Chapter -VI

Crop Diversification in the Districts of West Bengal: Empirical Evidences and Disaggregated Analysis

6.1 Introduction

Diversity is a phenomenon induced by the appropriate stimuli such as physical infrastructure, human capital, and institutional factors, etc., for the nutrient-rich foods and crops. The term 'diversification' has been derived from the word 'diverge' meaning 'to move or extend' to the direction different from a common point (Jha, Kumar and Mohanty, 2000). Agricultural diversification can well be explained in terms of the shift from the regional dominance of one crop towards the production of a large number of crops to meet the increasing demand of those crops. Diversification can also be conceived as the economic development of non agricultural activities (Start, 2001). The process of diversification can be typified as horizontal and vertical diversification. Horizontal diversification is that form wherein farmers diversify their agricultural activities either to stabilize or increase their income or both. It can either take the form of shift from subsistence farming to commercial farming or the shift from low value food crops to high value crops. Vertical Diversification refers to the farmers' access to non-farm income, i.e., the income from non agricultural sources (Haque, 1996).

Diversification, as a first step in the process, would encourage farmers to go into production of high value crops other than traditional ones. In a competitive economy and a favourable economic environment, farmers may be able to determine the crops that can be efficiently produced, allow them to gain profit and achieve a competitive advantage. The growth of agricultural output depends largely on the growth in productivity and the growth in area. In common parlance, productivity is defined as the ratio of production to area; the productivity factor thus incorporates both pure yield effect and the effects of changes in cropping pattern such as a shift from low-yield to high yield crop. The area effect includes changes in net sown area and cropping intensity (ratio of gross cropped area and net sown area).

Agricultural diversification in Asia and the Pacific has basically occurred in two important ways:

i) As a response to the changing demand structure for agricultural products;

ii) As a result of policies designed to achieve certain specific objectives.

Thus, agricultural diversification has been perceived as a strategy that augments growth, stabilizes farm income especially of the small and marginal farmers, generates full employment and attains the goal of food security. There is substantial evidence on crop area shifts from coarse cereals and pulses to rice, wheat, sugarcane and oilseeds during the seventies and eighties and in the subsequent period from crop sector to high value fruits vegetables crops, forestry, livestock and fishery activities (Sawant and Achuthan, 1995; Chand, 1996; Vyas, 1996; Pandey and Sharma, 1996; Saleth, 1999; Joshi, Gulati, Birthal and Tiwari,2004). While area changes within the cropping sector are stated to have induced by favourable price structure, adoption of high yielding varieties, changes in technology, a move towards horticultural crops and allied activities received impetus by liberal external trade policies under the structural adjustment programme.

Cropping pattern connotes spatio-temporal sequence of crops or proportion of area under different crops at a point of time. Crop Diversification or a change in cropping pattern signifies a change in the proportion of area under different crops. To realise sustained growth in agricultural output four important inter-related factors may be considered: institutional changes in the agrarian sector, rise in cropping intensity of land, switching over from low priced crops with low productivity to more productive and remunerative crops and techno-biological improvements. Among institutional factors equitable distribution of lands and pro-peasant tenurial arrangements, access to credit and other inputs may enhance agricultural production and productivity. However, to achieve sustained agricultural growth along with institutional changes, techniques of cultivation need to be improved. In a situation of constrains in cultivable land, increase in cropping intensity may enhance the agricultural production. The existing discourse suggests that cropping pattern gets influenced by various agro-climatic, technical and institutional factors (Vaidyanathan, 1992). Various price and non-price factors are identified in various studies which influence cropping pattern. Narain (1965), Boyce (1987), Chand (1995), Narayanmoorthy (1997), Sing *et al.*, (1997), Bhalla and Singh (1997), Ashok and Bulsubramania (2006) are few among many who examined the role of infrastructural factors like irrigation, road, market, institutions, technology etc., to bring in changes in the cropping pattern in different parts of India. Narain (1965), Sarkar (1988), Nayyar and Sen (1994), Vyas (1996) observed that changes in the relative prices do have considerable impact on cropping pattern. Chand and Chauhan (2002) considered land holdings of small and marginal farmers which did have considerable impact on crop diversification in India.

Lathar *et al.*, (1996) by conducting a study on Sonpet district of Haryana for the year 1993-94 observed the possibility of raising the income of marginal and small farmers through crop diversification. The study revealed that the adoption of new technology has a positive impact on both income and employment. However, input supply system, marketing system and research and extension programmes need to be upgraded to reap the benefit of advanced production technique. Sharma *et al.*, (1996) studied the growth in production of different crops in Rajasthan from 1960-61 to 1993-94. The study shows that oilseeds production has increased and increased in both area and productivity. There is also an increase in gross cropped area (GCA) for wheat but a decline in GCA has been observed for bajra, jowar and barley. Cropping pattern becomes more favourable for remunerative crops. Shyani and Panda (1998) in their study on Gujarat viewed that the farmers are gradually moving from subsistence crops to the commercial crops. Higher growth rate in acreage was observed for tur, castor Rapeseeds and mustard, sugarcane, maize and wheat and negative growth rate in acreage was observed for millet, jowar and cotton in different agro climatic zones of Gujrat. Ajjan and Selvaraj (1996) while analysing the impact of crop diversification among small tea growers in the Nilgiri district of Tamil Nadu argued that the area under potato registered a negative growth and area under tea experienced a positive growth. According to them, the return from tea stood at higher level in comparison to potato.

Increase in agricultural production through expansion of land area put to agriculture use is almost impossible in most of the states and West Bengal is no exception because of population growth, imbalanced land-man ratio and increasing demand for land for non-agricultural uses. Therefore, increase in agricultural output through more productive use of existing cultivable land seems to be more viable option (Ghosh 2011, Ghosh & Kuri 2005), Pingali *et al.*, (1997) and Joshi *et al.*, (2007) argued crop diversification helps the small and marginal farmers to improve their economic condition. In a situation of continuous shrinkage in land holding size and reduction in profitability, large farmers are in position to continue with rice since they can bear the rising cost of cultivation with input packages but small holders are unable to depend solely on rice and go for crop diversification as they can use family labour to their vantage point. However, flexibility of crop diversification for small and marginal farmers gets hindered by lack of irrigation facilities, market access and other infrastructural support etc.

It may be argued that the small and marginal famers (major constituent of faming community in West Bengal) should not only try to produce maximum output of a particular crop but also

go for crop diversification on a given plot of land because cultivation of cereals fulfils the consumption requirement but switching over to high value crops may provide stable employment and income to a large segment of the rural households who experience problem of seasonal unemployment and low income opportunities outside agriculture (De and Chattopadhyay, 2010). Since agriculture in West Bengal is largely dominated by the small and marginal farmers, crop diversification may prove to be a viable option and therefore it deserves special attention and empirical verification.

An attempt has been made here to understand the movement and spread of crop diversification in the districts of West Bengal using time series disaggregated data available in successive volumes of West Bengal Economic Review, published by Bureau of Applied Economics and Statistics, Government of West Bengal and District Statistical Handbook for the period 1970-71 to 2008-09 covering pre-reform, reform and post reform period respectively. Attempt has been made to provide a picture of nature and extent of crop diversification in West Bengal, and to examine the link between several typologies of diversification and agricultural growth over the past few decades and to analyse the relative importance of diversification process in affecting the growth of agricultural output and to test whether crop diversification has been growth inducive or depressive. The status and prospects of crop diversification is achieved by analysing the trend in cropping pattern as well as changes in land use pattern, cropping intensity, area share of major crops under cultivation, shift in crop area and by pattern of growth of agricultural productivity has also been attempted. For estimation of crop diversification, a good number of methods exists denoting specialization or diversification over a particular time period. Each method has its limitation or comparative advantage over the others in terms of empirical parameters. For the present purpose, Simpson Diversity Index (SI) along with Herfindahl Index (HI) has been used in this chapter to explore the nature and extent of crop diversification. Herfindahl index is the index of crop concentration and higher value of it indicates crop specialisation. Therefore, to obtain the index of diversification, it is subtracted from one, which is simplified form of Simpson index of diversification.

6.2 The Dynamics of Change in Cropping Pattern in West Bengal

The nature and direction of cropping pattern changes have been assessed here for nine major crops namely rice, wheat, pulses, other cereals, potato, jute, sugarcane, Rapeseeds and mustard, linseeds and other oilseeds under foodgrain and non-foodgrain items. These crops occupy more than eighty percent of the total area in almost all major districts of West Bengal.

The exercise is carried out in relative terms based on ten year averages of gross cropped area and total cropped area in all the districts of West Bengal from 1970-71 to 2008-09. Changes in crop area are evident during the seventies and early eighties representing post Green Revolution situation when area under wheat and rice expanded phenomenally in absolute and relative terms. The period from mid-eighties is characterized by policy changes on oilseed crops under technology mission programme and hence expansion of area under several oilseeds was undertaken. Finally, the period starting from the early nineties holds importance in terms of implementation of major trade liberalization policies.

The change in the typologies of diversification across districts of West Bengal gets reflected at the economy level through changes in the composition of crop contribution to gross cropped area. Despite existence of diverse agro-climatic scenario, foodgrains dominate the crop sector, amongst which rice and wheat are the prominent crops (Table 6.1). Over a period of time, the area under these crops has been consistent especially for rice and wheat, and at present, these crops cover more than one-third of the gross cropped area (GCA) in West Bengal. However, there has been a declining trend in the share of area under other foodgrains. This is primarily due to reduction in area under other cereals and pulses; although, one can observe different patterns across districts of West Bengal.

Table 6.1: Area under Different Crops (in 000 ha) in West Bengal (1970-71 to 2008-09)

Crop/Year	1970-71	1980-81	1990-91	2000-2001	2008-09
Aus	799.2	615.1	610.3	394	292.4
Aman	3969.9	4214.6	4306.5	3639.5	4086.6
Boro	186.5	346.5	896.1	1401.8	1556.7
Wheat	360.2	283	269.1	426	307
Pulses	669.5	524.3	314	274.5	184
Other Cereals	138.2	115.3	99.8	57.1	110
Potato	65.1	115.6	108.4	206.2	284
Jute	407.1	610.4	504.3	426.5	641.6
Sugarcane	38.3	14.3	29.3	15.1	25.8
Rapeseeds & Mustard	108.2	131.1	378.1	436	412.5
Linseed+Other Oilseeds	59.9	186.3	135.1	162.6	291.2
Total Cropped Area	**6802.1**	**7156.5**	**7651**	**7439.3**	**8191.8**
Gross Cropped Area	8785.2	9088.4	8662.3	9116.6	9801.5

Source: *Various issues of West Bengal Economic Review, Government of West Bengal.*

6.2.1 Changes in Cropping Pattern

There has been a significant change in the cropping pattern as well as in the relative area share of various crops in the gross value of crop area in the past few decades. During the 39 years from 1970-71 to 2008-09, the process of cropping pattern changes was slow and

halting. Rice and wheat, which accounted for more than 75 per cent of the total cropped area in 1970-71, still claimed 75 per cent of area during 2008-09. Again, the share of food-grains in the total cropped area also came down only marginally during this period. In West Bengal, whereas the area under high yielding jute and potatoes as percentage to total cropped area increased during 1970-71 to 2008-09, area under coarse cereals and pulses recorded a sharp decline (Table 6.2 and 6.3).

Table 6.2: Cropping Pattern Changes (Cropwise Area as Percentage of Total Cropped Area) in West Bengal (1970-71 to 2008-09)

Crop/Year	1970-71	1980-81	1990-91	2000-2001	2008-09
Aus	11.75	8.59	7.98	5.30	3.57
Aman	58.36	58.89	56.29	48.92	49.89
Boro	2.74	4.84	11.71	18.84	19.00
Wheat	5.30	3.95	3.52	5.73	3.75
Pulses	9.84	7.33	4.10	3.69	2.25
Other Cereals	2.03	1.61	1.30	0.77	1.34
Potato	0.96	1.62	1.42	2.77	3.47
Jute	5.98	8.53	6.59	5.73	7.83
Sugarcane	0.56	0.20	0.38	0.20	0.31
Rapeseeds & Mustard	1.59	1.83	4.94	5.86	5.04
Linseed+Other Oilseeds	0.88	2.60	1.77	2.19	3.55
Total Cropped Area	100.00	100.00	100.00	100.00	100.00

Source: *Calculated from the data collected from various issues of West Bengal Economic Review, Government of West Bengal.*

Table 6.3 presents relative areas (as percentage of gross cropped area) of crops in West Bengal from 1970-71 to 2008-09. It shows that the area share of principal crops has changed in response to both shift in area under competing crops or alternating crops as well as to fresh areas brought under cultivation. In both the cases, significant changes are observed in the nature and direction of crop pattern shifts. For rice as a whole, except boro rice, the relative share of area under gross cropped area reduced significantly for aus and amon rice. The introduction of boro rice (high yielding rice variety), and expansion of area under it was largely influenced by spread of minor irrigation and the greater availability of rural credit. This played a major role in increasing rice production and productivity in West Bengal. There was significant shift of cultivated area away from aus towards boro, although aman remains the most important rice crop, accounting for more than 60 per cent of rice production.

Compared to rice, wheat and pulses witnessed a fall in area. The area under wheat as percentage of gross cropped area reduced from 4.10 percent in the early seventies to 3.13 percent in 2008-09 and for pulses, it declined from 7.62 to 1.88 percent during the same period (Table 6.3).The most striking pattern in these results is that non food-grain items such as potatoes, jute and oilseeds have emerged as the most important source of growth in crop

sector despite their limited share in gross cropped area. The growing importance of non food-grain items is a result of increasing demand for these commodities in the domestic markets and their growing exports, supported by the development of roads, markets and processing to link their production with consumption (Joshi *et al.*, 2004). Though the contribution of non food items like jute, Rapeseeds and mustard and potatoes increased marginally during the 1970-71 to 2008-09, that of sugarcane and other cereals decreased.

Table 6.3: Cropping Pattern Changes (Cropwise Area as percentage of Gross Cropped Area) in West Bengal (1970-71 to 2008-09)

Crop/Year	1970-71	1980-81	1990-91	2000-2001	2008-09
Aus	9.10	6.77	7.05	4.32	2.98
Aman	45.19	46.37	49.72	39.92	41.69
Boro	2.12	3.81	10.34	15.38	15.88
Wheat	4.10	3.11	3.11	4.67	3.13
Pulses	7.62	5.77	3.62	3.01	1.88
Other Cereals	1.57	1.27	1.15	0.63	1.12
Potato	0.74	1.27	1.25	2.26	2.90
Jute	4.63	6.72	5.82	4.68	6.55
Sugarcane	0.44	0.16	0.34	0.17	0.26
Rapeseeds & Mustard	1.23	1.44	4.36	4.78	4.21
Linseed+Other Oilseeds	0.68	2.05	1.56	1.78	2.97
Total Cropped Area	9.10	6.77	7.05	4.32	2.98

Source: *Calculated from the data collected from various issues of West Bengal Economic Review, Government of West Bengal.*

Another important trend is the rising contribution of oilseeds and growing share of wheat during the decade of the nineties. The large contribution of Rapeseeds and mustard in crop income growth during the 1990s was due to the 'Technology Mission on Oilseeds', a programme launched in 1986 to stimulate production, reduce imports of oilseeds and achieve self-sufficiency in edible oils. To achieve these objectives the programme emphasised on improving oilseeds production technology, expanding the cultivated area under oilseeds and providing price support to the cultivators. The area planted under oilseeds (mainly Rapeseeds- mustard), had increased from 1.44 to 4.36 percent during 1980-81 to 1990-91.

6.2.2 Cropping Intensity

Cropping intensity is conventionally defined as the ratio (expressed as a percentage) of gross cropped area (GCA) to net sown area (NSA). [1] It measures the extent of land utilization by taking into account the area used for cultivation for more than once. The change in cropping intensity reflects the sensitivity of agricultural activities to socio-economic, agro-biological condition and climatic aberration from time to time. The level of cropping intensity is determined by several factors. The most important factor is the availability of water from

natural rainfall and man made irrigation system. However, the scope for year round cropping activities in most districts of West Bengal is often constrained by the seasonal distribution of rainfall. So long as this natural constraint is arrested, by means of irrigation facilities, the level of multiple cropping improves. However, it is futile to expect one to one correspondence between irrigation and cropping intensity. There are other crucial factors that could also significantly determine the level of cropping intensities such as farm size or operational holding, availability of surplus labour, machinery goods like tractors etc.

Table 6.4: Districtwise Cropping Intensity (1970-71 to 2008-09)

Dist/Year	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2008-09
Burdwan	162	166	171	178	189	191	165	164	175
Birbhum	144	157	143	143	152	156	136	147	159
Bankura	139	148	149	154	151	150	145	135	198
Midnapore	150	165	167	165	161	166	164	149	213
Howrah	203	184	204	234	212	206	190	175	168
Hoogly	163	180	185	198	206	209	198	214	227
24 Parganas	291	308	311	332	348	357	340	131	136
Nadia	230	236	242	251	243	249	242	204	200
Murshidabad	183	190	195	196	206	210	192	208	205
West Dinajpur	161	159	165	164	335	342	340	157	303
Malda	192	163	152	153	153	156	206	168	170
Jalpaiguri	136	144	146	150	153	153	167	131	130
Darjeeling	125	119	113	123	126	117	136	79	86
Cooch Behar	184	191	201	202	201	203	192	180	192
Purulia	106	109	104	109	102	110	104	98	105
West Bengal	159	164	165	169	171	174	168	184	185

Source: *Calculated from the data collected from various issues of West Bengal Economic Review and District Statistical Handbook, Government of West Bengal.*

Cropping intensity is used to be high when farmers on an average grow two seasonal crops a year, undertake multiple cropping or grow several crops in a year. It is low when farmers on an average grow less than two seasonal crops a year and also when they devote areas to annual crops (Table 6.4). The cropping intensity (GCA/NSA) is highest in West Dinajpur (303) followed by 24parganas (292), Nadia (230) and Howrah (203) in 1970-71.This result is opposite from the popular impression that irrigation is the only attribute that is capable of cultivating more than one crop a year. If we take a look at the area irrigated by government canals in these districts, they are at a distance far away from taking the advantages of development of irrigational facilities. On the contrary, the districts like Burdwan, Birbhum, Bankura and Midnapore were well ahead in those days in terms of irrigational facilities but still stood unfavourably against those of Malda, Cooch Behar where percentage of government canals are insignificant. Thus, according to V. K. R. V. Rao, it is not only the irrigated area that remain responsible for multiple cropping , in fact, in India, a large area

under double cropping is not irrigated but only rainfed (Rao, 1974). In Midnapore, West Dinajpur, Hoogly districts, cropping intensity has increased over a period of time (1970-71 to 2008-09) confirming an increasing trend in widespread multiple cropping whereas in Howrah, 24 Parganas, Darjeeling districts, the rate of intensity among the crops registered a sharp decline indicating that these areas are concentrating on one or two crops while varying the agricultural crops. In the other districts of West Bengal, the rates of cropping intensity are fluctuating over time. The changes in the crop pattern among the districts over the period can be a useful analytical tool for measuring the change in this regard. Another obvious factor bearing on the extent of multiple cropping is the relative weight of the long duration crops in the cultivators' choice of cropping pattern e.g., crops like sugarcane occupies the ground for most of the year or longer, thus precluding the chance of multiple cropping on that field where it is grown.

6.3 Diversification and Growth in Crop Output in West Bengal: A State Level Analysis

To understand the nature of changes in cropping pattern in West Bengal during the period 1970-71 to 2008-09, the rates of growth in acreage of different crops in time perspective have been considered. The whole period has been divided in four sub periods: 1970-79, 1980-89, 1990-1999 and 2000-2009.

Annual exponential rate of growth of the area under crops was estimated by fitting regressions of type $L_n\ Y_{it} = \alpha + \beta t$, where Y_{it} is the area under i^{th} crop at time t. The trend equations have been estimated by Ordinary Least Square method. The results are shown in Table 6.5. The cropping pattern in terms of growth in area remained heavily tilted towards rice and more precisely boro rice. As it evident from the following table (Table 6.5), during 1970-79 growth in area under boro was 2.54 per cent but since 1980 the growth in area under boro rice has been very impressive and significant (at 1% level). In fact, growth in area for aus remained negative throughout the period of study (1970-71 to 2008-09) while aman experienced positive growth of acreage from 1970 to 1999 but growth was significant only between 1990 and1999. From 2000 onwards growth in area became negative for aman. Among non-foodgrains, 1980 and onwards, potato, Rapeseeds and mustard emerged as important cash crops among the farmers of West Bengal. From 1990 and onwards area growth of jute also become positive and between 2000 and 2009 the area growth under jute was also found to be significant. Linseeds and other oilseeds (major crop under other oilseeds is teel) has achieved impressive growth of acreage (1.6 per cent and significant at 1per cent level).

Table 6.5: Exponential Growth in Area of Important Crops in West Bengal

Crops/Year	1970-1979	1980-1989	1990-99	2000-2009
Aus	-2.50	-1.69	-2.37	-3.10
	(-2.92)*	(-2.22)*	(-7.45)*	(-15.10)*
Aman	0.21	0.14	0.24	-0.05
	(0.64)	(0.49)	(1.93)**	(-0.62)
Boro	2.54	9.02	7.87	5.90
	(1.79)***	(7.17)*	(14.91)*	(17.35)*
Rice	-0.2	0.8	0.9	0.5
	(-0.5)	(3.0)*	(7.8)*	(7.0)*
Wheat	-1.1	-2.1	-0.9	0.3
	(-0.5)	(-1.2)	(-1.2)	(0.6)
Pulses	-2.5	-5.5	-5.1	-3.4
	(-3.5)*	(-8.5)*	(-19.1)*	(-19.8)*
Other Cereals	-3.5	-0.4	-2.5	-3.0
	(-0.5)	(-0.1)	(-1.0)	(-1.9)***
Foodgrains	-0.5	0.1	0.4	0.2
	(-1.5)	(0.5)	(3.2)*	(2.9)*
Potato	6.3	4.2	4.7	4.1
	(6.9)*	(5.2)*	(13.7)*	(18.5)*
Jute	3.6	-0.9	0.6	0.6
	(3.1)*	(-0.9)	(1.3)	(2.3)*
Sugarcane	-2.71	1.57	-3.15	-2.14
	(-1.09)	(0.71)	(-3.41)*	(-3.60)*
Rapeseeds and Mustard	2.0	12.5	6.9	5.1
	(1.1)	(7.5)*	(9.9)*	(11.4)*
Linseeds plus Other Oilseeds	11.3	-0.3	0.3	1.6
	(6.2)*	(-0.2)	(0.4)	(3.6)*

T stats are shown in parentheses

** Significant at 0.01, **Significant at 0.05, ***Significant at 0.1*

Source: *Calculated from the data collected from various issues of West Bengal Economic Review, Government of West Bengal.*

6.4 Components of Growth of Crop Output in West Bengal: Area Effect and Yield Effect

The aggregate change in the cultivated area of a region can be segregated on the basis of 'substitution' and 'expansion' effects while comparing the area growth rates of individual crops with the corresponding growth rate in gross cropped area. In other words, the aggregate change in the cropping pattern in each region can be due to either substitution of area among crops or by expansion of area under cultivation. For measuring the trend in area expansion and substitution, the method of Venkataramanan and Prahladachar (1980) has been applied. According to this method, an unchanged cropping pattern (no change in crop-mix) can be a situation where the respective areas under crops bear the same proportion to the gross cropped area (GCA) over the years. It implies that the rate of growth in area under individual crops must equal the rate of growth in the gross cropped area over the same time period. Such a change can be expressed in the form of a linear homogenous gross cropped area function, where given proportionate changes in area under individual crops are related to equal proportionate change in gross cropped area. The differences in the rates of growth in the area

of individual crops from the rate of growth of GCA, therefore provide evidence of change in the cropping pattern. The total change in the cropping pattern over time is the sum total of the substitution effect (the relative decline in area under some crops and corresponding equivalent increase in area under other substitutable crops for a given gross cropped area) and the expansion effect (effect of increase in the gross cropped area).

Change in output for a particular crop at a particular time point is resultant effect of change in area as well as change in productivity. Various possibilities may occur in this regard. Output may increase because of rise in productivity and increase in acreage simultaneously. Output may increase due to rise in productivity and that may offset the impact of fall in acreage. On the contrary, output may fall due to fall in both productivity and area under a particular crop, or fall in productivity may negate the impact of rise in area under cultivation of a particular crop and allow the output to fall. Finally, fall in area under cultivation may cancel out the impact of rise in productivity on output and can be a cause of fall in output. To explore the above possibilities, the concepts of area effect, yield effect and cropped area-gross cropped area elasticity shall prove to be useful on analytical ground. At operational and computational level, first the output, area and productivity of thirteen crops (both foodgrains and non-foodgrains) were chosen for the period spanning from 1970-71 to 2008-09. To calculate the exponential growth of output, area and productivity of chosen crops, the regression equation of the type $L_n\ Y_{it} = \alpha + \beta t$ was fitted. Here Y_{it} stands for output, area and productivity for i^{th} crop at time point t. α is the constant term and β gives us the exponential growth rate in output, area and productivity respectively. The trend equations are obtained by using ordinary least square method for the period 1970-71 to 2008-09 (Table 6.6). After obtaining the respective exponential growth rates of output area and productivity by using absolute change (Table 6.7) in output and productivity between 1970-71 and 2008-09, the area effect and yield effect were calculated. To do so, what percentage change in growth rate in output was caused by the growth rate in area and growth rate in productivity were calculated for the chosen crops (Table 6.8).

Finally, how much change in output was caused by area effect and yield effect were calculated in absolute terms. After obtaining the rate of growth and change in the rates of growth of acreage of different crops, substitution effect and expansion effect can easily be calculated. For a given gross cropped area (GCA), the substitution effect is defined as the relative decline in area under some crops and commensurate rise in the area of the substitutable crops. The expansion of GCA for a particular crop is denoted as expansion effect. To ensure, whether the area under any crop has undergone change because of inter-

crop shift of area or due to substitution effect or due to change in the total area under cultivation or expansion effect, the cropped area-gross cropped area elasticity (E) defined by Venkataramanan and Prahladachar (1980) has been used here.

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

If the value of E is greater than unity (or $E > 1$) for a particular crop then it suggests that area for that particular crop has increased due to both substitution effect and expansion effect. Alternatively if the value of E is negative (or $E < 0$) for a particular crop, then it can easily be said that that the crop has lost area to crops having elasticity greater than one. But if the value of E is positive but less than unity then it is difficult to ascertain whether the rise in area is due to expansion of area or due to inter-crop shift of area or substitution effect. Only conclusion follows here that the area of the crop has increased at a rate less than that of GCA.

From Table 6.7 and 6.8, it is evident that growth of output in West Bengal is mostly driven by growth of yield. In 1970-71, 6142 thousand tonnes of rice was produced and in 2008-09 the figure stood at 15037 thousand tonnes in West Bengal. Therefore, a rise in 8895 thousand tonnes have taken place in rice production and growth in productivity has added 7452 thousand tonnes and 1407 tonnes have been added due to growth in area and in absolute terms the figure stands at 980 thousand hectares. However, a close look reveals that the rise in area under rice is primarily driven by rise in area under cultivation of boro rice, which alone has registered an increase in area under cultivation by 1370 thousand hectares between 1970-71 and 2008-09 and its cropped area-gross cropped elasticity (E) is greater than unity. This clearly implies that area under boro cultivation has increased due to both substitution effect and expansion effect. It is also noticed that from 1970-71 to 2008-09, the production of aus rice has fallen both in absolute and relative term. In 1970-71, the aus production in the state was 910 thousand tonnes and in 2008-09 it came down to 605 tonnes. And this fall is primarily caused by a fall in the area under aus cultivation which is 506.8 thousand hectares in absolute term.

As a result, for aus rice, cropped area-gross cropped elasticity (E) stands negative or $E < 0$. Therefore, farmers have diverted their land from the cultivation of aus to boro cultivation and may be for other crops. Other than aus, fall in production in absolute terms has also been observed for wheat, pulses and sugarcane. For pulses and sugarcane, area under cultivation has fallen and as a result these two crops achieved negative cropped area-gross cropped elasticity ($E < 0$). This area has certainly been diverted to the cultivation of potato, Rapeseeds

and mustard, linseeds and other oilseeds and jute. These four cops have achieved values of cropped area-gross cropped elasticity which are greater than unity (E >1) i.e., for these crops both area effect and yield effect contributed positively for the rise of their output. These results again reaffirm the fact that farmers of west Bengal have moved from foodgrain production to non-foodgrain production and crop diversification has occurred apparently at moderate scale in West Bengal.

Table 6.6: Cropwise Exponential Growth in Output, Area and Yield in West Bengal (1970-71 to 2008-09)

Crops	Exp. Growth of Output	Exp. Growth of Area	Exp. Growth of Yield
Amon	2.41	0.06	2.38
Aus	-0.14	-2.88	2.77
Boro	6.31	5.84	0.44
Total Rice	3.02	0.48	2.53
Wheat	0.16	-0.07	0.23
Pulses	-2.54	-3.48	0.97
Foodgrain	2.64	0.15	2.48
Potato	5.78	4.70	1.10
Jute	3.17	1.10	2.00
Sugarcane	-0.37	-1.60	1.30
Rapeseeds and Mustard	7.58	4.90	2.60
Linseeds plus Other Oilseeds	5.98	2.90	3.00

Source: *Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal*

Table 6.7: Change in Production ('000 Tonnes) and Area ('000 Hectares) of Different Crops in West Bengal (1970-71 to 2008-09)

Crops/Year	Output		Change in Output	Area		Change in Area
	1970-71	2008-09		1970-71	2008-09	
Aman	4696.4	10074.3	5377.9	3969.9	4086.6	116.7
Aus	910.3	605.0	-305.3	799.2	292.4	-506.8
Boro	535.4	4358.0	3822.6	186.5	1556.7	1370.2
Rice	6142.1	15037.3	8895.2	4955.6	5935.7	980.1
Wheat	868.2	764.5	-103.7	360.2	307.0	-53.2
Pulses	377.2	129.7	-247.5	669.5	184.0	-485.5
Foodgrain	7493.3	16296.8	8803.5	6123.5	6536.7	413.2
Potato	929.7	4121.2	3191.5	65.1	386.0	320.9
Jute	2683.6	7872.6	5189.0	407.1	584.2	177.1
Sugarcane	2075.0	1638.3	-436.7	38.3	17.6	-20.7
Rapeseeds & Mustard	35.7	315.3	279.6	108.2	412.5	304.3
Linseeds & Other Oilseeds	23.5	267.3	243.8	59.9	291.2	231.3

Source: *Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal*

Table 6.8: The Decomposition of the Total Increase in Output in terms of Area Effect, Yield Effect and the Crop Area-Gross Cropped Area Elasticity of Crops in West Bengal (1970-71 to 2008-09)

Crops	Area Effect ('000 Tonnes)	Yield Effect ('000 Tonnes)	Increase In Area ('000 Hectares)	'E'
Aman	126.8	5319.8	116.7	0< E <1
Aus	-6243.5	6016.3	-506.8	E < 0
Boro	3537.5	269.3	1370.2	E > 1
Total Rice	1407.5	7452.1	980.1	0< E <1
Wheat	45.1	-148.9	-53.2	0< E <1
Pulses	-338.8	94.6	-485.5	E < 0
Foodgrain	513.1	8277.3	413.2	0< E <1
Potato	2595.2	607.4	320.9	E > 1
Jute	1800.6	3273.8	177.1	E > 1
Sugarcane	-1888.4	1534.4	-20.7	E < 0
Rapeseeds And Mustard	180.7	95.9	304.3	E > 1
Linseeds plus Other Oilseeds	118.2	122.3	231.3	E>1

Source: *Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal*

6.5 Magnitude and Extent of Crop Diversification in West Bengal: A Disaggregated District Level Analysis

At a given point of time, the extent of crop diversification can be measured by using several indices namely: 1. Herfindhal Index (HI) 2. Simpson Index (SI) 3. Ogive Index (OI) 4. Entropy Index (EI) 5. Modified Entropy Index (MEI) 6. Composite Entropy Index (CEI) etc. All these indices are computed on the basis of proportion of gross area under different crops cultivated in particular geographical locations. Among these indices HI, EI and MEI are most widely used to measure the extent of crop diversification. In this study Herfindahl Index has been used to measure the extent of crop concentration both at aggregate level i.e., for the state of West of Bengal as well as at disaggregated level or at district level. It is to be mentioned that the Herfindahl index is the index of concentration and higher value of it indicates crop specialisation. Therefore, to obtain the index of diversification, it is subtracted from one, which is simplified form of Simpson index of diversification. Herfindahl index is defined as:

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

Where:

P_i = Proportion of area under i^{th} crop

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

$$P_i = A_i \Big/ \sum_{i=1}^{n} A_i$$

Where,

A_i = Area under i^{th} crop and
$\sum A_i$ = Total cropped area

Therefore, Simpson Index of Diversification or

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

The HI index can accommodate a large number of alternative production choices; therefore large number of crops can be incorporated to measure the concentration/diversification. This implies that if the total area is equally shared among the large numbers of alternative crops, it means that the share of each crop would be very small or closer to zero. Therefore, higher the value of HI higher will be specialisation and lower value of HI will signify diversification. In case of perfect specialization the value HI index becomes one and zero signifies perfect diversification.

To understand the spatial pattern of diversification, the computed values of indices were ranked for the districts of West Bengal. To test the consistency of the ranking patterns of the districts based on the values of Hefindhal indices, Spearman's rank correlations of districtwise indices between any two years along with level of significance are also considered.

As the Herfindahl index suggests that if the value exceeds 0.5 then that particular region for which the value is calculated with a given sets of crops, is moving towards specialisation or more than 50 per cent of the total cropped area is used for cultivation of one or two specific crops. Here, to compute the indices for the state of West Bengal as well as for the districts, seven crops - a mix of foodgrains as well as non-foodgrains have been considered. They are rice, wheat, other cereals, pulses, jute, potato, Rapeseeds and mustard respectively. To understand the temporal change, nine points of time have been taken into account and these points of time are 1970-71, 1975-76, 1980-81, 1985-86, 1990-91, 1995-96, 2000-01 and 2008-09, five year interval except for the last period. Indices for the state for all these time periods remain fairly constant and hover around 0.56 in 1970-71 to 0.57 in 2008-09, barring 2000-01 when the Herfindahl index for the state assumed a value of 0.49 (Table 6.9). These results suggest that crop concentration is more pronounced than crop diversification. This is based on the fact that majority of the total cropped area in the State is used for foodgrain production and more precisely rice production.

To have a disaggregated picture of crop concentration or diversification, Herfindahl indices for the districts of West Bengal are also being computed by taking the same set of crops and time periods. Based on the values of Herfindahl indices, four observations can be made. In districts like Burdwan, Midnapore, Purulia, Bankura and 24-Parganas, crop concentration is strongly pronounced. From Table 6.9, it can be observed that the value of Herfindahl index stood at 0.7, 0.8, 0.8, 0.7 and 0.7 respectively for the districts of Burdwan, Midnapore, Purulia, Bankura and 24-Parganas in 190-71 and for that year the same set of districts assumed values 0.7, 0.8, 0.8, 0.8 and 0.6. On the contrary, in Nadia, Murshidabad, Malda and Darjeeling, crop diversification is strongly pronounced and their Herfindahl indices are 0.3, 0.2, 0.3 and 0.4 in 1970-71. In 2008-09, the Herfindahl indices for those districts are 0.3, 0.3, 0.4 and 0.3. Therefore, in these four districts, diversification of crop combinations was maintained. Hoogly and Birbhum have gradually been moving from a situation of diversified crop combinations to specialisation or production of one or two crops. However a reverse trend is observed in Cooch Behar and Jalpaiguri, where crop concentration has gradually been reduced and crop diversification has become more prominent (Table 6.9).

The extent of crop diversification can also be explained with the help of Simpson Index (Table 6.10). Since the Simpson index is calculated by deducting the value of Herfindahl index from unity, therefore, value closer to zero indicates crop concentration and value closer to one indicates crop diversification. For the districts of Burdwan, Midnapore, Purulia, Bankura and 24-Parganas in 190-71, the Simpson indices stood at 0.28, 0.18, 0.23 and 0.14 and in 2008-09 the same set of districts assumed values 0.23, 0.16, 0.15 and 0.28 and these values reaffirm that least diversification has taken place in these districts. Conversely, Simpson indices for Nadia, Murshidabad, Malda and Darjeeling remained higher than 0.5 from 1970-71 to 2008-09 and thus reveals that crop mix in those districts has remained diversified all along. Simpson indices for West Dinajpur either remained higher than 0.5 or closer to 0.5 for the entire study period. Simpson indices for the districts of Hoogly and Birbhum in 1970-71 were calculated as 0.46 and 0.44. In 2008-09, the indices stood at 0.47 and 0.31.

It clearly suggests that crop-mix has hardly changed in Hoogly and crop diversification has slightly increased in Birbhum. Finally, in Cooch Behar and Jalpaiguri, the value of Simpson indices were increased from 0.40, 0.32 in 1970-71 to 0.50 and 0.52 in 2008-09 and these results again corroborating the fact that crop concentration has increased in these two districts. Districtwise ranking in terms of Herfindahl indices and Simpson indices for all chosen years almost remained the same. Districts which were at the top in terms of ranking in

early years have maintained their ranking position even in the later years also. Midnapore, bankura, Purulia, Burdwan, 24 Parganas consistently occupied top positions in terms of crop concentration indices or Herfindahl indices and lower brackets in terms of crop diversification indices or Simpson indices (Table 6.11). The rank correlations of districtwise indices between any two years for all chosen years are found to be significantly positive (in most of the cases at 0.01level and only for few cases at 0.05 levels). This suggests that the districts where crop concentration or diversification was high at the initial stage, it continued to remain so at the later stage also (Table 6.12 & 6.13)

Table 6.9: Districtwise Herfindhal Indices of Crop Diversification in West Bengal (1970-71 to 2008-09)

District/Year	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2008-09
Burdwan	0.7185	0.7011	0.7423	0.7047	0.7093	0.5381	0.7092	0.7825	0.7676
Birbhum	0.5571	0.5720	0.7105	0.6815	0.6950	0.7504	0.6043	0.7251	0.6856
Bankura	0.8597	0.7568	0.8459	0.8196	0.7984	0.8294	0.8022	0.7426	0.7179
Midnapore	0.8186	0.7694	0.8047	0.8140	0.8418	0.8008	0.8052	0.7921	0.8395
Howrah	0.6826	0.6587	0.6394	0.6666	0.8189	0.8430	0.7400	0.7963	0.8188
Hoogly	0.5324	0.5906	0.5775	0.5285	0.5615	0.5663	0.4459	0.5136	0.5283
24 Parganas	0.7077	0.6895	0.7808	0.5481	0.6005	0.6340	0.5128	0.6904	0.6964
Nadia	0.3138	0.3059	0.2863	0.2732	0.3197	0.3368	0.2625	0.3109	0.3321
Murshidabad	0.2969	0.3297	0.3073	0.2751	0.3374	0.3243	0.2382	0.3474	0.3212
West Dinajpur	0.5650	0.4981	0.5186	0.4603	0.5919	0.5841	0.4053	0.5614	0.4915
Malda	0.3432	0.3580	0.3768	0.3763	0.4109	0.4901	0.3894	0.4377	0.4200
Jalpaiguri	0.6734	0.6252	0.5998	0.5292	0.6422	0.5830	0.5374	0.5418	0.4796
Darjeeling	0.4144	0.3990	0.3828	0.3834	0.3001	0.2933	0.2834	0.3517	0.3488
Cooch Behar	0.5993	0.5841	0.5573	0.5611	0.5978	0.5356	0.4980	0.5178	0.4945
Purulia	0.7615	0.7061	0.8067	0.7715	0.7697	0.7925	0.7693	0.7571	0.8449
West Bengal	0.5647	0.5563	0.5787	0.5287	0.5818	0.5643	0.4980	0.5824	0.5718

Source: *Calculation based on data collected from various volumes of District Statistical Handbook, Government of West Bengal*

Table 6.10: Simpson Indices of Crop Diversification in the Districts of West Bengal (1970-71 to 2008-09)

District/Year	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2008-09
Burdwan	0.2815	0.2989	0.2577	0.2953	0.2907	0.4619	0.2908	0.2175	0.2324
Birbhum	0.4429	0.4280	0.2895	0.3185	0.3050	0.2496	0.3957	0.2749	0.3144
Bankura	0.1403	0.2432	0.1541	0.1804	0.2016	0.1706	0.1978	0.2574	0.2821
Midnapore	0.1814	0.2306	0.1953	0.1860	0.1582	0.1992	0.1948	0.2079	0.1605
Howrah	0.3174	0.3413	0.3606	0.3334	0.1811	0.1570	0.2600	0.2037	0.1812
Hoogly	0.4676	0.4094	0.4225	0.4715	0.4385	0.4337	0.5541	0.4864	0.4717
24 Parganas	0.2923	0.3105	0.2192	0.4519	0.3995	0.3660	0.4872	0.3096	0.3036
Nadia	0.6862	0.6941	0.7137	0.7268	0.6803	0.6632	0.7375	0.6891	0.6679
Murshidabad	0.7031	0.6703	0.6927	0.7249	0.6626	0.6757	0.7618	0.6526	0.6788
West Dinajpur	0.4350	0.5019	0.4814	0.5397	0.4081	0.4159	0.5947	0.4386	0.5085
Malda	0.6568	0.6420	0.6232	0.6237	0.5891	0.5099	0.6106	0.5623	0.5800
Jalpaiguri	0.3266	0.3748	0.4002	0.4708	0.3578	0.4170	0.4626	0.4582	0.5204
Darjeeling	0.5856	0.6010	0.6172	0.6166	0.6999	0.7067	0.7166	0.6483	0.6512
Cooch Behar	0.4007	0.4159	0.4427	0.4389	0.4022	0.4644	0.5020	0.4822	0.5055
Purulia	0.2385	0.2939	0.1933	0.2285	0.2303	0.2075	0.2307	0.2429	0.1551
West Bengal	0.4353	0.4437	0.4213	0.4713	0.4182	0.4357	0.5020	0.4176	0.4282

Source: *Calculation based on data collected from various volumes of District Statistical Handbook, Government of West Bengal*

Table 6.11: Districtwise Ranking of Herfindhal Indices (HI) and Simpson Indices (SI) of Crop Concentration/Diversification in West Bengal (1970-71 to 2008-09)

	1970-71		1975-76		1980-81		1985-86		1990-91		1995-96		2000-01		2005-06		2008-09	
District/Year	HI	SI	HI	SI	HI	SI	HI	SI	HI	SI	HI	SI	HI	SI	HI	SI	HI	SI
Burdwan	4	12	4	12	5	11	4	12	5	11	10	6	5	11	3	13	4	12
Birbhum	10	6	10	6	6	10	5	11	6	10	5	11	6	10	6	10	7	9
Bankura	1	15	2	14	1	15	1	15	3	13	2	14	2	14	5	11	5	11
Midnapore	2	14	1	15	3	13	2	14	1	15	3	13	1	15	2	14	2	14
Howrah	6	10	6	10	7	9	6	10	2	14	1	15	4	12	1	15	3	13
Hoogly	11	5	8	8	9	7	10	6	11	5	9	7	10	6	11	5	8	8
24 Parganas	5	11	5	11	4	12	8	8	8	8	6	10	8	8	7	9	6	10
Nadia	14	2	15	1	15	1	15	1	14	2	13	3	14	2	15	1	14	2
Murshidabad	15	1	14	2	14	2	14	2	13	3	14	2	15	1	14	2	15	1
West Dinajpur	9	7	11	5	11	5	11	5	10	6	7	9	11	5	8	8	10	6
Malda	13	3	13	3	13	3	13	3	12	4	12	4	12	4	12	4	12	4
Jalpaiguri	7	9	7	9	8	8	9	7	7	9	8	8	7	9	9	7	11	5
Darjeeling	12	4	12	4	12	4	12	4	15	1	15	1	13	3	13	3	13	3
Cooch Behar	8	7	9	7	10	6	7	9	9	7	11	5	9	7	10	6	9	7
Purulia	3	13	3	13	2	14	3	13	4	12	4	12	3	13	4	12	1	15

Source: *Calculation based on data collected from various volumes of District Statistical Handbook, Government of West Bengal*

Table 6.12: Rank Correlation Matrix of Districtwise Herfindahl Indices of Crop Diversification in West Bengal

Year	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2008-09
1970-71	1								
1975-76	0.97**	1							
1980-81	0.95**	0.96**	1						
1985-86	0.93**	0.93**	0.95**	1					
1990-91	0.91**	0.90**	0.89**	0.93**	1				
1995-96	0.82**	0.81**	0.85**	0.83**	0.92**	1			
2000-01	0.59*	0.59*	0.59*	0.62**	0.62**	0.54*	1		
2005-06	0.89**	0.88**	0.87**	0.90**	0.96**	0.89**	0.59*	1	
2008-09	0.90**	0.92**	0.92**	0.92**	0.92**	0.86**	0.59*	0.95**	1

***Correlation is significant at the 0.01 level (2-tailed), *Correlation is significant at the 0.05 level (2-tailed).*

Table 6.13: Rank Correlation Matrix of Districtwise Simpson Indices of Crop Diversification in West Bengal

Year	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2008-09
1970-71	1								
1975-76	0.97**	1							
1980-81	0.94**	0.95**	1						
1985-86	0.92**	0.91**	0.94**	1					
1990-91	0.89**	0.88**	0.87**	0.92**	1				
1995-96	0.79**	0.77**	0.82**	0.79**	0.90**	1			
2000-01	0.93**	0.93**	0.93**	0.96**	0.97**	0.87**	1		
2005-06	0.86**	0.85**	0.85**	0.88**	0.95**	0.86**	0.93**	1	
2008-09	0.88**	0.90**	0.90**	0.90**	0.90**	0.84**	0.93**	0.94**	1

***Correlation is significant at the 0.01 level (2-tailed)*

6.6 Temporal and Spatial Shifts in Area Share of Major Crops at District Level in West Bengal

There has been a significant change in the cropping pattern as well as in the relative share of various crops in the total cropped area in the past few decades. In West Bengal as a whole, in most of the southern districts the area share of rice in the Total Cropped Area (TCA) has been the highest amongst other crops from 1970-71 to 2007- 08. Except for a few districts, the area covered under rice remained consistent over the different decades. There has been an increasing trend for the area under rice cultivation among the districts like Burdwan, Birbhum, Midnapore, Nadia, Murshidabad, Malda, Purulia and other districts like Howrah, Hoogly, 24 Parganas, West Dinajpur, Jalpaiguri, Darjeeling etc., experienced a declining trend for the area under rice cultivation.

While for wheat, area under cultivation has reduced over the decade (1970-71 to 2008-09) as a whole for West Bengal but under the districts of Northern Bengal cultivated area has increased for wheat. Area under wheat has substantially increased in Jalpaiguri and Malda district from 4 to 8 per cent from 1970-71 to 2008-09. The area shares of wheat showed a marginal increase during this period in other districts of North Bengal like West Dinajpur, Cooch Behar and Darjeeling. Except Malda and Darjeeling, other cereals constitute a very small proportion of total cropped area in all the districts of West Bengal. Proportionate area under other cereals has shown a marginal decrease for all the districts over the period (1970-71 to 2008-09) and it is true for Malda and Darjeeling too. In pre- reform period the area under pulses were occupying a significant proportion of total cropped area in Nadia, Murshidabad and Malda districts but after the adoption of new technology in 1980-81 in West Bengal shifting in area under pulses was reduced by a high percentage. The pace of increase in the share of Rapeseeds and mustard in the TCA has been slow, whereas the proportion of potatoes in the TCA has been increasing rapidly. The area under jute cultivation has increased significantly in Nadia and Murshidabad district and substantial growth in area under potatoes was observed in Bankura,Hoogly, Jalpaiguri and Darjeeling district. The share of oilseeds in total area increased in the districts like Bankura, Nadia, Murshidabad, West Dinajpur and Malda.

If we consider the share of agricultural production in the districts of West Bengal, important changes in the cropping pattern in agriculture would be observed over time. Between 1980-81 and 1990-91, there was an absolute fall in the area cultivated with foodgrains, other cereals. In the period after 1990-91, additionally there was an absolute fall in the area cultivated with pulses. Further, the area cultivated with oilseeds declined sharply after 1990-91. Between 1970-71 and

2008-09, the share in gross cropped area cultivated with food crops, foodgrains and cereals continuously declined, particularly after the mid-seventies (Table 6.14). The share in gross cropped area cultivated with oilseeds rose between 1980-81 and 1995-96, and declined afterwards. The share in gross cropped area cultivated with pulses declined after the late-eighties. On the other hand, beginning from the early seventies, there was a steady increase in the share in gross cropped area cultivated with potatoes.

Table 6.14: Districtwise Share of Area of Seven Major Crops as percentage of Total Cropped Area (1970-71 to 2008-09)

Table 6.14 A: Rice

District/Year	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2008-09
Burdwan	84.4	83.3	85.9	83.6	83.6	68.4	83.7	88.2	87.2
Birbhum	72.1	73.7	83.8	82.0	82.6	86.3	76.8	84.8	82.3
Bankura	92.6	86.6	91.9	90.4	89.2	90.9	89.4	85.6	84.1
Midnapore	90.3	87.4	89.5	90.1	91.7	89.3	89.6	88.7	91.4
Howrah	82.1	80.2	78.6	80.7	90.4	91.7	85.6	89.0	90.3
Hoogly	71.6	75.9	74.6	70.7	72.8	72.4	61.2	68.1	69.2
24 Parganas	83.6	82.4	88.1	72.1	76.3	78.5	69.4	82.6	82.9
Nadia	45.5	46.3	42.2	36.4	49.9	52.1	40.7	48.8	50.6
Murshidabad	45.8	50.3	48.7	43.4	53.0	50.3	35.2	54.1	50.4
West Dinajpur	74.0	69.0	70.2	65.1	76.0	75.4	59.6	73.3	68.4
Malda	52.0	54.6	57.6	57.8	61.3	68.3	59.1	64.1	62.3
Jalpaiguri	80.9	78.4	75.7	70.0	79.2	75.2	71.7	72.1	67.4
Darjeeling	50.0	49.2	45.0	49.3	38.1	31.3	29.7	46.4	44.3
Cooch Behar	75.6	75.3	71.8	72.1	75.7	70.4	67.5	69.7	67.3
Purulia	86.7	83.5	89.5	87.5	87.3	88.8	87.3	86.7	91.7

Source: *Calculation based on data collected from various volumes of West Bengal Economic Review, Government of West Bengal*

Table 6.14 B: Wheat

District/Year	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2008-09
Burdwan	4.7	6.0	1.6	1.5	0.4	0.5	0.9	0.2	0.3
Birbhum	17.2	13.8	4.8	4.3	3.1	4.2	6.5	4.3	7.3
Bankura	2.1	8.1	2.5	2.9	1.6	1.4	2.0	0.1	0.9
Midnapore	1.0	2.9	0.9	1.0	0.5	1.0	1.1	1.4	0.2
Howrah	5.1	4.1	0.7	0.7	0.1	0.6	0.8	0.3	0.1
Hoogly	7.7	8.0	1.9	1.6	0.2	0.3	0.5	0.5	0.4
24 Parganas	2.1	3.1	1.2	0.8	1.0	0.8	1.7	2.5	1.1
Nadia	9.6	10.7	8.9	11.1	7.3	8.1	10.7	8.5	6.6
Murshidabad	15.9	16.7	14.0	14.9	13.8	16.8	21.3	7.4	12.8
West Dinajpur	3.2	9.3	5.7	5.9	4.5	5.5	5.8	0.9	5.8
Malda	4.9	8.8	7.0	7.6	8.7	11.3	13.2	7.5	12.5
Jalpaiguri	0.3	6.0	2.5	2.7	3.0	6.1	7.3	1.2	4.5
Darjeeling	0.6	2.8	1.6	1.6	2.6	2.1	2.9	2.8	2.7
Cooch Behar	2.1	5.3	3.3	3.6	3.4	4.2	5.8	2.3	2.2
Purulia	0.3	4.6	0.6	0.7	0.4	1.4	1.0	4.3	0.3

Source: *Calculated from the data collected from various issues of West Bengal Economic Review, Government of West Bengal.*

Table 6.14 C: Other Cereals

District/Year	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2008-09
Burdwan	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1
Birbhum	0.5	0.3	0.4	0.2	0.2	0.1	0.1	0.1	0.1
Bankura	0.6	0.6	0.7	0.6	0.7	0.2	0.3	0.3	0.1
Midnapore	0.3	0.3	0.2	0.1	0.1	0.2	0.1	0.1	0.1
Howrah	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Hoogly	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24 Parganas	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Nadia	1.0	3.2	0.5	0.2	0.9	0.2	0.1	0.3	0.6
Murshidabad	3.0	2.3	2.4	1.1	0.7	0.3	0.3	1.0	0.8
West Dinajpur	2.1	1.6	1.1	1.2	0.1	0.2	0.2	1.8	4.2
Malda	10.6	7.8	7.3	5.1	3.1	3.1	1.7	3.7	3.0
Jalpaiguri	1.3	2.3	1.5	3.6	1.4	1.0	0.7	3.6	3.4
Darjeeling	40.2	39.1	41.9	36.7	31.1	24.7	21.5	35.4	37.5
Cooch Behar	0.5	1.5	0.5	0.6	0.8	0.2	0.2	0.9	2.0
Purulia	3.3	3.3	3.5	5.3	5.2	4.4	5.0	3.9	2.6

Source: *Calculated from the data collected from various issues of West Bengal Economic Review, Government of West Bengal.*

Table 6.14 D: Pulses

District/Year	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2008-09
Burdwan	5.2	5.3	2.7	2.0	0.4	0.2	0.8	0.2	0.4
Birbhum	8.6	10.1	6.8	5.0	1.9	2.7	4.9	4.3	3.4
Bankura	3.2	2.7	1.9	1.5	0.6	0.6	0.3	0.1	0.1
Midnapore	6.0	6.7	5.5	4.1	2.0	1.4	1.7	1.4	1.1
Howrah	6.8	11.2	13.6	11.7	3.1	0.5	0.3	0.3	0.8
Hoogly	5.3	3.7	2.5	1.9	0.2	0.2	0.5	0.5	0.1
24 Parganas	7.9	8.4	6.9	5.0	3.0	1.4	2.1	2.5	2.6
Nadia	28.1	25.2	20.5	14.0	12.9	7.9	10.1	8.5	6.6
Murshidabad	22.2	20.5	17.5	15.2	7.9	6.2	9.3	7.4	4.7
West Dinajpur	6.7	8.1	6.2	4.5	3.6	3.0	1.6	0.9	0.8
Malda	23.5	20.8	15.9	12.6	13.7	7.2	9.6	7.5	5.8
Jalpaiguri	1.2	2.9	2.3	2.0	1.4	0.7	1.8	1.2	1.2
Darjeeling	1.3	1.6	1.5	1.2	0.7	1.5	1.7	2.8	1.6
Cooch Behar	2.7	4.6	2.1	2.0	2.3	2.2	2.4	2.3	1.5
Purulia	8.9	7.6	6.1	6.2	6.4	4.7	6.2	4.3	4.9

Source: *Calculated from the data collected from various issues of West Bengal Economic Review, Government of West Bengal.*

Table 6. 14 E: Jute

District/Year	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2008-09
Burdwan	2.3	1.4	2.7	3.1	2.0	1.1	1.5	1.7	1.4
Birbhum	0.1	0.1	0.1	0.2	0.0	0.1	0.0	0.1	0.0
Bankura	0.2	0.2	0.5	0.3	0.1	0.1	0.1	0.1	0.0
Midnapore	1.2	1.1	2.1	1.9	0.9	0.8	0.6	0.5	0.4
Howrah	3.9	1.8	5.4	3.9	2.4	2.5	5.1	4.4	2.8
Hoogly	9.1	5.0	10.4	11.5	8.3	5.5	9.2	6.9	6.5
24 Parganas	4.5	4.7	1.6	14.9	10.1	10.9	13.9	6.3	6.7
Nadia	13.6	12.5	23.8	32.5	20.4	19.8	23.2	21.2	23.3
Murshidabad	10.8	7.4	13.4	19.7	15.8	18.5	22.2	17.6	19.3
West Dinajpur	9.8	7.4	13.1	16.4	7.3	7.2	16.5	12.2	9.8
Malda	5.7	4.2	8.9	12.7	6.4	5.9	6.4	7.0	6.3
Jalpaiguri	13.2	7.5	15.9	19.3	11.7	11.2	12.2	11.6	11.8
Darjeeling	3.9	2.2	4.9	6.0	23.7	36.4	37.9	3.3	3.6
Cooch Behar	16.3	10.4	19.9	19.7	15.3	19.1	19.4	16.4	19.1
Purulia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: *Calculated from the data collected from various issues of West Bengal Economic Review, Government of West Bengal.*

Table 6.14 F: Potato

District/Year	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2008-09
Burdwan	2.6	3.5	3.8	4.2	5.7	26.1	6.0	6.0	7.3
Birbhum	1.1	1.6	1.6	1.5	1.8	2.1	3.1	3.2	3.9
Bankura	0.7	1.1	1.6	1.8	4.0	4.3	4.9	6.2	7.4
Midnapore	1.0	1.4	1.5	2.1	3.0	4.6	4.9	6.2	5.5
Howrah	2.0	2.4	1.7	2.4	2.4	3.7	6.9	5.2	5.2
Hoogly	5.4	6.8	9.7	11.8	15.4	19.7	24.8	21.2	21.1
24 Parganas	0.3	0.6	0.7	1.6	1.1	1.2	2.7	1.0	1.1
Nadia	0.0	0.5	0.4	0.4	0.3	0.5	0.6	1.0	0.9
Murshidabad	0.4	0.9	1.1	1.0	0.9	1.0	1.4	1.4	1.5
West Dinajpur	0.5	1.2	0.8	1.0	0.7	1.0	2.8	1.7	1.9
Malda	0.2	0.4	0.3	0.4	0.3	0.5	0.6	0.7	1.0
Jalpaiguri	0.4	1.0	0.3	0.7	1.2	3.3	3.9	7.4	8.6
Darjeeling	3.0	4.2	4.8	4.5	2.9	3.9	6.2	8.9	10.0
Cooch Behar	0.5	1.0	0.3	0.8	1.3	2.0	2.8	6.0	6.0
Purulia	0.1	0.5	0.1	0.1	0.4	0.5	0.3	0.4	0.2

Source: *Calculated from the data collected from various issues of West Bengal Economic Review, Government of West Bengal.*

Table 6.14 G: Rapeseeds and Mustard

District/Year	1970-71	1975-76	1980-81	1985-86	1990-91	1995-96	2000-01	2005-06	2008-09
Burdwan	0.6	0.5	3.2	5.5	7.8	3.7	7.1	3.7	3.3
Birbhum	0.4	0.4	2.5	6.7	10.3	4.5	8.6	3.4	3.0
Bankura	0.5	0.7	1.0	2.5	4.0	2.5	3.1	7.6	7.4
Midnapore	0.4	0.3	0.3	0.8	1.8	2.8	2.0	1.6	1.2
Howrah	0.2	0.2	0.1	0.6	1.7	1.0	1.3	0.8	0.8
Hoogly	0.9	0.7	0.9	2.5	3.1	2.0	3.9	2.8	2.7
24 Parganas	1.5	0.7	1.5	5.6	8.5	7.2	10.2	5.0	5.4
Nadia	2.2	1.7	3.6	5.4	8.3	11.4	14.5	11.6	11.6
Murshidabad	2.0	1.9	2.8	4.8	7.8	6.9	10.2	11.2	10.5
West Dinajpur	3.7	3.4	2.9	5.9	7.9	7.5	13.6	9.2	9.1
Malda	3.1	3.3	2.8	3.8	6.4	3.8	9.3	9.6	9.2
Jalpaiguri	2.8	1.9	1.8	1.9	2.1	2.5	2.3	2.9	3.1
Darjeeling	1.0	0.8	0.4	0.7	0.9	0.2	0.1	0.3	0.3
Cooch Behar	2.3	1.9	2.1	1.2	1.2	1.8	1.9	2.5	1.9
Purulia	0.6	0.5	0.2	0.2	0.3	0.2	0.2	0.4	0.3

Source: *Calculated from the data collected from various issues of West Bengal Economic Review, Government of West Bengal.*

Considering significant cropping pattern changes that have taken place in each of the agriculturally dominant districts, it is important to explore whether such changes are accompanied by locational shifts in area share of major crops and crop groups. The analysis of area share of each district in a particular crop reflects spatial pattern in area shifts or concentration of a crop in a particular region. For instance, area under cereals is relatively more in the districts of Burdwan, Birbhum, Bankura, than the districts like Nadia, Murshidabad, Malda in Bengal. Similarly, area under oilseeds is concentrated largely in the Nadia, Murshidabad and Malda District. A detailed analysis of area share of districts in major crops (Table 6.14) indicates a negligible change in the relative share of rice, wheat and jute grown in different districts and a substantial shift in area under other cereals, oilseeds and pulses across the districts.

For all these crops taken together, it is clear that almost all the districts have specialized in cultivation of one or the other crop. Over a period of last four decades, the area share of all cereal crops except rice is declining in the southern districts of Burdwan, Birbhum, Midnapore, Howrah, Hoogly, Nadia and Murshidabad and fluctuating in Purulia and three northern districts of Malda, Jalpaiguri, and Darjeeling.

The above analysis clearly suggests that the post reform period is marked by changing preferences of crops from cereals to non cereals. These changes can lead to crop diversification or crop specialization and may increase crop output growth as well as alter the sources of growth. In the following section the extent and nature of crop diversification and specialization has been taken into account at district level to reveal their implications for output and productivity growth.

6.7 Factors Affecting Crop Diversification: Drivers and Constraints

To meet the needs of the burgeoning population of the state and to improve the economic wellbeing of the population engaged in agriculture, the degree of diversification of land use towards various crops occupies a special place in recent times. In the previous sections of this chapter, the trends and pattern of crop diversification have been discussed along with its nature in different district of West Bengal during last four decades. While the developments in the agricultural sector have created diversification opportunities, thereby enhancing the ability of farmers to diversify crops and increase their level of income. These factors acting as an instrument in the diversification process augment farm income by enhancing productivity, occupational mobility and eradicating existing income asymmetries among the farmers. Similarly, lack of adequate infrastructure, credit, access to market and normal rainfall can severely constrain the scope of diversification initiatives of the farmer where consumption of fertilizers, developed irrigation facilities can enhance the chance and scope of diversification in agriculture. An attempt has been made in this section to identify the factors that are responsible for crop diversification under the study region.

Pingali and Rosergrant (1995) have shown that diversification of foodgrain was triggered by rapid technological change in agricultural production, improved rural infrastructure and diversification in food demand. Pope and Prescott (1980) revealed a negative relation between farm size and specialisation. According to them, experience, price risks, wealth and education are few of the constraints towards diversification. This was attributed to the fact that wealthier farmers were less risk-averse. This argument challenged the findings of White and Irwin (1972) who established a positive relationship between farm size and specialisation. Singh (1996) illustrated that the impact of irrigation on crop diversification and according to him, income stability of a farmer is dependent upon cropping conditions and the level of irrigation. He noted that when expansion of irrigation takes place in an assured rainfall region, it leads to more crop specialisation in paddy production. In contrast, when an investment in well irrigation occurs in a dry land region, it enhances opportunities for further

crop diversification. Hence, the role of irrigation on crop specialisation or crop diversification depends on regional factors.

It is to be logically noted that fluctuations in crop diversification fluctuation is higher in drought prone areas and crop diversification is more sensitive to agro-climatic determinants such as soil conditions or rainfall. Gregson (1994) hypothesized that diversification is a function of labour availability, risk due to unstable prices, falling transportation cost and the suitability of soil for the crop. The study found that other than distance from market, the geography of the farm has little effect on crop choice when transportation cost is high. But, when transportation costs fall, the geographical locations of farms become a factor in crop choice. In another study, Gregson (1996) notes that higher specialisation takes place by more use of fertilizer as it allows farmers to get higher and stable income. In other words, more use of fertiliser lead farmers away from diversified farming to a more specialised crop mix. In examining the role of socio-economic factors on the levels of crop diversification, Minot *et al.*, (2006) indicated that increase in diversity is positively related with age and education of farmers and negatively with size of farm and irrigation. In this context, Zimmerer (1991) argues that shortage of labour in the labour intensive crops results in low profit by increasing diversification and hence it restricts diversification towards such crops.

In sum, the studies pertaining to diversity in the cropping pattern focussed on examining the role of both economic and non-economic factors. Therefore, on the basis of the previous studies on diversification and making allowance for data limitations, certain factors responsible for crop diversification has been identified. Thus the study considers both economic and non-economic factors such as rainfall index (agro-climatic variable), proxy variables for technology like, use of fertilizer and irrigation under government canals per GCA, number of primary agricultural credit societies (institutional variable), infrastructural variables like regulated market and road density, the percentage of agricultural labour force (used as a proxy for human capital) and percentage of farms under marginal and small holdings (asset variable). The association of these variables with the Simpson index (measures the extent of crop diversity) has been analysed by studying the correlation between Simpson indices of each district and each of the individual factor of the districts (Table 6.15). The Simpson index measures the extent of diversification and it varies between 0 and 1. If there is specialisation, then the index moves towards zero and if there is tendency of crop diversification then the index moves towards '1'. The positive or negative correlations of select variables with the Simpson index imply the association between the extent of

diversification and the causes of diversification. If the correlation coefficient between the diversification indices and the factors undertaken are negative and significant, it clearly indicates an inverse relationship between the extent of diversification and the parameters and vice versa.

Table 6.15: Correlation between SI Index and other factors responsible for Crop Diversification

Districts	Rainfall Index	Fertilizer	No. of Agricultural Credit Institution	No of Regulated Market	Road Density	Irrigation (Govt Canals)	Percentage of Agricultural Labour-force	Percentage of area under small and marginal firms
Burdwan (SI)	0.07	-0.25	-0.05	0.11	0.10	-0.16	0.28**	-0.14**
Birbhum(SI)	-0.35**	-0.46	0.78**	-0.19	-0.51**	-0.44**	-0.41	-0.54**
Bankura(SI)	0.00	0.73*	-0.44**	0.86*	0.45	0.29	-0.15	0.42
Midnapore(SI)	-0.31**	-0.29	0.40	-0.18	-0.49**	0.13	0.23	-0.22
Howrah(SI)	-0.85*	-0.66	0.49	-0.78	-0.18	-0.51**	0.63**	-0.64*
Hoogly(SI)	0.07	0.52**	-0.59	0.37**	0.44	-0.75	-0.53	0.51
24 Parganas(SI)	0.25	-0.08	-0.38	-0.01	0.00	-0.20	-0.41**	0.25
Nadia(SI)	0.00	-0.42	-0.17	0.05	-0.18	0.00	0.17	-0.04
Murshidabad(SI)	0.17	-0.17	0.28**	0.08	-0.02	0.65*	0.05	0.01
West Dinajpur(SI)	-0.18	0.08	-0.31	0.05	0.04	0.23	-0.21*	0.21
Malda(SI)	-0.82**	-0.54	0.78*	-0.77	-0.58	0.00	0.67**	-0.58**
Jalpaiguri(SI)	0.07	0.76**	-0.75**	0.59*	0.60*	0.66	-0.79	0.84
Darjeeling(SI)	0.69	0.44	-0.04	0.48	-0.72*	0.14	-0.53**	0.77*
Cooch Behar(SI)	0.22**	0.76**	-0.63	0.62*	-0.66**	0.40	-0.81	0.94
Purulia(SI)	-0.45**	-0.06	0.20**	-0.60	-0.48**	-0.59*	-0.13	-0.52**
West Bengal(SI)	0.06	0.04	-0.09	0.01	-0.04	-0.12	-0.06	0.15**

*Significant at 1% level, * * Significant at 5% level*

Source: *Calculated from the data collected from various issues of West Bengal Economic Review, District Statistical Handbook, Agricultural Census, Government of West Bengal.*

The correlation table shows that out of the two technological variables, fertilizer use has a positive and significant effect on the degree of diversification for districts like Bankura, Jalpaiguri, Darjeeling and Cooch Behar. Thus for these four districts, the present study does not support the result of Gregson (1996) where he has shown that higher use of fertiliser means higher degree of specialisation. For other districts, the association between extent of diversification and the fertilizer use is negative and insignificant. But it is true that availability and utilization of fertilizer made cultivation more expensive for some fertilizer intensive crops such as boro rice and potato in West Bengal. Both potato and boro rice are highly fertilizer intensive and irrigation intensive without which cultivation is impossible. The correlation coefficient of irrigation is however negative and significant for districts like Birbhum, Howrah and Purulia. This means that crop diversification is taking place in the rain fed area where the farmers are unable to cultivate the staple cereals like rice and wheat that

requires abundance of water throughout the period, and have low resources but abundance of labour force.

The development of infrastructural variables like road and availability of regulated market and institutional variables like credit play an important role in encouraging diversification. Road facilities reduce transport costs of inputs and outputs, thereby increasing the profit margin of the farmers. Roads have been seen as the main determinant factor leading to agricultural diversification, though there are other factors like availability of resources, support facilities, etc. This is reflected in the positive and significant coefficient of road for only Jalpaiguri district. The negative significant coefficients of road density for the districts like Birbhum, Midnapore, Malda, Darjeeling, Cooch Behar and Purulia implying that the lack of infrastructural facilities is restricting agricultural diversification and better road network actually enforces diversification in favour of high yielding variety of crops as it implies lower transportation cost and easy and quick disposal of commodities. Thus for these districts it also induces the post harvest risk of incurring losses in case of perishable commodities.

Access to market induces farmers to shift their cultivation of variety of crops especially those that yield higher income which play an active role only after access facilities to market are in place. Thus market is significantly related to income diversification. The negative coefficient for Howrah, Malda and Purulia implies that lower the number of regulated markets the lesser is the tendency of farmers to diversify and vice versa. Villages with poor access to market face higher transaction cost in buying from or selling to the national economy. It is expected that farms that have poor market access to be more specialized in crop production, have fewer non farm activities and fewer income sources.

Credit can influence diversification indices in a different way. Credit is believed to increase the risk bearing ability of farmers; therefore one can expect a positive effect of institutional credit on agricultural diversification provided increase in diversification fulfils the objective of rational farmers. The variable in this study for institutional credit is the number of primary agricultural societies per unit of gross cropped area in the district. This includes credit from cooperative societies and accounts for a bulk of production loan obtained from institutional sources. The signs and significance for Malda, Murshidabad, Birbhum and Purulia suggests that as intensity of credit from an institutional source increases diversification also increases in the districts. Credit reflects farmers' dependence on market purchased inputs, which in turn highlights the commercialization of agriculture in the region.

The availability of number of agricultural labour force (cultivators+ agricultural labourers) across the districts has significant influence on the diversification towards non-foodgrains. This is expected as non-foodgrains are highly labour intensive in nature compared to foodgrains like rice and wheat. Thus high labour intensity crops demands higher density of workers.

Larger farms with more gross cropped area are more diversified than small farms. This is not so much because of the greater costs of diversification for small farmers but because of more profitable opportunities for diversification as well as the capacity to bear higher costs of specialization by large farmers. As large farms hold more fields they can exploit location-specific production opportunities and they also have greater access to credit to finance more input-intensive cropping activities. At the same time, by diversifying crops and thus influencing the cropping calendar, large farms are able to reduce peak season labour requirements. Thus for most of the districts correlation coefficients of percentage of total small and marginal holding farms are negative with Simpson Index of crop diversification. Bankura, Hoogly, 24 Parganas, Cooch Behar and Jalpaiguri districts have positive association with extent of diversity emphasizing the facts that in these districts even with small size of farm, the farmers are taking risk to diversify their incomes as the sources of non farm income in these districts are almost absent or insignificant. Therefore, they diversify land towards the cultivation of boro paddy instead of jute or other competing crops for their survival though they lack inadequate farm size to benefit from scale economies.

6.8 Conclusion

From the overall analysis it may reasonably concluded that the rate of crop diversification in the districts of West Bengal in terms of area under coverage has not gained the expected momentum because of inadequacy in certain important factors that are essential to boost crop diversification. Moreover, the degree of diversification is not evenly distributed across the districts. While some of the districts are much ahead to adopt the technology of diversification, others are lagging behind. This might be because of the fact that even though the state has achieved its self sufficiency in staple food the emphasis is still focused towards increasing production of rice only. While productivity of crop production is associated with the intensive use of inputs, yield can be increased through better land management and farming practices, and weed and pest controlling. The inappropriate ways to apply tools and modern inputs and lack of knowledge for chemical inputs and how to get a good price always constrain farmers for profitability. It is therefore necessary to provide proper financial assistance and training on the part of the

government to spread knowledge of land management and farm practises. This will not only help the farmers in earning higher income, it will also open up opportunities of marketability and widened the export market resulting thereby creating more income and creating employment.

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