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Infrastructural Growth, Farm Size and Pattern of Crop Diversification Across the Districts of West Bengal

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Crop diversification thus became an important issue of research in agricultural economics not only within India and but also in other parts of the world. Choice of highly remunerative crops on the other hand depends on the availability of various agricultural technologies supported by appropriate infrastructure required for the timely cultivation, harvest, protection as well as marketing of those crops.

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Infrastructural Growth, Farm Size and Pattern of Crop Diversification Across the Districts of West Bengal

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Crop diversification thus became an important issue of research in agricultural economics not only within India and but also in other parts of the world. Choice of highly remunerative crops on the other hand depends on the availability of various agricultural technologies supported by appropriate infrastructure required for the timely cultivation, harvest, protection as well as marketing of those crops. In India as well as in West Bengal different regions recorded varied level of diversification in the past few decades, which may be due to the variation in the support of various infrastructural, technological and financial supports. Accessibility to different infrastructure, modern inputs and implements also depends on the financial strength of the farmers that varies across the farm size. This paper tried to examine the pattern of growth of various infrastructural and technological factors across the districts of West Bengal and the nature and extent of crop diversification during 1970 to 2005. It also tries to examine whether there is any significant relation between the infrastructural and technological factors and farm size with the level of diversification in West Bengal.

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1. INTRODUCTION

Crop diversification has been projected as the solution to several problems associated with agriculture including sustainability of farm income, agricultural employment and management of soil productivity and reduction in fluctuation and uncertainty of farm earning (Minhas and Parikh, 1966; Bhalla and Alagh, 1979; Boyce, 1987; Dhindsa and Sharma, 1995; Vyas, 1996; Bhalla and Singh, 1997; De, 2001). It can also be viewed as the survival needs of the farmers especially of the small and marginal ones. But,

the incidence of crop diversification in India was not significant before the introduction of new agricultural technology in the mid-nineteen sixties. With the advent of seed-fertilizer-irrigation technology a significant change in land allocation towards some high value cash crops, fruits and vegetables, particularly by the small farmers is observed in India (Joshi et. al, 2006). In West Bengal however, the diversification became prominent much later, only in 1980s (De, 2003).

The shifts in *cropping pattern* in India are traceable to changes in the relative prices of crops, expansion of irrigation and uses of technology that alter the relative profitability of crops in ways which affect different regions differently (Narain, 1965; Raj et al 1988). Development of infrastructure along with various price and other non-price factors are found responsible for the diversification of crops and hence a variation in growth of them caused significant spatial variation in the pace of crop diversification in India and West Bengal as well (Vyas, 1996; Chand, 1996; Narayanamoorthy, 1997; Singhal and Gauraha, 1997; Singh et al, 1997; Bhalla and Singh, 1997; De, 2003; De and Chattopadhyay, 2010). During 1980s and 1990s, the diversification has been wide-spread due to the supporting infrastructure development such as market centres, roads, transport etc., in the countryside along with seed-fertilizer-irrigation technology (Vyas, 1996; Bhalla and Singh, 1997).

Also, diversification is supposed to depend on the farm size as capacity to use technology, commercial motive and hence allocation of land towards cultivable crops depends on it and institutional factors. In the small peasant dominated Indian agriculture, availability of modern farm inputs during the recent decades helped even the small farmers to diversify land use towards high value crops and improve their earnings (GOI, 1997). In West Bengal, the high value crops like potato, summer paddy and mustard have received high priority among the farmers across all categories especially small farmers over the years (De, 2000). Diversification towards high value crops especially horticulture and some specific commercial crops like summer (boro) paddy, potato, mustard in the age of commercialisation and improved market infrastructure help the farmers to earn cash as much as possible for the improvement of the standard of living.

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This paper examined the pattern of various infrastructure developments across the districts of West Bengal during 1970–71 to 2004–05.¹ Also the role of various infrastructural factors on the spatio-temporal variations in diversification is analysed. The next section presents a review of some relevant studies. Thereafter, the materials and methods used for the analysis are described, which is followed by observations and analysis. Finally, the conclusions of the study are presented.

II. REVIEW OF RELEVANT LITERATURE

Literatures (Narain, 1965; Boyce, 1987; Narayanmoorthy, 1997; Sawant, 1997; Bhalla and Singh, 1997; Ashok and Balsubramania, 2006; De and Chattopadhyay, 2010) are available where the impact of various infrastructures; farm size, institutional factors, price, profitability etc on the diversification of crop at national or state level in India are examined. Chand (1995) observed that access to motorable road, market and irrigation facilities determines the success and profitability of diversification through high paying crops like off-season vegetables, while the role of farm size on the level of diversification were found to be very weak. Narain (1965), Nayyar and Sen (1994), Vyas (1996) on the other hand viewed that a significant change in the cropping pattern in the countryside was due to changes in the relative prices of the agricultural commodities. Also market infrastructure, institutional arrangements and technological change especially in irrigation contributed significantly to the changes in cropping pattern. However, Joshi and Gulati (2003) contradicted the argument and reported a negative impact of irrigation on crop diversification across the states of India during 1980-81 to 1999-2000.

With growing commercialisation of Asian agriculture, diversification level of national production would go up while at farm level the diversification would go down due to more specialisation, though some other studies reported mixed effects of infrastructural variables on crop diversity (Trimmer, 1997). De (2000) also examined the extent of crop diversification and its variation across different districts of West Bengal with the help of various indices like *Herfindahl Index* (HI), *Ogive Index* (OI), *Entropy* (EI) as well as *Modified Entropy Index* (MEI) and observed large scale variations in diversification across districts over time depending upon the growth of utilisation of technologically improved agro-implements. Chand and Chauhan (2002) however, observed that the land possessed by the small and marginal peasants significantly related to the extent of diversification of crops in India during 1968-69 to 1998-99. Regressing DIV_{mk} as the index of diversification for two sub-periods; 1968-69 to 1983-84 and 1983-84

to 1998-99 on institutional credit per hectare Gross Cropped Area (GCA), electricity used in agriculture per hectare GCA, percentage of GCA under irrigation, agricultural markets per 1000 sq km area, road length per 1000 sq km area and proportion of small and marginal holdings as explanatory variables they found that only three variables irrigation, road density and small and marginal holdings had significantly positive impact on agricultural diversification.

A few authors have also argued that small and marginal farmers practised agricultural diversification instead of depending on the cereal based production only due to their survival. For example, a framework for assessing the flexibility of paddy lands and rice growers to respond to commercialization through seasonal or permanent diversification out of rice monoculture system has been developed by Pingali et al (1997). According to them, small and marginal farmers need diversification of crops for meeting their cost of living but the flexibility of farmers in responding to diversification opportunities is in most cases constrained by the size of markets, price risks, soil suitability, quality of irrigation infrastructure, availability and cost of labour. Using data from the South Asian countries, Joshi et al (2007) reported similar results. Small and marginal holders, despite having advantages of cheap family labour in contrast to the hired labour; to manage effectively in diversifying crops are in most cases constrained by the availability of market and fair price, and quality of irrigation infrastructure. Thus, in many cases they fail to achieve their targets of diversifying crops.

Ashok and Balsubramania (2006) showed the importance of infrastructure in explaining the extent of diversification. They observed that access to motorable road; market and irrigation determine the extent, success and profitability of diversification through high paying crops, while the role of farm size was insignificant.

De (2003) discussed at length the nature of changes in cropping pattern in West Bengal and the determinants of crop diversification during 1970-71 to 1994-95. In order to analyse the nature of changes in cropping pattern, he considered the rate of growth of acreage of different crops both in absolute and relative terms over time. The whole period was divided into two sub-periods: 1970-71 to 1981-82 and 1982-83 to 1994-95 to understand the variation in crop diversification during pre and post economic reforms scenario. The analysis revealed that the cropping pattern in West Bengal in terms of allocation of acreage remained skewed towards boro paddy, potato and oilseeds (especially mustard). These were the three important emerging cash crops during the decades of 1980's and 90's. The other crops continued to lose their importance in the cropping pattern of West Bengal. That means a concentration of crop activities in season has been observed towards a crop group that also varied across the districts over time. The primary reason for inter-

¹ This time period has been chosen as per the availability of data both at district and state level.

district variations in the intensity of crop diversification was the use of mechanical devices to exploit ground water as well as surface water and other scientific techniques have been growing faster in those so-called agriculturally developed districts such as Hooghly, Burdwan, Nadia and Howrah than the other areas.

In a similar regional study based on the data of Himachal Pradesh, Sharma (2005) argued that the adoption of high value cash crops, particularly fruit crops, helps the mountainous regions because it promotes the productive use of abundant marginal lands available in these regions. He analysed the patterns, processes and factors that facilitated the process of agricultural development and crop diversification, on the basis of secondary and primary data, collected from different districts of Himachal Pradesh. He also studied the temporal changes in the process of diversification through changes in share of area under non-foodgrain crops and by constructing and ranking of districts by using Herfindahl index that mainly captures distribution and diversity. But it is not enough to capture the changes in the enterprise mix over time. He has constructed another index that measures changes in the area allocated to different crops between two time periods as suggested by Chand and Chauhan (2002). Based on the above methodology, Sharma observed that there were inter-district variations in the level and extent of diversification and the process of crop diversification gathered momentum after 1987-88 all over the state.

Using the method of Minot (2003), Joshi, Bithal and Minot (2006) showed that the main source of crop income growth in India during 1980s was the technology led growth of yields of various crops and diversification emerged as the dominant sources of growth in agricultural income during the 1990s. Diversification towards horticultural crops led to rise in agricultural income in the 1990s more than that in the 1980s. Moreover, compared to the southern and western regions, impact of crop diversification was less in eastern region including West Bengal during the 1990s. At international level, Ahmad and Isvilanonda (2003) examined the regional pattern of diversification at farm level in the Thailand and also examined the impact of diversification on the farm income. Also they tried to find out the constraints faced by the farmers in different regions and production environment. The regional disparity in agricultural development has been observed due to the farmers' inability in certain regions to diversify relatively profitable crops.

Wehbe et al (2006) have shown that diversification of agricultural practices may be helpful in mitigating climate risk along with insurance, irrigation development and technologies that sometimes hindered due to the limitation of financial access, poor information network and market failures in Mexico and Argentina. Also differences in diversification and access to coping

strategies between large and small farms have been a matter of concern and thus they advocated for the role of public sector.

In recent past, government of Tanzania also undertook a feasibility review for the diversification towards various horticultural crops and also for export diversification in order to reduce the impact of declining export earnings from cotton and coffee during the period of worldwide recession that affected mostly the small farmers who constitutes the majority of farming community. Those farmers also suffer from the lack of capital and other infrastructure needed for diversification (IDRC, 2008; CIAT, 2005).

III. MATERIALS AND METHODS

First of all, variation in various agro-infrastructures across the districts and its temporal variation since 1970 have been described by tabular method. Changes in inter-district variation have been examined through the changes in coefficient of variation. As the data is available for some items only for few discrete years like minor irrigation items, electricity use, market and road infrastructure; the convergence level is examined by the correlation between the initial values across the districts and the rate of growth during the whole period ((Baumol 1986), DeLong (1988), Barro (1991), Barro and Sala-i-Martin (1992), and Mankiw et al. (1992)) though there are some limitations of this method as pointed out by Quah (1993), Bernard and Durlauf (1996), and Evans (1997). A significant negative correlation in this will indicate *convergence* in the growth across the districts, which happens if the initially backward districts grow at faster rates as compared to the relatively advanced districts. Wherever, continuous series of data is available like major irrigation, use of chemical fertiliser etc; cointegration coefficients have been checked to know the pattern of growth in the state (Johansen, 1988; Engle and Granger, 1987).

The convergence of the districts is observed if the co-integration coefficient is significant, which is examined by using augmented Engle-Granger (AEG) test through the regression

$$\Delta Y_{it} = \alpha_i + \beta_i \cdot t + \gamma_{i0} Y_{i,t-1} + \sum_{j=1}^{p_i} \delta_{ij} \Delta Y_{i,t-j} + \varepsilon_{it} \quad (1)$$

where $t = 1, \dots, T \dots (1)$. Here, Y_{it} is the series of error of regression of a time series say, irrigation intensity of one district on those of others. Here the inference is based on the usual τ -statistic of γ_{i0} , which has a non-standard distribution. The Akaike information criterion is used to determine the lag length parameter p_i . Equation is estimated in both forms, including and excluding time trend (Engle and Granger, 1987). Also, the coefficient of variation among the districts of irrigation intensity etc and its variation over time is computed. From the trend of coefficient of variation we can examine the

convergence or divergence of the districts on that criterion.

The extent of crop diversification at a given point of time is examined by using various indices like, (1) Herfindahl Index (HI), (2) Simpson's Index (SI), (3) Entropy Index (EI) and (4) Modified Entropy Index (MEI). Among these indices the HI, SI and the entropy index are widely used in the literature of agricultural diversification. All these indices are computed on the basis of proportion of gross cropped area under different crops cultivated in a particular geographical area. It should be noted that the Herfindahl index is the index of concentration and thus the higher the value of it is an indication of specialisation of crop activities. Thus, it is subtracted from one to have the index of diversification, which is the simplified form of Simpson Index.²

A ranking of the districts on the basis of the computed values of these indices have been done to understand the spatial pattern of diversification. Again, to check whether the ranking pattern of the districts on the basis of these different indices are consistent or not, we have computed the spearman's rank correlation coefficient by taking the pairs of different indices and tested its level of significance. Here, the rank correlations are observed to be positive and significantly high for each pair of observations. Thus, without any loss of generality, any one of the indices can be used to describe the intensity of diversification. However, in the present study, analysis is made on the basis of computed Herfindahl indices so that the results can be compared with the earlier studies which have, by and large, used either Herfindahl index.

Since Herfindahl Index (HI) or Simpson Index assumes a very large (almost infinite) alternative of production choices, there exist a large number of crops which can be accommodated in measuring diversity by this index. Thus if the total area is equally shared among the large number of alternative crops, it means that the share of each crop would be exceedingly small and tending nearer to zero. The higher the value of HI, lower is the diversification and more is the concentration and vice versa. Here also the level of convergence of crop diversification among the districts is examined through the variation in coefficient of variation in Herfindahl Index over time as well as through cointegration coefficient of HI among the districts over time.

Data on area under crops, inputs used and various infrastructure facilities during the period of study across the districts in West Bengal have been collected from various issues of *Statistical Abstracts* and *District*

Statistical Handbooks published by the Bureau of Applied Economics and Statistics, and Office of the Directorate of Agriculture, Government of west Bengal⁴

In order to find out the impact of different factors on the level of diversification over time in different parts of rural West Bengal, a multiple regression of the form $L_n HI = \beta_1 + \beta_2 \sum L_n X_i + U_i$ is performed. Here, HI is the Herfindahl Index and X_i s are various infrastructures, technology and farm size related explanatory variables. The goodness of fit was, however, very poor which is due to the fact that HI takes values only between zero and one. Hence, the logit transformation of the dependent variable was tried out and that also did not yield good results. Finally, with the robust regression method by applying weighted median least squares on the logit HI and the three explanatory variables described above for the state as a whole throughout all the years, we obtained some reasonable results. However, for the case of inter-district variations in HI it could not be yielded good results due to very small degrees of freedom.

Among the several competing crops, allocation of area under three major crops (viz., paddy, potato and mustard) received high priority among the farmers over the years in West Bengal. It may be due to the farmers' expected profit from these crops relative to the other competitive crops and that has been guided by the expansion of several infrastructural and other factors. In order to examine the impact of different factors on the level of diversification over time in West Bengal, here the proportion of area under these three major growing crops, which have been responsible for changing diversification indices, are regressed on three variables like rainfall, proportion of GCA under canal irrigation and use of chemical fertiliser per unit of cropped area. These are the variables on which time series for the whole period are available at the district level as well as for the state as a whole. Here, log-linear specification i.e., Cobb-Douglas specification was adopted for the state as a whole. Using Dickey-Fuller test we found that dependent variables in all the cases follow stationary autoregressive process of order one and thus lagged (one period) endogenous variable was introduced as explanatory variable (Green, 2003). As time series information on other important explanatory infrastructure variables were not available for all the years under study these could not be included in the regression. Thus, finally district-wise growth of area under three fast growing crops during 1970-73 to 2002-05 (towards which high concentration was observed over time but at differential rates) was regressed on the growth of some selected explanatory variables for the same period. The similar log linear form was also adopted for running the regression.

² Here, the calculations are made for the composite districts of 24Paraganas, Midnapore and West Dinajpur. These districts were divided a few years back and the data on divided districts were not available separately for the early years of discussion. For the systematic analysis thus the combined figures for these composite districts have been calculated to make those comparable with their previous figures.

⁴ Primary statistics of production, acreage and yield of various crops are collected from different districts of West Bengal and compiled and published by these departments on a regular basis.

IV. OBSERVATION AND ANALYSIS

a) *Growth of infrastructure in West Bengal*

The basic infrastructure required for the growth of agriculture has expanded disproportionately in West Bengal across space and time. Irrigation is one of the prime factors for the improvement of agricultural productivity and large scale irrigation comes from various canals constructed over the years and that helps farmers diversifying their cultivation towards more remunerative crops like potato, oilseeds and to adopt cultivation of summer paddy which is totally irrigation intensive. Here proportion of GCA under canal irrigation has been considered instead of net sown area (NSA) as some of the net irrigated area is cultivated during non-monsoon season without the availability of canal water and the pattern of crops are chosen accordingly. So, growth of NSA under irrigation does not reflect the true picture of growth of irrigation potential in West Bengal. Percentage of GCA under canal irrigation has increased from 11.32 per cent in 1971-74 to about 20 per cent in 2002-05. In the past three and half decades it has not been able to utilise the river water with full potential and thus though we observe occurrence of flood in some years there is shortage of water supply during the cultivation of draught season crops.

It has been observed that during 1970 to 2005 Burdwan, Birbhum, Hooghly, Bankura were among the top five districts while 24 Paraganas, Nadia, Malda, West Dinajpur and Cooch Behar were the bottom five districts in terms of percentage of GCA under canal irrigation. Inter-district variation in the coverage of canal irrigation though declined in 1980s, it increased again since 1990. Though due to the exhaustion of scope of canal irrigation expansion in the frontrunner districts the laggard districts have been found to expand relatively faster still now the advanced districts remain at the top layer due to the inherited canal irrigation infrastructure and limited scope in some of the districts like Nadia, Malda, West Dinajpur and Cooch Behar. The coefficient does not show a strong convergence of the districts in terms of growth of area under canal irrigation facilities.

As per the information available, ground water irrigation has expanded extensively through DTW and STW during 1979-80 to 1999-2000; initially with diesel engines and later on with electric motors. In case of minor irrigation a similar picture is observed except the fact that the districts (Nadia, Malda) where canal irrigations were limited also recorded significant growth of minor irrigation facilities (Table-2). Though the ground water irrigation capacity has expanded remarkably, the river lift irrigation (RLI) as well as canal irrigation has not been expanded satisfactorily and both are under the control of government. It is an indication of poor attention given in terms of investment for the development of river-based irrigation projects in West Bengal. In majority of the cases the growth rates of deep

tube-well are much higher than that of RLI and shallow tube-well (STW). In the districts of Howrah, Hooghly, Birbhum, Burdwan, Midnapore and Murshidabad growth rates of STW are negative and in the former three districts it became nil due to failure of many STW to lift water and thus those have been converted to low capacity submersible pumps i.e., LTDW and other DTW with different capacities. However, in case of STW and RLI a significant convergence is observed, which is examined by the Karl Pearson's correlation between the initial values of the minor irrigation projects and the rates of growth during 1979-80 to 1999-2000 across the districts of West Bengal. This is because in the districts having more number of STW and RLI in the early years, have recorded a conversion towards DTWs of various capacities depending upon whether they are in individual capacity or cooperatives or government sponsored as well as exhaustion of RLI potential. Whereas in other districts, earlier RLI and relatively more expensive ground water irrigation potentials were not tapped and have become economic with the growing necessity and market for irrigation and thus grew at relatively faster rate than those former districts.

In terms of use of chemical fertiliser along with organic manure West Bengal has progressed a long way and triennial average of its consumption per hectare of GCA has increased from merely 13.65 kg in 1971-74 to 144.93 kg in 2002-05, i.e., it grew by over 961 per cent during past three decade (table-3). Hooghly, Howrah, Burdwan and Birbhum always remain within top five while Purulia, West Dinajpur and Jalpaiguri always remain within the bottom five throughout the period. If we look at the rate of growth, it appears that most of those districts initially using low chemical fertiliser per hectare of GCA recorded high rate of growth and vice versa. The correlation between the initial value across the districts and the rate of growth during the overall period is negative, which is an indication of the convergence of the intensity of use of chemical fertiliser. But most of the erstwhile advanced districts still remain relatively more advanced despite a minor change in the order and the coefficient of variation has not changed significantly, which indicates the weak level of convergence.

Table-4 represents the testing of cointegration of the districts in terms of trend of coefficient of variation in area under canal irrigation as well as intensity of chemical fertiliser use. It is also examined directly through the Augmented Engle-Granger test (AEG). Both the results are the indication of significant cointegration of the districts on both counts, i.e., a convergence of the districts in terms of application of irrigation and chemical fertiliser is observed. But if we look at the expansion of minor irrigation, whose data is not available for the continuous period a mixed result is observed.

Use of pump-sets replacing the traditional methods of lifting water for minor irrigation is important

for the increase in capacity of minor irrigation, which played a crucial role for the expansion of cultivation of various winter and summer crops that are mostly commercial. It also helps irrigating crops during monsoon season in the erratic rainfall year. The use of diesel and electric pump-set in West Bengal has increased remarkably from a meagre 0.76 and 0.30 per thousand hectare of GCA in 1972 to 66.07 and 6.36 in 2003 respectively (tables-5, 6). Burdwan, Howrah, Hooghly and Nadia have been at the forefront in using pump set, diesel as well as electric while West Dinajpur, Darjeeling, Birbhum, Purulia, Jalpaiguri and Malda recorded comparatively low use of pump-sets in the irrigation but shown relatively faster growth in terms of use of those. In Hooghly however, over time, electric pump-set has outweigh the diesel pump-set in terms of growth with the increase in utilisation of electricity to increase the capacity of water-lifting and growth of DTW of various capacities. Overall, the expansion of use of electricity in West Bengal has not been satisfactory as compared to the use of diesel engine, which would otherwise increase the capacity of irrigation far more than whatever has been achieved so far. The correlation measures also show that the initially developed districts in terms of use of pump-sets (diesel as well as electric) remain in the front and the relatively backward districts though growing at a faster rate, they are still lagging and the negative correlations between the initial values and growth rates are the indications of weak level of convergence of the districts on both cases.

Howrah, Hooghly, Burdwan, 24 Paraganas are again the advanced districts in terms of use of tractor, power tiller etc for the tilling of soil replacing the erstwhile bullocks and traditional plough and mode of transport of harvested crops and marketing of the same. It helped farmers switch over to some highly remunerative commercial crops like potato, summer paddy and made possible to go for multiple cropping on a larger proportion of cultivable land conditioned by the simultaneous expansion of irrigation capacity at individual as well as cooperative level. In the state as a whole, the use of tractor has increased from merely 0.10 per thousand hectares of GCA in 1972 to 3.45 in 2003. On the other hand, use of power tiller has increased from 0.37 in number per thousand hectares of GCA to 2.90 during the same period that made land suitable for the cultivation of potato and some other crops, which was not possible manually to a large extent before the arrival of such technology (tables 7 and 8). The laggard districts like West Dinajpur, Bankura, Murshidabad, Midnapore, Jalpaiguri etc though growing at a faster rate, are still lagging behind the formerly advanced districts. The coefficient of variations in intensity of both though increased in 1970s and 1980s, those declined thereafter. Along with that the significant positive correlations of the values of different years indicate the similar result as we observed in case of irrigation and

other infrastructure. The decline in values of positive correlation and coefficient of inter-district variation in recent decades is also reflected in the minor negative correlation between the initial year values and the overall growth rates during the whole period. Hence, a poor convergence level of the districts in the development of irrigation, fertiliser and cultivation infrastructure and adoption of modern techniques is observed.

The major black topping roads though not a precondition for the cultivation of major crops in West Bengal it helps timely marketing and earning remunerative price of the perishable crops. Road network in West Bengal has expanded by about 500 per cent during last three decade (table-9). Howrah, Hooghly from southern West Bengal and Darjeeling from the north have remained within top five districts in terms of growth of road network, while Midnapore, 24 Paraganas, Burdwan, Nadia have recorded much faster growth as compared to the state average. On the other hand, Malda, Cooch Behar and Purulia always remain within the bottom five positions and shown comparatively performance in terms of growth of road density.

In case of density of regulated market however, the North-Bengal districts have been in a better off position though there is big unregulated market competitiveness in the agriculturally developed southern part of the state (table-10). In case of both the road intensity and concentration of regulated market the advanced districts mostly remain advanced in the hierarchy and the laggard districts remain behind. But their growths have been convergent over time from the perspective of area. However, one may have a different result from the point of view of population and agricultural output.

Cold storage in West Bengal is used primarily for the preservation of perishable potato. It has not yet been developed for the other perishable crops like onion, vegetables, fruits, flowers or fishes. Hooghly, Burdwan, 24 Paraganas, Midnapore and Birbhum have been in the top five group in terms of the number of cold storage, while West Dinajpur, Nadia, Malda, Darjeeling, Purulia, Cooch Behar are the backward districts in terms of storage infrastructure and its growth over time, which is an indication of the divergence of growth across the districts (table-11).

Banking infrastructure especially the growth of regional rural and cooperative banks is viewed as the facilitators of financial liquidity through loan schemes so that the farmers especially the poor and marginal farmers can access and adopt various technology for the purpose of scientific cultivation and adopt appropriate crop pattern. Available information shows that per lakh population, since 1981 to 2000 there has been only 26 per cent growth in the state and there is significant variation in the growth across the districts. Despite the growth in absolute number; growth of bank

branches per lakh population varied from -30.94 per cent in 24Paraganas to 104.29 per cent in Midnapore. Throughout the period, Howrah, Hooghly, Burdwan and Birbhum always remain at the top-five cluster, while Jalpaiguri, Cooch Behar, West Dinajpur, Midnapore and Murshidabad remain in the bottom cluster. But the districts in the bottom cluster achieved relatively faster growth and hence indicate some level of convergence.

b) Pattern of Crop Diversification

From the computed crop diversification indices (as presented in Table 13. In West Bengal we observe practically a high level of diversification towards some high value crops across the seasons over the years and there has been a wide district-wise variation of *Herfindahl*, *Simpson*, *Entropy* and *Modified Entropy* indices and all of them show a similar pattern for all the chosen years. Value of HI declined over time, which is an indication of more diversification. The significantly positive rank correlation between indices of various years indicate that the districts which were earlier at top in the early years in terms of these indices remained at the top in the later years also. Nadia, Murshidabad and Malda have always been within top five and Purulia, Birbhum, Bankura and 24Paraganas have always been within the bottom five districts in terms of diversification of crops. As HI represents the extent of concentration of crops and SI is calculated by deducting the HI from unity, we find similar correlations between any two chosen years for both the HI and SI. Similar is the case for entropy and modified entropy indices where the values are calculated only with different base values. But there is hardly any change in the number of crops cultivated except tea in a few northern districts of West Bengal and hence the ranking in terms of both these measures are found to be the same. Concentration towards a few crops has emerged over the years as this particular crop cycle yields maximum possible annual return from a particular plot of land (De, 2003; De and Chattopadhyay, 2010). Area under aman and boro paddy, potato and mustard together increased from about 64 per cent of GCA in 1970-73 to around 77 per cent in 2002-05 despite some inter-district variations, which might be presumed to be due to variation in growth of some important factors like use of chemical fertiliser, irrigation, agro-implements, electricity, land under different size-classes of holding etc or labour force.

Moreover, the coefficient of variation in the indices is very high due to the variation in number of crops cultivated in some districts owing to the specific agro-climatic conditions. For example, tea is cultivated extensively in three northern West Bengal districts Darjeeling, Jalpaiguri and Cooch Behar. While the southern districts like Burdwan, Hooghly, Howrah, Nadia concentrate more on three specific crops, namely aman paddy followed by potato or mustard in winter and then

boro paddy during the summer in a crop cycle, which has been possible particularly due to the availability of minor irrigation in the off monsoon seasons and growing availability of technologically modern inputs, implements and other infrastructure. The relatively backward districts like Bankura, Purulia in terms of irrigation and other land improvement measures, follow a different cropping pattern suitable to the specific condition. However, majority of the farmers in different districts of West Bengal choose the cropping cycle in such a fashion that they can maximise their expected profit given the agro-climatic and other farming conditions including marketing facilities. If we look at the changes in coefficient of variations of the indices across the districts, it is observed to be on decline for the indices *SI*, *EI* and *MEI* over time but not statistically significant. It indicates that the laggard districts are gradually catching up with the developed districts in terms of diversification. In fact, the laggard districts gradually started getting benefit of several irrigation projects undertaken by the government, and also of the development of other infrastructures while the early advanced districts have been recording deceleration in the growth of those facilities as they have already reached the saturation level. Table 13a however shows the convergence of districts in terms of diversification of crops.

In order to examine the impact of different factors on the level of diversification over time in West Bengal, the results of robust weighted median least squares regression of Logit of HI on rainfall, chemical fertiliser per hectare of GCA and proportion of area under canal irrigation are presented below.

$$\text{Logit } H_t = 12.526^* - 0.6279 L_n I_t^* + 0.038 L_n CF_t^* - 0.0548 L_n R_t^* \\ (1.19) \quad (0.0897) \quad (0.01416) \quad (0.03414)$$

$$\text{Weighted } R^2 = 0.8146, F_{3,29} = 32.21, n = 33 \quad (2)$$

[R_t , CF_t and I_t represent rainfall, use of chemical fertiliser per hectare of GCA and percentage of GCA under canal irrigation respectively. Figures within the parentheses represent standard error of the corresponding coefficient. Here, * and ** indicate that the coefficient is significant at one and five per cent level of significance by two tailed test].

Equation-2 shows that chemical fertiliser has significantly positive impact on the probability of concentration index while the canal irrigation and rainfall have negative impact on the same. Actually, availability and utilisation of chemical fertiliser made cultivation more remunerative for the fertiliser intensive cash crops like boro paddy and potato but rainfall (on which irrigation is also partly dependent) and irrigation especially in the off-monsoon season is essential for the expansion of diverse crop activities and led to the

concentration of such crops over the years that is clear from its positive coefficients in respect of emerging crops of various seasons.

Now, the log linear regression of proportion of GCA under boro paddy, potato and mustard on the

factors like rainfall, chemical fertiliser per hectare of GCA and proportion of area under canal irrigation are presented below.

For boro paddy:

$$L_nAB_t = -0.406 - 0.0695 L_nR_t + 0.059 L_nCF_t + 0.183 L_nI_t^{**} + 0.0899 L_nAB_{(t-1)}^* \\ (3.067) \quad (0.235) \quad (0.05) \quad (0.10) \quad (0.07) \\ R^2 = 0.989, R_{bar}^2 = 0.986, F = 583.88, D=1.55, n = 33 \quad (3)$$

For mustard:

$$L_nAM_t = -1.397 - 0.238 L_nR_t^* + 0.169 L_nCF_t^* + 0.189 L_nI_t^{**} + 0.674 L_nAM_{(t-1)}^* \\ (2.085) \quad (0.076) \quad (0.062) \quad (0.16) \quad (0.11) \\ R^2 = 0.99, R_{bar}^2 = 0.989, F = 703.27, D=1.43, n = 33 \quad (4)$$

For potato:

$$L_nAP_t = -0.219 - 0.166 L_nR_t + 0.133 L_nCF_t^* + 0.28 L_nI_t^* + 0.785 L_nAP_{(t-1)}^* \\ (2.96) \quad (0.222) \quad (0.052) \quad (0.099) \quad (0.064) \\ R^2 = 0.988, R_{bar}^2 = 0.987, F = 568.98, D=1.02, n = 33 \quad (5)$$

In all the above three cases, availability and utilisation of chemical fertiliser and expansion of irrigation in general are found to have significant positive impact on the area under these crops. Both potato and boro paddy are highly irrigation and fertiliser intensive without which cultivation of these crops is almost impossible. Mustard as cultivated in winter season also depends on to some extent irrigation. Also, the demonstration effect generated for each year by the existing farmers on the decision to expand cultivation of these crops are also found significant as exhibited through the positive coefficient of the lagged value of the dependent variables. In fact, diversification of crops towards boro paddy, potato and mustard depends on minor irrigation which has been clearly indicated in table-14.

Information on some of the important infrastructure variables is available only for some specific years such as 1970, 1990 and 2005 at the district level. Role of these variables certainly has significant impact on the diversification as discussed above. Now, to examine the inter-district variations of these crops, the percentage variations in area under these three crops for the whole period are separately regressed on the percentage growth of some infrastructural variables across the districts in West Bengal. After thorough examination, only the relevant variables are included in the analysis to avoid the problem of degrees of freedom and multicollinearity. The estimated results are presented in tables- 14 and 15.

Results of table-14 shows that the growth of irrigation (both minor and major), use of electricity in agriculture measured by a proxy variable namely, number of electric pump-sets, storage facility have significant positive impact on the inter-district variations in growth of proportion of area under boro paddy in

West Bengal during 1970-73 to 2002-05. Also, percentage of agricultural labour force to total working force and proportion of area under small and marginal farms have significant positive impact on inter-district variations. It indicates that the small and marginal farmers having limited cultivable land and no other sources of income try to adopt more and more multiple cropping and diversify land towards the cultivation of boro paddy instead of til, jute or other competing crops for their survival. This is supported by some infrastructural variables such as irrigation, electricity, availability of fertiliser; road density etc. Variations in growth of these factors across the districts are also evident. Though the small farmers do not own tractor, deep tube well, they try to avail the facilities of such technology from local informal markets. The impact of use of some machines such as tractor and tiller do not give any significant result because of the existence of multi-collinearity. However, use of power tiller is seen to be more prevalent in case of boro cultivation than the tractor owing to some user convenience in the fragmented plots of smaller holdings.

In case of potato (table-15), it is observed that the variations in intensity of chemical fertiliser use, storage capacity, intensity of minor irrigation has strong positive impact while tractor and power tiller, has positive but not highly significant impact on the growth of proportion of area under potato. As expected, market played a negative role in explaining the inter-district variations in diversification towards potato cultivation. Actually, potato market has always been speculative and exploited by the business groups in their favour. However, the growth of proportion of area under small and marginal farms showed a significant positive impact on the diversification towards potato, the fastest growing winter crop in the state of West Bengal.

Table-15 also reveals that variations in expansion of market, density of road are responsible for significant inter-district variations in diversification towards mustard over the years. Uses of fertiliser and minor irrigation show significant inverse relation in the context of inter-district variations in the growth of mustard cultivation. However, the growth of tractor and power tiller, storage facilities and proportion of cropped area under small and marginal farms has positive impact on mustard cultivation though not highly significant. Thus, the statistical results relating to mustard do not permit us to arrive at a firm conclusion regarding the factors responsible for diversification.

It is clear from the above results that size of holdings is one of the important factors explaining the extent of diversification at any rate in different districts of West Bengal. This is in conformity with the results obtained by some other researchers not only for India but for some other countries as well (Chand and Chauhan, 2002; Pingali et.al., 1997; Wehbe et.al., 2006; Joshi et.al, 2007; IDRC, 2008). The other infrastructural variables like irrigation, use of chemical fertiliser etc., are also important but the nature and extent of variations of these variables for different crops in different districts of West Bengal do not follow any rigid pattern. Hence it would be misleading to assume that they contribute in the same way for everywhere in the state. Existing studies, however, have failed to depict such reality.

V. CONCLUDING OBSERVATIONS

Results suggest that there has been significant growth in infrastructure primarily in the front of irrigation, various implements for minor and major irrigation, agro-machinery and other implements and also to avail chemical fertiliser, transport, finance, storage etc. But the growth has been varied across the categories and over time across the districts. Major irrigation projects are maintained by the government, which is also dependent on the river networks, while minor irrigation facilities are primarily maintained by the individual farmers depending upon their resource strength and financial aid from various government organisations. District-wise variation in major irrigation intensity across the districts over time has been found to be comparatively higher than the intensity of fertiliser use. But the district-wise variation has been found to decline over time and the statistical measures suggest convergence of the districts on both terms. Moreover, the districts having less scope of canal irrigation recorded faster growth of minor irrigation. Compared to the irrigation and fertiliser use; electrification of agricultural practices, road, banking and storing infrastructures have not grown proportionately and in those cases poor level of convergence is observed.

The value of diversification indices in West Bengal has increased though not at a very faster rate

but reallocation of land towards a few crops has been taking place continuously. Among the varieties of crops, the growth of summer or boro paddy, potato and mustard cultivation has been accelerating over the past three decades whereas the cultivation of wheat, other cereals, pulses, jute, sugarcane etc has been declining over the years. Data analysed separately for different sub-periods also confirm this phenomenon. The level of diversification has also been associated with the large scale inter-district variations. Interestingly, the level of diversification in the relatively backward agricultural districts like Bankura, Midnapore has taken place at relatively faster pace than the other advanced districts such as Burdwan, Hooghly etc. This is reflected through the decline in coefficient of inter-district variations in diversification indices over the years. However, it may be noted that the relatively advanced districts always maintained their relative positions in terms of diversification due to the better availability of agricultural and supporting infrastructure. Decline in coefficient of variation with respect to diversification indices over the years is an indication that the laggard districts where irrigation and other infrastructure have increased at relatively faster rate, could diversify at relatively faster pace than the hitherto advanced districts. The cointegration measures also suggest convergence of the districts in terms of diversification of crops.

Minor irrigation facilities supported by the electricity, storage and marketing facilities etc have played important roles with varied degrees for the diversification of crops and inter-district variation in diversification has been associated with those factors. Also, availability of fertiliser along with expansion of irrigation and agro-implements through raising yield of crops, helped in many cases to diversify the selected crops. Therefore, agricultural infrastructures are found to be crucial in promoting diversification of crops and ensure sustainable income and employment of the farmers. This explains as why small and marginal farmers who have limited land resources for maintaining minimum living standard diversify their crop cultivation. Though, growth of infrastructures has significant impact on the diversification, disparities in growth of such infrastructures lead to differences in diversification of crops towards boro paddy, potato and mustard. So-called political stability since the inception of Marxist government in West Bengal in 1977 and the new economic reforms in the 1990s have not been much helpful to alter the scenario of selective agricultural diversification in West Bengal.

In conclusion, therefore, it can be said that policies towards the expansion of infrastructure like road network, irrigation facilities through different modes wherever possible, marketing and storage facilities, power supply especially to the minor irrigation setups, availability of fertiliser, and facilitating those especially to

the poor farmers are the important preconditions for the diversification of crops across the districts and future prospects of agriculture. As the poor farmers take the leading role here in diversification, markets and other infrastructure should be fair and competitive for their rational use by them. However, many of the poor farmers suffer from the lack of capital and thus provision of capital through cooperative and regional rural banks need to be well warranted.

REFERENCES RÉFÉRENCES REFERENCIAS

- Ahmad A and Isvilanonda S (2003). Rural Poverty and Agricultural Diversification in Thailand. Paper presented at the *Second Annual Swedish School of Advanced Asia and Pacific Studies (SSAAP)*, 24-26 October, 2003 in Lund, Sweden.
- Ashok KR and Balasubramanian R (2006). Role of Infrastructure in Productivity and Diversification of Agriculture. *A Research Report*. SANEI. Islamabad. Pakistan.
- Barro, R.J. (1991). Economic Growth in a Cross-Section of Countries. *Quarterly Journal of Economics*, 106: 407-43.
- Barro, R.J. and Sala-i-Martin, X. (1992). Convergence. *Journal of Political Economy*, 100: 223-51.
- Baumol, W.J. (1986). Productivity Growth, Convergence and Welfare: What the Long-run Data Show. *American Economic Review*, 76: 1072-85.
- Bernard, A. and Durlauf, S. (1996). Interpreting Tests of the Convergence Hypothesis. *Journal of Econometrics*, 71: 161-74.
- Bhalla GS and Singh G (1997). Recent Development in Indian Agricultural: A State Level Analysis. *Economic and Political Weekly*. March 29. A8-A12.
- Boyce JK (1987). *Agrarian Impasse in Bengal, Institutional Constraints to Technological Change*. Oxford University Press.
- Chand R (1995). A Critique on the Methods of Measuring Economic Diversification. Paper presented in the training course on *Quantitative Techniques for Policy Analysis in Agricultural Economics*. conducted by the Division of Agricultural Economics. Indian Agricultural Research Institute: New Delhi during Nov. 27 to Dec. 9, 1995.
- Chand R. (1996), "Diversification through High Value Crops in Western Himalayan Region: Evidence from Himachal Pradesh", Seminar Paper, Indian Society of Agricultural Economics, Oct.-Dec., pp. 652-63.
- Chand R and Chauhan S (2002). Socio-Economic Factors in Agricultural Diversification in India. *Agricultural Situation in India*. 58(11): 523 - 529.
- CIAT (2005). How Can the Poor Benefit from the Growing Markets for High Value Agricultural Products? *International Workshop: Synthesis Report*, Cali: Centro Internacional de Agricultura Tropica (CIAT), Columbia.
- De, U. K. (2000): Diversification of Crop in West Bengal: A Spatio-Temporal Analysis. *Artha Vijnana*, XLII (2), 170-182.
- De UK (2003). *Economics of Crop Diversification*. Akansha Publishing House. New Delhi.
- De, U. K., Chattopadhyay, M. (2010), "Crop Diversification by Poor Peasants and Role of Infrastructure: Evidence from West Bengal", *Journal of Development and Agricultural Economics*, Vol. 2, No. 9, October, pp. 340-350.
- DeLong, J.B. (1988). Productivity Growth, Convergence, and Welfare: Comment. *American Economic Review*, 78: 1138-54.
- Engle, R.F, Granger, C.W. (1987). Co-integration and Error Correction: Representation, Estimation and Testing. *Econometrica*, 55: 251-276.
- Evans, P. (1997). How Fast Do Economies Converge?. *Review of Economics and Statistics*, 79: 219-25.
- Government of India (GOI), (1997). *Operational Land Holdings in India, 1991-92: Salient Features*, NSS 48th round, Report No. 407, Department of Statistics.
- Green WH (2003). *Econometric Analysis*. Pearson Education. Singapore.
- IDRC (2008), Policy Paper: http://www.idrc.ca/uploads/user-s/123651101MLPG_policy1.pdf
- Johansen, S. (1988). Statistical Analysis of Cointegration Vectors. *Journal of Economic Dynamics and Control*, 12: 231-254.
- Joshi PK and Gulati A (2003). From Plate to Plough: Agricultural Diversification in India. Paper presented at the '*Dragon and Elephant: A Comparative Study of Economic and Agricultural Reforms in China and India*'. New Delhi. India: March 25-26.
- Joshi PK, Gulati A and Cummings R Jr (2007). *Agricultural Diversification and Smallholders in South Asia*. Academic Foundation. New Delhi.
- Joshi PK, BIRTHAL PS and Minot N (2006). Sources of Agricultural Growth in India: Role of Diversification towards High Value Crops. *MTID Discussion Paper No. 98*. IFPRI; Markets, Trade & Institutions Division: November.
- Mankiw, G., Romer, D., and Weil, D. (1992). A Contribution to the Empirics of Economic Growth. *Quarterly Journal of Economics*, 107: 407-37.
- Minot N (2003). Income diversification and Poverty Reduction in the Northern Uplands of Vietnam. Paper presented at the *Annual Meeting of the American Agricultural Economic Association*. Montreal: Canada, 27-30 July.
- Narain Dharm (1965). *Impact of Price Movements on Areas under Selected Crops in India: 1900-1939*. Cambridge University Press. ch.1.

29. Narayanamoorthy A (1997). Crop Diversification and Yield Response to Fertilisers. *Productivity*. 38(1): 118-125.
30. Nayyar D and Sen A (1994). International Trade and Agricultural Sector in India. In Bhalla GS (ed) *Economic Liberalisation and Indian Agriculture*. Institute for Studies in Industrial Development. New Delhi.
31. Pingali PL, Hossain M and Gerpacio RV (1997). *Asian Rice Bowls- The Returning Crisis?*. CAB International. Wallingford.
32. Quah, D. (1993). Galton's Fallacy and Tests of the Convergence Hypothesis. *The Scandinavian Journal of Economics*, 95: 427-43.
33. Raj K.N., Sen A.K., Rao C.H.H. (eds.) (1988), *Dharm Narain, Studies on Indian Agriculture*, Oxford University Press.
34. Sawant SD (1997). Performance of Indian Agriculture with Special Reference to Regional Variations. *Indian Journal of Agricultural Economics*. 52(3): 353-73.
35. Sharma HR (2005). Agriculture diversification in South Asia: Patterns, Determinants and Policy Implication. *Economic and Political Weekly*. 39(24): 2457 – 2467.
36. Singh IJ, Rai KN and Karwasra JC (1997). Regional Variations in Agricultural Performance in India. *Paper presented at the Annual Conference of Indian Society of Agricultural Economics*.
37. Singhal M. and Gauraha A. K. (1997), "Crop Diversification in Madhya Pradesh: An Economic Analysis", Paper presented at the Annual Conference of Indian Society of Agricultural Economics.
38. Timmer CP (1997). Farmers and Markets: The Political Economy of New Paradigms. *Journal of Agricultural Economics*. 79: 621-627.
39. Vyas VS (1996). Diversification in Agriculture: Concept, Rationale and Approaches. *Indian Journal of Agricultural Economics*. 51(4): 636-643.
40. Wehbe M, Eakin H, Seiler R, Vinocur M, Avila C and Marutto C (2006). Local Perspectives on Adaption to Climate Change: Lessons from Mexico and Argentina. *AIACC Working Paper No. 39*. September 2006.

Table 1 : Percentage of GCA Under Canal Irrigation across Districts of West Bengal

1	2	3	4	5	6
District	1970-73	1979-82	1989-92	2002-05	Growth Rate during 1970-3 to 2002-5 (%)
Burdwan	46.59 (1)	44.86 (1)	45.09 (1)	38.80 (2)	-16.72 (12)
Birbhum	37.00 (2)	41.93 (2)	41.83 (3)	26.10 (3)	-29.47 (14)
Bankura	19.60 (4)	36.43 (3)	42.06 (2)	45.37 (1)	131.48 (6)
Midnapore	10.59 (5)	14.81 (5)	16.99 (5)	13.40 (6)	26.53 (8)
Howrah	3.52 (7)	3.26 (8)	3.37 (8)	11.95 (7)	239.93 (4)
Hooghly	27.40 (3)	25.08 (4)	22.91 (4)	21.90 (4)	-20.06 (13)
24Paraganas	0.00 (14)	0.00 (14)	2.81 (9)	2.42 (11)	0.00 (9)
Nadia	0.00 (15)	0.00 (15)	0.00 (15)	0.00 (15)	0.00 (10)
Murshidabad	7.92 (6)	8.10 (6)	8.04 (6)	5.23 (10)	-34.00 (15)
West Dinajpur	0.02 (12)	0.00 (12)	0.00 (13)	0.72 (12)	3444.09 (1)
Malda	0.00 (13)	0.00 (13)	0.00 (14)	0.00 (14)	0.00 (11)
Jalpaiguri	2.95 (9)	1.80 (10)	2.11 (10)	15.37 (5)	420.29 (3)
Darjeeling	3.33 (8)	2.90 (9)	2.02 (11)	5.36 (9)	60.72 (7)
Cooch Behar	0.06 (11)	0.03 (11)	0.16 (12)	0.17 (13)	202.66 (5)
Purulia	0.79 (10)	5.11 (7)	8.14 (7)	8.38 (8)	965.92 (2)
W B	11.32	13.09	14.29	13.59	20.01
C-V	67.07	70.56	49.12	61.75	75.58
Corr_{ij}	R ₂₃ = 0.96	R ₂₄ = 0.24	R ₂₅ = 0.82	R ₄₅ = 0.91	R₂₆ = -0.29
Top five	Burdwan, Birbhum, Hooghly, Bankura, Midnapore	Burdwan, Birbhum, Hooghly, Bankura, Midnapore	Burdwan, Birbhum, Hooghly, Bankura, Midnapore	Bankura, Burdwan, Birbhum, Hooghly, Jalpaiguri	West Dinajpur, Purulia, Jalpaiguri, Howrah, Cooch Behar
Bottom five	Nadia, 24Paragana- s, Malda, West Dinajpur, Cooch Behar	Nadia, 24Paragana- s, Malda, West Dinajpur, Cooch Behar	Nadia, Malda, West Dinajpur, Cooch Behar, Darjeeling	Nadia, Malda, Cooch Behar, West Dinajpur, 24Paraganas	Murshidabad, Birbhum, Hooghly, Burdwan, Malda

Note: R_{ij} indicates correlation between column i and j.

Table 2 : Progress of Minor Irrigation Projects (Ground and River-lift Irrigation) in West Bengal under Government
Minor Irrigation Schemes in West Bengal (Number)

District	1979-80			1987-88			1994-95						1999-2000						Rate of Growth during 1979-80 to 1999-2000 (%)		
	DT W	R LI	S T W	D T W	R LI	S T W	H D T W	M D T W	L D T W	Tot al DT W	RLI	ST W	HD TW	MD TW	LDT W	Tot al DT W	RLI	ST W	Total DTW	RLI	STW
Burdwan	301	237	408	332	266	408	447	24	176	647	259	101	547	38	344	929	276	93	208.64 (6)	16.46 (13)	-77.21 (7)
Birbhum	45	91	--	46	103	--	42	20	12	74	98	--	39	46	41	126	110	--	180.00 (7)	20.88 (12)	--
Bankura	64	130	--	66	175	--	45	20	83	148	180	24	42	77	147	266	224	153	315.63 (5)	72.31 (7)	--
Midnapore	172	267	187	223	368	187	190	20	217	427	387	71	393	41	768	1202	425	1	598.84 (1)	59.18 (8)	-99.47 (8)
Howrah	89	56	30	93	95	30	79	20	--	99	91	--	96	53	--	149	111	--	67.42 (13)	98.21 (5)	--
Hooghly	240	260	361	261	316	361	312	17	276	605	304	80	412	44	879	1335	343	--	456.25 (2)	30.92 (9)	--
24-Paraganas	228	140	318	252	211	318	246	29	59	334	208	356	316	44	160	520	245	341	128.07 (9)	75.00 (6)	7.23 (5)
Nadia	517	272	600	532	319	600	591	32	228	851	299	758	660	33	293	986	330	827	90.72 (12)	21.32 (11)	37.83 (4)
Murshida bad	383	302	936	402	340	909	469	32	150	651	343	748	518	32	225	775	393	764	102.35 (11)	30.13 (10)	-18.38 (6)
West Dinaipur	116	270	200	134	345	200	308	11	--	319	333	407	280	18	18	316	314	1651	172.41 (8)	16.30 (14)	725.50 (2)
Malda	128	353	239	164	381	239	257	11	24	292	347	232	266	18	6	290	347	1008	126.56 (10)	-1.70 (15)	321.76 (3)
Jalpaiguri	33	27	--	33	71	--	46	--	--	46	77	202	59	--	84	143	122	1564	333.33 (4)	351.85 (2)	--
Darjeeling	1	11	--	1	23	--	--	--	--	--	23	--	--	--	--	0	27	147	-100.00 (14)	145.45 (3)	--
Cooch-Behar	15	23	90	15	88	90	30	--	--	30	95	252	68	--	--	68	244	1112	353.33 (3)	960.87 (1)	1135.56 (1)
Purulia	--	55	--	--	100	--	--	--	--	--	128	--	--	--	--	0	128	--	--	132.73 (4)	--
West Bengal	2332	2496	3369	2554	3198	3342	3062	236	1225	4523	3172	3231	3696	443	2965	7104	3739	7661	204.63	49.80	127.40
C-V	91.27	71.07	79.16	87.54	59.02	77.80	79.02	34.02	70.22	77.84	56.84	87.3	75.04	40.64	109.70	95.85	49.28	85.27	-0.08*	-0.55*	-0.54*

Sources: (i) Government of West Bengal, Directorate of agriculture,

(ii) Government of West Bengal, Directorate of Irrigation and Waterways.

Notes: (i) Figures relates to Minor Irrigation Schemes of the Government of west Bengal,

(ii) -- indicates the value is nil.

(iii) DTW→ Deep tube well, STW→Shallow tube well, HDTW→ High capacity deep tube well LDTW→ Low capacity deep tube well, MDTW →Middle capacity deep tube well, RLI→River lift irrigation.

(iv) * Indicates the correlation between the initial (1979-80) values and the growth rates during 1979-80 to 1999-2000 across the districts.

Table 3 : District-wise Use of Chemical Fertilizer Per Hectare of GCA in West Bengal during 1971-4 to 2002-5 (Kg/Hec)

1	2	3	4	5	6
District	1971-74	1979-82	1989-92	2002-05	Growth Rate during 1971-74 to 2002-05 (%)
Burdwan	21.88 (4)	62.58 (3)	122.79 (4)	161.43 (7)	637.73 (10)
Birbhum	22.80 (3)	43.10 (4)	119.85 (5)	137.68 (10)	503.84 (13)
Bankura	19.90 (5)	30.93 (9)	69.53 (13)	136.40 (11)	585.36 (11)
Midnapore	9.29 (11)	30.34 (10)	74.16 (12)	131.01 (12)	1310.13 (6)
Howrah	30.19 (2)	110.96 (1)	252.36 (1)	421.31 (2)	1295.33 (7)
Hooghly	39.62 (1)	99.52 (2)	185.86 (2)	235.70 (3)	494.84 (14)
24Paraganas	12.86 (8)	32.98 (7)	92.02 (7)	170.66 (4)	1227.22 (9)
Nadia	15.76 (7)	44.53 (5)	85.59 (8)	90.32 (14)	472.94 (15)
Murshidabad	11.50 (9)	32.22 (8)	78.92 (10)	70.62 (15)	514.24 (12)
West Dinajpur	3.36 (15)	18.16 (13)	59.38 (15)	100.82 (13)	2903.93 (2)
Malda	10.01 (10)	31.09 (11)	103.61 (6)	139.08 (9)	1289.62 (8)
Jalpaiguri	5.83 (13)	11.36 (15)	64.58 (14)	166.10 (5)	2746.68 (3)
Darjeeling	16.40 (6)	33.04 (6)	125.28 (3)	462.14 (1)	2717.45 (4)
Cooch Behar	3.69 (14)	15.30 (14)	74.57 (11)	162.95 (6)	4310.04 (1)
Purulia	6.14 (12)	20.79 (12)	80.14 (9)	145.29 (8)	2266.13 (5)
W. B.	13.65	36.89	94.54	144.93	961.55
C-V	67.07	70.56	49.12	61.75	75.58
Corr_{ij}		R₂₃ = 0.91	R₂₄ = 0.81	R₂₅ = 0.44	R₂₆ = -0.63
Top five	Hooghly, Howrah, Birbhum, Burdwan, Bankura	Howrah, Hooghly, Burdwan, Birbhum, Nadia	Howrah, Hooghly, Darjeeling, Burdwan, Birbhum	Darjeeling, Howrah, Hooghly, 24Para- ganas, Jalpaiguri	Cooch Behar, West Dinajpur, Jalpaiguri, Darj- eeling, Purulia
Bottom five	Midnapore, Purulia, Jalpaiguri, Cooch Behar, West Dinajpur	Malda, Purulia, West Dinajpur, Cooch Behar, Jalpaiguri	Cooch Behar, Mid- napore, Bankura, Jalpaiguri, West Dinajpur	Bankura, Midnapore, West Dinajpur, Nadia, Murshidabad	Bankura, Murshidabad, Birbhum, Hooghly, Nadia

Note: R_{ij} indicates correlation between column i and j.

Table 4 : Testing Co-integration of the districts of West Bengal in terms of Expansion in proportion of GCA under Canal Irrigation and Growth of Chemical Fertiliser Use Per Hectare of GCA during 1970-71 to 2004-05

Item	Method	Criteria	Coeff	T-value	Adj. R ²	F-Stat.	Log-likelihood	AIC	Max-lag	Remark
Canal Irrigation	Sty. of CV of Dists.	Level	-0.144	-1.59	0.044	2.53	-113.45	6.79	8	No Co-int.
		1 st Diff.	-1.236	-7.031	0.602	49.44	-110.93	6.844	8	Co-integrated
	AEG	Level	-1.779	-6.726	0.684	35.63	-28.374	1.901	8	Co-integrated
		1 st Diff.	-6.133	-5.71	0.868	37.75	-27.582	2.316	8	Co-integrated
Chem. Fertiliser	Sty. of CV of Dists.	Level	-0.72	-4.173	0.34	17.42	-143.11	8.795	8	Co-integrated
		1 st Diff.	-1.42	-8.59	0.701	73.79	-143.23	9.077	8	Co-integrated
	AEG	Level	-1.27	-7.308	0.621	53.40	-91.86	5.688	8	Co-integrated
		1 st Diff.	-3.10	-6.026	0.838	50.84	-88.08	6.139	8	Co-integrated

Notes: (1) Critical value at 1% level = -3.639, at 5% level = -2.951, at 10% level = -2.614

(2) Sty. Indicates stationarity, AEG indicates Augmented Engle-Granger test.

Table 5 : District-wise Diesel Pump-sets per thousand hectare of GCA in West Bengal

1	2	3	4	5	6	7
District	1972	1982	1989	1994	2003	Growth Rate during 1972 to 2003 (%)
Burdwan	0.87 (4)	45.30 (3)	64.35 (5)	74.55 (5)	58.00 (9)	6541.90 (10)
Birbhum	0.16 (14)	18.05 (9)	39.89 (8)	56.41 (7)	53.41 (11)	33515.01 (3)
Bankura	0.27 (10)	20.49 (8)	36.68 (9)	50.40 (10)	92.07 (2)	34121.98 (2)
Midnapore	0.91 (3)	31.92 (6)	72.22 (3)	56.30 (8)	96.33 (1)	10475.70 (8)
Howrah	8.68 (1)	32.26 (5)	47.71 (7)	54.63 (9)	54.08 (10)	522.95 (15)
Hooghly	1.75 (2)	104.55 (1)	86.74 (1)	84.10 (1)	60.92 (8)	3372.03 (12)
24Paraganas	0.74 (5)	42.55 (4)	70.41 (4)	70.87 (6)	71.68 (4)	9592.42 (9)
Nadia	0.66 (6)	46.74 (2)	74.86 (2)	82.22 (2)	75.88 (3)	11325.66 (7)
Murshidabad	0.51 (7)	21.38 (7)	54.20 (6)	76.24 (4)	69.12 (5)	13345.41 (6)
West Dinajpur	0.25 (11)	5.60 (11)	23.75 (10)	37.51 (11)	64.46 (7)	25999.89 (4)
Malda	0.17 (12)	11.49 (10)	16.94 (11)	81.04 (3)	67.44 (6)	39286.78 (1)
Jalpaiguri	0.44 (8)	0.00 (14)	3.39 (13)	8.38 9 (13)	19.70 (14)	4394.18 (11)
Darjeeling	0.17 (13)	0.00 (15)	3.80 (12)	0.92 (15)	1.88 (15)	1015.49 (14)
Cooch Behar	1.37 (9)	3.90 (12)	2.97 (14)	25.13 (12)	41.71 (12)	2946.86 (13)
Purulia	0.11 (15)	3.71 (13)	2.70 (15)	7.18 (14)	20.15 (13)	18248.58 (5)
W. B.	0.76	28.19	47.80	57.43	66.07	8649.29
C-V	188.18	105.38	74.44	56.68	46.66	90.68
Corr_{ij}		R ₂₃ = 0.22	R ₂₄ = 0.19	R ₂₅ = 0.11	R ₂₆ = 0.02	R₂₇ = -.41
Top 5 Districts	Howrah, Hooghly, Midnapore, Burdwan, 24Paraganas	Hooghly, Nadia, Burdwan, 24Paraganas, Howrah	Hooghly, Nadia, Midnapore, 24Paraganas, Burdwan	Hooghly, Nadia, Malda, Murshidabad Burdwan	Midnapore, Bankura, Nadia, 24Paraganas, Murshidabad	Malda, Bankura, Birbhum WestDinajpur, Purulia
Bottom 5 Districts	WestDinajpur, Malda, Darjeeling, Birbhum, Purulia	WestDinajpur, CoochBehar, Purulia, Jalpaiguri, Darjeeling	Malda, Darjeeling, Jalpaiguri, CoochBehar, Purulia	WestDinajpur, Cooch Behar, Jalpaiguri, Purulia, Darjeeling	Birbhum, CoochBehar, Purulia, Jalpaiguri, Darjeeling	Jalpaiguri, Hooghly, CoochBehar, Darjeeling, Howrah

Note: R_{ij} indicates correlation between column i and j.

Table 6 : Districtwise Use of Electric Pump-Set per thousand hectare of GCA in West Bengal

1	2	3	4	5	6	7
District	1972	1982	1989	1994	2003	Rate of Growth during 1972 to 2003 (%)
Burdwan	0.68 (2)	2.19 (3)	5.18 (6)	9.27 (3)	10.40 (2)	1418.32 (8)
Birbhum	0.09 (11)	1.01 (7)	6.53 (4)	11.06 (2)	10.71 (1)	11570.44 (2)
Bankura	0.14 (8)	0.29 (10)	1.39 (10)	7.56 (5)	5.36 (8)	3683.29 (4)
Midnapore	0.10 (9)	1.94 (5)	3.99 (8)	3.67 (6)	6.03 (7)	5797.97 (3)
Howrah	0.70 (3)	1.74 (6)	11.04 (2)	0.61 (13)	1.46 (13)	108.90 (15)
Hooghly	0.01 (14)	3.98 (2)	7.98 (3)	7.42 (7)	9.78 (4)	152018.18 (1)
24Paraganas	0.26 (6)	2.09 (4)	5.83 (5)	7.24 (8)	6.38 (6)	2363.27 (6)
Nadia	1.05 (1)	10.30 (1)	15.19 (1)	18.64 (1)	10.09 (3)	859.65 (13)
Murshidabad	0.58 (4)	0.58 (8)	5.09 (7)	8.02 (4)	8.10 (5)	1295.22 (9)
West Dinajpur	0.18 (7)	0.21 (12)	1.05 (11)	2.28 (10)	2.21 (12)	1140.53 (11)
Malda	0.31 (5)	0.29 (11)	2.73 (9)	3.63 (9)	3.46 (9)	1005.52 (12)
Jalpaiguri	0.10 (10)	0.00 (14)	0.51 (12)	0.68 (12)	2.27 (11)	2109.29 (7)
Darjeeling	0.01 (12)	0.00 (15)	0.00 (15)	0.12 (15)	0.08 (15)	546.21 (14)
Cooch Behar	0.04 (13)	0.58 (9)	0.20 (13)	0.80 (11)	0.54 (14)	1184.19 (10)
Purulia	0.00 (15)	0.10 (13)	0.18 (14)	0.43 (14)	3.46 (10)	3431.88 (5)
W. B.	0.30	1.87	4.64	6.28	6.36	2051.58
C-V	112.91	156.16	99.23	95.48	70.21	307.78
Corr_{ij}		R ₂₃ = 0.66	R ₂₄ = 0.76	R ₂₅ = 0.60	R ₂₆ = 0.38	R₂₇ = -.26
Top 5 Districts	Nadia, Burdwan, Howrah, Murshidabad, Malda	Nadia, Hooghly, Burdwan, 24Parag, Midnapore	Nadia, Howrah, Hooghly, Birbhum, Midnapore	Nadia, Birbhum, Burdwan, Murshidabad, Bankura	Birbhum, Burdwan, Nadia, Hooghly, Murshidabad	Hooghly, Birbhum, Midnapore, Bankura, Purulia
Bottom 5 Districts	Birbhum, Darjeeling, CoochBehar, Birbhum, Purulia	Malda, WestDinajpur, Purulia, Jalpaiguri, Darjeeling	WestDinajpur, Jalpaiguri, CoochBehar, Purulia, Darjeeling	CoochBehar, Jalpaiguri, Howrah, Purulia, Darjeeling	Jalpaiguri, WestDinajpur, Howrah, CoochBehar, Darjeeling	WestDinajpur, Malda, Nadia, Darjeeling, Howrah

Note: R_{ij} indicates correlation between column i and j.

Table 7 : District-wise Use of Tractor per thousand hectare of GCA in West Bengal

1	2	3	4	5	6	7
District	1972	1982	1989	1994	2003	Rate of Growth during 1972 to 2003 (%)
Burdwan	0.23 (2)	1.49 (1)	3.82 (1)	4.89 (2)	9.45 (3)	3946.36 (4)
Birbhum	0.14 (5)	0.14 (6)	0.69 (5)	1.32 (7)	2.66 (6)	1757.64 (12)
Bankura	0.03 (14)	0.05 (8)	0.57 (6)	1.37 (6)	4.09 (5)	14071.95 (2)
Midnapore	0.04 (13)	0.09 (7)	0.33 (10)	0.52 (11)	1.22 (13)	2688.35 (8)
Howrah	0.35 (1)	0.41 (3)	0.83 (4)	3.00 (3)	9.60 (2)	2679.37 (9)
Hooghly	0.06 (10)	0.98 (2)	1.53 (2)	5.32 (1)	11.66 (1)	18049.39 (1)
24Paraganas	0.15 (4)	0.27 (4)	0.48 (8)	1.44 (5)	4.24 (4)	2645.32 (10)
Nadia	0.13 (6)	0.18 (5)	0.86 (3)	1.45 (4)	2.62 (7)	1881.89 (11)
Murshidabad	0.06 (11)	0.04 (10)	0.25 (11)	0.58 (9)	1.99 (9)	3051.02 (5)
West Dinajpur	0.03 (15)	0.04 (11)	0.52 (7)	0.44 (12)	1.77 (10)	5383.68 (3)
Malda	0.08 (8)	0.05 (9)	0.00 (14)	0.61 (8)	2.35 (8)	2815.23 (7)
Jalpaiguri	0.16 (3)	0.00 (14)	0.35 (9)	0.34 (13)	1.21 (14)	631.88 (14)
Darjeeling	0.07 (9)	0.00 (15)	0.00 (15)	0.55 (10)	0.30 (15)	312.86 (15)
Cooch Behar	0.05 (12)	0.02 (13)	0.12 (13)	0.27 (14)	1.44 (11)	2913.28 (6)
Purulia	0.10 (7)	0.04 (12)	0.17 (12)	0.17 (15)	1.39 (12)	1286.32 (13)
W. B.	0.10	0.27	0.74	1.45	3.59	3476.50
C-V	77.78	167.78	135.39	110.44	95.19	117.02
Corr_{ij}		R₂₃ = 0.43	R₂₄ = 0.43	R₂₅ = 0.44	R₂₆ = 0.52	R₂₇ = - 0.31
Top 5 Districts	Howrah, Burdwan, Jalpaiguri, 24Paraganas, Birbhum	Burdwan, Hooghly, Howrah, 24Paraganas, Nadia	Burdwan, Hooghly, Nadia, Howrah, Birbhum	Hooghly, Burdwan, Howrah, Nadia, 24 Paraganas	Hooghly, Howrah, Burdwan, 24Paraganas, Bankura	Hooghly, Bankura, WestDinajpur Burdwan, Murshidabad
Bottom 5 Districts	Murshidabad, CoochBehar, Midnapore, Bankura, WestDinajpur	WestDinajpur, Purulia, Cooch Behar Jalpaiguri, Darjeeling	Murshidabad, Purulia, CoochBehar, Malda, Darjeeling	Midnapore , WestDinajpur, Jalpaiguri, CoochBehar, Purulia	CoochBehar, Purulia, Midnapore, Jalpaiguri, Darjeeling	Nadia, Birbhum Purulia, Jalpaiguri, Darjeeling
Note: R _{ij} indicates correlation between column i and j.						

Table 8 : District-wise Use of Power Tiller per thousand hectare of GCA in West Benga

1	2	3	4	5	6
District	1982	1989	1994	2003	Rate of Growth during 1982 to 2003 (%)
Burdwan	0.32 (4)	1.15 (4)	1.42 (5)	4.21 (3)	1214.34 (7)
Birbhum	0.11 (6)	0.26 (8)	0.37 (9)	0.49 (12)	363.31 (12)
Bankura	0.06 (9)	0.11 (10)	1.30 (6)	3.36 (4)	5825.64 (1)
Midnapore	0.14 (5)	1.63 (3)	2.47 (3)	7.24 (2)	5098.46 (2)
Howrah	2.49 (2)	3.43 (2)	8.32 (1)	2.29 (7)	-7.97 (15)
Hooghly	4.43 (1)	7.21 (1)	5.21 (2)	7.36 (1)	66.09 (13)
24Paraganas	0.33 (3)	0.96 (5)	1.59 (4)	3.20 (5)	878.94 (10)
Nadia	0.07 (8)	0.27 (7)	1.00 (7)	1.10 (9)	1450.42 (6)
Murshidabad	0.02 (12)	0.05 (12)	0.09 (13)	0.41 (13)	2086.47 (4)
West Dinajpur	0.01 (13)	0.02 (13)	0.17 (12)	0.53 (11)	4458.14 (3)
Malda	0.11 (7)	0.32 (6)	0.25 (11)	2.31 (6)	1987.04 (5)
Jalpaiguri	0.00 (14)	0.14 (9)	0.35 (10)	1.41 (8)	910.53 (9)
Darjeeling	0.00 (15)	0.00 (15)	0.00 (15)	0.17 (15)	0.00 (14)
Cooch Behar	0.06 (10)	0.07 (11)	0.84 (8)	0.79 (10)	1167.90 (8)
Purulia	0.03 (11)	0.00 (14)	0.00 (14)	0.18 (14)	426.43 (11)
W. B.	0.37	0.95	1.40	2.90	677.39
C-V	227.94	186.26	147.83	101.72	109.52
Corr_{ij}		$R_{23} = 0.98$	$R_{24} = 0.81$	$R_{25} = 0.56$	$R_{26} = -0.35$
Top 5 Districts	Hooghly, Howrah, 24Paraganas, Burdwan, Midnapore	Hooghly, Howrah, Midnapore, Burdwan, 24Paraganas,	Howrah, Hooghly, Midnapore, 24Paraganas, Burdwan	Hooghly, Midnapore, Burdwan, Bankura, 24 Paraganas	Bankura, Midnapore, WestDinajpur, Murshidabad, Malda
Bottom 5 Districts	Purulia, Murshidabad, WestDinajpur, Jalpaiguri, Darjeeling	CoochBehar, Murshidabad, WestDinajpur, Purulia, Darjeeling	WestDinajpur Murshidabad, Nadia, Purulia, Darjeeling	WestDinajpur Birbhum, Murshidabad, Purulia, Darjeeling	Purulia, Birbhum, Hooghly, Darjeeling, Howrah

Note: R_{ij} indicates correlation between column i and j.

Table 9 : District-wise Road Length in West Bengal Maintained by PWD, Municipality and all Panchayats
Per Sq Km area

1	2	3	4	5	6
District	1980	1990	2000	2003	Rate of Growth during 1973-2000
Burdwan	21.35 (11)	6101 (5)	74.14 (7)	189.50 (7)	787.38 (3)
Birbhum	43.53 (5)	51.21 (7)	63.97 (10)	157.03 (9)	260.75 (11)
Bankura	30.37 (8)	35.07 (12)	35.92 (15)	129.37 (10)	325.98 (7)
Midnapore	13.17 (15)	52.63 (6)	60.12 (11)	209.84 (4)	1493.28 (1)
Howrah	139.41 (1)	170.02 (2)	187.00 (3)	466.21 (1)	234.42 (12)
Hooghly	76.55 (3)	116.40 (3)	298.88 (2)	285.27 (3)	272.63 (10)
24Paraganas	16.88 (14)	46.34 (9)	92.53 (5)	204.14 (5)	1109.23 (2)
Nadia	22.92 (10)	70.78 (4)	94.35 (4)	193.61 (6)	744.66 (4)
Murshidabad	44.09 (4)	2803 (14)	83.50 (6)	184.03 (8)	317.42 (8)
WestDinajpur	34.44 (7)	44.04 (10)	38.96 (13)	109.60 (11)	218.26 (14)
Malda	16.92 (13)	47.26 (8)	53.64 (12)	56.22 (15)	232.24 (13)
Jalpaiguri	27.70 (9)	34.29 (13)	36.49 (14)	109.19 (12)	294.24 (9)
Darjeeling	10392 (2)	371.59 (1)	414.25 (1)	443.12 (2)	326.40 (6)
Cooch Behar	40.75 (6)	36.65 (11)	72.14 (8)	66.92 (14)	64.21 (15)
Purulia	19.91 (12)	23.34 (15)	66.34 (9)	106.11 (13)	433.05 (5)
W. B.	29.26	54.66	82.15	174.27	495.69
C-V	83.10	112.80	97.01	62.78	82.65
Corr _{ij}		R ₂₃ = 0.75	R ₂₄ = 0.74	R ₂₅ = 0.85	R ₂₆ = - 0.42
Top 5 Districts	Howrah, Darjeel- ing, Hooghly, Murshidabad, Birbhum	Darjeeling, Hooghly, Murshidabad, Nadia, Burdwan	Darjeeling, Hooghly, Howrah, Nadia, 24Paraganas	Howrah, Darjee- ling, Hooghly, Midnapore, 24Paraganas	Midnapore, 24Paraganas, Burdwan, Nadia, Purulia
Bottom 5 Districts	Burdwan, Purulia, Malda, 24Paraganas, Midnapore	CoochBehar, Bank- ura, Jalpaiguri, Mu- rshidabad, Purulia	Midnapore, Malda, WestDinajpur, Jalpaiguri, Bankura	WestDinajpur, Jalpaiguri, Purulia, CoochBehar, Malda	Birbhum, Howrah, Malda, WestDinajpur, CoochBehar
Note: R _{ij} indicates correlation between column i and j.					

Table 10 : District-wise Total Regulated Market in West Bengal per 1000 Sq Km

1	2	3	4	5	6
District	1989	1994	1997	2000	Growth Rate during 1989 to 2000 (%)
Burdwan	5.14 (4)	5.14 (8)	6.42 (6)	6.42 (6)	25.00 (9)
Birbhum	0.44 (14)	1.77 (13)	1.77 (15)	3.99 (10)	800.00 (1)
Bankura	1.60 (11)	2.48 (11)	2.48 (11)	2.48 (13)	54.55 (7)
Midnapore	1.10 (13)	1.69 (14)	2.35 (12)	2.50 (12)	126.67 (5)
Howrah	4.14 (5)	4.83 (9)	4.83 (9)	4.83 (9)	16.67 (12)
Hooghly	23.21 (3)	23.53 (3)	27.66 (3)	27.98 (3)	20.55 (10)
24Paraganas	0.00 (15)	2.33 (12)	2.33 (13)	2.33 (14)	0.00 (14)
Nadia	2.30 (9)	2.56 (10)	2.56 (10)	3.07 (11)	33.33 (8)
Murshidabad	2.79 (6)	5.78 (6)	5.59 (7)	5.78 (7)	106.67 (6)
West Dinajpur	2.43 (7)	5.43 (7)	7.68 (5)	8.05 (5)	230.77 (3)
Malda	1.94 (10)	9.71 (5)	5.55 (8)	5.27 (8)	171.43 (4)
Jalpaiguri	2.43 (8)	9.90 (4)	9.74 (4)	9.90 (4)	306.67 (2)
Darjeeling	25.03 (2)	28.60 (2)	28.60 (2)	27.41 (2)	9.52 (13)
Cooch Behar	33.40 (1)	32.81 (1)	32.22 (1)	32.81 (1)	-1.75 (15)
Purulia	1.60 (12)	1.60 (15)	2.25 (14)	1.92 (15)	20.00 (11)
W. B.	4.03	5.92	6.28	6.46	60.23
C-V	148.56	112.65	112.50	109.02	162.30
Corr _{ij}		R ₂₃ = 0.97	R ₂₄ = 0.98	R ₂₅ = 0.98	R ₂₆ = - 0.33
Top 5 Districts	CoochBehar, Dar- jeeling, Hooghly, Burdwan, Howrah	CoochBehar, Dar- jeeling, Hooghly, Jalpaiguri, Malda	CoochBehar, Darj- eeling, Hooghly, Jalpaiguri, West Dinajpur	CoochBehar, Darjeeling, Hooghly, Jalpaiguri, WestDinajpur	Birbhum, Jalpaiguri, WestDinajpur, Malda, Midnapore
Bottom 5 Districts	Bankura, Purulia, Midnapore, 24Paraganas,	Bankura, 24Paraganas, Birbhum, Midnapore, Purulia	Bankura, Midnapore, 24Paraganas Purulia, Birbhum	Nadia, Midnapore, Bankura, 24Paraganas, Purulia	Purulia, Howrah, Darjeeling, 24Paraganas, CoochBehar
Note: R _{ij} indicates correlation between column i and j.					

Table 11 : District-wise Number of Cold Storage in West Bengal

1	2	3	4
District	1969-70	2006-07	Growth Rate 1969-70 to 2006-07
Burdwan	27 (2)	102 (2)	277.78 (4)
Birbhum	6 (5)	16 (6)	166.67 (6)
Bankura	2 (8)	41 (4)	1950.00 (2)
Midnapore	7 (3)	57 (3)	714.29 (3)
Howrah	4 (7)	9 (9)	125.00 (7)
Hooghly	45 (1)	133 (1)	195.56 (5)
24Paraganas	6 (4)	7 (10)	16.67 (9)
Nadia	0 (12)	3 (12)	--
Murshidabad	5 (6)	11 (8)	120.00 (8)
West Dinajpur	0 (11)	5 (11)	--
Malda	0 (13)	3 (13)	--
Jalpaiguri	1 (9)	25 (5)	2400.00 (1)
Darjeeling	0 (14)	1 (14)	--
Cooch Behar	0 (10)	12 (7)	--
Purulia	0 (15)	0 (15)	--
W. B.	103	425	312.62
C-V	183.13	140.87	--
Corr _{ij}		$R_{23} = 0.93$	$R_{24} = -0.08$
Top 5 Dist.	Hooghly, Burdwan, Midnapore, 24Paraganas, Birbhum,	Hooghly, Burdwan, Midnapore, Bankura, Jalpaiguri	Jalpaiguri, Bankura, Midnapore, Burdwan, Hooghly
Bottom 5 Dist.	West Dinajpur, Nadia, Malda, Darjeeling, Purulia, Cooch Behar	West Dinajpur, Nadia, Malda, Darjeeling, Purulia	Purulia, Darjeeling, Malda, Nadia, West Dinajpur
Note: R_{ij} indicates correlation between column i and j.			

Table 12 : District-wise Number of Bank Branches Per Lakh Population since 1981

1	2	3	4	5
District	1981	1991	2000	Growth Rate 1981-to 2000
Burdwan	3.85 (4)	5.88 (3)	5.00 (3)	29.87 (8)
Birbhum	4.35 (3)	6.67 (2)	5.56 (2)	27.82 (10)
Bankura	2.63 (10)	5.88 (4)	5.00 (4)	90.11 (2)
Midnapore	2.33 (12)	5.56 (7)	4.76 (7)	104.29 (1)
Howrah	4.35 (2)	5.56 (6)	4.76 (6)	9.43 (13)
Hooghly	3.85 (5)	5.56 (5)	4.76 (5)	23.64 (11)
24Paraganas	2.78 (8)	2.13 (15)	1.92 (14)	-30.94 (15)
Nadia	2.70 (9)	4.76 (11)	3.70 (12)	37.04 (6)
Murshidabad	1.96 (14)	4.55 (12)	3.70 (13)	88.78 (3)
West Dinajpur	1.75 (15)	4.55 (13)	1.85 (15)	5.71 (14)
Malda	3.13 (7)	5.26 (8)	4.17 (8)	33.23 (7)
Jalpaiguri	2.63 (11)	4.76 (14)	3.85 (11)	46.39 (5)
Darjeeling	5.88 (1)	7.14 (1)	6.67 (1)	13.44 (12)
Cooch Behar	2.27 (13)	5.00 (9)	4.17 (9)	83.70 (4)
Purulia	3.23 (6)	5.00 (10)	4.17 (10)	29.10 (9)
W. B.	4.17	5.88	5.26	26.14
C-V	34.67	21.72	28.99	94.65
Corr _{ij}		$R_{23} = 0.63$	$R_{24} = 0.75$	$R_{25} = -0.43$
Top 5 Dists.	Darjeeling, Howrah, Birbhum, Burdwan, Hooghly	Darjeeling, Birbhum, Burdwan, Bankura, Hooghly	Darjeeling, Birbhum, Burdwan, Bankura, Hooghly	Midnapore, Bankura, Murshidabad, Cooch Behar, Jalpaiguri
Bottom 5 Dists.	Jalpaiguri, Midnapore, Cooch Behar, Murshidabad, West Dinajpur	Nadia, Murshidabad West Dinajpur, Jalpaiguri, 24Paraganas	Jalpaiguri, Nadia, Murshidabad, 24Paraganas, West Dinajpur	Hooghly, Darjeeling, Howrah, West Dinajpur, 24Paraganas

Table 13 : Crop Diversification Indices in West Bengal for Various Years between 1970-3 to 2002-5

	Herfindahl Index				Simpson Index			
0	1	2	3	4	5	6	7	8
District	1970-73	1979-82	1989-92	2002-05	1970-73	1979-82	1989-92	2002-05
Burdwan	.5278 (5)	.4839(7)	.4013(6)	.3734 (7)	.4722(11)	.5161(9)	.5987(10)	.6266 (9)
Birbhum	.4027 (8)	.5594(4)	.5014(3)	.4378 (3)	.5973 (8)	.4406(12)	.4986(13)	.5622(13)
Bankura	.6261 (2)	.6388(2)	.5171(2)	.4862 (2)	.3739(14)	.3612(14)	.4829(14)	.5138(14)
Midnapore	.5821 (4)	.6156(3)	.4811(5)	.4017 (5)	.4179(12)	.3844(13)	.5189(11)	.5983(11)
Howrah	.4515 (6)	.4915(6)	.3318(9)	.3841 (6)	.5485(10)	.5085(10)	.6682(7)	.6159(10)
Hooghly	.3119 (11)	.3277(8)	.2888(11)	.2771 (12)	.6881 (5)	.6723(7)	.7112(5)	.7229 (4)
24Paraganas	.5829 (3)	.5550(5)	.4836(4)	.4153 (4)	.4171(13)	.4450(11)	.5164(12)	.5847(12)
Nadia	.1666 (15)	.1642(15)	.1502(15)	.1476 (15)	.8334 (1)	.8358(1)	.8498(1)	.8524 (1)
Murshidabad	.1766 (14)	.1763(14)	.1772(14)	.1686 (14)	.8234 (2)	.8237(2)	.8228(2)	.8314 (2)
West Dinajpur	.3095 (12)	.2985(12)	.3711(8)	.2825 (11)	.6905 (4)	.7015(4)	.6289(8)	.7175 (5)
Malda	.1769 (13)	.1825(13)	.2194(13)	.2094 (13)	.8231 (3)	.8175(3)	.7806(3)	.7906 (3)
Jalpaiguri	.4160 (7)	.3557(9)	.3964(7)	.3654 (8)	.5840 (9)	.6443(8)	.6036(9)	.6346 (8)
Darjeeling	.3541 (9)	.3262(10)	.2838(12)	.3283 (10)	.6459 (7)	.6738(6)	.7162(4)	.6717 (6)
Cooch Behar	.3328 (10)	.3003(11)	.3255(10)	.3310 (9)	.6672 (6)	.6997(5)	.6745(6)	.6690 (7)
Purulia	.7035 (1)	.7665(1)	.6916(1)	.7791 (1)	.2965(15)	.2335(15)	.3084(15)	.2209(15)
W B	.3593	.3698	.3398	.2966	.6407	.6302	.6602	.7034
CV of Index	41.67	44.71	38.71	42.25	28.72	31.86	23.20	23.68
Rank Correlation	$R_{12} = 0.943, R_{13} = 0.889, R_{14} = 0.936,$ $R_{23} = 0.925, R_{24} = 0.964, R_{34} = 0.954$				$R_{56} = 0.943, R_{57} = 0.889, R_{58} = 0.936,$ $R_{67} = 0.925, R_{68} = 0.964, R_{78} = 0.954$			

Notes: (i) R_{ij} is the rank correlation between i^{th} and j^{th} column. All the correlation coefficients are significant at 1 per cent level of significance by two tailed test.
(ii) Figures in the parentheses represent ranking of the district.

Table 13: Conclld

	Entropy Index				Modified Entropy Index			
0	1	2	3	4	5	6	7	8
District	1970-73	1979-82	1989-92	2002-05	1970-73	1979-82	1989-92	2002-05
Burdwan	1.1395(11)	1.2695(9)	1.3242(9)	1.3119(11)	-.4586(11)	-.5109(9)	-.5329(9)	-.5279(10)
Birbhum	1.3069(7)	1.0816(11)	1.1655(12)	1.2430(13)	-.5260(7)	-.4353(11)	-.4690(12)	-.5002(12)
Bankura	0.8743(14)	0.9120(14)	1.1478(14)	1.1848(15)	-.3518(14)	-.3670(14)	-.4619(13)	-.4768(14)
Midnapore	0.9935(13)	0.9507(13)	1.1811(11)	1.3143(10)	-.3998(13)	-.3826(13)	-.4753(11)	-.5289(9)
Howrah	1.2992(9)	1.1799(10)	1.1553(13)	1.2224(14)	-.5228(9)	-.4748(10)	-.4649(14)	-.4919(13)
Hooghly	1.5309(5)	1.5542(5)	1.5858(4)	1.5114(9)	-.6161(5)	-.6255(5)	-.6382(4)	-.6082(8)
24Paraganas	1.0154(12)	1.0692(12)	1.1865(10)	1.3094(12)	-.4086(12)	-.4303(12)	-.4775(10)	-.5269(11)
Nadia	1.9683(1)	1.9683(1)	2.0225(2)	2.0243(1)	-.7921(1)	-.7921(1)	-.8139(1)	-.8146(1)
Murshidabad	1.9409(3)	1.9641(2)	1.9503(3)	1.9523(2)	-.7811(3)	-.7904(2)	-.7848(3)	-.7857(2)
West Dinajpur	1.6066(4)	1.6506(4)	1.5021(6)	1.7509(4)	-.6465(4)	-.6642(4)	-.6045(6)	-.7046(4)
Malda	1.9494(2)	1.8897(3)	2.0180(1)	1.8444(3)	-.7845(2)	-.7605(3)	-.8121(2)	-.7423(3)
Jalpaiguri	1.2010(10)	1.4044(8)	1.3451(7)	1.6494(5)	-.4833(10)	-.5652(8)	-.5413(8)	-.6638(5)
Darjeeling	1.3007(8)	1.4416(7)	1.5226(5)	1.5735(7)	-.5235(8)	-.5801(7)	-.6127(5)	-.6332(6)
Cooch Behar	1.3903(6)	1.4957(6)	1.4874(8)	1.5570(8)	-.5595(6)	-.6019(6)	-.5986(7)	-.6266(7)
Purulia	0.7265(15)	0.5814(15)	0.7210(15)	0.5748(6)	-.2924(15)	-.2340(15)	-.2901(15)	-.2313(15)
W. B.	1.5503	1.5390	1.5947	1.6719	-.6239	-.6193	-.6418	-.6728
CV of Index	28.82	30.05	25.75	24.97	28.82	30.05	25.75	24.97
Rank Correlation	$R_{12} = 0.95, R_{13} = 0.871, R_{14} = 0.821,$ $R_{23} = 0.946, R_{24} = 0.914, R_{34} = 0.932$				$R_{56} = 0.95, R_{57} = 0.871, R_{58} = 0.821,$ $R_{67} = 0.946, R_{68} = 0.914, R_{78} = 0.932$			

Note: All the correlation coefficients are significant at 1 per cent level of significance by two tailed test.

Table 13 a : Testing Co-integration of the districts of West Bengal in terms of growth of HI during 1970-73 to 2002-05

Method	Criteria	Coeff.	T-value	Adj. R ²	F-Stat.	Log-likelihood	AIC	Max-lag	Remark
Sty. of CV of Dists.	Level	-0.623	-4.061	0.686	12.79	-52.46	4.175	8	No Co-int.
	1 st Diff.	-1.615	-3.10	0.878	30.996	-50.19	4.399	8	Co-integrated
AEG	Level	-1.128	-6.179	0.545	38.18	99.57	-6.10	8	Co-integrated
	1 st Diff.	-2.872	-6.781	0.79	36.07	86.54	-5.70	8	Co-integrated

Notes: (1) Critical value at 1% level = -3.679, at 5% level = -2.96, at 10% level = -2.62

(2) Sty. Indicates stationarity, AEG indicates Augmented Engle-Granger test.

Table 14 : Regression *Coefficients* of Percentage Growth of Proportion of GCA under *Boro Paddy* on Explanatory Variables with Varied Specifications (n = 15)

	Dependent Variable: Ln Δboro (Log-log Model)	Dependent Variable: Ln Δboro (Excluding Some Explanatory Variables)	Dependent Variable: Δboro (Line-log Model)
Explanatory Variables	R ² = .847, Adj.R ² = .643, F = 4.15	R ² = .765, Adj. R ² = .671, F = 8.15	R ² = .963, Adj.R ² = .896, F = 14.34
Constant	-1.857	-1.872***	-216.040*
Ln Δfertiliser	.036	.528	-.524
Ln Δmarket	.261	---	---
Ln Δstore	.252*	.271*	13.946*
Ln Δsf	.629**	.875*	20.761*
Ln Δepump	-.194	---	7.582*
Ln ΔAL	.380	---	41.285
Ln Δminorlrri	.478**	.515*	2.883
LnΔ roadacity	.171	---	5.234
Ln Δcanalirri	---	---	16.157
Ln Δtractill	---	---	-3.01

Notes: (1) Here fertiliser indicates consumption of chemical fertiliser per hectare of GCA in the district, market = number of market per thousand Sq. Km., store = number of storage per thousand Sq. Km., sf = percentage of GCA under small and marginal farm, epump= number of electric pump set per hectare of GCA, AL=agricultural labourer as percentage of total working force, minorlrri= number of minor irrigation set up, roadacity= road density per thousand Sq. Km., tractill= total number of tractor and power tiller per hectare of GCA, canalirri= percentage of GCA under canal irrigation. HereΔ indicates percentage change of the variable during the whole period.

(2) *, ** and *** indicate that the coefficient is significant at five, ten and twenty per cent level of significance by two tailed test.

Table 15 : Regression Coefficients of log of Percentage Growth of Proportion of GCA under *Potato* and *Mustard*,
(n = 15)

	Dependent Variable: Ln Δ Potato	Dependent Variable: Ln Δ Mustard
Explanatory Var.	R ² = .818, Adj. R ² = .491, F = 2.50	R ² = .830, Adj. R ² = .702, F = 6.51
Constant	-5.208*	4.759*
Ln Δ fertiliser	.810**	-.655**
Ln Δ market	-.388*	.268**
Ln Δ store	.214*	.073***
Ln Δ sf	.487*	.136
Ln Δ epump	.102	---
Ln Δ AL	.170	---
Ln Δ minorlrri	.208***	-.275*
Ln Δ roadacity	-.263	.362**
Ln Δ tractill	.178	.160
Note: Same as table-14.		

Appendix Table 1 : District-wise Percentage of Agricultural Labourer to total working force in
Wes Bengal since 1971

District	1971	1981	1991	2001
Burdwan	4.90 (8)	28.16 (6)	29.76 (5)	29.88 (7)
Birbhum	16.15 (1)	35.42 (1)	34.32 (1)	36.95 (2)
Bankura	9.45 (4)	30.72 (5)	30.8 (4)	35.18 (4)
Midnapore	12.78 (2)	27.90 (8)	21.96 (11)	31.66 (5)
Howrah	2.60 (13)	14.25 (14)	14.49 (14)	10.13 (15)
Hooghly	3.66 (10)	26.90 (9)	26.13 (8)	24.29 (10)
24Paraganas	3.16 (11)	16.19 (12)	22.5 (10)	18.87 (12)
Nadia	6.41 (7)	27.92 (7)	26.98 (7)	23.21 (11)
Murshidabad	11.23 (3)	31.57 (3)	27.93 (6)	27.99 (9)
West Dinajpur	8.64 (5)	32.13 (2)	33.44 (2)	38.30 (1)
Malda	2.85 (12)	30.90 (4)	31.59 (3)	30.68 (6)
Jalpaiguri	3.76 (9)	15.39 (13)	15.8 (13)	17.64 (13)
Darjeeling	1.51 (15)	8.65 (15)	11.64 (15)	10.21 (14)
Cooch Behar	1.59 (14)	26.50 (10)	24.76 (9)	29.50 (8)
Purulia	8.57 (6)	20.13 (11)	20.86 (12)	36.09 (3)
W. B.	3.02	23.64	23.07	24.92
Top 5 Districts	Birbhum, Midnapore, Murshidabad, Bankura, WestDinajpur	Birbhum, WestDinajpur, Murshidabad, Malda, Bankura	Birbhum, WestDinajpur, Malda, Bankura, Burdwan	WestDinajpur, Birbhum, Purulia, Bankura, Midnapore
Bottom 5 Districts	24Paraganas, Malda, Howrah, CoochBehar, Darjeeling	Purulia, 24Paraganas, Jalpaiguri, Howrah, Darjeeling	Midnapore, Purulia, Jalpaiguri, Howrah, Darjeeling	Nadia, 24Paraganas, Jalpaiguri, Darjeeling, Howrah

Appendix Table 2 : Number of Villages Electrified in West Bengal (District-wise)

District	1973	1989	1994	2000	Rate of Growth during 1973- 2000
Burdwan	830 (1)	2143 (3)	2411 (3)	2441 (4)	194.10 (13)
Birbhum	272 (8)	2191 (4)	2213 (6)	2213 (6)	713.60 (4)
Bankura	320 (7)	1596 (7)	2304 (5)	2412 (5)	653.75 (6)
Midnapore	706 (3)	3859 (1)	5166 (1)	5567 (1)	688.53 (5)
Howrah	244 (10)	694 (13)	755 (13)	755 (13)	209.43 (11)
Hooghly	644 (4)	1743 (6)	1898 (7)	1898 (7)	194.72 (12)
24Paraganas	823 (2)	2859 (2)	3218 (2)	3314 (2)	302.67 (9)
Nadia	612 (5)	1242 (10)	1254 (10)	1254 (10)	104.90 (15)
Murshidabad	454 (6)	1561 (9)	1781 (8)	1794 (8)	295.15 (10)
West Dinajpur	85 (14)	2099 (5)	2377 (4)	2496 (3)	2836.47 (1)
Malda	245 (9)	1587 (8)	1596 (9)	1596 (9)	551.43 (7)
Jalpaiguri	178 (12)	694 (14)	725 (14)	725 (14)	307.30 (8)
Darjeeling	190 (11)	434 (15)	510 (15)	524 (15)	175.79 (14)
Cooch Behar	71 (15)	1082 (11)	1118 (12)	1118 (12)	1474.65 (2)
Purulia	158 (13)	1075 (12)	1480 (11)	1567 (11)	891.77 (3)
W. B.	5832	24858	28806	29574	407.10
Top 5 Dists.	Burdwan, 24Paraganas, Midnapore, Hooghly, Nadia	Midnapore, 24Paraganas, Burdwan, Birbhum, WestDinajpur	Midnapore, 24Paraganas, Burdwan, WestDinajpur, Bankura	Midnapore, 24Paraganas, West Dinajpur, Burdwan, Bankura	West Dinajpur, CoochBehar, Purulia, Birbhum, Midnapore
Bottom 5 Dists.	Darjeeling, Jalpaiguri, Purulia, WestDinajpur, CoochBehar	CoochBehar, Purulia, Howrah, Jalpaiguri, Darjeeling	Purulia, CoochBehar, Howrah, Jalpaiguri, Darjeeling	Purulia, CoochBehar, Howrah, Jalpaiguri, Darjeeling	Howrah, Hooghly, Burdwan, Darjeeling, Nadia

Appendix Table 3 : District-wise Area under Small Farms and its Growth during 1969-70 to 2001-02

District	Area in Hectare				Percentage Growth	Percentage of Total Agricultural Farm Area			
	1969-70	1990-91	1995-96	2001-02	1969-70 to 2001-02	1969-70	1990-91	1995-96	2001-02
Burdwan	263790.83	271859	313517	341507	29.46 (8)	64.37 (10)	58.75 (11)	66.39 (11)	72.33 (12)
Birbhum	165859.26	173730	217978	225265	35.82 (6)	59.19 (12)	57.66 (12)	70.41 (8)	73.51 (10)
Bankura	231635.13	253377	251222	256509	10.74 (14)	66.02 (9)	65.42 (8)	64.64 (13)	65.99 (13)
Midnapore	612871.04	676856	714163	750136	22.40 (9)	75.28 (4)	79.72 (2)	86.11 (2)	91.06 (2)
Howrah	84774.368	90686	93128	95166	12.26 (13)	92.05 (1)	87.27 (1)	88.62 (1)	88.18 (4)
Hooghly	163507.56	179866	177513	187247	14.52 (12)	78.98 (2)	77.12 (3)	80.83 (4)	86.01 (5)
24Paraganas	489469.04	521376	507712	581064	18.71 (10)	73.88 (5)	73.59 (4)	76.70 (6)	88.88 (3)
Nadia	183173.9	233356	289535	1486081	711.30 (1)	66.37 (8)	65.68 (6)	81.24 (3)	97.32 (1)
Murshidabad	249909.2	231687	340200	356322	42.58 (4)	71.46 (6)	54.11 (13)	77.01 (5)	81.15 (7)
WestDinajpur	221331.46	294471	316803	356199	60.93 (2)	53.49 (13)	64.52 (9)	69.79 (9)	79.31 (8)
Malda	161193.18	202720	205804	251874	56.26 (3)	63.68 (11)	67.00 (5)	68.19 (10)	84.28 (6)
Jalpaiguri	150028.95	144812	169100	195799	30.51 (7)	46.01 (14)	42.00 (14)	47.42 (14)	55.14 (14)
Darjeeling	51741.272	49941	60134	59285	14.58 (11)	32.27 (15)	31.67 (15)	38.81 (15)	38.91 (15)
CoochBehar	148301.2	176930	181733	208214	40.40 (5)	76.98 (3)	65.53 (7)	65.86 (12)	75.80 (9)
Purulia	182830.44	176261	184255	189861	3.85 (15)	66.89 (7)	59.82 (10)	70.78 (7)	72.94 (11)
W. B.	3360416.8	3677928	4022797	4365529	29.91	66.39	65.03	71.99	78.71
Top 5 Dists.					Nadia, Westdinajpur, Malda, Murshidabad, CoochBehar	Howrah, Hooghly, CoochBehar, Midnapore, 24Paraganas	Howrah, Midnapore, Hooghly, 24Paraganas Malda	Howrah, Midnapore, Nadia, Hooghly, Murshidabad	Nadia, Midnapore, 24Paraganas Howrah, Hooghly
Bottom 5 Dists.					Darjeeling, Hooghly, Howrah, Bankura, Purulia	Malda, Birbhum, WestDinajpur, Jalpaiguri, Darjeeling	Burdwan, Birbhum, Murshidabad, Jalpaiguri, Darjeeling	Burdwan, CoochBehar, Bankura, Jalpaiguri, Darjeeling	Purulia, Burdwan, Bankura, Jalpaiguri, Darjeeling

Appendix Table 4 : District-wise Area under Large Farms and its Growth during 1969-70 to 2001-02

District	Area in Hectare				Percentage Growth	Percentage of Total Agricultural Farm Area			
	1969-70	1990-91	1995-96	2001-02		1969-70	1990-91	1995-96	2001-02
Burdwan	409.80	2783	3121	992	142.07	0.1 (13)	0.60 (3)	0.66 (4)	0.21 (7)
Birbhum	2185.68	1133	1359	707	-67.65	0.78 (3)	0.38 (8)	0.44 (5)	0.23 (6)
Bankura	561.37	494	745	304	-45.85	0.16 (10)	0.13 (13)	0.19 (11)	0.08 (12)
Midnapore	2930.84	1483	2253	900	-69.29	0.36 (4)	0.17 (12)	0.27 (10)	0.11 (9)
Howrah	110.52	262	185	393	255.59	0.12 (11)	0.25 (10)	0.18 (12)	0.36 (4)
Hooghly	310.54	72	166	304	-2.11	0.15 (9)	0.03 (15)	0.08 (15)	0.14 (8)
24Paraganas	530.02	509	671	246	-53.59	0.08 (14)	0.07 (14)	0.10 (14)	0.04 (14)
Nadia	717.57	1530	1035	870	21.24	0.26 (8)	0.43 (6)	0.29 (9)	0.06 (13)
Murshidabad	1084.13	993	773	158	-85.43	0.31 (6)	0.23 (11)	0.17 (13)	0.04 (15)
WestDinajpur	496.54	1769	1461	5257	958.73	0.12 (12)	0.39 (7)	0.32 (8)	1.17 (3)
Malda	582.20	1625	1116	324	-44.35	0.23 (7)	0.54 (4)	0.37 (6)	0.11 (10)
Jalpaiguri	119931.86	121236	120833	124745	4.01	36.78 (2)	35.16 (2)	33.88 (2)	35.13 (2)
Darjeeling	65489.90	66537	65809	82829	26.48	40.85 (1)	42.20 (1)	42.48 (1)	54.36 (1)
CoochBehar	0.00	1402	2206	259	-81.53*	0 (15)	0.52 (5)	0.80 (3)	0.09 (11)
Purulia	847.32	840	822	688	-18.80	0.31 (5)	0.29 (9)	0.32 (7)	0.26 (5)
W. B.	195885.12	202668	202555	218976	11.79	3.87	3.58	3.62	3.95
Top 5 Dists.						Darjeeling, Jalpaiguri, Birbhum, Midnapore, Purulia	Darjeeling, Jalpaiguri, Burdwan, Malda, CoochBehar	Darjeeling, Jalpaiguri, CoochBehar, Burdwan, Birbhum	Darjeeling, Jalpaiguri, WestDinajpur, Howrah, Purulia
Bottom 5 Dists.						Howrah, WestDinajpur, Burdwan, 24Paraganas CoochBehar	Murshidabad, Midnapore, Bankura, 24Paraganas, Hooghly	Bankura, Howrah, Murshidabad 24Paraganas, Hooghly,	CoochBehar, Bankura, Nadia, 24Paraganas, Murshidabad

Note: *Growth from 1991 to 2001 in case of Cooch Behar