA | NA | NA | 123.0 (2.27) |
| Ladies Finger (Winter + Rainy + Summer) | NA | NA | NA | NA | NA | NA | NA | NA | 60.7 (1.12) |
| Sweet Potato (Summer + Rainy) | NA | NA | NA | NA | NA | NA | NA | NA | 24.9 (0.46) |
| Raddish (Winter + Summer) | NA | NA | NA | NA | NA | NA | NA | NA | 33.3 (0.61) |
| Total Chillies (Dry) | 7.0 (0.13) | 8.3 (0.15) | 8.0 (0.15) | 18.5 (0.33) | 24.5 (0.44) | 41.3 (0.76) | 51.5 (0.94) | 60.5 (1.10) | 61.40 (1.13) |
| Cabbage | NA | NA | NA | NA | NA | NA | NA | NA | 67.26 (1.24) |
| Cauliflower | NA | NA | NA | NA | NA | NA | NA | NA | 59.58 (1.10) |
| Tomato | NA | NA | NA | NA | NA | NA | NA | NA | 44.98 (0.83) |

NA- Not available; Figures in parentheses indicate percentage of the net cropped area.

RESULTS AND DISCUSSION

Movement of area under each of the principal crops over time demarcated into two time period has been summarized in the foregoing discussion. Now the question comes what are the factors which have been responsible for such area movement.

Let us examine whether the area movement of crops discussed above has been made by reallocation of land between the crops grown in a particular crop season. For this purpose, it is necessary to identify the crops which are technically feasible to be grown on the same piece of land in a particular crop season. These crops may plausibly be termed as competing crops so far as use of land and other resources is in question. Thus, the crops namely, wheat, potato, rape & mustard, and gram can reasonably be said to be competing crops grown in winter or rabi season in the state of West Bengal. Sugarcane is an annual crop covering both rainy (kharif) and winter (rabi) season. Hence, from the view point of competing use of land and other resources the crop sugarcane can also be treated as competitive to the crops grown in winter season. Therefore, at the first instance it is necessary to examine whether land devoted to these competing crops has been reallocated amongst themselves or new land has been devoted to these crops or both allocation phenomena have brought about during the span of time under consideration.

In farm economics, it is a problem of optimum combination of competitive enterprises (here competing crops) under resource constraint at a point of time with an objective of revenue maximization or a problem of optimum combination of competing crops with relaxation of resource constraint and changing production technology

and prices over time. Instant problem is analogous to the latter one.

Based upon the theoretical framework stated above the relative price of a crop plays an important role not only in the question of allocation of land to a particular crop but also in the allocation of new land among the competing crops. A glance to the district wise time series area data of wheat reveals its continuous expansion during the period 1966-67 to 1975-76 and thereafter dwindling with inter year fluctuation up to early eighties and then shows an increasing trend with fluctuation upto 2002-03. It is, therefore, interesting to examine the role of relative price of wheat, an important cereal crop, in explaining its area movement from late sixties to 2002-03. Pal (1990) in his study after detail analysis of district level disaggregated data has arrived to the following conclusion.

By using correlation analysis and working out relationship between area expansion of wheat and area movement of its competing crops and taking negative values of co-efficient indicating area substitution he concluded that expansion of wheat area during the period 1967-68 to 1975-76 can not be explained fully in terms of area contraction of its competing crops. Increase in wheat area can partly be attributable to the contraction of area under gram implying that extension of wheat area during the said period in West Bengal has taken place mainly due to extension of sown area. With correlation coefficient between area under wheat and its relative prices with respect to each of its competing crops (using one year lagged price) he concluded that relative price did not play any role in expansion of area under wheat during the period 1967-68 to 1975-76. Extension of area under irrigation and remarkable increase in yield per unit area jointly contributing towards higher relative profitability of wheat as compared to its competing crops was responsible for

wheat area expansion despite unfavourable movement of relative prices of wheat over the said period in the major wheat growing districts of West Bengal.

By using same analytical tool Pal (1990) observed that the total shortfall in wheat area during the period 1975-76 to 1982-83 had not been totally diverted to its competing crops. Nevertheless, a phenomenal substitution was made between wheat and mustard and to some extent between wheat and potato. The relative prices exerted an impetus to the decline in wheat area in West Bengal during the period but the main thrust underlying the area shift from wheat to mustard and potato was emerged from higher relative gains in yield rates of the latter crops.

AREA MOVEMENT

Now let us explain the area movement of wheat and its competing principal crops in West Bengal during the period 1982-83 to 2003-04. It is worth to mention here that the vegetable and spice crops namely cauliflower, cabbage, tomato, brinjal, and chillies have emerged in different districts of West Bengal after mid eighties as the important winter crops which are competing to wheat. But

time series area, yield, and price data of these crops are not available from any secondary source. Such data are available only from 2000-01 onwards. This data lacunae keeping in view, one has to proceed with the available secondary data and take necessary help of primary data to fill up the data gap to the extent possible.

The correlation analysis as used by Pal (1990) in his study has been used to find out the factors which have contributed to area reallocation between wheat and its principal competing crops over the period 1982-83 to 2003-04. The zero order correlation coefficients between temporal movement of area under wheat and that of each of competing crops during the period 1982-83 to 2003-04 are presented in Table 11. The value of correlation coefficient between the movement of wheat area and that of potato in the district of Bankura and Hooghly are found negative and statistically significant. A glance to time series area data of wheat and potato in these two districts reveals that a phenomenal area transfer from wheat to potato has been brought about. In Burdwan district the correlation coefficient between movement of wheat and potato

Table 11: Co-efficient of Correlation Between area under Wheat and area under each of its Competing Crops in Different Districts of West Bengal (1982-83 to 2003-04).

| Districts | Co-efficient of correlation between area under | | | |
|---------------------|--|----------------|--------------|-----------------|
| | Wheat & Sugarcane | Wheat & Potato | Wheat & Gram | Wheat & Mustard |
| (1) | (2) | (3) | (4) | (5) |
| Burdwan | 0.412 | - 0.274 | 0.409 | - 0.245 |
| Birbhum | - 0.393 | 0.561** | 0.664** | 0.164 |
| Bankura | - 0.188 | - 0.523* | 0.022 | - 0.230 |
| Midnapore | 0.584** | 0.514** | 0.290 | 0.247 |
| Howrah | 0.271 | 0.231 | 0.028 | - 0.295 |
| Hooghly | - 0.164 | - 0.751** | 0.287 | 0.148 |
| 24-PGS (North) | 0.564** | 0.216 | 0.439* | 0.175 |
| 24-PGS (South) | 0.807** | 0.780** | 0.930** | 0.932** |
| Nadia | - 0.114 | 0.388 | 0.362 | 0.215 |
| Murshidabad | 0.516* | 0.679** | - 0.018 | 0.508* |
| Purulia | - 0.026 | 0.239 | 0.188 | - 0.271 |
| Malda | 0.368 | 0.784** | - 0.706** | 0.592** |
| Dinajpur (Combined) | 0.223 | 0.618** | 0.199 | 0.116 |
| Jalpaiguri | 0.234 | 0.571** | 0.147 | - 0.167 |
| Darjeeling | 0.149 | 0.444* | - 0.049 | - 0.142 |
| Cooch Behar | - 0.395 | 0.256 | - 0.200 | 0.188 |
| West Bengal | 0.186 | 0.599** | 0.304 | 0.376 |

* Correlation co-efficient is significant at 5 per cent level of significance.

** Correlation co-efficient is significant at 1 per cent level of significance.

area is shown negative but not statistically significant implying that declining trend in wheat area is not explained by an increase in area under potato as has taken

place in the district during the said period. In remaining 13 districts this correlation coefficient is found positive and in 8 out of these 13 districts namely Birbhum, Midnapore, 24

Parganas (S), Murshidabad, Malda, Dinajpur, Jalpaiguri and Darjeeling the positive coefficients are statistically significant. In the state level this correlation coefficient is positive and statistically significant. It indicates that both wheat and potato area has been phenomenally increasing at the state level which has been confirmed by recorded increasing trend of both wheat and potato area during the period. At the district level both area under wheat and potato has been expanding in 12 out of 13 districts showing positive correlation coefficient. In one district namely 24 Parganas (S) both wheat and potato area has declined during the period.

In the same way, considering the magnitude and direction of correlation coefficients cited in Table 11 and seeing the trend in area under wheat and its other competing crops one may safely infer that no phenomenal area substitution between wheat and mustard, wheat and sugarcane and between wheat and gram has taken place in any of the districts of West Bengal excepting the district of Malda where area transfer from gram to wheat is discernable. It is rather notable that both the area under, wheat and mustard in three districts (24 Parganas(S), Murshidabad, and Malda), wheat and sugarcane in two (24 Parganas (N) and Murshidabad), and wheat and gram in one district (Birbhum) has been simultaneously increasing while the area under wheat and sugarcane in two districts (Midnapore and 24 Parganas (N)) and area under wheat and gram in two districts (24 Parganas (N) and 24 Parganas (S)) has been dwindling sympathetically. At the state level the correlation coefficients between area movement of wheat and mustard, wheat and sugarcane and

that between wheat and gram is noted positive indicating sympathetic movement but not statistically significant.

From the foregoing discussion the possibility of area substitution between wheat and its competing crops namely potato, mustard, sugarcane and gram is not founded. On the contrary, both the area under wheat and its competing crops have been simultaneously increasing over the period under consideration. Thus, one may safely contend that the glaring enhancement of area under wheat, potato and mustard during the period 1982-83 to 2003-04 as observed in almost all the districts in West Bengal has been due to increase in sown area, no phenomenal area transfer from gram to these crops is founded. Area under sugarcane during the period has increased marginally with inter year fluctuation which seems to have its irrelevance in explaining such area upswing of wheat, potato and mustard over the period. It is interesting to note that the area under other principal competing crops of wheat like cabbage, cauliflower, tomato among the winter vegetable crops and spice crop like chilli is recorded a remarkable upswing during the said period as have been highlighted by the opinion survey conducted among the respondent farmers in the district of Cooch Behar. One can arrive at the same revelations for almost all other districts of West Bengal during the period if similar survey is conducted. With this added information one can plausibly come to the contention that the distinguishable change in crop profile and cropping pattern in West Bengal from mid-eighties onward is attributable to the remarkable increase in sown area in winter season.

Table 12: Correlation Co-efficient between area Movement of Wheat and Movement of Price Relatives of Wheat in Different Districts of West Bengal (1982-83 to 2003-04).

| Districts | Co-efficient of correlation between area under wheat and its price relative to price of | | | |
|---------------------|---|---------|---------|----------|
| | Sugarcane (gur) | Potato | Gram | Mustard |
| (1) | (2) | (3) | (4) | (5) |
| Burdwan | 0.501* | 0.100 | 0.819** | 0.356 |
| Birbhum | 0.032 | 0.203 | - 0.081 | 0.250 |
| Bankura | 0.186 | - 0.026 | 0.213 | 0.248 |
| Midnapore | - 0.116 | 0.552** | - 0.049 | 0.457* |
| Howrah | 0.180 | 0.663* | - | 0.311 |
| Hooghly | - 0.160 | - 0.322 | 0.182 | - 0.148 |
| 24-PGS (North) | 0.551* | 0.324 | 0.397 | 0.357 |
| 24-PGS (South) | - | - 0.396 | - | - 0.566* |
| Nadia | 0.140 | 0.490* | 0.251 | 0.614* |
| Murshidabad | - 0.406 | 0.309 | - 0.270 | 0.123 |
| Purulia | -0.208 | -0.320 | -0.383 | -0.552 |
| Malda | -0.528* | 0.020 | 0.068 | 0.008 |
| Dinajpur (Combined) | -0.296 | -0.026 | 0.096 | 0.409 |

| | | | | |
|-------------|--------|-------|--------|---------|
| Jalpaiguri | -0.430 | 0.048 | -0.383 | -0.150 |
| Darjeeling | - | 0.124 | - | -0.916* |
| Cooch Behar | 0.079 | 0.314 | - | 0.173 |
| West Bengal | -0.151 | 0.214 | -0.089 | 0.460* |

* Correlation co-efficient is significant at 5 per cent level of significance.

** Correlation co-efficient is significant at 1 per cent level of significance.

PRICE MOVEMENT

Now let us identify the factors, which have become operative in changing such cropping pattern in the state of West Bengal. To start with one may examine the role of prices in changing allocation pattern of land and other resources for growing various crops in winter season. In this context, the question comes which prices of wheat and its competing crops can be taken as pertinent prices, the variation of which positively correlates with the area under wheat. Pal, A (1990) in his study has taken the harvest prices as pertinent prices with the reasoning that most of the agricultural produces are generally marketed immediately after the harvest. He also has taken the price of the preceding year to correlate it with the crop area in the present year (one year lag). Agreeing with the reasoning and conceptual background of lagged response as adopted by Pal can be used for the present study. Values of correlation coefficients between area under wheat and its price relative to each of its competing crops are given in Table 12. Price series of 1981-82 to 2002-03 have been correlated with area series of 1982-83 to 2003-04, assuming one year lag in response of area to price. Change in area under wheat and its competing crops from

1982-83 to 2003-04 are shown in Table 13. Significant direct association between area movement of wheat and price movement of wheat relative to price of potato and mustard is found in the district of Midnapore indicating response of product price to increasing area under wheat in this district but not by transferring area from potato and mustard as the area of the latter two crops in the district have increased many folds over the period (Table 13). Similar picture is noted for the district of Nadia. In Howrah district positive association between movement of wheat area and that of price of wheat in relation to price of potato is noticed where wheat area itself was declined. It is worth to mention here that the coverage of area under wheat in Howrah is recorded too negligible to be taken into account in understanding the response of price to change in area of wheat. Direct relationship between change in wheat area and its price relatives with respect to price of gur (marketable product of sugarcane) and gram in Burdwan and with respect to price of gur only in 24 Parganas (North) is visualized where in Burdwan district area under wheat, sugarcane and gram have declined simultaneously during the period.

Table 13: Change in Area under Wheat and Its Competing Crops ('000 ha)

| Districts | Average area of triennium ending 1982-83 | | | | | Average area of triennium ending 2003-04 | | | | | Difference | | | | |
|---------------------|--|-----------------|--------|------|---------|--|-----------------|--------|-------|---------|------------------|-------------------|-------------------|-------------------|-------------------|
| | Wheat | Sugarcane (gur) | Potato | Gram | Mustard | Wheat | Sugarcane (gur) | Potato | Gram | Mustard | Wheat | Sugarcane (gur) | Potato | Gram | Mustard |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) |
| Burdwan | 9.3 | 1.3 | 25.2 | 1.4 | 23.2 | 5.0 | 0.7 | 45.8 | 0.8 | 46.3 | -4.3 (-46.24) | -0.6 (-46.15) | 20.6 (81.75) | -0.6 (-42.86) | 23.1 (99.57) |
| Birbhum | 17.4 | 2.8 | 6.3 | 9.0 | 14.8 | 28.2 | 1.0 | 11.3 | 10.4 | 36.3 | 10.8 (62.07) | -1.8 (-64.29) | 5.0 (79.37) | 1.4 (15.56) | 21.5 (145.27) |
| Bankura | 9.3 | 0.6 | 5.4 | 0.4 | 4.4 | 9.3 | 0.01 | 19.5 | 0.02 | 11.6 | - | -0.59 (-98.33) | 14.1 (261.11) | -0.38 (-95.00) | 7.2 (163.64) |
| Midnapore | 7.8 | 1.8 | 15.5 | 0.02 | 3.0 | 13.5 | 3.0 | 68.2 | 0.3 | 22.3 | 5.7 (73.08) | 1.2 (66.67) | 52.7 (340.0) | 0.28 (1400.0) | 19.3 (643.33) |
| Howrah | 0.6 | 0.1 | 2.2 | 0.01 | 0.2 | 0.4 | 0.04 | 8.3 | 0.01 | 1.1 | -0.2 (-33.33) | -0.06 (-60.00) | 6.1 (277.27) | - | 0.9 (450.0) |
| Hooghly | 5.6 | 0.1 | 37.4 | 0.2 | 5.6 | 0.7 | 0.6 | 87.7 | - | 9.8 | -4.9 (-87.50) | 0.5 (500.0) | 50.3 (134.49) | -0.2 (-100.0) | 4.2 (75.00) |
| 24-PGS (North) | 8.9 | 0.9 | 4.8 | 1.6 | 13.1 | 12.5 | 1.1 | 6.8 | 0.6 | 35.4 | 3.6 (40.45) | 0.2 (22.22) | 2.0 (41.67) | -1.0 (-62.50) | 22.3 (170.23) |
| 24-PGS (South) | 8.9 | 0.9 | 5.2 | 1.5 | 13.1 | 1.4 | 0.1 | 3.8 | - | 3.2 | -7.5 (-84.27) | -0.8 (-88.89) | -1.4 (-26.92) | -1.5 (-100.0) | -9.9 (-75.57) |
| Nadia | 38.7 | 5.3 | 2.3 | 20.1 | 23.0 | 58.5 | 2.5 | 4.1 | 16.3 | 84.0 | 19.8 (51.16) | -2.8 (-52.83) | 1.8 (78.26) | -3.8 (-18.91) | 61.0 (265.22) |
| Murshidabad | 79.6 | 5.7 | 6.4 | 21.5 | 21.7 | 135.5 | 6.2 | 8.0 | 10.8 | 67.5 | 55.9 (70.23) | 0.5 (8.77) | 1.6 (25.00) | -10.7 (-49.77) | 45.8 (211.06) |
| Purulia | 1.1 | 0.4 | 0.3 | 0.3 | 0.4 | 3.8 | 0.7 | 1.5 | 0.2 | 0.7 | 2.7 (245.45) | 0.3 (75.00) | 1.2 (400.0) | -0.1 (-33.33) | 0.3 (75.00) |
| Malda | 19.4 | 2.6 | 1.2 | 16.7 | 8.3 | 50.9 | 3.6 | 2.5 | 7.9 | 35.9 | 31.5 (162.37) | 1.0 (38.46) | 1.3 (108.33) | -8.8 (-52.69) | 27.6 (332.33) |
| Dinajpur (Combined) | 34.7 | 0.9 | 5.0 | 6.6 | 22.5 | 52.1 | 0.1 | 12.8 | 0.8 | 57.3 | 17.4 (50.14) | -0.8 (-88.89) | 7.8 (156.00) | -5.8 (-87.88) | 34.8 (154.67) |
| Jalpaiguri | 7.9 | 0.1 | 1.5 | 0.02 | 8.1 | 22.4 | 0.05 | 19.9 | 0.03 | 7.2 | 14.5 (183.34) | -0.05 (-50.00) | 18.4 (1226.7) | 0.01 (50.00) | -0.9 (-11.11) |
| Darjeeling | 2.0 | - | 4.5 | - | 0.5 | 3.0 | - | 7.1 | - | 0.1 | 1.0 (50.0) | - | 2.6 (57.78) | - | -0.4 (-80.00) |
| Cooch Behar | 11.2 | 0.05 | 1.4 | 0.01 | 7.3 | 24.4 | - | 11.8 | - | 14.3 | 13.2 (117.86) | -0.05 (-100.0) | 10.4 (742.86) | -0.01 (-100.0) | 7.0 (95.90) |
| West Bengal | 262.3 | 23.5 | 124.6 | 79.4 | 146.2 | 421.6 | 19.7 | 319.1 | 48.16 | 433.0 | 159.3 (60.73) | -3.85 (-16.35) | 194.5 (156.10) | -31.2 (-39.31) | 286.8 (196.17) |

Figures in parentheses indicate percentage change of area.

In other districts the relationship between area movement of wheat and price movement of wheat in relation to the prices of its competing crops are found to have either significant negative association or no association. At the state level, only direct association between wheat area movement and its price movement relative to the price of mustard is noticed. And at the same time it is also noted that both the area under wheat and mustard has remarkably increased during the period under consideration. From the above discussion one can arrive at the contention that the price might have played a role in devoting more area under wheat in a small part of the state. But the role of price is not found to be effective to bring about increase in wheat area by transferring land from its competing crops. The expansion of wheat area during the period has brought about by bringing in new land under wheat cultivation.

Relative Profitability:

Let us examine the role of relative profitability in explaining the expansion of wheat area during the period under consideration. To work out the movement of profitability of wheat in relation to its competing crops time series data on both gross revenue and cost of cultivation of wheat and its competing crops are required. Time series data of gross revenue may be generated by using time series yield and price data. But the time series cost data are not available at the district level from any secondary source. Under the circumstances, the time series gross revenues of wheat relative to that of its competing crops have been taken as an alternative indicator of relative profitability of wheat. The zero order correlation coefficients between movement of wheat area and movement of gross revenues of wheat with respect to that of its competing crops are shown in Table 14.

Table 14: Co-efficient of Correlation between Area under Wheat and Gross Revenue relatives under each of Its Competing Crops in Different Districts of West Bengal (1982-83 to 2003-04).

| Districts | Co-efficient of correlation between area under wheat and its gross revenue relative to gross revenue of | | | |
|---------------------|---|----------|---------|---------|
| | Sugarcane | Potato | Gram | Mustard |
| Burdwan | 0.517* | 0.107 | 0.753** | 0.312 |
| Birbhum | -0.050 | 0.318 | -0.036 | 0.125 |
| Bankura | 0.332 | -0.004 | 0.642** | 0.147 |
| Midnapore | 0.089 | 0.514* | -0.201 | 0.041 |
| Howrah | 0.290 | 0.486 | - | -0.023 |
| Hooghly | 0.334 | -0.345 | 0.700* | -0.129 |
| 24-PGS (North) | 0.701** | 0.475* | 0.746** | 0.505* |
| 24-PGS (South) | - | -0.395 | - | -0.567* |
| Nadia | 0.235 | 0.192 | 0.311 | 0.483* |
| Murshidabad | -0.179 | -0.154 | -0.435 | -0.012 |
| Purulia | -0.111 | -0.302 | -0.246 | -0.328 |
| Malda | -0.598** | -0.627** | 0.128 | 0.064 |
| Dinajpur (Combined) | -0.006 | -0.498* | 0.528* | 0.389 |
| Jalpaiguri | -0.789* | -0.863** | - | -0.382 |
| Darjeeling | - | -0.106 | - | -0.875* |
| Cooch Behar | -0.372 | -0.511* | - | -0.289 |
| West Bengal | -0.082 | 0.322 | -0.062 | 0.314 |

* Correlation co-efficient is significant at 5per cent level of significance.

** Correlation co-efficient is significant at 1per cent level of significance.

Comparing Table 14 with Table 12 it comes out that the positive role of relative price in declining area under wheat shown by Table 12 has been reaffirmed by the relative profitability in the district of Burdwan. Similarly, non responsiveness of relative price in explaining the expansion of wheat area as noticed in Table 12 is also founded by considering the relative profitability of wheat in the district of Birbhum, Murshidabad and Purulia. While in 24 Parganas (South) negative role of relative price in declining area under wheat is also corroborative

by relative profitability consideration. The negative role of relative price and relative profitability of wheat in explaining of its area movement is also visualized in Malda and Darjeeling district. In Cooch Behar, Dinajpur and Jalpaiguri the response of relative price to the movement of wheat area is not observed. But by relative profitability consideration it appears that the area under wheat cultivation in these three northern districts has been expanding during the period despite negative relative profitability of wheat. In Bankura and Hooghly it is not the

relative price but the relative profitability has played a positive role in augmenting wheat area as revealed by comparing Table 12 with Table 14. A positive role of relative price in upswing of wheat area in the district of Midnapore, 24 Parganas (North) and Nadia as revealed by Table 12 has also been firmly established by relative profitability consideration. A direct response of relative price noted in Howrah district is ruled out by relative profitability consideration. Thus, positive response of relative profitability to the movement of wheat area is explained in 6 out of 16 districts. In remaining 10 districts either the contrary role or no role of relative profitability is established which is also reflected at the state level where non responsiveness of relative profitability in explaining the upward movement of wheat area is founded. Here relative gross revenue has been taken as good approximation of relative profit, which is a product of relative price and relative yield rate. It is therefore the relative yield rate which has become operative in explaining change in wheat area in 6 out of 16 districts in the state of West Bengal.

In this context, it is pertinent to note that the area under wheat and its two important principal competing crops namely, potato and mustard have been increasing simultaneously over the period under consideration in 15 districts including 6 districts mentioned above. A careful

examination of Table 13 and Table 15 it becomes conspicuous that the technological change in the form of remarkable enhancement of yield rate in the production of wheat, potato and mustard has contributed to higher relative profitability which in turn has brought about such increase in area under these crops where sympathetic movement of area under irrigation (Table 16) has paved the way in such area movement. It is, therefore, contended that the area expansion of wheat over the period under consideration has been promoted by expansion of irrigated area and technological change in the form use of high yielding wheat seed, increased use of chemical fertilizers, etc. which contributed to higher profitability of wheat and in few districts to higher relative profitability.

Now the question comes why the land under wheat has not been reallocated to potato and mustard, rather bringing in more land under wheat, despite higher rate of increase of relative yield rate of the latter two crops (Table 15). One may argue at this juncture that the resource constraint might have been barrier in diverting land used for wheat production to the production of potato and mustard. To examine the validity of this proposition resource requirement for cultivation of wheat, potato, and mustard have been worked out from the primary data collected from sample villages of Cooch Behar district and presented by Table 17.

Table 15: Yield rate (Kg/ha) in West Bengal by districts.

| Districts | Triennium ending 1982-83 | | | | | Triennium ending 2003-04 | | | | | Difference | | | | |
|---------------------|--------------------------|-----------------|--------|------|---------|--------------------------|-----------------|--------|------|---------|------------------|-----------------|-------------------|------------------|-----------------|
| | Wheat | Sugarcane (gur) | Potato | Gram | Mustard | Wheat | Sugarcane (gur) | Potato | Gram | Mustard | Wheat | Sugarcane (gur) | Potato | Gram | Mustard |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) |
| Burdwan | 2040 | 5855 | 21963 | 672 | 867 | 2357 | 6701 | 28282 | 678 | 836 | 317 (15.56) | 846 (14.45) | 6319 (28.77) | 6 (0.89) | -31 (-3.61) |
| Birbhum | 1680 | 5781 | 11621 | 701 | 563 | 2745 | 5430 | 22384 | 1095 | 1044 | 1065 (63.41) | -351 (-6.07) | 10763 (92.61) | 394 (56.23) | 480 (8.27) |
| Bankura | 1616 | 5885 | 18230 | 672 | 768 | 1912 | 7492 | 23097 | 931 | 832 | 296 (18.31) | 1607 (27.31) | 4867 (26.70) | 259 (38.52) | 64 (8.34) |
| Midnapore | 1877 | 5855 | 16813 | 672 | 278 | 2153 | 8588 | 24303 | 1013 | 833 | 276 (14.71) | 2733 (46.69) | 7490 (44.56) | 341 (50.72) | 554 (199.16) |
| Howrah | 1753 | 5855 | 20471 | 212 | 665 | 1900 | 7371 | 27139 | 611 | 634 | 147 (8.37) | 1516 (25.89) | 6667 (32.57) | 399 (187.91) | -31 (-4.61) |
| Hooghly | 1956 | 5855 | 22640 | 671 | 665 | 1979 | 7491 | 21577 | 723 | 749 | 23 (1.19) | 1636 (27.95) | -1063 (-4.70) | 52 (7.75) | 84 (12.69) |
| 24-PGS (North) | 1929 | 5939 | 13630 | 515 | 481 | 2212 | 7371 | 21789 | 860 | 844 | 283 (14.65) | 1431 (24.10) | 8169 (59.86) | 345 (66.99) | 363 (75.40) |
| 24-PGS (South) | 1929 | 5939 | 13630 | 515 | 481 | 2026 | 8564 | 19244 | 271 | 894 | 97 (5.03) | 2625 (44.20) | 5614 (41.19) | -244 (-47.38) | 413 (85.86) |
| Nadia | 2119 | 5939 | 13633 | 453 | 611 | 2159 | 7453 | 24323 | 923 | 835 | 41 (1.92) | 1514 (25.49) | 10690 (78.41) | 471 (103.98) | 224 (36.64) |
| Murshidabad | 1817 | 6291 | 11983 | 544 | 634 | 2352 | 7295 | 22985 | 747 | 913 | 535 (29.47) | 1005 (15.97) | 11002 (91.82) | 203 (37.23) | 279 (44.03) |
| Purulia | 1678 | 5855 | 20331 | 672 | 665 | 2074 | 7308 | 15281 | 928 | 703 | 395 (23.56) | 1454 (24.83) | -5050 (-24.84) | 255 (37.98) | 38 (5.77) |
| Malda | 1985 | 4515 | 6342 | 978 | 553 | 2547 | 7459 | 20028 | 783 | 917 | 562 (28.30) | 2944 (65.21) | 13686 (215.79) | -195 (-19.95) | 364 (65.76) |
| Dinajpur (Combined) | 2176 | 4506 | 6499 | 686 | 370 | 2164 | 7459 | 17998 | 519 | 723 | -12 (-0.57) | 2952 (65.52) | 11499 (176.93) | -167 (-24.38) | 353 (95.58) |
| Jalpaiguri | 1780 | 4506 | 5629 | 877 | 383 | 1828 | 7459 | 21211 | 298 | 548 | 48 (2.68) | 2952 (65.52) | 15582 (276.81) | -579 (-66.02) | 165 (43.21) |
| Darjeeling | 1928 | - | 7964 | - | 436 | 1637 | - | 14765 | - | 469 | -291 (-15.10) | - | 6801 (85.40) | - | 33 (7.65) |
| Cooch Behar | 1787 | 4506 | 6195 | 585 | 326 | 1793 | 7459 | 22577 | - | 477 | 6 (0.35) | 2952 (65.52) | 16381 (264.41) | -585 (-100.0) | 150 (46.07) |
| West Bengal | 1922 | 5781 | 17856 | 645 | 572 | 2240 | 7502 | 23521 | 886 | 833 | 318 (16.53) | 1721 (29.77) | 5665 (31.73) | 240 (37.24) | 261 (46.54) |

Figures in parentheses indicate percentage change of yield rate.

Table 16: Gross irrigation potential created in three census period in West Bengal.

| Census | Gross Irrigation Potential created ('000 ha) | | | | | |
|---|--|--------|-------|-------|-------|--------|
| | DW | STW | DTW | SF | SL | Total |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1 st Minor Irrigation Census (1986-87) | 44.0 | 994.5 | 197.6 | 427.7 | 695.2 | 2359.1 |
| 2 nd Minor Irrigation Census (1994-95) | 39.9 | 1543.6 | 258.2 | 459.0 | 496.7 | 2797.4 |
| 3 rd Minor Irrigation Census (2000-01) | 45.4 | 2002.2 | 308.7 | 470.7 | 600.2 | 3427.2 |

Note: DW- Dug-well, STW- Shallow Tube-well, DTW- Deep Tube-well, SF- Surface Flow scheme, SL- Surface Lift scheme

Table 17: Cost of cultivation per acre of wheat, potato, and mustard in Cooch Behar District in the year 2003-04 (in Rs).

| Crop | Cash Cost | Prime Cost (Cost D) |
|---------|-----------|---------------------|
| (1) | (2) | (3) |
| Wheat | 4266.20 | 5013.37 |
| Potato | 15214.25 | 16428.58 |
| Mustard | 3934.89 | 4646.73 |

A look to the requirement of cash cost (it includes costs of seed, manures, fertilizers, micronutrients, plant protection chemicals, irrigation charges, hired human labor and bullock labor) and prime cost per acre of wheat, potato and mustard clearly brings into focus that the resource constraint has not been operative in the question of diversion of land from wheat to mustard cultivation, it might be operative for diversion of land from wheat to potato. Expansion of wheat area despite higher resource requirement of wheat as compared to mustard cultivation can not, therefore, be explained by resource constraint. Here, it is worthy to note that the wheat is a staple cereal crop next to rice in the state of West Bengal. Hence, it is appropriate to turn to the demand side to examine the nature of impetus which might come therefrom in bringing about change in supply side. It happens to be a demonstrated fact that the food crops are produced on the farm primarily for home consumption and secondarily for the market. As observed by Dharam Narain (1967) "it is true that the Indian farmer devotes a significant portion of his land to raising his own requirements; and in his decision in regard to the uses to which to put it he would be insensitive to price. But it is natural to expect that in sowing his 'surplus' acres he would look to the market. The dichotomy between what is meant for the market and what is meant for self-consumption cuts across individual crop areas". Therefore, it is realistic to assume that "if the farmer wants to produce food for his family consumption, the resources utilized for production of food for family consumption should be deducted from the total available

resources and the remaining resources should be considered to be available to the farm-firm" (Desai, 1963).

With these two important findings showing the insensitiveness of price and profitability in allocating farm resources to the production of food crops keeping in view, the position of wheat in meeting self-consumption of the farmers of West Bengal can be examined. Pal (1990) in his study conducted an opinion survey with suitably framed questionnaire among wheat growing farmers and non-farm households to understand the position of demand for wheat as food crop to rice consuming Bengali people. The opinion survey highlighted that increase in demand for wheat at farm and non-farm level during the period late sixties to mid-seventies has been due to inflationary pressure felt after mid-sixties (Radha and Sharma, 1975). He observed that the small and marginal farmers and people in the low income brackets generally consume more wheat as compared to large farmers and people belonging to high income brackets. A sharp increase in the level of price specially those of necessary commodities from mid-sixties onwards has caused severe erosion in the purchasing power particularly of small and marginal farmers and the people belonging to the lower income groups. As a consequence, despite continuous increase in the relative price of wheat (wheat- rice price ratio) people belonging to the low income groups and small and marginal farmers have been forced to substitute rice by wheat to a considerable extent in view of lower absolute price of wheat. The increased level of consumption of wheat by the farmers and hence expansion of their wheat

acreage during late sixties to mid seventies he has explained in terms of inflationary upsurge. Pal (1990) by extending his study from the period of wheat acreage expansion (mid-sixties to mid-seventies) to the period of contraction of wheat acreage (mid-seventies to early eighties) he has also established the playing of the same

factors in contracting wheat acreage in the state of West Bengal. With dwindling of relative price of wheat (wheat-rice price ratio) *inter alia* narrowing the absolute price gap between rice and wheat and thereby substitution of wheat by rice consumption to a considerable extent he explained the contraction of wheat area by the farm households.

Table 18: Movement of Relative Price of Wheat and Absolute Price Difference between Rice and Wheat at State Level.

| Year | Retail price of wheat | Retail price of rice | Price Relative (Price of Wheat / Price of rice) | Retail price of rice minus Retail price of wheat |
|------|-----------------------|----------------------|---|--|
| (1) | (2) | (3) | (4) | (5) |
| 1982 | 2.11 | 3.01 | 0.70 | 0.90 |
| 1983 | 2.18 | 3.42 | 0.64 | 1.24 |
| 1984 | 2.02 | 2.96 | 0.68 | 0.94 |
| 1985 | 2.01 | 3.06 | 0.66 | 1.05 |
| 1986 | 2.12 | 3.33 | 0.64 | 1.21 |
| 1987 | 2.26 | 3.46 | 0.65 | 1.20 |
| 1988 | 2.50 | 3.77 | 0.66 | 1.27 |
| 1989 | 2.81 | 4.04 | 0.70 | 1.23 |
| 1990 | 2.80 | 4.30 | 0.65 | 1.50 |
| 1991 | 3.46 | 5.13 | 0.67 | 1.67 |
| 1992 | 4.23 | 5.71 | 0.74 | 1.48 |
| 1993 | 4.11 | 5.72 | 0.72 | 1.61 |
| 1994 | 4.58 | 6.47 | 0.71 | 1.89 |
| 1995 | 4.74 | 7.04 | 0.67 | 2.30 |
| 1996 | 5.29 | 7.48 | 0.71 | 2.19 |
| 1997 | 6.18 | 7.66 | 0.81 | 1.48 |
| 1998 | 6.37 | 8.90 | 0.72 | 2.53 |
| 1999 | 7.53 | 10.51 | 0.72 | 2.98 |
| 2000 | 7.21 | 8.84 | 0.82 | 1.63 |
| 2001 | 6.73 | 8.68 | 0.78 | 1.95 |
| 2002 | 6.65 | 8.23 | 0.81 | 1.58 |
| 2003 | 7.04 | 8.84 | 0.80 | 1.80 |
| 2004 | 7.58 | 9.56 | 0.79 | 1.98 |

Demand Side:

Now let us examine whether the above phenomenon has been operative in the demand side in determining wheat acreage during the period extending from 1982-82 to 2003-04. Relative prices of wheat with respect to prices of rice (wheat-rice price ratios) and absolute price difference between wheat and rice have been calculated from 1982 to 2004 and cited in Table 18. An increasing trend of relative price of wheat has been conspicuous over the period. Spectacular increase in wheat acreage over the period 1982-83 to 2003-04, keeping in view, it implies that the consumption of wheat at the farm level has been increasing with the increase in relative price of wheat. It may appear to have some incongruity with the usual micro analysis in which it is the relative price of a commodity which is used to have inverse relation to its level of consumption. At the same time it is also observed that

absolute price difference between rice and wheat has also been increasing during the period. Thus, here also it is established that the difference in absolute price between rice and wheat rather than the relative price of the latter has played a pivotal role in determining the composition of food basket under the pressure of inflation, which has already been founded by Pal (1990) in his study covering the period 1967-68 to 1982-83. Now one may reasonably be affirmed that the wheat which was once an inferior good to the Bengali people has become a normal good with the introduction of HYV in wheat production front along with increase in irrigated area under the condition of inflationary upsurge.

Nothing has been said so far about the other competing crops particularly winter vegetable and chilli, area of which are experienced a notable upswing over period

under consideration. Data on area and production of vegetable and spice crops are available only since 2000-2001 from secondary source (Director of Agriculture, Govt. of West Bengal). Data on prices and costs of these crops are not available over time from any secondary source. Hence, it is hardly possible to adopt above analytical procedure in explaining area expansion of these crops during the period. Pal (1990) in his study has pointed out that the crops like winter vegetables gradually come into the domain of competing crops of wheat from early eighties. A glance to the magnitude of area coverage of such crops as recorded during 2000-01 to 2002-03 cited

in Table 19 substantiates the presumption of area augmentation of winter vegetable crops and chilli during the period under consideration. The results of opinion survey conducted among the respondent farmers summarized by Table 20 also corroborates above presumption. In view of non-availability of price and cost data from any secondary source the return and cost data collected by sample survey in the study area in the year 2003-04 and the net revenue obtained per acre of cabbage, cauliflower, brinjal tomato and chilli are shown in Table 21.

Table 19: Coverage of area under winter vegetable crops and chilli at the state level.

| Average area of Triennium ending 2002-03 (in '000 ha) | | | | | |
|--|-----------------|-----------------|-----------------|-----------------|-------------------------|
| Winter brinjal | Cabbage | Cauliflower | Tomato | Chilli | Total Winter vegetables |
| (1) | (2) | (3) | (4) | (5) | (6) |
| 96.39 (1.78) | 67.26 (1.24) | 59.58 (1.10) | 44.98 (0.83) | 61.40 (1.13) | 293.51 (5.42) |

Figure in parenthesis indicates percentage of the net cropped area.

Table 20: Observation of opinion survey in the study area.

| Villages | Number of respondents reporting increase in area under crops over last 5 years | | | | |
|-------------------|--|----------------|---|--------|-----------------------------------|
| | Kharif | Rabi (winter) | | | Pre-kharif |
| | Less disease susceptible and drought tolerate HYV Swarnamasuri | Potato | Winter vegetables cabbage/ cauliflower/ tomato/ brinjal | Chilli | Less disease susceptible HYV rice |
| (1) | (2) | (3) | (4) | (5) | (6) |
| Advanced Villages | 70 (87.5) | 50 (62.50) | 80 (100.00) | - | 75 (93.75) |
| Backward Villages | 75 (93.75) | 80 (100.09) | 80 (100.00) | - | 70 (87.5) |
| Combined | 145 (90.62) | 130 (81.25) | 160 (100.0) | - | 145 (90.62) |

Figure in parenthesis indicates percentage of respective total.

Table 21: Yield and return per acre of sample farms in Cooch Behar district for the year 2003-04.

| Crop | Yield (q) | Gross revenue (Rs) | Net revenue over cost A ₁ exclusive of land revenue (Rs) | Net revenue over cost D (Rs) | Average price obtained per quintal (Rs) |
|---------------|-----------|--------------------|---|------------------------------|---|
| (1) | (2) | (3) | (4) | (5) | (6) |
| Cabbage | 153.24 | 27299.24 | 19558.22 | 17183.82 | 177.27 |
| Cauliflower | 74.41 | 23570.66 | 15771.45 | 13345.90 | 315.97 |
| Brinjal | 46.06 | 22556.50 | 16656.43 | 14118.43 | 487.80 |
| Tomato | 171.48 | 39179.25 | 28630.88 | 25495.75 | 226.80 |
| Chilli(green) | 54.21 | 29544.74 | 19406.63 | 16834.51 | 547.90 |
| Wheat | 9.02 | 6210.03 | 1943.83 | 1196.67 | 627.79 |

By comparing the net revenue figures of winter vegetable crops and chilli with that of wheat one may reasonably come to the conclusion that higher profitability of these winter crops brings about sizeable dent in their area expansion where extension of area under irrigation has

paved the way to sympathetic movement within the limit of resource constraints and risk bearing ability of the farmers in producing such perishable crops like vegetables and green chilli.

Now let us switch over to elicit factors which have been operative behind the remarkable monotonically expansion of area under summer rice during the period. At the first place, the competing crops of summer rice need to be identified. It is known that the term 'summer rice' is used to mean the rice which one is harvested in summer. And similarly, the terms autumn rice and winter rice are used to mean the rice crops harvested in autumn and winter season respectively. Generally, harvesting time varies from April to May for summer rice, within first fortnight of October for autumn rice, and from middle of November to December for winter rice in the state of West Bengal depending upon the agro-climatic variation between northern and southern part of the state and duration of crop varieties chosen by the farmers. It is important at this juncture to take a historical overview on the cultivation of these three types of rice with the introduction of high yielding photo insensitive varieties from late sixties in the state. In the initial phase autumn rice was almost all of direct sown photo sensitive local varieties and usually grown under rainfed condition. And in case of winter rice a gradual substitution of photo sensitive local varieties by photo insensitive HYV has been bringing about predominantly with rainfed culture. While summer rice always means the rice crop almost totally with HYV and under irrigated culture. With bringing in more area under irrigation, direct sown local rice varieties predominantly grown in rainfed condition has gradually been replaced and at present one can rarely identify any direct sown local rice variety grown and harvested in autumn season. Similar change is noticed in case of winter rice.

With the above brief historical overview one can now able to identify the crops which may be termed as competitive to summer rice so far as use of land and other farm resources is in question. Considering the time of harvesting and continuous emergence of high yielding short duration rice varieties through research it is observed that a farmer may choose short duration variety of rice for its cultivation after harvesting summer rice, which may be harvested within 1st fortnight of October. It is possible in most of the districts of West Bengal. Hence, autumn rice cannot be treated as competitive to summer rice. On the other hand, the crop jute in the state is predominated by olitorious varieties requiring land with relatively upper situation which is disadvantageous for cultivation of summer rice. Jute of capsularis varieties requiring lower land situation are, however, grown in the North Bengal districts mostly with rainfed culture while summer rice is grown with irrigated culture. Thus, in strict sense, jute is also not a competing crop of summer rice.

From the above discussion it becomes clear that the movement of area under summer rice cannot be explained by the movement of prices and profitabilities of the crop in relation to those of competing crops. It also brings into focus that with the expansion of irrigation facility to lower land situation, which is congenial for summer rice cultivation, and in summer there is hardly any alternative good crop option other than cultivation of summer rice. A few selected crops under summer vegetable are however reportedly cultivated on such land.

Despite area coverage of such irrigated low land by some selected summer vegetable crops the area under summer rice is recorded to have been increasing with leaps and bounds in all districts during the period (Table 22). A look to the Table 23 it reveals that yield rate of summer rice has enhanced barely 17.8 per cent at the state level and even declined in three districts over the period of two decade ending 2003-04. From the sample data the net revenue of summer rice over prime cost has been calculated to be only Rs 4005 per acre. Thus, based on above observation one may plausibly come to the contention that monotonically expansion of area under summer rice with a high pace is not explained by favourable movement of its profitability (as reflected by the movement of yield rate). One may be tempted to explain the expansion of area under summer rice in terms of increasing utilization of fixed farm resources with an objective of maximization of farm income. But this explanation of utilization of fixed farm resources is tenable only for the short run, not for a long period like two decades. It is, therefore, necessary to turn to the demand side.

In West Bengal, rice is the principal cereal food crop. Therefore, increasing consumption demand for rice with the increase in population cannot be ignored. By comparing Table 22 and Table 23 it is interesting to note that area under autumn rice has declined a little more than 42 per cent and that of winter rice remained by and large unchanged in spite of their respective yield is recorded to have been a little more than doubled over the period. While area under summer rice is recorded a spectacular increase reaching more than four folds despite its yield rate remaining almost unchanged during the period. In totality rice area has increased from 5082.6 to 5922.6 thousand hectares and yield rate has become a little more than doubled (from 1193 kg to 2494 kg per hectare) over the

Table 22: Area ('000 ha) of rice crops in West Bengal by districts.

| Districts | Average area of triennium ending 1982-83 | | | | Average area of triennium ending 2003-04 | | | | Difference | | | |
|---------------------|--|-------------|-------------|------------|--|-------------|-------------|------------|--------------------|-------------------|--------------------|--------------------|
| | Winter rice | Summer rice | Autumn rice | Total rice | Winter rice | Summer rice | Autumn rice | Total rice | Winter rice | Summer rice | Autumn rice | Total rice |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) |
| Burdwan | 415.5 | 54.7 | 22.8 | 493.0 | 415.7 | 216.7 | 21.9 | 654.4 | 0.2 (0.06) | 162.0 (296.0) | -0.90 (-3.90) | 161.3 (32.72) |
| Birbhum | 314.2 | 13.3 | 5.9 | 333.4 | 308.1 | 76.6 | 6.0 | 390.6 | -5.13 (-1.95) | 63.3 (474.5) | 0.1 (1.10) | 57.20 (17.15) |
| Bankura | 326.0 | 5.3 | 23.3 | 354.6 | 292.6 | 43.4 | 23.1 | 359.1 | -33.37 (-10.24) | 38.1 (718.2) | -0.2 (-1.0) | 4.53 (1.28) |
| Midnapore | 786.3 | 65.5 | 48.8 | 898.9 | 753.8 | 242.5 | 68.6 | 1065.0 | -32.5 (-4.13) | 177.0 (270.3) | 19.8 (40.7) | 166.2 (18.50) |
| Howrah | 79.3 | 9.7 | 2.1 | 91.1 | 76.9 | 52.0 | 2.8 | 131.8 | -2.4 (-2.98) | 42.3 (436.1) | 0.8 (37.1) | 40.7 (44.73) |
| Hooghly | 178.5 | 46.8 | 11.3 | 236.6 | 197.7 | 100.4 | 6.5 | 304.7 | 19.1 (10.72) | 53.6 (114.5) | -4.7 (-42.0) | 68.1 (28.77) |
| 24-PGS (North) | 574.8 | 49.0 | 22.8 | 646.6 | 183.1 | 90.9 | 21.4 | 295.5 | -391.7 (-68.15) | 41.9 (85.6) | -1.4 (6.1) | -351.2 (-54.31) |
| 24-PGS (South) | 574.8 | 49.0 | 22.8 | 646.6 | 344.5 | 71.9 | 13.9 | 437.0 | -230.3 (-40.06) | 22.9 (46.8) | -9.0 (-39.3) | -209.6 (-32.42) |
| Nadia | 97.8 | 31.3 | 86.4 | 215.5 | 129.0 | 144.6 | 57.4 | 331.0 | 31.2 (31.87) | 113.3 (361.6) | -28.9 (-33.5) | 115.5 (53.60) |
| Murshidabad | 193.0 | 23.6 | 92.1 | 308.8 | 234.9 | 119.5 | 47.3 | 401.7 | 41.9 (21.69) | 95.9 (406.9) | -44.8 (-48.6) | 92.9 (30.09) |
| Purulia | 233.4 | 0.2 | 1.8 | 235.4 | 269.8 | 1.3 | 2.1 | 273.2 | 36.4 (15.60) | 1.1 (533.3) | 0.4 (20.4) | 37.8 (16.06) |
| Malda | 140.7 | 22.0 | 51.4 | 214.1 | 136.2 | 66.1 | 9.8 | 212.2 | -4.5 (-3.20) | 44.1 (200.6) | -41.6 (-80.9) | -1.9 (-0.89) |
| Dinajpur (Combined) | 344.9 | 7.5 | 109.3 | 461.7 | 354.1 | 133.3 | 9.5 | 497.1 | 9.2 (2.67) | 125.8 (1677.3) | -99.8 (-91.30) | 35.4 (7.67) |
| Jalpaiguri | 196.0 | 0.1 | 68.6 | 264.7 | 181.7 | 19.1 | 56.3 | 257.2 | -14.3 (-7.31) | 19.0 (19000) | -12.3 (-17.9) | -7.6 (-2.86) |
| Darjeeling | 35.2 | - | 7.1 | 42.3 | 28.9 | 1.3 | 5.8 | 36.0 | -6.3 (-17.91) | 1.3 | -1.3 (-17.7) | -6.3 (-14.91) |
| Cooch Behar | 189.1 | 0.2 | 94.9 | 284.2 | 222.7 | 30.5 | 22.9 | 276.2 | 33.6 (17.75) | 30.3 (15150) | -72.0 (-75.8) | -8.1 (-2.84) |
| West Bengal | 4103.7 | 329.3 | 648.5 | 5082.6 | 4129.8 | 1417.1 | 375.8 | 5922.6 | 26.1 (0.63) | 1087.8 (330.3) | -272.8 (-42.10) | 840.0 (16.53) |

Figures in parentheses indicate percentage change of area.

Table 23: Yield rate (Kg/ha) of rice crops in West Bengal by districts.

| Districts | Average yield of triennium ending 1982-83 | | | | Average yield of triennium ending 2003-04 | | | | Difference | | | |
|---------------------|---|-------------|-------------|------------|---|-------------|-------------|------------|--------------------|------------------|------------------|---------------------|
| | Winter rice | Summer rice | Autumn rice | Total rice | Winter rice | Summer rice | Autumn rice | Total rice | Winter rice | Summer rice | Autumn rice | Total rice |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) |
| Burdwan | 1540 | 2371 | 1824 | 1635 | 2901 | 3008 | 2893 | 2990 | 1361 (88.38) | 637 (26.87) | 1069 (58.61) | 1355 (82.90) |
| Birbhum | 1320.7 | 2276 | 1660 | 1358.3 | 2913.3 | 2865 | 2660 | 2914.7 | 1592.6 (120.60) | 589 (25.88) | 1000 (60.24) | 1556.33 (114.58) |
| Bankura | 1171.3 | 1493 | 1149 | 1180 | 2816 | 2981 | 2750 | 2802.3 | 1644.7 (140.41) | 1488 (99.67) | 1601 (139.34) | 1622.33 (137.49) |
| Midnapore | 952.3 | 2675 | 913 | 1084.7 | 2245.3 | 3054.5 | 2255 | 2425.7 | 1293 (135.77) | 379.5 (14.19) | 1342 (146.99) | 1341 (123.63) |
| Howrah | 1186 | 2351 | 1790 | 1336.3 | 2006.3 | 2636 | 2232 | 2279 | 820.3 (69.17) | 285 (12.12) | 442 (24.69) | 942.7 (70.54) |
| Hooghly | 1496.3 | 2434 | 1845 | 1676.3 | 2632 | 2506 | 2416 | 2647 | 1135.7 (75.90) | 72 (2.96) | 571 (30.95) | 970.7 (57.90) |
| 24-PGS (North) | 971.7 | 2712 | 1649 | 1132.3 | 2371 | 3118 | 2194 | 2606.3 | 1399.3 (144.01) | 406 (14.97) | 545 (33.05) | 1474 (130.17) |
| 24-PGS (South) | 971.7 | 2712 | 1649 | 1132.3 | 2078.3 | 2791 | 2367 | 2224 | 1106.7 (113.89) | 79 (2.91) | 718 (43.54) | 1091.7 (96.41) |
| Nadia | 1078 | 2493 | 1212 | 1301.7 | 2417 | 3479 | 2151 | 2814.3 | 1339 (124.21) | 986 (39.55) | 939 (77.48) | 1512.7 (116.21) |
| Murshidabad | 1168 | 2753 | 1092 | 1219.7 | 2569 | 3131 | 1958 | 2715 | 1401 (119.95) | 378 (13.73) | 866 (79.30) | 1495.3 (122.60) |
| Purulia | 1000 | 2469 | 653 | 998.3 | 2275 | 2092 | 2086 | 2271.3 | 1275 (127.50) | -377 (-15.27) | 1433 (219.45) | 1273 (127.51) |
| Malda | 1197.3 | 2647 | 806 | 1250.3 | 2197.3 | 3596 | 1961 | 2601 | 1000 (83.52) | 949 (35.85) | 1155 (143.30) | 1350.7 (108.02) |
| Dinajpur (Combined) | 971 | 1960 | 798 | 749.3 | 1961.3 | 2688 | 1445 | 2175.3 | 990.3 (101.99) | 728 (37.14) | 647 (81.08) | 1226 (129.14) |
| Jalpaiguri | 997 | - | 582 | 915 | 1601.3 | 1833 | 1451 | 1609 | 604.3 (60.62) | 1833 | 869 (149.31) | 694 (75.85) |
| Darjeeling | 1187.3 | 1800 | 586 | 1101.3 | 1735.3 | 1601 | 1575 | 1711 | 548 (46.15) | -199 (-11.06) | 989 (168.77) | 609.7 (55.36) |
| Cooch Behar | 1062.7 | 2436 | 617 | 939 | 1652.3 | 2324 | 1569 | 1738 | 589.7 (55.49) | -112 (-4.60) | 952 (154.30) | 799 (85.09) |
| West Bengal | 1124.7 | 2534 | 960 | 1193.3 | 2344 | 2986 | 2070 | 2493.7 | 1219.3 (108.42) | 452 (17.84) | 1110 (115.62) | 1300.3 (108.97) |

Figures in parentheses indicate percentage change of yield rate.

Table 24: Per Capita Availability of Rice, Wheat, Major Cereals, and Foodgrains in West Bengal.

| Per capita per day availability (in kg) of | | | | | |
|--|------------|-------|---------------|------------|------------|
| Year | Total rice | Wheat | Major cereals | Tot pulses | Foodgrains |
| (1) | (2) | (3) | (4) | (5) | (6) |
| 1961-62 | 0.376 | 0.003 | 0.379 | 0.027 | 0.412 |
| 1962-63 | 0.338 | 0.002 | 0.340 | NA | NA |
| 1963-64 | 0.399 | 0.002 | 0.401 | NA | NA |
| 1964-65 | 0.420 | 0.002 | 0.422 | NA | 0.457 |
| 1965-66 | 0.349 | 0.002 | 0.351 | 0.031 | 0.389 |
| 1966-67 | 0.336 | 0.003 | 0.339 | 0.029 | 0.375 |
| 1967-68 | 0.354 | 0.005 | 0.359 | 0.025 | 0.391 |
| 1968-69 | 0.384 | 0.018 | 0.402 | 0.030 | 0.438 |
| 1969-70 | 0.393 | 0.031 | 0.424 | 0.024 | 0.455 |
| 1970-71 | 0.389 | 0.055 | 0.444 | 0.024 | 0.475 |
| 1971-72 | 0.402 | 0.057 | 0.459 | 0.020 | 0.486 |
| 1972-73 | 0.346 | 0.042 | 0.388 | 0.017 | 0.410 |
| 1973-74 | 0.344 | 0.037 | 0.381 | 0.021 | 0.408 |
| 1974-75 | 0.380 | 0.048 | 0.428 | 0.022 | 0.457 |
| 1975-76 | 0.390 | 0.068 | 0.458 | 0.023 | 0.488 |
| 1976-77 | 0.331 | 0.059 | 0.390 | 0.020 | 0.415 |
| 1977-78 | 0.409 | 0.056 | 0.465 | 0.018 | 0.489 |
| 1978-79 | 0.356 | 0.054 | 0.410 | 0.014 | 0.429 |
| 1979-80 | 0.308 | 0.040 | 0.348 | 0.016 | 0.369 |
| 1980-81 | 0.382 | 0.024 | 0.406 | 0.012 | 0.424 |
| 1981-82 | 0.293 | 0.019 | 0.312 | 0.012 | 0.329 |
| 1982-83 | 0.243 | 0.030 | 0.273 | 0.011 | 0.288 |
| 1983-84 | 0.381 | 0.041 | 0.422 | 0.012 | 0.440 |
| 1984-85 | 0.380 | 0.038 | 0.418 | 0.010 | 0.435 |
| 1985-86 | 0.367 | 0.034 | 0.401 | 0.012 | 0.419 |
| 1986-87 | 0.380 | 0.031 | 0.411 | 0.009 | 0.432 |
| 1987-88 | 0.408 | 0.029 | 0.437 | 0.010 | 0.453 |
| 1988-89 | 0.454 | 0.027 | 0.481 | 0.009 | 0.495 |
| 1989-90 | 0.460 | 0.015 | 0.475 | 0.009 | 0.499 |
| 1990-91 | 0.430 | 0.021 | 0.451 | 0.008 | 0.464 |
| 1991-92 | 0.481 | 0.023 | 0.504 | 0.007 | 0.517 |
| 1992-93 | 0.453 | 0.023 | 0.476 | 0.008 | 0.491 |
| 1993-94 | 0.472 | 0.024 | 0.496 | 0.007 | 0.510 |
| 1994-95 | 0.469 | 0.029 | 0.498 | 0.005 | 0.509 |
| 1995-96 | 0.448 | 0.028 | 0.476 | 0.005 | 0.486 |
| 1996-97 | 0.469 | 0.031 | 0.500 | 0.006 | 0.510 |
| 1997-98 | 0.483 | 0.030 | 0.513 | 0.006 | 0.524 |
| 1998-99 | 0.478 | 0.028 | 0.506 | 0.005 | 0.516 |
| 1999-2000 | 0.486 | 0.030 | 0.516 | 0.005 | 0.525 |
| 2000-01 | 0.432 | 0.037 | 0.469 | 0.008 | 0.480 |
| 2001-02 | 0.522 | 0.033 | 0.555 | 0.006 | 0.564 |
| 2002-03 | 0.484 | 0.030 | 0.514 | 0.006 | 0.522 |

same period. And as a consequence per capita daily availability¹ of rice has increased from 306 g to 479 g. Per

capita daily availability of wheat, the second important stable cereal, is also found to increase from 24 g to 33 g

during the period (Table 24). Rao (2000) in his study has also observed an increase in monthly per capita cereal consumption in rural Bengal from 13.64 kg in 1972-73 to 14.96 kg in 1993-94 in contrast to its decline in other major states of India. Increase in per capita availability and per capita consumption of cereal keeping in view one may reasonably arrive at the conclusion that the production of rice is aimed at primarily for home consumption and secondarily for the market as that for wheat (stated earlier) in a small farm dominated agricultural economy like West Bengal. As there is hardly any alternative crop which may be raised in low lying irrigated land, summer rice is cultivated on such land principally to meet self consumption demand and then for the market. In view of higher yield rate of summer rice than that of winter rice and autumn rice, the increasing requirement of family consumption could be met by devoting relatively less amount of land. And as a consequence despite increase in yield rate of winter and autumn rice a portion of land erstwhile allocated for rice

production has been diverted to the production of vegetable and other non-cereal crops which has been reflected by contraction of area under autumn rice (as autumn or winter rice is not competing crop of summer rice in the question of utilization of land and other resources, which has been explained a little earlier) in all the districts and that of winter rice in 9 out of 16 districts (Table 22). Crop diversification by introducing summer and rainy vegetables, groundnut, sunflower, maize, garlic and peas on such land has been substantiated by the reporting of the sample farmers of Cooch Behar district (Table 25). In winter season crop diversification by vegetable and spice crops has already been discussed. In this context it is worthy to note that about 93 per cent of the land holdings in rural West Bengal, accounting for nearly 72 per cent of the land, are operated by marginal and small farmers (Statistical Abstract, 2001-02). Distributional pattern of land holdings of sample farmers of Cooch Behar district as shown in Table 31 is also corroborative to the above statement.

Table 25: Crops newly introduced during last 5 years.

| Villages | Name of crops under | | | | | | | | | | | | | | |
|-------------------|---------------------|----------------|---------------|---------------|---------------|----------------|---------------|---------------|----------------|---------------|---------------|---------------|----------------|----------------|----------------|
| | Kharif | | | | | Rabi | | | | Pre-kharif | | | | | |
| | Swarna masuri | Basmati | BR-11 | Ranjit masuri | Mala | Ground-nut | Sunflower | Maize | Pea | Sahi-alam | Parijat | IR-26 | Nayanmani | Hybrid rice | Lalat rice |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) |
| Advanced villages | 80 (100.0) | 40 (50.00) | 60 (75.00) | 70 (87.50) | 30 (37.50) | 30 (37.50) | 40 (50.00) | 30 (37.50) | 60 (75.00) | 80 (100.0) | 70 (87.50) | 70 (87.50) | 50 (62.50) | 30 (37.50) | 50 (62.50) |
| Backward villages | 70 (87.50) | 63 (78.75) | - | - | - | 80 (100.0) | - | - | 78 (97.50) | - | - | - | 80 (100.0) | 80 (100.0) | 80 (100.0) |
| Combined | 150 (93.75) | 103 (64.37) | 60 (37.50) | 70 (43.75) | 30 (18.75) | 110 (68.75) | 40 (25.00) | 30 (18.75) | 138 (86.25) | 80 (50.00) | 70 (43.75) | 70 (43.75) | 130 (81.25) | 110 (68.75) | 130 (81.25) |

Figures in parentheses indicate percentage of respective total.

Table 26: Crop area extended during last 5 years.

| Villages | Name of crops under | | | |
|-------------------|---------------------|----------------|----------------|----------------|
| | Kharif | Rabi | | Pre-kharif |
| | Swarnamasuri | Potato | Vegetables | Summer rice |
| (1) | (2) | (3) | (4) | (5) |
| Advanced Villages | 70 (87.50) | 50 (62.50) | 80 (100.0) | 75 (93.75) |
| Backward villages | 75 (93.75) | 80 (100.0) | 80 (100.0) | 70 (87.50) |
| Combined | 145 (90.62) | 130 (81.25) | 160 (100.0) | 145 (90.62) |

Figures in parentheses indicate percentage of respective total.

Table 27: Crop area declined during last 5 years.

| Villages | Name of crops under | | | | | | | | |
|-------------------|---------------------|--------------------|---------------|---------------|----------------|---------------|----------------|----------------|--------------------------|
| | Kharif | | Rabi | | | | | | Prekharif |
| | Aus rice | Local rice variety | Mustard | Wheat | Tisi, Magha | Lentil | Tobacco | Khesari | China boro (Summer rice) |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Advanced Villages | 75 (93.75) | 80 (100.0) | 50 (62.50) | 50 (62.50) | 75 (93.75) | 30 (37.50) | 75 (93.75) | 50 (62.50) | 50 (62.50) |
| Backward Villages | 80 (100.0) | 56 (70.00) | - | - | 76 (95.00) | - | 80 (100.0) | 76 (95.00) | - |
| Combined | 155 (96.88) | 136 (85.00) | 50 (31.25) | 50 (31.25) | 151 (94.37) | 30 (18.75) | 155 (96.87) | 126 (78.75) | 50 (31.25) |

Figures in parentheses indicate percentage of respective total.

Table 28: Name of the crops presently not grown.

| Villages | Name of crops under | | | | | | |
|-------------------|---------------------|--------------------|----------------|----------------|---------------|----------------|----------------|
| | Kharif | | Rabi | | | Pre-kharif | |
| | Aus rice | Local rice variety | Tobacco | Tisi, Magha | Kalai | Sugarcane | Tobacco |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Advanced Villages | 53 (66.25) | 71 (88.75) | 65 (81.25) | 57 (71.25) | 57 (71.25) | 50 (62.50) | 80 (100.0) |
| Backward Villages | 65 (81.25) | 48 (60.00) | 75 (93.75) | 52 (65.00) | - | 77 (96.25) | 80 (100.0) |
| Combined | 118 (73.75) | 119 (74.37) | 140 (87.50) | 109 (68.12) | 57 (35.62) | 127 (79.37) | 160 (100.0) |

Figures in parentheses indicate percentage of respective total.

Table 29: Name of the crops is going to be eliminated.

| Villages | Name of crops under | | | | | |
|-------------------|--------------------------|--------------------|---------------|----------------|----------------|-------------|
| | Kharif | | Rabi | | | Pre--kharif |
| | Double transplanted rice | Local rice variety | Local chilli | Onion | Maskalai | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Advanced Villages | 76 (95.00) | 80 (100.0) | 43 (53.75) | 51 (63.75) | 64 (80.00) | - |
| Backward Villages | 55 (68.75) | 60 (75.00) | - | 75 (93.75) | 77 (96.25) | - |
| Combined | 131 (81.87) | 140 (87.50) | 43 (26.87) | 126 (78.75) | 141 (88.12) | - |

Figures in parentheses indicate percentage of respective total.

Table 30: Name of the crop area showing interyear fluctuation.

| Villages | Name of crops under | | | |
|-------------------|---------------------|----------------|----------------|----------------|
| | Kharif | Rabi | Pre-kharif | |
| | | Potato | Summer rice | Jute |
| (1) | (2) | (3) | (4) | (5) |
| Advanced villages | - | 78 (97.50) | 72 (90.00) | 60 (75.00) |
| Backward villages | - | 80 (100.0) | 75 (93.75) | 80 (100.0) |
| Combined | - | 158 (98.75) | 147 (91.87) | 140 (87.50) |

Figures in parentheses indicate percentage of respective total.

Table 31: Distribution of Households according to Landowning Classes.

| Class of landowners by size group of operational holding (in acre) | No. of households in | | |
|--|----------------------|-------------------|----------------|
| | Backward villages | Advanced villages | Combined |
| (1) | (2) | (3) | (4) |
| Upto 1.50 | 22 (27.50) | 7 (8.75) | 29 (18.12) |
| 1.51 – 3.00 | 28 (35.00) | 28 (35.00) | 56 (35.00) |
| 3.01 – 4.50 | 16 (20.00) | 27 (33.75) | 43 (26.87) |
| 4.51 – 6.00 | 8 (10.00) | 11 (13.75) | 19 (11.87) |
| 6.01 and above | 6 (7.50) | 7 (8.75) | 13 (8.14) |
| All classes | 80 (100.0) | 80 (100.0) | 160 (100.0) |

Figures in parentheses indicate percentage of respective total.

Thus, remarkable enhancement of crop area with crop diversification facilitated by large scale expansion of irrigation as elicited in all districts of West Bengal has brought about by the marginal and small farmers. As a consequence, cropping intensity in the state has increased steadily from 136 per cent in 1980-81 to 180 per cent in 2000-01, the second highest in the country, next only to Punjab. In 1990s, West Bengal was recorded to have highest growth of per capita net state domestic product (NSDP) among all the states in the country. Between 1991-92 and 1998-99 NSDP in West Bengal grew at the rate of 6.88 per cent as against 5.14 per cent in Maharashtra and 4.81 per cent in Gujarat (Mishra, 2001). With this

observation one can reasonably come to the contention that the increasing cropping intensity and crop diversification has contributed largely to the income growth of rural West Bengal particularly that of marginal and small farmers. This increase in income has not only enhanced the level of cereal consumption per head stated earlier but also brings about change in the composition of food basket. It is also highlighted from opinion survey (Table 25 to Table 30) that the area under fine quality of rice varieties namely Basmati, BR-11, Ranjit, Masuri along with high yielder varieties like Swarna Masuri have also been recently introduced. It implies that the farm or non-farm people belonging to higher income groups have

changed their preference pattern in favour of finer quality of rice along with increased level of vegetable consumption.

CONCLUSION

With the introduction of HYV technology since late sixties a remarkable change in crop-mix and cropping pattern has been experienced in West Bengal. But the pattern of change is found to have its variation over time. In the second phase, hike in area under summer rice with high pace as witnessed in the first phase has also been maintained. In case of wheat a moderate increasing trend in its area is also visualized. But area under autumn rice is revealed a continuous dwindling over the entire period from 1967-68 to 2002-03 while that of winter rice shows increasing trend upto late nineties and thereafter declined. But moderate increase in area under rape and mustard and potato as revealed in the first phase has also been maintained. In the second phase a remarkable increase in area under winter and summer vegetables and chillies has come into the focal point in changing crop economy in the state of West Bengal. The present study is devoted to identify the factors that have been operative in changing crop-mix and cropping pattern during the period. By using simple correlation analysis the movement of area under different crops over time has been explained and it is found that no transfer of area has been brought about to wheat from its competing crops in both the periods. Rather both the area under wheat and its competing crops have been increasing simultaneously (excepting gram) over the entire period. By using same correlation analysis it is also revealed that neither the relative price nor the relative profitability has played the pivotal role in explaining the area expansion of wheat and its competing crops. Continuous expansion of area under summer rice over the entire period and the decline in area under autumn rice and winter rice in the later phase have also not been explained by relative profitability consideration. It is the consumption demand for cereal of farm and non-farm people which has played the pivotal role in changing crop-mix and cropping pattern in both the periods. In a small farm dominated agricultural economy of West Bengal the consumption demand of cereal has been continuously increasing and to meet the increasing consumption demand in the first instance more and more land have been allocated to the production of summer rice and wheat. For Bengali people rice is the principal staple cereal. In rural areas the use of wheat as staple cereal was not notable in pre-HYV era. With the inflationary upsurge from late sixties onwards and thereby severe erosion of the purchasing power the wheat as a cheaper staple cereal has come up as a staple cereal by substituting rice. With narrowing the gap of price differences between rice and wheat the preference of rice to wheat and in effect, dwindling in wheat area is visualized. The meeting of consumption demand having been satisfied the surplus

land is devoted to raise paying crops like vegetables and chilli in order to increase farm income. The continuous increase in area under irrigation and evolving of high yielding short duration rice varieties through research have played an important role in the process of observed reallocation of land with the twin objectives to meet self-consumption demand of cereal and increasing farm income.

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ⁱ Per head production has been taken as an approximation of Per Capita Availability. And average figure of triennium ending 1982-83 and that of 2002-03 is taken into consideration while comparing the change over the period.