

Variation of Agriculture Sector Development: With Special Reference to West Bengal State

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ABSTRACT The present paper seeks to examine inter-district disparities in rural agricultural sector in West Bengal and its impact on agricultural development through a (cross-sectional study) inter-temporal analysis of 18 districts. Composite indices of rural economic have been prepared for selected 10 indicators, in the period of time 1980-81, 1990-91 and 2000-01. The technique of Principal Component Analysis (PCA), Rotate Factor Matrix (Kaiser Varimax Method) has been used to prepare the composite index of agricultural development and dimension index of agricultural development. The analysis reveals that extreme disparities continue to persist with respect to the availability of economic indicators in rural areas at the district level. The ranking pattern of districts in terms of development of rural infrastructure has also remained broadly unchanged. Similarly, a strong correlation between ranks of districts in economic infrastructure has been observed. Agricultural economic infrastructure was found to have a strong positive effect on gross value of agricultural produce and a strong negative effect on rural poverty. West Bengal agriculture should promotion of diversified and export oriented agriculture. Particular attention needs to be paid to the backward districts for more balanced regional development. This calls for increased investment in rural infrastructure by both the public and private sectors.

INTRODUCTION

Agricultural sector is a prime sector of the economy of West Bengal where expansion of industrial sector is limited due to its topographical constraints. The study of the relationship between value of agricultural produce per hectare of net area sown and agricultural values are relevant and significant to find out the roots to pace of agricultural development. There is the coexistence of developed and developing districts in West Bengal. The changing pattern of association of agricultural development indicators for the decadal year of 1980-81, 1990-91 and 2000-01 has been analyzed. Some ten (10) variables have been identified at district level in West Bengal to analyze the level of agricultural development.

The existence of sharp inter-district disparity in development had been recognized and brought to focus in 1971 by the Bengal Chamber of Commerce and Industry, Calcutta (BCCI 1971) when it stated: "While the Calcutta Metropolitan District or the district of Burdwan in the coal-iron ore belt represents a relatively high level of development, the outlying regions like

Darjeeling, Cooch Behar and Jalpaiguri in the north or Purulia, Bankura and Murshidabad in the west reflect a sorry plight of stagnation and decay. Indeed, a greater degree of intra-state regional imbalance is not witnessed in any other state of the Indian Union, as the data provided by the Census of India, reveals."

After independence the centralized planning was implemented for eliminating regional inequalities, but it remained a serious problem in India. Regional disparities in India have widened day by day (Joshi 1997; Krishan 2001; Singh 2006). The basic cause of regional disparities is the states lacking an inherent mechanism to ensure that, in the long run, the benefits of economic change are distributed equally, on a per capita basis. Regional differences are to a large extent built in due to large unequal natural endowments and lack of infrastructure facilities which form the basis for rapid economic growth (Krishnaiah and Reddy 1998). The regional disparity in India is now a matter of serious concern. There are solemn regional disparities among different states of our country. Similarly, we have regional inequalities among different regions in a state. Even in a district there are

disparities among different blocks. India is a large federal nation and it is well known that there are widespread disparities in the levels of economic and social development between the different regions of the nation. The lingual states that emerged after the recongnisation were socially homogeneous but economically heterogeneous (Kundu and Raza 1982; Krishan 2000).

The ninth plan (1997-2002) aimed at growth with social justice and equity. The Planning Commission in its 10th plan (2002-2007) advocates the area approach and aims to strengthen decentralization of planning. Thus, the decentralized planning policy procedure was adopted to prepare village plans by collecting village requirements at block levels and finally they were put together at district level for district plans. But such attempts were confined only on paper. Removal of regional imbalances in development has remained the avowed goal of planning in India (Mohan 2005).

In such scenario it is important to identify the backward regions of the country, state and even at district level in terms of development of major components as well as to measure the level of disparities amongst different regions.

The paper is divided into five sections for the purpose of our analysis. Section I and II deals with introduction and methodology. Section III attempt has been made the level of agricultural development through construction of composite indices. In the Section IV has been identifying various dimension of agricultural development. Finally, in the Section V attempt has been made findings, conclusions and recommendations.

Share of Agriculture in District Domestic Product by West Bengal District

The percentage share of agriculture in DDP over the period 1980-81, 1990-91 and 2000-2001 is calculated district-wise and presented in Table 1.

Kolkata's position with respect to other districts is more or less the lowest because of its metropolitan character. The contribution of agriculture to DDP is the maximum in Uttar Dinajpur district in the year 1980-81; where as Cooch Behar district (44.41 and 44.27) contribution is more consistent than the other districts in the year 1990-91 and 2000-2001.

Dakshin Dinajpur consistently occupies the second position in the year 1980-81 and 2000-

Table 1: Share of agriculture in DDP

<i>Districts</i>	<i>1980-1981</i>	<i>1990-1991</i>	<i>2000-2001</i>
Burdwan	31.36	27.61	20.68
Birbhum	53.78	42.28	35.10
Bankura	55.14	42.97	36.15
Midnapore	47.14	30.70	30.79
Howrah	8.06	8.96	10.61
Hooghly	30.04	29.00	22.90
24 Parganas (N)	15.73	19.64	16.87
24 Parganas (S)	17.78	23.96	18.61
Nadia	40.35	41.04	35.59
Murshidabad	46.86	37.39	32.36
Malda	49.34	41.32	41.60
Uttar Dinajpur	63.06	26.63	41.29
Dakshin Dinajpur	63.05	18.51	44.20
Jalpaiguri	36.52	40.49	33.96
Darjeeling	9.98	32.66	29.71
Cooch Behar	54.20	44.41	44.27
Purulia	38.70	28.28	24.90
Kolkata	0.00	0.34	0.32

Source: Statistical Abstract, the Bureau of Applied Economics and Statistics, GoWB (various years)

2001 and in the lower echelon the position of the Howrah district remains unchanged among the benchmark years. In West Bengal, percentage share of agriculture in DDP is 27.84, 27.18, and 24.18 in the three points of time.

Objectives

In the present paper an attempt has been made to make a detailed district-level analysis and to identify various dimensions of agricultural development in West Bengal. The study is based on the secondary data. We have taken 10 (ten) indicators viz., A-1 Gross value of agricultural produce per hectare of net area sown, A-2 Gross value of agricultural produce per capita of rural population, A-3 Gross value of agricultural produce per agricultural workers, A-4 Percentage of area under commercial crops to gross cropped area, A-5 Percentage of net area sown to total geographical area, A-6 Cropping intensity, A-7 Percentage of agricultural workers to total (main) workers, A-8 Credit to agriculture (Rs. Per Capita), A-9 Consumption of fertilizer per hectare of gross cropped area, A-10 Average size of holdings to compare among districts or regions.

Rationale of the Choice of Indicators of Agricultural Development

The first three indicators A-1, A-2, A-3 and A-4 have been selected to exhibit the overall

performance of agriculture in terms of agriculture productivity, labour productivity and availability of agricultural produce for consumption of the population, besides showing the effects of all technological inputs on land. West Bengal has enough potential for horticulture development; as such A-5 has been selected to assess the horticultural development. It reveals the level of diversification within agricultural sector from food grain production to commercial crops in terms of percentage of area under commercial crops. Net area under agricultural use has been evaluated with the help of A-6 and the intensity of cropping A-7, is measured through the ratio of gross to net cropped area, which shows the rate of utilization of net area under cultivation in different districts and enlightens on the scope of bringing additional area under multiple cropping. Indicator A-8, which obviously lead to increase in the productivity of the farm sector. Modernization and commercialization of agriculture sector have been examined with the help of A-9 and A-10, which indicates consumption of fertilizers for increasing the productivity of land. With the help of this indicator, modernization of agriculture sector can be evaluated at the district level.

METHODOLOGY

The present paper seeks to examine inter-district disparities in rural agricultural sector in West Bengal and its impact on agricultural development through a (cross-sectional study) inter-temporal analysis using some statistical techniques like ranking, coefficient of variation, Principal Component Analysis / Factor Analysis and Rotated Factor Matrix (Kaiser Varimax Method) etc. By using data obtained from various authentic sources like Census Reports (Various issues), Statistical Abstracts, Government of West Bengal (GoWB, various issues), Economic Reviews (GoWB, various issues) etc.

Classification of Districts, on the basis of values of the indices of development the districts have been classified into two categories, viz. developed and developing (or less developed or backward). The developed districts are those, which have the composite index value above the state average. Districts having value of composite index below the state average are categorized as developing (or backward) districts.

Agricultural sector reveals three dimensional

development— *modernized agricultural development, traditional agricultural development and overall agricultural development*. In the present study, modernized agricultural development is named to that dimension of agricultural development in which indicators such as consumption of fertilizer per hectare of gross cropped area, percentage of area under commercial crops to gross cropped area and credit to agriculture are positively and significantly associated with that dimension or factor in addition to other indicators. Traditional agricultural development points towards that dimensions in which above said three indicators do not have positive and significant correlation with that particular factor. Overall agricultural development is named to that dimension which is positively associated with first three indicators, viz. gross value of agricultural produce per hectare of net area sown, gross value of agricultural produce per capita of rural population and gross value of agricultural produce per agricultural workers (which are measuring performance of agriculture sector), along with indicators pertaining to modernization and commercialization of agriculture.

DISTRICT-WISE COMPOSITE INDICES OF AGRICULTURAL DEVELOPMENT

District-wise Analysis of the Level of Agricultural Development

District-wise level of agricultural development has been analyzed with the help of composite indices of agricultural development. These indices have been calculated by taking first principal component from the principal component matrix derived from the inter-correlation matrix of 10 (ten) variables.

The inter-correlation matrices of the selected 10 variables of agricultural development separately for the years 1980-81, 1990-91 and 2000-2001 are given in Appendix 1.

It may be observed from Appendix 1 that the value of agricultural produce per hectare of net area sown is positively and significantly correlated with value of agricultural produce per capita of rural population, cropping intensity and consumption of fertilizer per hectare of gross cropped area.

Correspondingly, Appendix 1 reveals that value of agricultural produce per hectare of net

area sown is significantly and positively correlated with value of agricultural produce per capita of rural population, percentage of area under commercial crops to gross cropped area, percentage of net area sown to total geographical area, cropping intensity and consumption of fertilizer per hectare of gross cropped area.

Inter-correlation matrix of 2000-01, Appendix 1 depicts that value of agricultural produce per hectare of net area sown is significantly and positively associated with gross value of agricultural produce per capita of rural population, percentage of area under commercial crops to gross cropped area, percentage of net area sown to total geographical area, cropping intensity and consumption of fertilizer per hectare of gross cropped area. Obviously, this correlation matrix does not represent a clear-cut picture.

It may be observed from Appendix 2 that the principal component matrix has retained four principal components, which taken together, explains 88.85 per cent of the total variance. Four principal indicators are significantly correlated with the first principal component (a_1 , $s > 0.576$ is significant for 10 degrees of freedom at 5 per cent level of significance). It explained 38.53 per cent of the total variance. As is obvious from the last column of Appendix 2, all the communalities (h^2) are very high ranging from +0.69 to +0.98, which indicates that each variable taken for analysis is significantly correlated with all other variables.

The selected indicators were, by and large, correlated with each other in the reference years, that is, 1980-81, 1990-91 and 2000-2001, and in most of the cases the correlation was significant as well. The first principal component explained 38.53 percent of the total variance in 1980-81, 46.39 percent in 1990-91 and 43.55 percent in 2000-2001.

The composite index of agricultural development for each district at three selected points of time was computed. Such an index of Agricultural Development (AD) for 1980-1981 was computed by using the following equation:

$$AD_1 = (-0.04399) Z_1 + (-0.48874) Z_2 + (0.25493) Z_3 + (0.53487) Z_4 + (-0.70163) Z_5 + (0.75832) Z_6 + (-0.73493) Z_7 + (0.93016) Z_8 + (-0.16285) Z_9 + (0.87291) Z_{10} \dots\dots\dots (I)$$

Where, AD1 is composite index of agricultural development of a district, $Z_1, Z_2, Z_3, Z_4, \dots, Z_{10}$ are the values of variables in standardized form and the figures in parentheses are factor loadings or weights.

The above equation (I) shows that the coefficient of correlation of agricultural development ranges between -0.04 and +0.93.

The composite index of agricultural development of a district for 1990-1991 was constructed by using the following formula:

$$AD_2 = (0.78539) Z_1 + (0.80120) Z_2 + (-0.45224) Z_3 + (0.70100) Z_4 + (0.92578) Z_5 + (0.89996) Z_6 + (0.66660) Z_7 + (0.53776) Z_8 + (0.41155) Z_9 + (0.33926) Z_{10} \dots\dots\dots (II)$$

Where, AD₂ is composite index of agricultural development of a district, $Z_1, Z_2, Z_3, Z_4, \dots, Z_{10}$ are the values of variables in standardized form and the figures in parentheses are factor loadings or weights.

The above equation (II) shows that the coefficient of correlation of agricultural development ranges between +0.33 and +0.92.

Similarly, the composite index of agricultural development of a district for the year

2000-2001 was constructed by using the following formula:

$$AD_3 = (0.78513) Z_1 + (0.85548) Z_2 + (-0.22307) Z_3 + (0.70042) Z_4 + (0.83471) Z_5 + (0.89635) Z_6 + (0.41540) Z_7 + (0.63158) Z_8 + (0.36072) Z_9 + (0.51461) Z_{10} \dots\dots\dots (III)$$

Where, AD3 is composite index of agricultural development of a district, $Z_1, Z_2, Z_3, Z_4, \dots, Z_{10}$ are the values of variables in standardized form and the figures in parentheses are factor loading or weights.

The equation (III) reveals that the coefficient of correlation of agricultural development ranges between -0.22 and +0.89.

All the eighteen districts of West Bengal have been ranked according to their levels of agricultural development as per values of indices during three selected points of time, that is, 1980-81, 1990-91 and 2000-2001 (Table 2).

It is clear from the Table 2 that on the basis of level of agricultural development in 1980-81, district Darjeeling was at the top position followed by Jalpaiguri, Nadia and Cooch Behar, in that order. On the other hand, district Dakshin Dinajpur was at bottom, preceded immediately by Uttar Dinajpur. After a decade, in 1990-91, district Hooghly was at the topmost position, followed by Nadia, Uttar Dinajpur, Murshidabad, Burdwan, Birbhum, Dakshin Dinajpur, Malda, Cooch Behar, 24 Parganas (N), Bankura and Jalpaiguri. On the other hand, district Kolkata was at the bottom, preceded immediately by Purulia. The comparative levels of agricultural de-

velopment as reflected in the ranking of the districts in the year 2000-2001 at top position was Nadia, followed by Hooghly, Cooch Behar, Malda, Burdwan, Murshidabad, Darjeeling, Birbhum, 24 Parganas (N), Uttar Dinajpur, Jalpaiguri, Midnapore, Dakshin Dinajpur and Howrah. On the other hand, district Kolkata was at the bottom preceded immediately by Purulia, 24 Parganas (S) and Bankura.

It may be observed from the Table 2 that the absolute average index for the state as whole has increased marginally during the three points of time as it increased by + 0.5378 and + 0.0102 points, that is, 1980-81 to 2000-01. Thus, marginal increase points towards slight improvement in the level of agricultural development.

The extent of disparities which may be visualized from the Table 2, the value of coefficient of variation has shown declining trend during the period of 1980-81 to 2000-2001.

Further, the districts have been classified into two categories on the basis of their levels of agricultural development. On the basis of levels of development, the districts have been classified as developed and developing. Developed districts are those which have the composite index value of agricultural development above the state average whereas developing districts have a value below the state average.

The classification of districts according to

composite index of agricultural development for the year 1980-81, 1990-91 and 2000-2001 is given in Table 3.

It is important to note that in order to compute mean and standard deviation, a positive constant of maximum minus value has been added to the entries in all the variables to have a data set with all positive values.

Inter-temporal analysis of Table 3 reveals that in 1980-81 four districts, viz. Darjeeling, Jalpaiguri, Nadia and Cooch Behar were in the developed districts category. In 1990-91, twelve districts, namely Hooghly, Nadia, Uttar Dinajpur, Murshidabad, Burdwan, Birbhum, Dakshin Dinajpur, Malda, Cooch Behar, 24 Parganas (N), Bankura and Jalpaiguri, got placed this category. Further, in 2000-01, here also fourteen districts, viz. Nadia, Hooghly, Cooch Behar, Malda, Burdwan, Murshidabad, Darjeeling, Birbhum, 24 Parganas (N), Uttar Dinajpur, Jalpaiguri, Midnapore, Dakshin Dinajpur and Howrah felt in the developed category districts but some districts are changed their position in compare with 1990-91.

Thus, it appears that the inter-district disparities of agricultural development, which actually featured in the year 1990-91 and also continued to exist up to 2000-2001 with inconsequential shifting in the ranking pattern.

But in the year 1980-81, the patterns of agri-

Table 2: District-wise indices of agricultural development

Districts	1980-81		1990-91		2000-01	
	Index	Rank	Index	Rank	Index	Rank
Burdwan	0.1399	9	0.8450	5	0.8429	5
Birbhum	0.0711	16	0.8285	6	0.7980	8
Bankura	0.1143	12	0.7546	11	0.7265	15
Midnapore	0.0810	15	0.7066	14	0.7700	12
Howrah	0.1260	11	0.7268	13	0.7519	14
Hooghly	0.1593	6	1.0000	1	0.9796	2
24 Parganas (N)	0.1313	10	0.7641	10	0.7949	9
24 Parganas (S)	0.1112	14	0.5443	17	0.5613	16
Nadia	0.2340	3	0.9409	2	1.0000	1
Murshidabad	0.1490	7	0.8451	4	0.8313	6
Malda	0.1115	13	0.8167	8	0.8490	4
Uttar Dinajpur	0.0692	17	0.8867	3	0.7933	10
Dakshin Dinajpur	0.0000	18	0.8183	7	0.7698	13
Jalpaiguri	0.5814	2	0.7518	12	0.7747	11
Darjeeling	1.0000	1	0.7054	15	0.8239	7
Cooch Behar	0.2273	4	0.8111	9	0.8559	3
Purulia	0.1633	5	0.5527	16	0.5586	17
Kolkata	0.1478	8	0.0000	18	0.0000	18
Mean	0.2010	**	0.7388	**	0.7490	**
S.D.	0.2621	**	0.2225	**	0.2171	**
C.V.	130.43	**	30.11	**	28.99	**

Rank Correlation Coefficients are: R12 = -0.084 R13 = + 0.33, R23 = + 0.76

Table 3: Classification of district according to level of agricultural development

1980-81		1990-91		2000-01	
Districts	Index	Districts	Index	Districts	Index
<i>Developed Districts</i>					
Darjeeling	1.0000	Hooghly	1.0000	Nadia	1.0000
Jalpaiguri	0.5814	Nadia	0.9409	Hooghly	0.9796
Nadia	0.2340	Uttar Dinajpur	0.8867	Cooch Behar	0.8559
Cooch Behar	0.2273	Murshidabad	0.8451	Malda	0.8490
		Burdwan	0.8450	Burdwan	0.8429
		Birbhum	0.8285	Murshidabad	0.8313
		Dakshin Dinajpur	0.8183	Darjeeling	0.8239
		Malda	0.8167	Birbhum	0.7980
		Cooch Behar	0.8111	24 Parganas (N)	0.7949
		24 Parganas (N)	0.7641	Uttar Dinajpur	0.7933
		Bankura	0.7546	Jalpaiguri	0.7747
		Jalpaiguri	0.7518	Midnapore	0.7700
				Dakshin Dinajpur	0.7698
				Howrah	0.7519
Mean	0.5107		0.8386		0.8311
C.V.	66.61		16.50		17.27
<i>Developing Districts</i>					
Purulia	0.1633	Howrah	0.7268	Bankura	0.7265
Hooghly	0.1593	Midnapore	0.7066	24 Parganas (S)	0.5613
Murshidabad	0.1490	Darjeeling	0.7054	Purulia	0.5586
Kolkata	0.1478	Purulia	0.5527	Kolkata	0.0000
Burdwan	0.1399	24 Parganas (S)	0.5443		
24 Parganas (N)	0.1313	Kolkata	0.0000		
Howrah	0.1260				
Bankura	0.1143				
Malda	0.1115				
24 Parganas (S)	0.1112				
Midnapore	0.0810				
Birbhum	0.0711				
Uttar Dinajpur	0.0692				
Dakshin Dinajpur	0.0000				
Mean	0.1125		0.53932		0.46162
C.V.	95.80		56.47		70.24

cultural development have considerably changed. One district, viz. Darjeeling which was in the list of developed districts during 1980-81, but in 1990-91 and also in 2000-01 reshuffled some districts, namely, Uttar Dinajpur, Dakshin Dinajpur, Malda, Midnapore, Birbhum and 24 Parganas (N) which have emerged from developing to developed districts. This fact may be seen in the context of considerable increase in some of the key indicators, viz. value of agricultural produce in terms of per hectare net area sown, per capita rural population, per agricultural workers and also percentage of area under commercial crops to gross cropped area in these districts.

DISTRICT-WISE DIMENSIONS OF AGRICULTURAL DEVELOPMENT

Level of agricultural development at district level has further been analyzed with the help of

varimax rotation of the factors of agricultural development so that various dimensions of agricultural development could be traced at district level.

The various dimensions of socio-economic agricultural development at district level with the help of Factor Analysis (cluster analysis) as the purpose of Factor Analysis is to identify groups of variables with shared common variance. The various dimensions of agricultural development have been identified by rotating the principal component matrix with varimax rotation (Kaiser Varimax Method) for the selected reference years, that is, 1980-81, 1990-91 and 2000-01. It is relevant to mention that the Principal Component Matrices have further been transformed into Rotated Factor Matrices for identification of various dimensions and extent of dimensional agricultural development at district level. Further, districts have been ranked according to level of

development in various dimensions. For studying the nature and extent of dimensional development of different districts similar selected indicators of agricultural development have been taken for analysis.

Evaluating the factor loadings for the years 1980-81, 1990-91 and 2000-01 enables us to determine the factors. Each variable has been assigned to the factor with which it has the highest loading. The second, third and fourth highest loadings, if significant have also be considered. Only those factor-loadings which are greater than 0.576 (or nearer to this value) are considered as significant. Therefore, for calculating composite scores of different dimensions of each district only significant factor loadings have been considered. It is evident from the Appendix 3 that each variable is significantly correlated with at least one factor.

(A) Dimensions of Agricultural Development, 1980-81

For the year 1980-81, Appendix 3, the *first factor* explains 29.66 per cent of the total variance and two indicators are positively correlated with this factor. These indicators are percentage of net area sown to total geographical area and percentage of agricultural workers to total (main) workers. Again two indicators, namely credit to agriculture (Rs. per capita) and average size of holdings are negatively and significantly correlated with this factor. Evidently, only two indicators are positively and significantly correlated with this dimension of agricultural development. Hence, this cluster does not point out towards specific dimension of agricultural development.

The *second factor* explains 21.54 per cent of the total variance and three indicators are positively and significantly correlated with this factor. These indicators are, namely, percentage of area under commercial crops to gross cropped area, cropping intensity and credit to agriculture (Rs. per capita). The positive and significant association of proportion of area under commercial crops to gross cropped area which an outcome of utilization of several inputs like improved seeds, fertilizer and irrigation shows the extent of modernization in agriculture. Therefore, this dimension of agricultural development may be named as *modernized agricultural development*.

The *third factor* explains 18.97 per cent of the total variance which has positive and significant

correlation with two indicators, namely, gross value of agricultural produce per hectare of net area sown and consumption of fertilizer per hectare of gross cropped area which indicates that used in input in a modern way of fertilizer and increase in productivity. Hence, this cluster does not point out towards specific dimension of agricultural development.

The *fourth factor* explains 18.68 per cent of total variance which has positive and significant correlation with two indicators, namely gross value of agricultural produce per capita of rural population and gross value of agricultural produce per agricultural workers. This dimension of agricultural development may be given the name *traditional agricultural development*.

The factor scores with respect to the first, second, third and fourth factors for the year 1980-81 have been calculated with the help of the following equations and presented in Appendix 4.

First Dimension of Agricultural Development

$$AD_1 = (-0.9423) Z_5 + (-0.7502) Z_7 + (0.6570) Z_8 + (0.7606) Z_{10} \dots\dots\dots (IV)$$

Where AD_1 is the first dimension of agricultural development; Z_5 , Z_7 , Z_8 and Z_{10} are values of variables in standardized form and the figures in parentheses are factor loadings with respect to the first factor.

Second Dimension of Agricultural Development

$$AD_5 = (0.9789) Z_4 + (0.6486) Z_6 + (0.6717) Z_8 \dots\dots\dots (V)$$

Where AD_5 is the second dimension of agricultural development; Z_4 , Z_6 and Z_8 are values of variables in standardized form and the figures in parentheses are factor loadings with respect to the second factor.

Third Dimension of Agricultural Development

$$AD_6 = (0.9075) Z_1 + (0.9321) Z_9 \dots\dots\dots (VI)$$

Where AD_6 is the third dimension of agricultural development; Z_1 and Z_9 are values of variables in standardized form and the figures in parentheses are factor loadings with respect to the third factor.

Fourth Dimension of Agricultural Development

$$AD_7 = (0.8407) Z_2 + (0.9152) Z_3 \dots\dots\dots (VII)$$

Where AD_7 is the fourth dimension of agricultural development; Z_2 and Z_3 are values of variables in standardized form and the figures in parentheses are factor loadings with respect to the fourth factor.

It may be observed from the Appendix 4 that the first dimension of agricultural development is a cluster of indicators of agricultural sector. This dimension included the indicators percentage of net area sown to total geographical area and percentage of agricultural workers to total (main) workers, these two indicators has shown negative association with the factor. Therefore, proportion of geographical area and agricultural workers did not show any positive effect on development of agricultural sector relative to first dimension at district level. But two indicators are positive association with the first factor which represents the performance of agricultural credit and land holdings on development of agricultural sector at district level, in these respect fourteen districts are positioned above the state average.

Likewise, second dimension of agricultural development during the same period was a cluster of indicators pertaining to multiple cropping intensity and agricultural credit which is dependency on agriculture sector for employment purpose. District Darjeeling emerged as the most developed, closely followed by Jalpaiguri, Nadia, Hooghly, Cooch Behar, Uttar Dinajpur and Murshidabad as is evident from the ranking of these districts (Appendix 4).

The third dimension of agricultural development is a cluster of indicators of agricultural sector, which represent performance of value of agricultural produce and fertilizer consumption. In this respect, district Hooghly was at the top in the list, closely followed by Howrah, Burdwan, 24 Parganas (N), Birbhum, Nadia and Darjeeling districts. On the other hand, the district which could be identified as the least developed was Kolkata, preceded by Jalpaiguri district.

In the matter of fourth dimension of agricultural development is cluster of indicators of agricultural sector, which represent performance of land and labour. In this respect district Dakshin Dinajpur was at the top in the Appendix-4 shown, closely followed by Burdwan, Hooghly, Birbhum, Bankura, Jalpaiguri, 24 Parganas (N), Cooch Behar, Purulia, Uttar Dinajpur and Midnapore districts. On the other hand, the district which could be identified as the least developed was Kolkata, preceded by 24 Parganas (S) district.

(B) Dimensions of Agricultural Development, 1990-91

On the basis of three identified factors after

rotating principal component matrix into varimax rotation, three dimensions of agricultural development have been worked out for the year 1990-91 in Appendix-3.

The *first dimension* of agricultural development exhibits a cluster of indicators, namely percentage of net area sown to total geographical area, cropping intensity, percentage of agricultural workers to total (main) workers and credit to agriculture (Rs. per capita), which has been named as *traditional agricultural development*.

The *second dimension* is group of indicators, viz. gross value of agricultural produce per capita of rural population, percentage of area under commercial crops to gross cropped area and average size of holdings. Hence, this cluster does not point out towards specific dimension of agricultural development.

The *third dimension* is group of indicators, viz. gross value of agricultural produce per hectare of net area sown, cropping intensity and consumption of fertilizer per hectare of gross cropped area, which has been named as *modernized agricultural development*.

The factor scores with respect to the first and third factors for the year 1990-91 have been calculated with the help of the following equations and presented in Appendix-4 accordingly.

First Dimension of Agricultural Development

$$AD_8 = (-0.7277) Z_3 + (0.7848) Z_5 + (0.5051) Z_6 + (0.9508) Z_7 + (0.6365) Z_8 \dots\dots\dots (VIII)$$

Where AD_8 is the first dimension of agricultural development; Z_3 , Z_5 , Z_6 , Z_7 and Z_8 are values of variables in standardized form and the figures in parentheses are factor loadings with respect to the first factor.

Second Dimension of Agricultural Development

$$AD_9 = (0.8410) Z_2 + (0.7979) Z_4 + (0.7901) Z_{10} \dots\dots\dots (IX)$$

Where AD_9 is the second dimension of agricultural development; Z_2 , Z_4 and Z_{10} are values of variables in standardized form and the figures in parentheses are factor loadings with respect to the second factor.

Third Dimension of Agricultural Development

$$AD_{10} = (0.8426) Z_1 + (0.7730) Z_6 + (0.8729) Z_9 \dots\dots\dots (X)$$

Where AD_{10} is the third dimension of agricultural development; Z_1 , Z_6 and Z_9 are values of variables in standardized form and the figures in parentheses are factor loadings with respect to the third factor.

It is evident from the Appendix 4, that second dimension revealed ten districts, namely Jalpaiguri, Darjeeling, Nadia, Hooghly, Burdwan, Cooch Behar, Bankura, Birbhum, Murshidabad and 24 Parganas (N) were fairly developed districts with respect to the second dimension or *traditional agricultural development*, and the remaining eight districts were found to be less developed due to their value of composite indices being lower than the state average.

Similarly, in the matter of third dimension that is, *modernized agricultural development* Hooghly, Howrah, Nadia, 24 Parganas (N), Malda, Murshidabad, Cooch Behar, Burdwan and Birbhum districts are emerged as developed districts and remain nine districts are fell in the less developed category. It has been observed that commercialization of agricultural development has been taken place due to maximum used of fertilizer, which increases cropping intensity, which leads to increase value of agricultural produce in agricultural sector.

(C) Dimensions of Agricultural Development, 2000-01

The *first factor* brings out the first dimension of agricultural development for the year 2000-01 in Appendix 3. This factor clearly forms a cluster of five variables, namely gross value of agricultural produce per hectare of net area sown, gross value of agricultural produce per capita of rural population, percentage of area under commercial crops to gross cropped area, percentage of net area sown to total geographical area and cropping intensity. This dimension may be designated as *overall agricultural development*.

The *second factor* brings out another dimension of agricultural development. This factor forms a cluster of three indicators, viz. gross value of agricultural produce with respect to per capita of rural population, credit to agriculture (Rs. per capita) and average size of holdings, but this cluster does not point out towards specific dimension of agricultural development.

The *third factor* explains 22.03 per cent of the total variance which has positive and significant correlation with two indicators, namely percentage of net area sown to total geographical area and percentage of agricultural workers to total (main) workers. Evidently, only one indicator is negative and significantly correlated with this dimension of agricultural development. Hence,

this cluster does not point out towards specific dimension of agricultural development.

The *fourth factor* brings out the fourth dimension of agricultural development for the year 2000-01. This factor clearly forms a cluster of two variables, namely, gross value of agricultural produce per hectare of net area sown and consumption of fertilizer per hectare of gross cropped area. This dimension may be designated as *modern agricultural development*.

The factor scores with respect to the first, second and fourth factors for the year 2000-01 have been calculated with the help of the following equations and presented in Appendix 4.

First Dimension of Agricultural Development

$$AD_{11} = (0.7578) Z_1 + (0.6486) Z_2 + (0.9057) Z_4 + (0.7264) Z_5 + (0.8592) Z_6 \dots\dots\dots (XI)$$

Where AD₁₁ is the first dimension of agricultural development; Z_1 , Z_2 , Z_4 , Z_5 and Z_6 are values of variables in standardized form and the figures in parentheses are factor loadings with respect to the first factor.

Second Dimension of Agricultural Development

$$AD_{12} = (0.6612) Z_2 + (0.8451) Z_8 + (0.9359) Z_{10} \dots\dots\dots (XII)$$

Where AD₁₂ is the second dimension of agricultural development; Z_2 , Z_8 and Z_{10} are values of variables in standardized form and the figures in parentheses are factor loadings with respect to the second factor.

Third Dimension of Agricultural Development

$$AD_{13} = (-0.9245) Z_3 + (0.5908) Z_5 + (0.9369) Z_7 \dots\dots\dots (XIII)$$

Where AD₁₃ is the third dimension of agricultural development; Z_3 , Z_5 and Z_7 are values of variables in standardized form and the figures in parentheses are factor loadings with respect to the third factor.

Fourth Dimension of Agricultural Development

$$AD_{14} = (0.5578) Z_1 + (0.9484) Z_9 \dots\dots\dots (XIV)$$

Where AD₁₄ is the fourth dimension of agricultural development; Z_1 and Z_9 are values of variables in standardized form and the figures in parentheses are factor loadings with respect to the fourth factor.

The district-wise indices of the first dimension that is, overall agricultural development, have been presented in Appendix 4. It may be observed from this appendix that twelve districts, namely Nadia, Hooghly, Murshidabad, Cooch

Behar, 24 Parganas (N), Malda, Uttar Dinajpur, Dakshin Dinajpur, Jalpaiguri, Howrah, Burdwan and Darjeeling were above or near the value of the state average. Hence, these twelve districts may be considered as developed districts with respect to overall agricultural development. On the other hand, remaining six districts were placed below the state average and as such these districts may be considered as less developed in this respect. It may also be observed that extent of inter-district disparity with respect to overall agricultural development was fairly low.

In the matter of fourth dimension that is, modernized agricultural development, namely, Howrah, Hooghly, Darjeeling, 24 Parganas (N), Burdwan, Malda and Nadia emerged as developed districts due to their placement above the state average. Remaining eleven districts were less developed in this respect. Extent of inter-district disparities was relatively high in this respect than the first dimension.

FINDINGS

1. The average level of agricultural development of West Bengal exhibits an increasing trend during 1980-81 to 2000-01. The ranking pattern of districts is similar in interdistrict diversifications, the rank correlation coefficient being $R_{12} = -0.084$ $R_{13} = +0.33$, for the period 1980-81 to 2000-01. This shows that the level of agricultural development is associated with resources endowment of the districts in this state. Inter-districts variations in levels of agricultural development demonstrate a declining trend in the reference years.
2. In the first dimension, that is, modernized agricultural development shows that in the beginning that is, Hooghly, Howrah, Burdwan, 24 Parganas (N), Birbhum and Nadia were the developed districts remaining twelve districts lagged behind. On the other hand, Dakshin Dinajpur, Jalpaiguri, Burdwan, Hooghly, Birbhum, Bankura, Darjeeling, Cooch Behar, Purulia and 24 Parganas (N) emerged as developed districts with respect to traditional agricultural development and the remaining eight districts remained in the backward category.
3. In the year 1990-91, Uttar Dinajpur, Dakshin Dinajpur, Birbhum, Malda, Nadia, Murshidabad, Hooghly, Burdwan, Midnapore, Cooch Behar and Bankura districts emerged

as developed districts in the matter of first dimension, that is, traditional agricultural development, and the remaining seven districts were less developed. Alternatively, nine districts, namely, Hooghly, Howrah, Nadia, 24 Parganas (N), Malda, Murshidabad, Cooch Behar, Burdwan and Birbhum were identified as developed districts with respect to modernized agricultural development and the remaining nine districts were backward.

4. During 2000-01, two dimensions, namely, overall agricultural development and modernized agricultural development were recognized. Twelve districts, namely, Nadia, Howrah, Murshidabad, Cooch Behar, 24 Parganas (N), Malda, Uttar Dinajpur, Dakshin Dinajpur, Jalpaiguri, Howrah, Burdwan and Darjeeling emerged as developed districts with respect to overall agricultural development, remaining six districts lagged behind. On the other hand, in the case of other dimension, that is, modernized agricultural development, seven districts, namely Howrah, Hooghly, Darjeeling, 24 Parganas (N), Burdwan, Malda and Nadia emerged as developed districts but in the remaining eleven districts were less developed.

CONCLUSION

The problem of regional imbalances, at both inter-state and intra-state levels has persisted in India even during the post-plan era. Although concern was voiced about regional disparities in India right from the beginning of the planning era, yet a more concerted effort to address this problem was made only in the Third Five-Year Plan. In the subsequent plans also this problem was taken up seriously and as a consequence, several area development programmes were started to mitigate the extent of disparities in the socio-economic development. West Bengal is one of the recipients of funds under various Area Development Programmes initiated by the Central Government, under full or partial sponsorship.

RECOMMENDATIONS

The above analysis based on various indicators of agricultural development has made it clear

that some districts are relatively backward in West Bengal. Therefore, any plan or programme for improving the level of development of these backward regions should go together.

It is heartening to note that efforts have been made at the level of the State Government to develop growth centres in West Bengal through the establishment of Uttarbanga Unnayan Parishad, Darjeeling Gorkha Hill Council, Paschimanchal Unnayan Parishad, Sunderbans Development Board and the most significant fact is that there has been a beginning to address the problem of the region. Such a regional development agency must be strengthened, since it can play a coordinating role for greater convergence of agricultural development efforts to prepare a blueprint for regional development involving local Panchayats of the region. These efforts are to be combined with the provision of adequate resources for the Development Council to perform developmental activities properly and to attract outside investments, so that the developing districts comprising the region may possibly catch up with the other relatively developed districts of West Bengal State.

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APPENDICES

Appendix 1

<i>Inter-correlation matrix of agriculture development in 1980-1981</i>										
<i>Variable number</i>	<i>A - 1</i>	<i>A - 2</i>	<i>A - 3</i>	<i>A - 4</i>	<i>A - 5</i>	<i>A - 6</i>	<i>A - 7</i>	<i>A - 8</i>	<i>A - 9</i>	<i>A -10</i>
A - 1	1.000									
A - 2	0.613	1.000								
A - 3	0.242	0.627	1.000							
A - 4	0.168	0.134	0.279	1.000						
A - 5	0.401	0.712	0.033	0.328	1.000					
A - 6	0.489	0.201	0.111	0.616	0.166	1.000				
A - 7	0.254	0.725	-0.100	0.057	0.749	0.098	1.000			
A - 8	0.096	-0.138	0.386	0.667	-0.259	0.607	-0.350	1.000		
A - 9	0.744	0.200	-0.200	0.102	0.331	0.209	0.044	-0.068	1.000	
A - 10	0.210	0.128	0.423	0.476	-0.143	0.703	-0.027	0.816	-0.124	1.000
<i>Inter-correlation matrix of agriculture development in 1990-1991</i>										
<i>Variable number</i>	<i>A - 1</i>	<i>A - 2</i>	<i>A - 3</i>	<i>A - 4</i>	<i>A - 5</i>	<i>A - 6</i>	<i>A - 7</i>	<i>A - 8</i>	<i>A - 9</i>	<i>A -10</i>
A - 1	1.000									
A - 2	0.615	1.000								
A - 3	-0.223	0.014	1.000							
A - 4	0.672	0.719	0.171	1.000						
A - 5	0.598	0.673	-0.588	0.548	1.000					
A - 6	0.804	0.527	-0.538	0.590	0.828	1.000				
A - 7	0.204	0.466	-0.723	0.168	0.751	0.522	1.000			
A - 8	0.114	0.546	-0.087	0.347	0.536	0.311	0.491	1.000		
A - 9	0.600	0.031	-0.371	0.097	0.313	0.578	-0.006	-0.049	1.000	
A - 10	0.213	0.654	0.318	0.437	0.140	0.134	0.063	0.194	-0.038	1.000
<i>Inter-correlation matrix of agriculture development in 2000-01</i>										
<i>Variable number</i>	<i>A - 1</i>	<i>A - 2</i>	<i>A - 3</i>	<i>A - 4</i>	<i>A - 5</i>	<i>A - 6</i>	<i>A - 7</i>	<i>A - 8</i>	<i>A - 9</i>	<i>A -10</i>
A - 1	1.000									
A - 2	0.570	1.000								
A - 3	-0.033	0.070	1.000							
A - 4	0.617	0.540	0.054	1.000						
A - 5	0.498	0.679	-0.484	0.615	1.000					
A - 6	0.829	0.679	-0.297	0.683	0.777	1.000				
A - 7	-0.060	0.356	-0.761	-0.005	0.644	0.316	1.000			
A - 8	0.421	0.585	0.093	0.254	0.293	0.343	0.209	1.000		
A - 9	0.559	0.109	-0.066	0.110	0.162	0.256	-0.149	0.328	1.000	
A - 10	0.207	0.637	0.258	0.179	0.161	0.275	0.140	0.726	0.148	1.000

Note: Critical value of r at 10 percent level = 0.497

Critical value of r at 5 percent level = 0.576

Critical value of r at 1 percent level = 0.714

Appendix 2

Variable	Principal component matrix of agricultural development									
	1980-81					1990-91				
	P_1	P_2	P_3	P_4	h^2	P_1	P_2	P_3	h^2	
1	-0.044	0.716	-0.615	-0.234	0.947	0.785	0.043	0.538	0.908	
2	-0.489	0.760	0.339	-0.216	0.979	0.801	0.503	-0.146	0.916	
3	0.255	0.735	0.473	-0.287	0.911	-0.452	0.828	0.176	0.921	
4	0.535	0.358	0.163	0.724	0.965	0.701	0.518	0.185	0.794	
5	-0.702	0.359	0.139	0.540	0.932	0.926	-0.187	-0.177	0.923	
6	0.758	0.200	-0.169	0.217	0.691	0.900	-0.224	0.242	0.919	
7	-0.735	0.072	0.424	0.132	0.743	0.667	-0.347	-0.587	0.909	
8	0.930	0.162	0.107	0.095	0.912	0.538	0.184	-0.548	0.623	
9	-0.163	0.363	-0.864	0.117	0.919	0.412	-0.392	0.678	0.783	
10	0.873	0.099	0.261	-0.215	0.886	0.339	0.717	-0.010	0.629	
Eigenvalue	3.853	2.099	1.799	1.134	**	4.640	2.116	1.571	**	
Percentage variance	38.530	20.991	17.985	11.339	**	46.397	21.163	15.705	**	
Cumulative variance (%)	38.530	59.522	77.507	88.846	**	46.397	67.560	83.265	**	

Appendix 3

Variable	Rotated factor matrix (Varimax method)									
	1980-81					1990-91				
	Factor-1	Factor-2	Factor-3	Factor-4	h^2	Factor-1	Factor-2	Factor-3	h^2	
1	-0.070	-0.025	0.907	0.343	0.947	0.133	0.425	0.843	0.908	
2	0.469	-0.160	0.162	0.841	0.979	0.416	0.841	0.190	0.916	
3	-0.154	0.222	-0.032	0.915	0.911	-0.728	0.484	-0.397	0.921	
4	0.043	0.979	-0.034	0.062	0.965	0.128	0.798	0.375	0.794	
5	0.942	0.125	0.112	0.127	0.932	0.785	0.308	0.461	0.923	
6	-0.492	0.649	0.166	-0.018	0.691	0.505	0.257	0.773	0.919	
7	0.750	-0.262	-0.258	0.211	0.743	0.951	0.046	0.056	0.909	
8	-0.657	0.672	-0.100	0.138	0.912	0.636	0.439	-0.161	0.623	
9	0.111	0.027	0.932	-0.193	0.919	-0.031	-0.141	0.873	0.783	
10	-0.761	0.404	-0.244	0.291	0.886	-0.053	0.790	-0.044	0.629	
Eigenvalue	2.97	2.15	1.90	1.87	**	2.92	2.76	2.65	**	
Percentage of variance	29.66	21.54	18.97	18.68	**	29.21	27.59	26.47	**	
Cumulative variance (%)	29.66	51.20	70.17	88.85	**	29.21	56.79	83.27	**	

Note: Critical value of q_i at 5 per cent level = 0.576

Critical value of q_i at 1 per cent level = 0.714

Appendix 4

S. No.	Districts	Dimensions of agricultural development												Dimensions of agricultural development in 2000-01											
		in 1980-81						in 1990-91						in 2000-01						in 2000-01					
		First dimension index	Second dimension index	Third dimension index	Fourth dimension index	First dimension index	Second dimension index	Third dimension index	Fourth dimension index	First dimension index	Second dimension index	Third dimension index	Fourth dimension index	First dimension index	Second dimension index	Third dimension index	Fourth dimension index	First dimension index	Second dimension index	Third dimension index	Fourth dimension index	First dimension index	Second dimension index	Third dimension index	Fourth dimension index
1	Burdwan	0.7503	13	0.3709	9	0.6965	3	0.9743	2	0.7456	8	0.7640	5	0.5986	8	0.6942	11	0.7106	3	0.8058	5	0.4920	5		
2	Birbhum	0.8447	5	0.3009	12	0.4910	5	0.9051	4	0.8407	3	0.6577	8	0.5829	9	0.5895	14	0.7290	2	0.9198	2	0.4128	9		
3	Bankura	0.7693	11	0.2675	13	0.3037	13	0.8664	5	0.7120	11	0.6816	7	0.5143	13	0.5491	15	0.6673	5	0.8057	6	0.3945	11		
4	Midnapore	0.8310	6	0.2497	14	0.3900	9	0.6991	11	0.7266	9	0.4711	14	0.5254	11	0.6421	13	0.5945	9	0.7921	8	0.4169	8		
5	Howrah	0.7805	10	0.3155	11	0.8146	2	0.4716	16	0.5701	12	0.2911	17	0.9837	2	0.7112	10	0.3369	17	0.5055	15	1.0000	1		
6	Hooghly	0.8007	9	0.5568	4	1.0000	1	0.9157	3	0.7759	7	0.7785	4	1.0000	1	0.9099	2	0.6387	7	0.7346	11	0.8173	2		
7	24 Parganas (N)	0.7568	12	0.2494	15	0.5748	4	0.7699	7	0.5680	13	0.5976	10	0.7188	4	0.7852	5	0.4841	12	0.5699	14	0.5259	4		
8	24 Parganas (S)	0.7456	14	0.1931	16	0.2981	15	0.3984	17	0.5395	16	0.3254	16	0.4359	16	0.4478	16	0.3933	16	0.6859	12	0.3910	12		
9	Nadia	0.8141	7	0.6081	3	0.4589	6	0.6736	12	0.8105	5	0.8028	3	0.7741	3	1.0000	1	0.6788	4	0.6425	13	0.4594	7		
10	Murshidabad	0.8798	3	0.4777	7	0.4052	8	0.5887	15	0.7832	6	0.6539	9	0.6413	6	0.8081	3	0.5089	11	0.7791	9	0.3627	15		
11	Malda	0.8710	4	0.3777	8	0.3687	10	0.5969	14	0.8121	4	0.5573	13	0.6556	5	0.7732	6	0.5899	10	0.7599	10	0.4763	6		
12	Uttar Dinajpur	0.9911	2	0.4931	6	0.3088	12	0.7235	10	1.0000	1	0.5928	11	0.5250	12	0.7505	7	0.4129	15	1.0000	1	0.3158	16		
13	Dakshin Dinajpur	1.0000	1	0.3690	10	0.3229	11	1.0000	1	0.8779	2	0.5666	12	0.4813	15	0.7477	8	0.4197	14	0.9108	3	0.2964	17		
14	Jalpaiguri	0.3706	17	0.7361	2	0.2137	17	0.8129	6	0.5532	14	1.0000	1	0.4977	14	0.7259	9	0.6522	6	0.4989	16	0.3640	14		
15	Darjeeling	0.0000	18	1.0000	1	0.4227	7	0.6274	13	0.5103	17	0.9885	2	0.5547	10	0.6644	12	1.0000	1	0.1050	17	0.5603	3		
16	Cooch Behar	0.8097	8	0.5306	5	0.3006	14	0.7441	8	0.7257	10	0.7081	6	0.6174	7	0.7862	4	0.6000	8	0.7988	7	0.4049	10		
17	Purulia	0.6686	15	0.1736	17	0.2881	16	0.7423	9	0.5515	15	0.4151	15	0.3825	17	0.3878	17	0.4484	13	0.8669	4	0.3704	13		
18	Kolkata	0.5007	16	0.0000	18	0.0000	18	0.0000	18	0.0000	18	0.0000	18	0.0000	18	0.0000	18	0.0000	18	0.0000	18	0.0000	18		
	Mean	0.7325		0.4039		0.4255		0.6950		0.6724		0.6029		0.5827		0.6652		0.5481		0.6767		0.4478			
	C.V.	31.55		74.04		70.46		35.90		37.55		47.22		48.31		38.63		51.81		39.33		64.92			