*Ind. Jn. of Agri. Econ.*
*Vol.69, No.1, Jan.-March 2014*

# Crop Diversification and Agricultural Growth in West Bengal

**Suranjana Dasgupta and Sankar Kumar Bhaumik***

ABSTRACT

This paper examines the trend and pattern of diversification of the crop sector in West Bengal during the period 1980-81 to 2009-10. In this context, the paper examines the impact of crop diversification on agricultural output growth in West Bengal. We also look into the sources of growth of the crop sector that accounts for about 80 per cent of the total value of agricultural output in West Bengal. The factors contributing to diversification of the cropping pattern are also examined.

**Keywords: Crop diversification, Agricultural growth, Cropping pattern.**

**JEL: Q100, Q110, Q150.**

## I

## INTRODUCTION

Crop diversification seems to have started in West Bengal way back in 1983-84, which also coincided with the time when Indian agriculture in general started to diversify away from the cereals. This was a time when the growth of cereals production in India started showing signs of stagnation. However, this diversification away from cereals took many directions. The biggest beneficiaries of this move were oilseeds and potatoes. Another major beneficiary was the horticultural crops. But the pace of diversification towards horticultural crops was accelerated only in the 1990s (Chand *et al*., 2008) which coincided with the liberalisation of the economy. Among the major states of India, horticultural crops like fruits and vegetables were grown on more than 10 per cent of the gross cropped areas in Kerala, Orissa and West Bengal during 1990-91 (*ibid*). Among the states, the performance of West Bengal in the production of horticultural crops is commendable in as much as it now occupies second position with a share of 14.8 per cent in all India production of horticultural crops, the first position being occupied by Maharashtra (*ibid*).

Nevertheless, West Bengal to this date remains primarily an agricultural state with ten of its districts deriving 30 per cent or more of their net district domestic product from agriculture. Although the share of agriculture in the net state domestic product is continuously falling in West Bengal, the state continues to depend heavily on agriculture. Industry and services are yet to account for a major share of the net district domestic product in most of the districts of West Bengal, let alone providing

*Associate Professor of Economics, Bethune College, Kolkata-700 006 (West Bengal) and Professor, Department of Economics, University of Calcuta, Kolkata-700 073 (West Bengal), respectively.

This paper forms a part of the Ph.D. thesis of the first author prepared under supervision of the second author for submission to the University of Calcutta.

employment to a large section of their growing labour force. So it is imperative that rapid agricultural development takes place in the state with per acre agricultural productivity in terms of value generation rising fast.

Agricultural diversification construed in the sense of change in the cropping pattern towards high value crops is undoubtedly a major factor contributing towards agricultural development. This is because of two main reasons. First, it has been observed that the benefits of the new technology or green revolution in cereals gets exhausted after an 'optimum' level is reached, and unless new high-value crops are introduced, agricultural growth becomes stagnant. Secondly, the small and the marginal farmers who dominate the agricultural scenario of most of the Indian states, including West Bengal, can generate higher farm income and employment and mitigate risks by adopting a diversified crop portfolio (Vyas, 1996). The data available from the Agricultural Census (2005-06) show that 81.17 per cent of the operating households in West Bengal belong to the 'marginal' category and 14.38 per cent to the 'small' category. Thus together they make up the formidable force of 95.5 per cent of the total number of farmers in the state, operating about 79.5 per cent of the total operated area.

Against this backdrop, this paper examines the trend and pattern of diversification of the crop sector in West Bengal during the period 1980-81 to 2009-10. In this context, the study examines the impact of crop diversification on agricultural output growth in West Bengal. It also looks into the sources of growth of the crop sector that accounts for about 80 per cent of the total value of agricultural output in West Bengal. The factors that are responsible for diversification of the cropping pattern in the state are also examined.

The year 1980-81 has been chosen as the starting point of our discussion because, as pointed out earlier, agricultural growth started picking up in West Bengal and cropping pattern started changing towards non-food grains crops alias high return crops from mid-1980s only.

The rest of the paper is organised as follows: Section II describes the data and methodology used in the paper. Section III discusses the pace and pattern of agricultural diversification in West Bengal since 1980-81. Section IV describes the impact of crop diversification on agricultural output growth. Section V analyses the factors behind crop diversification. A summary of the major findings and important lessons that emerge from the state's experience are given in Section VI.

## II

## DATA AND METHODOLOGY

This study is completely based on secondary data collected from various publications and records of the West Bengal Government, mainly various issues of *Statistical Abstracts*, *Economic Review* and *Agricultural Census Reports*. We divided our study period (1980-81 to 2009-10) into two sub-periods, 1980-81 to 1994-95 and

1995-96 to 2009-10, as that conforms to a rough division between the pre-globalisation and post-globalisation periods in the context of Indian agriculture. Another justification towards such a division is that growth rate of agricultural production in West Bengal started decelerating since mid-1990s.[1]

To understand the extent of crop diversification, first of all, changes in proportion of area under different crops to total cropped area is considered. Since data on gross cropped area are not available for the earlier years of the decade of 1980s an approximation is made by aggregating the area under principal crops. However, a change in the cropping pattern alone does not give a precise measure as to how diversified the crop mix has been over time and space. So to investigate this aspect more precisely, we computed the values of Herfindahl Index[2] over the whole period. Further, as diversification is usually defined as a shift of the resources from crop with low returns to crops with high returns, we computed shares of the 'expansion effect' and 'substitution effect' in the total change of area under different crops between 1980-81 to 2009-10 (and also for the two sub-periods) to see whether diversification is taking place in favour of crops with higher returns replacing the traditional ones.

According to one strain of the literature, agricultural diversification is measured as a sustained rise in the share of area and value of horticultural crops like vegetables and fruits in the total area cropped and total value of agricultural output respectively (Joshi *et al*., 2007; Birthal *et al*., 2007). However, as the data for these crops for the state of West Bengal is available only since 1997-98, our analysis of this aspect is confined to the period of 1997098 to 2009-10 only.

As regards decomposition of agricultural production growth in West Bengal into the contributions of changes in area, yield and cropping pattern, we used the seven-factor additive model which follows from Minhas and Vaidyanathan (1965) and Parikh (1966) and subsequently used by Dhindsa and Sharma (1995) and De (2003). Following this model, the total change in agricultural output (which is the aggregate of the value of each crop output at the base year's price) over the time period can be divided into various components as follows:

$$Q_t - Q_0 = \Delta Q_t = A_t \Sigma C_{it} Y_{it} P_i - A_o \Sigma C_{io} Y_{io} P_i$$

or

$$\Delta Q = (A_t - A_0)\, \Sigma C_{i0} Y_{i0} P_i + A_o \Sigma C_{io}\, (Y_{it} - Y_{i0})\, P_i + A_0 \Sigma (C_{it} - C_{i0})\, Y_{i0} P_i$$
$$+ (A_t - A_0)\, \Sigma (C_{it} - C_{i0})\, Y_{i0} P_i + A_t - A_0)\, \Sigma C_{i0}\, (Y_{it} - Y_{io})\, P_i$$
$$+ A_0 \Sigma (C_{it} - C_{i0})\, (Y_{it} - Y_{i0}) P_i + (A_t - A_0)\, \Sigma (C_{it} - C_{i0})\, (Y_{it} - Y_{i0}) P_i$$

where $Q_0 = A_0 \Sigma C_{i0} Y_{i0} P_i$ and $Q_t = A_i \Sigma C_{it} Y_{it} P_i$ represents total value of agricultural output at constant prices $P_i$ of the region in the base period and final period respectively. $A_0$ and $A_t$ are gross cropped areas in the base period and final period respectively. $C_{i0} = (A_{i0} / A_0)$, $C_{it} = (A_{it} / A_t)$ and $Y_{i0}$ and $Y_{it}$ represent respectively the proportion of area under i-th crop to gross cropped area in the base and final periods and yield of i-th crop in the base and final year. $P_i$'s are the prices (triennia average of

harvest prices) of crops in the base period. The first three components on the right hand side represent the direct effect of area, yield and cropping pattern. The next three are the interaction effects of area and cropping pattern, area and yield, cropping pattern and yield. The last one is the interaction of all three: area, yield and cropping pattern.

As regards the factors that are likely to drive crop diversification, we have considered the institutional factors like the change in the structure of operational holdings among the different categories of farmers over time and a few demand side and supply side factors. While the demand side factors are represented by per cent of urban population and per capita income, the supply side factors considered are intensity of irrigation and fertiliser consumption per hectare of the gross cropped area.

## III

## TREND AND PATTERN OF AGRICULTURAL DIVERSIFICATION

To begin with, let us look into the performance of agriculture in the state of West Bengal during our study period. Table 1 shows that during the thirty year period (1980-81 to 2009-10), the net state domestic product originating from agriculture and allied activities in West Bengal recorded a growth rate of 4 per cent per annum. The overall growth rate of the state economy was 5.8 per cent per annum. Between the two sub-periods, the growth rate in agriculture was higher during the sub-period spanning 1980-81 to 1994-95 (5.39 per cent), which declined substantially during 1995-96 to 2009-10 (1.97 per cent).

TABLE 1. ANNUAL GROWTH RATE OF NSDP IN WEST BENGAL (AT CONSTANT 1993-94 PRICES): 1980-81 TO 2009-10

| Sector | 1980-81 to 1994-95 | 1995-96 to 2009-10 | 1980-81 to 2009-10 |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| Primary | 5.06 | 2.30 | 3.95 |
| Agriculture | 5.39 | 1.97 | 4.00 |
| Forestry | -1.15 | 6.09 | 1.99 |
| Fishery | 5.98 | 2.95 | 4.53 |
| Mining and quarrying | -6.26 | 4.75 | -1.95 |
| Secondary | 2.94 | 7.34 | 5.23 |
| Teritary | 5.15 | 7.79 | 7.19 |
| Total NSDP | 4.91 | 6.09 | 5.80 |

*Source*: Computed by using data available from Bureau of Applied Economics and Statistics, Government of West Bengal.

*Note*: Growth rates have been calculated by fitting the function InY= a + bt.

This performance of the agricultural sector of the state is closely associated with changes in the cropping pattern which again culminates into crop diversification. Table 2 shows the exponential growth rate of the absolute area and production of the principal crops in West Bengal. It is found that the annual exponential growth rate of area under food grains was only 0.29 per cent during 1980-81 to 2009-10. The first

sub-period (1980-81 to 1994-95) showed an increasing trend with regard to the growth of area under food grains but the second sub-period (1995-96 to 2009-10) showed a decreasing trend.

TABLE 2. EXPONENTIAL GROWTH RATES OF AREA AND PRODUCTION OF PRINCIPAL CROPS IN WEST BENGAL

| | Area | | | Production | | |
|---|---|---|---|---|---|---|
| Crops | 1980-81 to 1994-95 | 1995-96 to 2009-10 | 1980-81 to 2009-10 | 1980-81 to 1994-95 | 1995-96 to 2009-10 | 1980-81 to 2009-10 |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Aus | -1.41 | -5.29 | -3.35 | 3.09 | -3.88 | -0.39 |
| Aman | 0.27 | -0.48 | -0.1 | 3.83 | 1.11 | 2.47 |
| Boro | 8.54 | 1.55 | 5.05 | 10.19 | 1.31 | 5.75 |
| Total rice | 1.11 | -0.23 | 0.45 | 5.09 | 0.98 | 3.03 |
| Wheat | 1.58 | 0.46 | 1.02 | 2.04 | 1.40 | 1.72 |
| Total cereals | 1.05 | -0.14 | 0.45 | 4.80 | 1.07 | 2.93 |
| Pulses | -4.73 | -1.10 | -2.92 | -3.17 | -0.13 | -1.65 |
| Food grains | 0.74 | -0.16 | 0.29 | 4.64 | 1.07 | 2.85 |
| Oilseeds | 2.89 | 1,85 | 2,37 | 6.15 | 2.52 | 4.34 |
| Jute | 0.53 | 1.15 | 0.84 | 3.19 | 2.52 | 2.86 |
| Sugarcane | 0.16 | 0.49 | 0.33 | 18.65 | 6.57 | 12.61 |
| Tobacco | -2.77 | 0.57 | -1.10 | -6.92 | 5.08 | -0.92 |
| Potatoes | 5.79 | 2.86 | 4.32 | 7.83 | 1.29 | 4.56 |
| Spices | 6.01 | 0.41 | 3.21 | 6.69 | 4.44 | 5.57 |

*Sources*: Computed by using data available from *Statistical Abstract* (various issues) and *Economic Review* (various issues), Bureau of Applied Economics and Statistics, Government of West Bengal.

Within food grains, the growth rate of area under cereals was 0.45 per cent for the period as a whole but negative in the second sub-period. Area under rice also grew at the rate of 0.45 per cent during our study period and here also the growth of area was negative in the second sub-period. The area under aus and aman paddy reduced at the rate of –3.35 per cent and –0.10 per cent respectively during 1980-81 to 2009-10. For aus, the growth rate has been negative for both the sub-periods whereas for aman the growth rate was negative only in the second sub-period. The area under boro rice registered a positive growth rate of 5.1 per cent for the entire period and 8.6 per cent and 1.6 per cent for the sub-periods of 1980-81 to 1994-95 and 1995-96 to 2009-10 respectively. The state registered negative trend growth rates of area under pulses, for both the sub-periods and hence for the entire period. Among the non-food grains crops, the growth rate of area under oilseeds has been quite impressive which eventually emerged as one of the key elements to bring about overall change of cropping pattern and crop diversification in West Bengal. The trend growth rate of area under potato suggests that potato has been another important ingredient of cropping pattern change and diversification besides boro rice and oilseeds.

The annual growth rate of production for food crops in West Bengal during 1980-81 to 2009-10 was 2.85 per cent per annum. The rate has been higher during the sub-period 1980-81 to 1994-95 (4.46 per cent per annum) than in the latter sub-period 1995-96 to 2009-10 (1.07 per cent). Boro rice emerged as an important food crop as well as commercial crop over time in West Bengal. Output of boro increased at an

exponential rate of 5.75 per cent per annum during the whole period. The growth rate has been most spectacular (above 10 per cent per annum) during the first sub-period (1980-81 to 1994-95). However, the growth rate decelerated during the second sub-period to 1.3 per cent per annum. The growth rate of production of pulses has been negative all along.

Among the non-food crops, production of potatoes and oilseeds grew positively throughout our study period. However, in case of potatoes, the growth rate decelerated during the second sub-period to 1.29 per cent per annum to 7.83 per cent per annum in the first sub-period. The production of boro rice, oilseeds and potatoes registered relatively high growth rates among the crops and the output of aus and pulses registered fall over this period.

The growth rates of area and production of principal food grain crops like aus, aman, boro and potatoes show declining trends during the second sub-period or the post-globalisation period. This points to an accelerated pace of diversification which implies larger area allocation for the non-food grain crops as well as horticultural crops during this latter period of our study. This will become further clear from our discussion below.

Table 3 shows the trend growth rate in area and production of horticultural crops for the period 1997-98 to 2009-10 and the two sub periods 1997-98 to 2003-04 and 2004-05 to 2009-10.[3] The growth rate of area under vegetables and fruits has been 1.48 per cent and 4.82 per cent respectively for the period as a whole. It appears that the growth rate of area decelerated a bit from 2005-06 onwards. Output of fruits in the state grew at an exponential rate of 6 per cent per annum during 1997-98 to 2009-10. The annual growth rate of output of vegetables in the state has been 2.83 per cent for this period.

TABLE 3. EXPONENTIAL GROWTH RATES OF AREA AND PRODUCTION OF FRUITS AND VEGETABLES IN WEST BENGAL

| | Area | | | Production | | |
|---|---|---|---|---|---|---|
| Crops | 1997-98 to | 2004-05 to | 1997-98 to | 1997-98 to | 2004-05 to | 1997-98 to |
| (1) | 2003-04 | 2009-10 | 2009-10 | 2003-04 | 2009-10 | 2009-10 |
| | (2) | (3) | (4) | (5) | (6) | (7) |
| Vegetables | 1.70 | 1.20 | 1.48 | 2.46 | 3.29 | 2.83 |
| Fruits | 5.00 | 4.61 | 4.82 | 5.75 | 6.30 | 6.00 |

*Source*: As in Table 2.

An idea about the extent of crop diversification at the state level can be formed by looking into the changes in area shares of various crops and horticulture to gross cropped area. It is observed from Table 4 that rice which is the main staple food of the state still continues to be the most important crop, commanding almost 70 per cent of the total cropped area in the state. However, the share of area under food grains as a whole came down from 84.13 per cent in 1980-81 to 77.53 per cent in 2009-10. Among the food grains, the area shares of the traditional varieties of rice like aus and aman as well as pulses have fallen drastically while that of boro rice

increased substantially. Among the non-food grains, the area shares of oilseeds, potatoes, fruits and vegetables increased over the period by varying degrees. Here we observe that fall in the area share of food grains and hence rise in the area share of non-food grains were sharper after 1995-96, which is the post-globalisation period. It also needs mention that the total area under fruits, vegetables and flowers in West Bengal has increased continuously during this period from 887.25 thousand hectares in 1997-98 to 1162.96 thousand hectares in 2009-10 registering a rise of 31 per cent.

TABLE 4. PERCENTAGE OF AREA UNDER DIFFERENT CROPS TO TOTAL CROPPED AREA IN WEST BENGAL

| Crops | 1980-81 | 1985-86 | 1990-91 | 1995-96 | 2000-01 | 2005-06 | 2009-10 |
|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Aus | 8.48 | 6.66 | 7.83 | 6.42 | 5.04 | 3.55 | 2.66 |
| Aman | 58.13 | 56.26 | 55.25 | 53.86 | 46.53 | 50.64 | 49.51 |
| Boro | 4.78 | 7.06 | 11.50 | 14.59 | 17.92 | 17.01 | 17.76 |
| Total rice | 71.39 | 69.98 | 74.58 | 74.87 | 69.48 | 71.20 | 69.92 |
| Wheat | 3.90 | 4.20 | 3.45 | 4.25 | 5.45 | 4.51 | 3.92 |
| Other cereals | 0.39 | 0.33 | 0.32 | 0.24 | 0.23 | 0.21 | 0.19 |
| Total cereals | 76.90 | 75.53 | 79.32 | 80.01 | 75.66 | 76.84 | 75.27 |
| Pulses | 7.23 | 5.80 | 4.03 | 2.67 | 3.51 | 2.74 | 2.27 |
| Food grains | 84.13 | 81.33 | 83.34 | 82.68 | 79.17 | 79.58 | 77.53 |
| Oilseeds | 4.38 | 5.11 | 6.58 | 6.24 | 7.65 | 7.92 | 8.47 |
| Potatoes | 1.59 | 1.91 | 2.50 | 3.22 | 3.83 | 4.36 | 4.81 |
| Jute | 8.42 | 10.07 | 6.42 | 6.49 | 7.84 | 6.88 | 7.63 |
| Sugarcane | 0.20 | 0.18 | 0.16 | 0.22 | 0.28 | 0.18 | 0.17 |
| Spices | 0.38 | 0.62 | 0.69 | 0.83 | 0.91 | 0.73 | N.A. |
| Fruits and vegetables | N.A. | N.A. | N.A. | N.A. | 11.07 | 11.73 | 12.62 |

*Source*: As in Table 2.

The above discussion clearly shows that there has been a change in the cropping pattern of West Bengal in favour of crops like boro rice, oilseeds and potatoes and more recently of vegetables and fruits. The crops losing ground were aus, aman and pulses within the food grains sector and to some extent sugar cane and jute among the non-food grains. Moreover, this change, though started from mid-1980s became sharp during second half of 1990s. After 2000-01 however, the pace of the change seems to have become rather slow and stagnant. This becomes clear when we look at the values of Herfindahl Index (HI), which is an inverse measure of the degree of diversification.

The extent of diversification in West Bengal seems to have increased over the years. This becomes clear when the HI values for the entire period considered. As shown in Table 5, the value of HI fell from 0.36 in 1980-81 to 0.30 in 2009-10. However, there have been differences in the pace of diversification between the sub-periods in that the pace of diversification got slackened after 2000-01, more specifically after 2007-08. In fact, the value of the HI has not changed much after 2007-08. This is true irrespective of inclusion/exclusion of horticultural crops for computation of HI values.

TABLE 5. HERFINDAHL INDEX OF DIVERSIFICATION OF THE CROP SECTOR IN WEST BENGAL

| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|
| Excluding horticultural crops | | | | | | | |
| 1980-81 | 1985-86 | 1990-91 | 1995-96 | 2000-01 | 2005-06 | 2007-08 | 2009-10 |
| 0.36 | 0.34 | 0.34 | 0.33 | 0.27 | 0.30 | 0.28 | 0.30 |
| Including horticultural crops | | | | | | | |
| | | 1997-98 | 2000-01 | 2002-03 | 2005-06 | 2007-08 | 2009-10 |
| | | 0.26 | 0.22 | 0.24 | 0.24 | 0.23 | 0.23 |

*Source*: As in Table 2.

A defining condition of agricultural diversification is that the resources are shifted out from less remunerative crops to more remunerative crops. This is expected to give rise to a strong and positive substitution effect for the incoming crops and negative substitution effect for the outgoing crops (De, 2003). The total change in the area under the individual crops during the entire period 1980-81 to 2009-10 and the two sub-periods has been split into expansion effect and substitution effect in the following way: First, area under any crop in the base period (1980-81) is subtracted from the gross cropped area in the final year (2009-10) and then multiplied by base year proportion of area under that crop to gross cropped area, that is $(a_o/A_o)$, $(A_t - a_o)$ where 'a' and 'A' represent area under an individual crop and gross cropped area respectively. The suffix o to t represent base and final years. The result here gives the expansion of area under the crop due to variation in gross cropped area only. Thereafter, this value is deducted from the total change in area $(a_t - a_o)$ under the crop, to give the substitution effect. The results obtained for the two sub-periods and the entire period are presented in Table 6.

It is observed that during our study period (1980-81 to 2009-10), a major change in area under the crops like boro, oilseeds and potatoes occurred due to substitution effect. As has been noted before, these are the crops which played a leading role in the process of cropping pattern change in West Bengal over the years. At the same time, for aus, aman and pulses, the substitution effect has been significantly negative and stronger than the expansion effect. For fruits and vegetables, however, we have a strong and positive substitution effect as well as a positive expansion effect.

The implication of the above finding is that the cropping pattern change in West Bengal took place in a diversified way with areas under some crops being mostly substituted with the new crops rather than being expanded. This is also evident from the fact that while the gross cropped area has expanded in the state in absolute terms, the net cropped area has actually fallen. Our computation shows that the annual growth rate for the gross cropped area in West Bengal during 1980-81 to 2009-10 was 0.73 per cent while the growth rate for the net cropped area was negative (- 0.16 per cent per annum).

TABLE 6. DECOMPOSITION OF CHANGES IN AREA UNDER INDIVIDUAL CROPS INTO EXPANSION EFFECT AND SUBSTITUTION EFFECT IN WEST BENGAL

*('000 ha)*

| | 1980-81 to 1994-95 | | | 1995-96 to 2009-10 | | | 1980-81 to 2009-10 | | |
|---|---|---|---|---|---|---|---|---|---|
| Crop | Expansion | Substitution | Total change | Expansion | Substitution | Total change | Expansion | Substitution | Total change |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Aus | 72.86 | -191.10 | -118.23 | 22.77 | -283.04 | -260.27 | 113.68 | -499.51 | -385.83 |
| Aman | 461.16 | -298.26 | 162.90 | 47.14 | 369.39 | 416.53 | 719.49 | -824.39 | -104.90 |
| Boro | 37.00 | 616.70 | 653.70 | 185.54 | -447.14 | -261.60 | 57.72 | 1112.31 | 1170.03 |
| Total rice | 571.02 | 127.35 | 698.37 | 255.46 | -360.82 | -105.37 | 890.88 | -211.58 | 679.30 |
| Wheat | 28.58 | 18.55 | 47.13 | 14.08 | -12.38 | -105.37 | 44.59 | 26.14 | 70.73 |
| Pulses | 50.64 | -243.91 | -193.27 | 10.29 | -57.56 | -47.27 | 79.01 | -340.64 | -261.63 |
| Oilseeds | 38.57 | 146.50 | 185.07 | 22.64 | 155.13 | 177.77 | 60.17 | 294.23 | 354.40 |
| Potatoes | 13.14 | 97.86 | 111.00 | 10.44 | 141.10 | 151.53 | 20.51 | 253.73 | 274.24 |
| Jute | 58.24 | -84.47 | -26.23 | 21.75 | 81.41 | 103.17 | 90.86 | -6.43 | 84.43 |
| Sugarcane | 2.56 | -13.26 | -10.70 | 0.55 | 2.85 | 3.40 | 4.00 | -10.70 | -6.70 |
| Spices | 3.10 | 30.80 | 33.90 | 2.75 | 18.29 | 21.03 | 4.84 | 51.66 | 56.50 |
| Tobacco | 1.84 | -6.11 | -4.27 | 0.55 | -0.35 | 0.20 | 2.87 | -6.40 | -3.53 |
| Fruits* | - | - | - | - | - | - | 2.98 | 73.80 | 76.78 |
| Vegetables* | - | - | - | - | - | - | 18.87 | 111.63 | 130.50 |

*Source*: As in Table 2

*Note*: *expansion and substitution effects for fruits and vegetables refer to the period 2000-01 to 2009-10.

## IV

## IMPACT OF CROP DIVERSIFICATION ON AGRICULTURAL PRODUCTION

In this section, we seek to understand the impact of observed crop diversification on agricultural production in West Bengal by undertaking a component analysis of the change in total agricultural production. It appears from Table 7 that during 1980-81 to 2009-10, almost 54 per cent of growth in agricultural output has been contributed by yield growth, followed by cropping pattern changes (18.73 per cent), and only 9.11 per cent of output growth has been due to acreage growth. The interaction effects together contributed only 18.17 per cent of total change in agricultural output of which contribution of yield-cropping pattern effects is the highest (8.06 per cent). Relative contribution of different components varied significantly between the two sub-periods. The area effect declined and yield effect increased substantially during the second sub-period (1995-96 to 2009-10) compared to the first sub-period (1980-81 to 1994-95). The cropping pattern effect also fell during the second sub-period compared to the first sub-period. Thus, the component analysis revealed that most of the increase in output has been brought about by the yield growth. Cropping pattern change is the second largest contributor to the growth of agricultural output. The positive value of the yield-cropping pattern interaction component is indicative of a shift of area in favour of crops with higher yield and higher prices, which are boro rice, potatoes and major oilseeds as evident from our earlier analysis.

TABLE 7. RELATIVE CONTRIBUTION OF VARIOUS COMPONENTS TO THE GROWTH OF TOTAL CROP OUTPUT IN WEST BENGAL

*(per cent)*

| Effects | 1980-81 to 2009-10 | 1980-81 to 1994-95 | 1995-96 to 2009-10 |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| Individual | | | |
| Area | 9.11 | 10.71 | 5.30 |
| Yield | 53.99 | 57.45 | 72.43 |
| Cropping pattern | 18.73 | 22.15 | 15.64 |
| Sub-total | 81.83 | 90.31 | 93.37 |
| Interaction | | | |
| Area and cropping pattern | 2.34 | 1.68 | 0.33 |
| Area and yield | 6.76 | 4.35 | 1.53 |
| Yield and cropping pattern | 8.06 | 3.40 | 4.66 |
| Area, yield and cropping pattern | 1.01 | 0.26 | 0.01 |
| Sub-total | 18.17 | 9.69 | 6.53 |
| Grand total | 100 | 100 | 100 |

*Source*: As in Table 2.

Table 8 provides information on the exponential growth rates of yields of the major crops in West Bengal. It is clear that the growth rates of yield of aus and aman were positive and relatively high followed by that of pulses throughout our study period. The growth rate of yield of food grains as a whole has also been quite impressive at 2.64 per cent per annum. Among the non-food grain crops, the growth

rates of yield of oilseeds and jute has been positive and high. The growth rate of yield of potatoes has been positive during the first sub-period, but turned negative during the second sub-period.

TABLE 8. EXPONENTIAL GROWTH RATES OF YIELD OF PRINCIPAL CROPS IN WEST BENGAL DURING 1980-81 TO 2009-10

| Crops | 1980-81 to 1994-95 | 1995-96 to 2009-10 | 1980-81 to 2009-10 |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| Aus | 4.79 | 1/39 | 3.09 |
| Aman | 3.53 | 1.60 | 2.57 |
| Boro | 1.36 | -0.22 | 0.57 |
| Total rice | 3.97 | 1.2 | 2.57 |
| Wheat | 0.46 | 0.93 | 0.7 |
| Total cereals | 3.74 | 1.21 | 2.48 |
| Pulses | 1.64 | 0.95 | 1.29 |
| Food grains | 3.79 | 1.49 | 2.64 |
| Oilseed | 3.34 | 0.69 | 2.02 |
| Jute | 2.7 | 1.26 | 1.98 |
| Sugarcane | 15.40 | 10.39 | 12.89 |
| Tobacco | -4.15 | 4.51 | 0.18 |
| Potatoes | 2.84 | -4.01 | -0.58 |

*Source*: Same as in Table 2.

We have computed the correlation coefficient between the yield of the crops and the Herfindahl Index to find out whether the yield growth of different crops helped the process of diversification. It is found that the correlation coefficient between yield of food grains and Herfindahl index is negative and very high (- 0.84) indicating that the extent of diversification has largely been determined by shifting plots of land out of the traditional crops like aus, aman and pulses whose yield increased substantially over the period 1980-81 to 2009-10 (as shown in Table 8) towards the non-food grain crops. At the same time, the correlation coefficient between yield of non-food grain crops and Herfindahl Index is also negative but not so high (- 0.51). This again indicates that the resources shifted out of food grains have been reallocated to the non-food grains in a diversified manner.

We also computed the correlation coefficient between the yield rates of the crops and the percentage of gross cropped area allocated to them. The correlation coefficients between the yield rates of aus, aman and pulses and the percentages of gross cropped area allocated to them are found to be negative while the correlation coefficients between the yield rates and percentages of cropped area allocated to boro rice and oilseeds are found to be positive.

Thus, it is more or less clear that the diversified nature of the crop mix in West Bengal is largely due to the fact that with an increase in the yield rate of food grains, resources have been shifted out of the traditional food grain crops as mentioned above to a number of non-food grain crops as well as to boro rice whose yield has also increased. Due to the rise in the yield rate of the traditional food grain crops, the farmers could satisfy their own consumption needs from smaller proportion of land

allocated to these crops and reallocate plots of land so released to more remunerative non-food grain crops.

Of course, this diversified nature of the crop mix might also be the consequence of the dominance of the small and marginal farmers in the state. The small and the marginal farmers due to their small resource base tend to mitigate risk by maintaining a diversified crop portfolio. They are unwilling to expose themselves to the market risk of rising food grain prices and hence tend to produce their own food baskets (Dorjee Kinlay *et al*., 2007).

In this context, we examine the structure of operational land holdings in West Bengal. As evident from Table 9, there has been a progressive marginalisation of the peasantry, especially since launching of the Operation Barga programme in the early 1980s. By 1990-91, the small and the marginal peasants (operating $\leq$ 2 hectares) accounted for 91.45 per cent of the total operational holdings of the state and operated about 66 per cent of the total area. This increasing trend towards marginalisation of holdings continued even after 1990-91. By the year 2005-06, the small and the marginal peasants together accounted for 96 per cent of all operational holdings and 80 per cent of total operated area. The average size of holdings also declined sharply, from 1.20 hectares in 1970-71 to 0.94 hectares in 1980-81, and further to 0.79 hectares in 2005-06. This is presumably the most salient feature of the West Bengal agrarian economy which primarily offers in the context for diversification.

In the literature, it has been stated that it is the small and marginal farmers who show the greatest impulse and tendency to diversify their crop-mix in order to mitigate risks. Some studies have produced empirical evidence in support of such a contention. In West Bengal also it seems that the dominant factor behind diversification has been the predominance of the small and marginal farmers. To have a better understanding of their roles in hastening the pace of diversification, we presented information on the cropping pattern and the diversification index for different size classes of farmers for the years 1985-86, 1990-91 and 2000-01 in Table 10.[4] We found that the Herfindahl Index varies inversely with the farm size, confirming that the smaller the size of holdings, higher is degree of the diversification. The per cent of gross cropped area allocated to vegetables is also higher for the marginal and the small farmers compared to their larger counterparts. Moreover, between 1985-86 and 2000-01, the percentage of gross cropped area under vegetables increased substantially for the marginal and the small farmers. The table also show that the share of food grain crops, especially rice, in the gross cropped area is also high on the marginal and small farms. This indicates that the marginal and small farmers optimise their cropping pattern in a way that enables them to obtain higher income without adversely affecting their food security. Such a view is corroborated by Birthal *et al*. (2008).

TABLE 9. PERCENTAGE DISTRIBUTION OF OPERATIONAL HOLDINGS AND OPERATED AREA ACCORDING TO SIZE CLASSES IN WEST BENGAL

| | 1980-81 | | 1985-86 | | 1990-91 | | 1995-96 | | 2000-01 | | 2005-06 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Size classes (ha) | No. | Op-area | No. | Op.area | No. | Op.area | No. | Op.area | No. | Op.area | No. | Op.area |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) |
| Marginal (below 1.0) | 69.7 | 29.2 | 71.0 | 32.3 | 73.8 | 36.5 | 76.4 | 42.9 | 80.4 | 49.7 | 81.2 | 50.7 |
| Small (1.0 – 2.0) | 19.6 | 31.2 | 19.1 | 31.1 | 17.6 | 30.0 | 16.8 | 29.1 | 14.9 | 29.0 | 14.4 | 28.9 |
| Semi-medium (2.0 – 4.0) | 8.8 | 25.3 | 8.4 | 24.5 | 7.3 | 22.4 | 5.8 | 18.7 | 4.2 | 14.1 | 4.0 | 14.0 |
| Medium (4.0 – 10.0) | 1.9 | 10.7 | 1.5 | 8.6 | 1.3 | 7.5 | 0.9 | 5.7 | 0.5 | 3.2 | 0.4 | 2.5 |
| Large (10.0 and above) | 0.0 | 3.7 | 0.0 | 3.6 | 0.0 | 3.6 | 0.0 | 3.6 | 0.0 | 4.0 | 0.0 | 4.0 |
| Average size (ha) | 0.94 | | 0.92 | | 0.90 | | 0.85 | | 0.82 | | 0.79 | |

*Source*: Agricultural Census (various years), Directorate of Agriculture, Government of West Bengal.

TABLE 10. CROPPING PATTERN AND HERFINDAHL INDEX VALUES FOR DIFFERENT FARM SIZES IN WEST BENGAL

| Farm size | Per cent of gross cropped area under | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cereals | Rice (total) | Pulses | Oilseeds | Jute | Potatoes | Fruits | Vegetables | Spices | Tea | HI-value |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| | | | | | 1985-86 | | | | | | |
| Marginal (≤ 1 ha) | 70.00 | 65.26 | 4.92 | 4.31 | 7.66 | 5.77 | 0.75 | 2.20 | 0.70 | - | 0.44 |
| Small (1–2 ha) | 74.00 | 69.38 | 4.59 | 4.27 | 7.58 | 5.03 | 0.46 | 1.34 | 0.48 | - | 0.49 |
| Semi medium (2–4 ha) | 76.00 | 71.90 | 3.86 | 4.19 | 7.13 | 4.04 | 0.75 | 1.13 | 0.66 | - | 0.53 |
| Medium (4–10 ha) | 78.00 | 73.14 | 4.13 | 4.30 | 6.05 | 3.44 | 1.07 | 0.85 | 0.84 | - | 0.54 |
| Large (≥ 10 ha) | 97.00 | 96.59 | 0.05 | 0.42 | 0.25 | 0.35 | 1.01 | 0.07 | 0.35 | - | 0.93 |
| All sizes | 74.00 | 69.31 | 4.42 | 4.21 | 7.26 | 4.84 | 0.69 | 1.52 | 0.63 | - | 0.49 |
| | | | | | 1990-91 | | | | | | |
| Marginal (≤ 1 ha) | 66.69 | 71.68 | 2.75 | 5.57 | 7.44 | 5.17 | 0.45 | 1.97 | 0.81 | - | 0.46 |
| Small (1–2 ha) | 67.69 | 72.85 | 2.68 | 5.62 | 7.00 | 5.37 | 0.40 | 1.19 | 0.59 | - | 0.47 |
| Semi medium (2–4 ha) | 70.47 | 75.35 | 2.72 | 5.55 | 6.37 | 3.80 | 0.60 | 1.07 | 0.69 | - | 0.51 |
| Medium (4–10 ha) | 72.20 | 76.87 | 2.07 | 5.59 | 5.65 | 2.78 | 0.86 | 0.89 | 0.68 | - | 0.53 |
| Large (≥ 10 ha) | 7.44 | 6.69 | 0.19 | 0.86 | 0.61 | 0.47 | 0.10 | 0.19 | 0.04 | 0.88 | 0.77 |
| All sizes | 72.20 | 67.26 | 2.64 | 5.51 | 6.89 | 4.73 | 0.49 | 1.46 | 0.69 | - | 0.46 |
| | | | | | 2000-01 | | | | | | |
| Marginal (≤ 1 ha) | 67.98 | 63.28 | 1.36 | 5.27 | 9.82 | 5.14 | 0.35 | 8.64 | 0.57 | - | 0.42 |
| Small (1–2 ha) | 72.12 | 68.61 | 1.58 | 5.92 | 9.56 | 5.10 | 0.44 | 4.12 | 0.43 | - | 0.49 |
| Semi medium (2–4 ha) | 76.55 | 73.65 | 1.29 | 5.99 | 8.04 | 5.25 | 0.44 | 1.21 | 0.37 | - | 0.56 |
| Medium (4–10 ha) | 79.12 | 77.01 | 0.85 | 5.21 | 6.78 | 4.74 | 1.19 | 0.79 | 0.34 | - | 0.60 |
| Large (≥ 10 ha) | 7.09 | 7.03 | 0.05 | 0.25 | 0.17 | 0.26 | 0.10 | 0.01 | 0.00 | 0.88 | 0.78 |
| All sizes | 69.66 | 65.68 | 1.38 | 5.47 | 9.28 | 5.06 | 0.41 | 6.02 | 0.49 | - | 0.45 |

*Source*: As in Table 10.

It thus appears that the small and the marginal farmers provided the greatest impetus towards the process of diversification in West Bengal agriculture, given that the other demand and supply side factors played their respective roles. Among the demand side factors, it can be stated that the per capita income and the per cent of total population residing in urban areas is continuously on the rise during the last three decades in West Bengal. The per capita income at 1993-94 prices was Rs. 4949.71 in 1980-81 and increased to Rs. 15368.78 in 2009-10. The percentage of population living in urban areas was only 26.47 in 1981, but increased to 31.89 in 2011.

Among the supply side factors we may consider the technological factors like irrigation and consumption of fertilisers. Rise in the yield level of the crops is facilitated, among others, by expansion of the irrigated area and increased fertilisers consumption. Both the net and gross cropped areas irrigated in the state increased over the years. Along with it, the consumption of fertilisers per hectare of gross cropped area has also gone up. These two factors did help largely in bringing about an increase in the yield level of the food crops and some of the non-food grain crops, thus spurring diversification. The association between the technological factors like proportion of gross cropped area irrigated, fertiliser consumption per hectare and the extent of diversification in the state becomes clear when we refer to Figure 1.

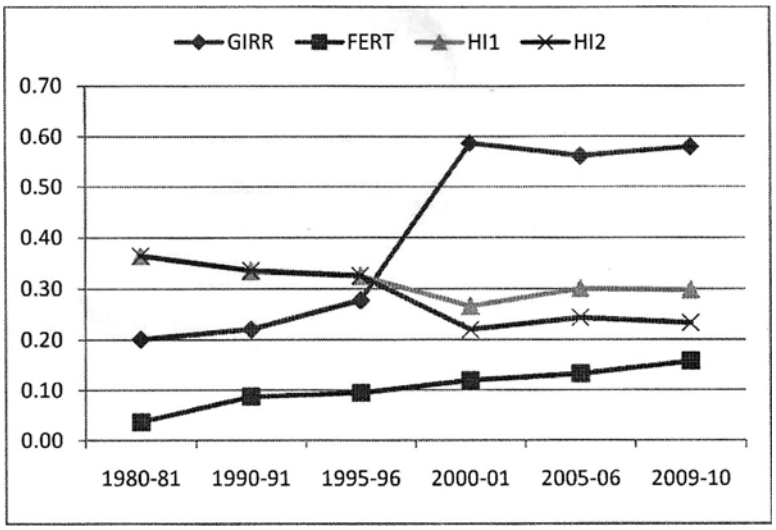


Figure 1. Relation between HI and GIRR and FERT.

The above diagram shows the trend in the growth of the proportion of gross cropped area irrigated (GIRR)[5] over time, consumption of fertilisers per hectare of gross cropped area (FERT) and Herfindahl Index without horticultural crops (HI1) as well as Herfindahl index including horticultural crops (HI2), measured along the

vertical axis, over the years spanning 1980-81 to 2009-10 measured along the horizontal axis. There has been a secular rise in the consumption of fertilisers per hectare of the gross cropped area. The proportion of gross cropped area irrigated increased most sharply during the period 1995-96 to 2000-2001 and fell during 2000-01 to 2005-06. The HI shows an almost matching downward trend as that of the proportion of gross cropped area irrigated till 2005-06. The proportion of gross cropped area irrigated was maximum in 2000-01 and the lowest value of HI1 as well as HI2 (meaning maximum diversification) occurred also in 2000-01. Thereafter, as the proportion of gross cropped area irrigated fell during the period 2000-01 to 2005-06, the HI increased, meaning that the diversification has been slower. After 2005-06, the proportion of gross cropped area irrigated started to rise again but only very moderately. During this period there has been no change in the value of the HI1. However, the value of HI2 which includes areas under vegetables and fruits has fallen, indicating that during this period whatever diversification took place in the state was in favour of high value horticultural crops. It seems that the moderate increase in the gross cropped area irrigated during 2005-06 to 2009-10 has been used to diversify areas towards the cultivation of more vegetables and fruits.

## VI

## SUMMARY AND CONCLUSION

From the above analysis, it is clear that crop diversification in West Bengal has taken place largely in favour of boro rice, potatoes and oilseeds. Since late 1990s, the horticultural crops like vegetables and fruits also started gaining ground. The diversification seems to have taken place in favour of high value crops or the crops which seem to provide higher relative return to the cultivators. The spur in the pace and extent of diversification in West Bengal seems to have taken place during 1995-96 to 2000-01, i.e., in the post-globalisation period. It seems that the higher level of demand for high value crops as well as higher cash requirements of the farmers to satisfy their family needs led to this higher diversification. But higher diversification also requires better infrastructure and technological support, especially increase in irrigation facilities. The growth in the area under above-mentioned crops originated from the expansion of area under irrigation. Crops like boro rice and potatoes are highly dependant on irrigation, as they are grown in off-monsoon seasons. However, the process of diversification suffered a setback after 2000-01, more specifically from 2005-06 onwards mainly due to lackadaisical expansion of irrigation facilities.

It has been established in our discussion that for the growth of the new commercial crops like boro rice, oilseeds and potatoes, the substitution effect played a major role, indicating a shifting of resources from the less remunerative crops to more remunerative crops. Once the limit to the potential of increasing diversification through expansion of area under the above-mentioned crops which are subject to scale economies is reached, diversification towards horticulture started. This is

mainly because the state agriculture is dominated by the small and marginal farmers and it suits the small and marginal farmers to maintain a diversified crop mix, with a larger share of vegetables in the gross cropped area. The cultivation of vegetables is possible with minor irrigation. Thus, the majority of small and marginal farmers using benefits of modern technology, subsidised fertilisers, improved variety of seeds, and most of all availability of water through minor irrigation schemes played a leading role in diversification of agriculture in West Bengal.

It also appears from our study that agricultural growth in West Bengal in general varied positively with the level of crop diversification. The small and the marginal farmers who are risk-averters started allocating plots of land to non-food grains as well as food grains crops in order to mitigate risk. They could maintain a diversified portfolio of crops because of an increase in the yield level of the food grains as well as non-food grains. An almost secular increase in the yield level of most of the crops was again possible due to expansion of irrigation, among other things. The deceleration in the growth rate of agriculture in the decade of 2000s was coupled with a rise in the value of the Herfindahl index, indicating a fall in the level of diversification. This coincides with fall in the gross cropped area under irrigation.

In conclusion, we can say that the cropping pattern change in West Bengal has indeed been an emerging reality which is reflected through adoption of a diversified crop-mix by the farmers. This diversified crop-mix may be attributed to the predominance of the small and marginal farmers who, in order to mitigate risk, spread out their cultivated area among a number of non-food grain crops including vegetables but, at the same time, do not trade with their food security. They prefer to grow food crops to meet their food requirements after which they go in for cultivation of cash-earning commercial crops. It seems that diversion towards the non-food crops becomes possible when yield levels of the food crops. It seems that diversion towards the non-food crops becomes possible when yield levels of the food crops and some non-food crops improve following expansion of irrigation facilities, especially minor irrigation.

Thus, it remains a major responsibility of the government to allocate larger funds for the expansion of the irrigation schemes as well as ensuring easy access to credit for installing minor irrigation capacities by the marginal and small farmers who lack in their own resources. Institutional measures such as the ‘barga operation’ in the past led to the swelling of the rank of small and marginal operators. However, the spread of technology and infrastructure development still remains a major requirement of the day. Institutional reforms coupled with technological change will induce the marginal farmers to realise the benefits of higher diversification and raise their income levels further.

*Received June 2013.* *Accepted March 2014.*

## NOTES

1. This becomes clear from visual inspection of the series for production of various crops.

2. Herfindahl Index (HI) is computed as $HI = \sum_{i=1}^{n} p_i^2$ where $p_i = A_i / \sum_{i=1}^{n} A_i$, $p_i$ is the proportion of area under i-th crop and $A_i$ is the actual under i-th crop. The index is defined as a sum of squares of all 'n' proportions and is a measure of concentration. When the value of HI falls, it indicated rising diversification and vice-versa. This measure of diversification was used by Sharma (2005) and Chand *et al.* (2008).

3. The growth rate of horticultural crops like vegetables and fruits have been divided into two sub-periods as the value of HI did not change much after 2005-06. It has become clear from our analysis that whatever little change in HI took place after 2005-06 was due to increased area under fruits and vegetables which again resulted mainly due to shifting of area from other crops.

4. Data on these are not available beyond 2000-01.

5. The data for the gross cropped area irrigated in West Bengal is collected from Central Water Commission, Ministry of Agriculture, Government of India.

## REFERENCES

Birthal, P.S., P.K. Joshi, Devesh Roy and Amit Thorat (2007), *Diversification in Indian Agriculture Towards High Value Crops: The Role of Small Holders*, IFPRI Discussion Paper # 00727, November, International Food Policy Research Institute, Washington D.C., U.S.A.

Birthal, P.S., P.K. Joshi, Sonia Chauhan and Harvinder Singh (2008), "Can Horticulture Revitalise Agricultural Growth?", *Indian Journal of Agricultural Economics*, Vol.63, No.3, July-September, pp.310-321.

Chand, Ramesh, S.S. Raju and L.M. Pandey (2008), "Progress and Potential of Horticulture in India", *Indian Journal of Agricultural Economics*, Vol.63, No.3, July-September, pp.299-309.

De, U.K. (2003), *Economics of Crop Diversification*, Akansha Publishing House, New Delhi.

Dorjee Kinlay, Sumiter Broca and Prabhu Pingali (2007), "Diversification in South Asian Agriculture: Trends and Constraints", in P.K. Joshi, Ashok Gulati and Cummings Jr. (2007) (Eds.), *Agricultural Diversification and Smallholders in South Asia*, Academic Foundation, New Delhi.

Dhindsa, K.S. and A. Sharma (1995), "Analysis of Cropping Pattern Changes in Punjab During 1965-66 to 1990-91", *Indian Economic Review*, Vol.30, No.1, January-June, pp.69-87.

Joshi, P.K., Ashok Gulati and P.S. Birthal (2007), "Agricultural Diversification in India: Status, Nature and Pattern in India", in P.K. Joshi, Ashok Gulati and Cummings Jr. (2007) (Eds.), *Agricultural Diversification and Smallholders in South Asia*, Academic Foundation, New Delhi.

Minhas, B.S. and A. Vaidyanathan (1965), "Growth of Crop Output in India, 1951-54 to 1958-61: An Analysis by Component Elements", *Journal of the Indian Society of Agricultural Statistics*, Vol. 17, No. 2, pp. 230-252.

Parikh, Ashok (1966), "Analysis of Growth Components and Methods of Constructing the Index Number of Agricultural Production under Constant Cropping Pattern", *Indian Journal of Agricultural Economics*, Vol.21, No.3, July-September, pp. 41-47.

Sharma, H.R. (2005), "Agricultural Development and Crop Diversification in Himachal Pradesh: Understanding the Patterns, Processes, Determinants and Lessons", *Indian Journal of Agricultural Economics*, Vol. 60, No. 1, January-March, pp.71-93.

Vyas, V.S. (1996), "Diversification in Agriculture: Concept, Rationale and Approaches", *Indian Journal of Agricultural Economics*, Vol. 51, No.4, October-December, pp.636-643.