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The Trend of Agricultural Development in West Bengal: A District Level Study

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Structured Abstract:

Purpose: The present paper is to identify districts which display better / worse performance of agriculture, while examining a comparison of the position of agriculture in pre-reform and post-reform periods in West Bengal. It also seeks to explain the factors which are responsible for acceleration / deceleration growth rates in agriculture.

Design / methodology / approach: The author has selected the time period from 1977-78 to 2013-14 for analysing his above mentioned objectives. Further, he opts for an exploratory study using the entire time period into two sub-periods, 1977-78 to 1991-92 & 1992-93 to 2013-14. The present paper uses the method of computing simple exponential growth rates, kinked exponential growth rates and log quadratic estimates. This study has discussed three economic variables, namely, area, production and yield under foodgrains connected with the agrarian economy in the districts of West Bengal. For the purpose of this study, data are curled from the Statistical Abstract, Govt of West Bengal and various issues of Economic Review.

Findings: This paper shows that the growth rate area, production and yield under foodgrains rate constitute broadly a statistically significant decline at the break point (1992-93) in district of West Bengal during 1992-93 to 2013-14. The deceleration growth rate of foodgrains appears due to reform policy on agriculture.

Research limitations / implications: All causes for slow growth of agrarian economy (foodgrains) in liberalization era cannot be explained in this study.

Originality / value: Farmers may accept the research suggestions which can help them improve production and remove the major obstacles lying before it.

Keywords: Foodgrains, Deceleration, Acceleration, Growth Rate

1. Introduction

The maximum share of total workforce is engaged in the agriculture sector in our country. Therefore, it is necessary to improve the agriculture sector. Agriculture, in most

developing economies, is the core sector providing a livelihood to a significant proportion of the population, especially in rural areas. Since this sector faces the largest brunt of underemployment, unemployment and poverty, a growing agriculture and allied sector is expected to contribute vastly to overall growth and poverty alleviation. Increasing the productive capacity of agriculture through higher productivity has been an important goal in developing countries. It has been suggested that due to limited scope for expansion of arable land there is a need to increase yields to their technically highest levels through appropriate investment in basic infrastructure, human development, and research and extension services [Chavas 2006, Zepeda 2006].

The Government of India has taken macroeconomic policy framework for improving the objectives like changes in exchange rate and trade policy, devaluation of the currency, gradual dismantling of the industrial licensing system and reduction in industrial protection which would benefit tradable agriculture by ending discrimination against it and by turning the terms of trade in its favour (Bhalla and Singh, 2009). This policy has helped to promote exports leading to rapid agricultural growth. But this new economic policy (1991) has failed to reach country's objectives. Therefore, the explanation of this failure is required in this context. Again, the impact of national policy – how far it is extended to district level – need to be cautiously analyzed.

1.1 Literature Review

Sahoo and Balaji (2017) observed that the 1st period (1993-94 to 2004-05) recorded a slower rise in Monthly per capita consumer expenditure (MPCE) and faster rose in gini causing a slow reduction in poverty. The 2nd period (2004-05 to 2011- 12) witnessed a faster increased in real MPCE with a slow growth in inequality causing faster reduction in poverty both in rural and Urban India. The 2nd period was approaching towards the pro-poorness, while the 1st period did not.

Bhalla and Singh (2009) found that the post-reform period (1990-93 to 2003-06) was characterised by deceleration in the growth rate of crop yields as well as total agricultural output in most states in India. According to them, the agricultural sector should face a deceleration its growth rates of aggregate yield and output and the process of agricultural diversification should slow down. They suggested that agricultural workers who constituteed 58% of the total workforce should be facing deceleration in their productivity and income levels as well as distress during the post-reform period.

The growth of agriculture sector in India decelerated sharply during the liberalization period. This is because of Structural Adjustment Policy of the Central Government. The trend of growth rate of foodgrains in our country is 1% in 1991-92 to 2006-07, which is estimated by the Development Research Group, Mumbai, (Balakrishnan, Golait and Kumar, 2008).

The Central government in India since the early nineties had adopted the policy of the market economic reform under the structural adjustment programme of the IMF and the World Bank. The direct and immediate impact of this policy was a cut in a food and fertilizer subsidy and therefore a rise in fertilizer price. The prices of nitrogenous fertilizer were increased by 40 % in July 1991 and subsequently the rise was reduced to 30 % in August 1991(Rao, 1998). The prices of phosphatic and potassic fertilizers doubled following the decontrol in the early 1990s. Since the fertilizer was used on more than 85 % of irrigated land and about 50 % of unirrigated land by 1988-89 (Rao and Gulati, 1994), such a unilateral withdrawal of a fertilizer subsidy is bound to have a detrimental impact on the economy.

On agricultural credit front the NEP implies a policy of a credit squeeze in agriculture. Initially, the Narasimham Committee (GOI, 1989) recommended a cut of priority sector lending from 40 % to 10 % and the abolition of the concessional rate of interest. Though out of the popular pressure government had to postpone the immediate implementation of the Narasimham Committee recommendation it continued its policy of credit squeeze. As a result of this policy,the share of priority sector advances in total credit in India declined from 40.7 % in 1990 to 31.8 % in 1993. There is also a tendency of decline in the share of 'household sector' because of the fall in the proportion of small-size advances; and steep increase in the share of bank credit offered at higher interest ranges of 15 % and above (EPW Research Foundation, 1995). At the all India level the outstanding credit to agriculture (direct and indirect) to total bank credit came down from 15.9 % in 1990 to 13.6 % in 1993 and 13 % in 1994. For West Bengal the same ratio declined from 8.25 % to 6.08 % between 1990 and 1994. West Bengal government though was forced to swallow the bitter pill of the market economic reform; it no way did give up its state interventionist policies.

The estimation of growth rates of foodgrains for the state of West Bengal has been calculated by Bhattacharyya and Bhattacharyya (2007). They found that area under foodgrains, production and yield growth rates reduced in the period 1992-93 to 2002-03.

According to them, the early 1990s were a period when the Indian economy and Indian agriculture experienced a sea change in the policy regime from state intervention to market reform. There are strong enough grounds to believe that the trend break in the negative direction was a result of this economic reform.

Many researchers are interested to know about the impact of economic reform on agriculture at the state level as well as national level. The district level study is neglected by the researchers. It is more important because the "implementation of planning "by the district authority is more significant factor. So, the author is interested to know about the agrarian economy at the district level in West Bengal.

1.2 The objectives of this study

The present paper would like to explain the performance of agriculture at the district level in West Bengal. This study is to identify districts which display better / worse performance of agriculture, while examining a comparison of the position of agriculture in pre-reform and post- reform periods. It also seeks to explain the factors which are responsible for acceleration / deceleration growth rates in agriculture.

1.3 Limitation

There are some causes for slow growth rate of foodgrains in reforms era. All causes for slow growth of agrarian economy (foodgrains) in liberalization era cannot be explained in this study. Therefore, researchers are encouraged to test the other factors further.

2. Methodology

2.1 Variables

The study is primarily based on the secondary data of area, production and yield underfoodgrains connected with the agrarian economy of districts of West Bengal. The author has selected the time period from 1977-78 to 2013-14 for analysing his above mentioned objectives. Further, he opts for an exploratory study using the entire time period into two sub- periods, 1977-78 to 1991-92 & 1992-93 to 2013-14. The present paper uses the method of computing simple exponential growth rates, kinked exponential growth rates and log quadratic estimates. The first two techniques indicate growth rates and trend breaks but last one shows the degree of instability. The source of data is the

various issues of Statistical Abstract, Bureau of Applied Economics and Statistics, Government of West Bengal and Economic Review of various years.

The present paper has considered three variables for present study which are - a. area under foodgrains b. total production of foodgrains, c. yield or production per unit. The author considers area, production and yield under foodgrains as dependent variables and time as an independent variable for the regression analysis framework. These variable are called general variables.

The present study considers 15 agriculture production districts. Further, The author has clubbed three districts - 24 Parganas = 24 North and 24 South , Midnapore = West and East Midnapore and lastly Dinajpur equals to North and South Dinajpur due to separately data are not available.

2.2 Theoretical Methodology

This study considers the time period from 1977-78 to 2013-14 (ie, 37 years) for the analysis of growth rates of the selective variables in agrarian economy of West Bengal. The Left Front government came to power in 1977 in West Bengal. The major contribution of the Left Front government was the successful implementation of the existing laws. The policies of the agrarian reform of the Left Front government were, first, the "operation barga" or the policy of spot recordation of share tenants. Therefore, author considers about the staring year, 1977-78 and the ending year, 2013-14 for analysis of the present study. After 2013-14, data are not available.

The author divides the entire time period into two sub- periods; the time period from 1977-78 to 1991-92, is called "Before Reform Era (BRE) or 1st sub-period" and from 1992-93 to 2013-14 is called "After Reform Era (ARE) or 2nd sub-period". In India, the liberalization regime started in 1991. The post reform regime immediately started to withdraw credit subsidies in agriculture sector. The year, 1992-93 considers the trend break, if any, it assumes that though the new economic policy formally came into effect in 1991, its effect was realized in 1992-93. The author used "SPSS 20" version package for estimation of growth rates of economic variables.

2.2.1 The methodology to estimate the parameter (growth rate) of the equations 1, 4 and 6 is taken from Bhattacharyya and Bhattacharyya (2007). The equations have been explained in following paragraphs.

a. Simple exponential equation.

Here, the linear form equation is $\ln Qt = a + bt$ …(1) where Qt = output, t = time, b = coefficient on time, and a = constant. The coefficient on time, b, is the continuous rate of growth. By the definition, growth rates is, $\frac{1}{y}\frac{dy}{dt} = g_t$ …..(2), differentiating Qt with respect to t, it gives $\frac{1}{Qt}\frac{dQt}{dt} = b$ …..(3) from equation 1. Therefore, from equations 2 and 3, the estimate of b is presented as an annual growth rate. It is presented as regression coefficient (RC, henceforth) in tables 1 and 2.

b. Kinked exponential equation.

This model imposes linear restrictions in order to eliminate the discontinuity between sub-periods. As a matter of fact, it is a superior basis for comparisons of sub-period growth rates. Author uses the following form of the single kink case. He has normalized time by considering t= 0 at the break point, k. The sub-period growth rates can then be estimated with a joint intercept: $\ln Q_t = a + b_1 D_1 t + b_2 D_2 t + u_t$ ..(4) where t = time period, D_1 and D_2 are two dummy variables described as D_1= 1 for first sub-period , $D_1 = 0$ for second sub-period. Similarly, $D_2 = 1$ for second sub-period , $D_2 = 0$ for first sub-period, and $Q_t = output$, $a = \text{int}\,ercept$. Differentiating Q_t with respect to t in equation 4, it finds $\frac{1}{Qt}\frac{dQt}{dt} = b_1 D_1 + b_2 D_2 .....(5)$

Putting two data sets, it gives the estimated values of b_1 and b_2 respectively. Here, b_1 and b_2 are called the growth rate for 1st and 2nd sub-periods prospectively. The value RCs, b_1 and b_2 for 1st and 2nd sub-periods are presented as RC pd1 and RC pd2 respectively in table 3.

c. Log-quadratic equation.

The present study uses several methods / models for estimation of trend over time. The models are simple exponential form, kinked exponential form and log-quadratic form. It has to estimate the growth rates of two sub-periods (BRE & ARE). The author selects log- quadratic functional form: $\ln Q_t = a + bt + ct^2 + u_t$.....(.6) where Q_t = Output as usual, a = intercept, b = coefficient on time and u_t, for estimation of growth rates of two sub-

periods since the chance of acceleration or deceleration of growth rates over time is integrated by this form. If there is (i) constant growth, then c = 0; (ii) an accelerating growth rate, then c = + (positive value) and (iii) a deceleration growth rate indicates c= - (negative value). To avoid the problem of multi-co linearity, it has normalized time by considering t = 0 at the year of trend break 1992-93. The value RCs, b and c for 1st and 2nd sub-periods are presented as RC pd1 and RC pd2 respectively in table 4.

2.3 Useful term associated with econometrics analysis

i. The "r" is the correlation coefficient between the two variables. The "R^2", indicates the amount of change in the dependent variable that can be attributed to our one independent variable. The R^2 of 0.813 indicates that 81.3% (100 x 0.813) of the variance in the yield rate of Bakura district can be explained by the time (independent variable).

ii. He considers the equation for goodness of fit which is sufficiently large adjusted R^2 tested by F test.

iii. Author has selected the equation with highest $R^{2\ bar}$ as the best fit equation for estimation of parameters.

iv. In our tables show * significant at 1 % level, ** significant at 5% level and # indicate for insignificant at which the model can accurately explain variation in the dependent variable.

v. Finally, the parenthesis in before number indicates negative sign and after number marks as standard error.

3. Results and Discussion

The results and discussion are presented at the section of appendix in tables 1, 2, 3 and 4.

3.1 Burdwan- Table 1 presents the growth rates of 15 agricultural districts in West Bengal on the area; production and yield under foodgrains respectively. From the table 1, it is clear that the area under foodgrains of Burdwan district is the highest the growth rate (0.6%) among the districts in the period 1977-78 to 2013-14. But table 2 shows that the growth rate of area is declining from 0.5% in the first sub-period to 0% in the second sub-period. The table 3 has been presented that this rates are 1.3% in 1977-78 to 1991-92 and 0.3% in 1992-93 to 1913-14 respectively. Finally table 4 reveals significant constant growth rate in the second sub-period. This means that the impact of liberalization policy

on area under foodgrains is constant trend in the district level. It is impact of liberalization policy on farmers. The cost of agricultural operation is high due to withdraw subsidy on fertilizer. So, the cultivation of foodgrains has been declined.

The growth rate of production for foodgrains is 6th position which is 2.4% in 1977-78 to 2013-14 in table 1. The table 2 shows that the significant growth rate is reducing from 3.7% in BRE era to 0.4% in ARE. According to kinked equation, it is seen from table 3 that the growth rate reduces from 4.6% in BRE to 1.1% in AEA. The log-quadratic estimation in table 4 reveals deceleration growth rate between these two periods.

The table 1 shows that the growth rate of yield under foodgrains is 1.8% in 1977-78 to 2013-14 for Burdwan district. Looking into sub-period analysis, table 2 reveals that the growth rate of yield reduces from 3.2% in 1977-78 -- 1991-92 to 0.4% in 1992-93 to 2013-14 for the same district. The tables 3 and 4 present the same trend between two sub-periods. It is statistically significant outcome. Though, the irrigated area is 50.56% of total foodgrains as on 30.09.2003(Official Website). Therefore, it has important role on agriculture. Agriculture is largely regulated by rainfall as in the other district of the state, the developing irrigation system has been very helpful in minimizing the effects of the vagaries of nature.

3.2 Howrah- For the Howrah district, according to simple exponential method in table 1 reveals that growth rates are 0.2% for area, 2% for production and 1.7% for yield respectively in 1977-78 to 2013-14. Table 2 shows that the growth rate of area, production and yield under foodgrains are 1.7%, 6.6% and 5% in BRE compared to -0.4% for area, 0.2% for production and 0.6% for yield in ARA respectively. Table 3 reveals that kinked estimation growth rate under foodgrains are1.7% of area, 5.3% of production and 0.3% of yield in 1977-78 to 1991-92 compared to -0.7%, -0.1% and 0.6% in 1992-93 to 2013-14 respectively. Table 4 presents log-quadratic estimation of growth rate which is also showing the deceleration growth rates of three economic variables between these two sub-periods.

3.3 Purulia- Cultivation of Purulia district is largely mono cropped nature. The share of total cultivated land is about 60% (Official website) up land. The crops are grown mostly under rain fed condition; generally with low fertilizer consumption per unit area. Thus per hector production is also low as compared to other district of West Bengal. The growth rate of area, production and yield under foodgrains of Purulia district in table 2

are 1.4%, 4.4% and 3.1% in the 1st sub-period compared to 0-.4% for area, 0.8% for production and 1.2% for yield in 2nd sub-period respectively. According to kinked exponential method, the growth rates of area, production and yield in table 3 are 1.5%, 4.5% and 3% respectively in BEA compared to 0-.7%, 1.7% and 2.5% in ARE. Table 4 shows that significant acceleration growth rate for area and production between these two sub-periods in Purulia district. It does not mean the effect of liberalization policy due to the rough weather and soil; Purulia lags behind in agricultural arena from the other district of West Bengal. In 2006 the Ministry of Panchayati Raj named Purulia one of the country's 250 most backward districts (out of total 640).

3.4 Bakura- Growth rates of area, production and yield under foodgrains in the Bakura district are different scenario in 1992-93 to 2013-14. Table 1 shows that growth rates are 0-.3% for area, 2.2% for production and 2.4% for yield respectively during 1977-78 to 2013-14. It is a backward district of West Bengal. In 2006 the Ministry of Panchayati Raj named Bankura one of the country's 250 most backward districts (out of a total of 640). It is one of the nineteen districts in West Bengal currently receiving funds from the Backward Regions Grant Fund Programme. Simple exponential method, it is shown in table 2 that growth rate of area, production and yield are 0.7%, 4.9% and 4.2% in BRE compared to -0.6% for area, -0.1% for production and 0.5% for yield in ARE respectively. According to kinked exponential method in table 3, growth rates for three variables have been changed from 1st sub period to 2nd sub-period; these are 1.1% to -1.1% for area, 4.3% to 2.2% for production and 4.7% to 1.7% for yield rate respectively. Table 4 shows a significant deceleration growth rates between these two sub-periods. Whereas, growth rate for area is constant in second sub-period.

3.5 Nadia - By simple exponential method in table 1**,** it shows that growth rates are 0% for area, 2.2% for production as well as yield for the period1977-78 to 2013-14. Table 2 shows that the growth rates of three economic variables reduce from BRE to ARE. But the growth rates are statically significant in both sub-periods. In 1992-93 to 2013-14, the growth rates reduce to -0.5% from 0.9% for area, 0.0% from 5.9% for production and 0.5% from 4.9% for yield in table 2. The economy of this district mainly depends on agriculture. Though the growth rate of theses parameters are decreasing in 1992-93 to 2013-14 but these values are positive except area due to increase significantly over the years 30.37% irrigation land of the total agricultural in 1976-77 to 78.10% in 2000-01. The farmers of this district are benefited from the introduction of new technology.

According to kinked method, these are same tendency for all variables between tow sub-periods. Finally, table 4 reveals a significant deceleration between these two sub-periods.

3.6 Midnapore- From the table1, it is clear that the growth rate of area under foodgrains is the second highest (0.5%) among the districts in the period of 1977-78 to 2013-14, but the growth rate of production is highest (3.1%) among the districts for same period. It is 2.6% for yield for the same period. The declining growth rates are 0.5% to 0.1% for area, 4.8% to 0.8% for production and 4.3% to 0.8% for yield during 1st sub-period to 2nd sub-periods in table 2.

Looking into the production under foodgrains in the same district, table 3 reveals that the growth rate of production is 5.1% in before reform era whereas that of production in the reform era is 1.8%. But the yield growth rate in the same district is 4.3% in the BRE compared to 1.6% in the ARE. The similar trend of growth rates is reflected by the log-quadratic estimation. It shows a deceleration growth rate for production and yield rate over two sub-periods which are shown in table 4.

3.7 24 Parganas- It is difficult to analyze 24 Parganas at present since this district has been divided into North 24 Parganas and South 24 Parganas on March 1, 1986. South 24 Parganas, unfortunately, is a district where the potential in agriculture is severely underutilized. The district represents mostly mono-crop cultivation with kharif paddy being the dominant one. With only about 30 % of net cultivable area having irrigation facility, increasing cropping intensity and crop diversification remain difficult for the farmers. The South 24 Parganas is situated to the south along with Kolkata. On the hand, North 24 Parganas is bordered by Bangladesh to the north and east and Nadia district to the North. It has to discuss the agriculture status in cumulative way due to not available the data before 1986.

By simple exponential method, the growth rate of area is negative though insignificant (-0.1%) for the period 1977-78 to 2013-14 in table 1. But growth rates for production and yield under foodgrains are 2% and 2.2% respectively for the same period. Table 2 shows that the growth rate of area, production and yield rate under foodgrains are 0.5%, 3.7% and 03.2% in the 1st sub-period compared to 0-.4% for area, 0.2% for production and 0.7% yield rate in the 2nd sub-period in this district. The kinked estimation of growth rates for three variables is similar trend between these two sub-periods in table 3. The

log-quadratic method in table 4, this rate indicates deceleration growth between two sub-periods.

3.8 Darjeeling- The agriculture sector of Darjeeling district has been affected in the period of liberalization era. The table 2 shows that the status of foodgrains of three variables decreases from 1st sub-period to 2nd sub-period which are 1.5% to - 0.7% for area, 4.9% to -0.8% for production and 3.4% to - 0.1% for yield rate. Similar trend is reflected in table 3 and table 4.

3.9 Hooghly- The most important district of West Bengal is Hooghly. The district is economically better-off both in terms of agriculture and industry. It is among the very few districts in West Bengal which successfully adopted the strategy of green revolution especially with respect to rice. Table 2 presents that simple exponential growth rates show a decline from 0.2% to 0.1% for area, 3.3% to 0.7 % for production and 3% to 0.5% for yield between two sub-periods. The same estimation according to kinked method is 3.6% to 1.5% for production and 3% to 1% for yield rate between two sub-periods. Table 4 shows a deceleration growth rate between two sub-periods.

3.10 Cooch Bihar- Cooch Bihar district is located in the north-eastern part of the of state and bound by the district of Jalpaiguri in the north, state Assam in the east and the international border in the form of Indo-Bangladesh boundary in the south as well as in the west. Almost 85-90% of the total population depends on agriculture. Table 1 shows at the growth rate of area under foodgrains is negative (0.3%) for the period 1977-78 to 2013-14 but that of production is 2.5% and 2.7% for yield during the same period. Whereas, the growth rate decreased from 0.5% to -0.2% for area, 2.8% to 1.6% for production and 2.3% to 1.8% for yield between 1977-78 -1991-92 to 1992-93 -2013-14 in table 2. It might be result of less adoption of new technology; consumed less fertilizer decreased irrigated area under foodgrains.

3.11 Malda- This district is the one of backward districts of West Bengal. The main factors of backward are low per capita income, low yield per acre of land, backwardness in industrialisation, shortage of capital and entrepreneurship, and also the lack of infrastructure and large labour surplus. The economy of the district is basically an agrarian one. The most of the people of this district depends on agriculture. Its location is surrounded by Bangladesh and South Dinajpur in the east, Santal Parganas of Jharkhand state in the west, Uttar Dinajpur in the north and Murshidabad in the south. The net

irrigated area of this district is 55.63% of the total net cultivated area in 2012(Official website). Looking into agrarian transformation of this district, it presents in table 2 that the growth rates of area, production and yield rate of foodgrains in 1st sub-period are 0.5%, 4% and 3.5% respectively compared to -0.0% for area, 0.6% for production and 1.2% for yield in second sub-period. According to kinked estimation method of growth rates in table 3, it displays that the growth rates are similar tendency in both periods.

3.12 Dinajpur -West Dinajpur was bifurcated into Uttar Dinajpur and DakshinDinajpur on 1 April, 1992. This study explores the combined status of agriculture of two districts since not available data source (already mentioned 2nd paragraph in variable section). The simple exponential growth rates of area, production and yield under foodgrains are 0.0%, 2.4% and 2.4% respectively during 1977-78 to 2013-14 in table 1. The growth rates on area, production and yield rate are very worse situation in BRE among the district of West Bengal. These rates increased from -0.3% to -0.1% for area, -1.3% to 1.3% for production and -0.1% to 1.3% for yield during 1977-78 to1991-92 and 1992-93 to 2013-14 in table 2. It is a remarkable change in agriculture. Dinajpur district has been benefited by new technology in agriculture in the reform era. It might be the cause of expansion of irrigated area, more consumption of fertilizer, awareness of new technology etc. These rates have been estimated by the kinked method which represent similar trend between two periods in table 3. Table 4 shows an acceleration growth between these sub-periods.

3.13 Murshidabad- The location of Murshidabad district is bordered by East Bangladesh, North-Malda district, South-Nadia and Burdwan district. To the west lied Birbhum and Jharkhand state of India. The lion share of population engaged in agriculture sector. Agriculture is the backbone of this district. It is backwardness in terms of industry. Simple exponential estimation of growth rates for whole period is shown in table 1. These rates are 0.2% for area, 2.5% for production and 2.3% for yield rate respectively for the period 1977-78 to 2013-14. The performance of foodgrains in BRE is better compared to ARE in table 2. The percentages of growth rate by kinked exponential method are 0.0% to 0.3% for area, 3.7% to 1.7% for production and 3.8% to 1.4% for yield from the period 1977-78 - 1991-92 to 1992-3 -2013-14 in table 3.

3.14 Jalpaiguri- The percentage of irrigated area to cultivated area is 40% of this district. Area brought under HYV seeds is 60% (Official website of this district). The growth rates of area, production and yield for whole period from 1977-78 to 2013-14 are 0-.4%, 2.1% and 2.5% respectively in table 1. The growth rate of production and yield increased

from 1.2% and 1.6% in 1977-78 to 1991-92 to1.4% and 1.7% respectively during 1992-93 to 2013-14 following the simple exponential growth rate. However, using kinked exponential, it represents that the same increase from 1% to 2.7% for production and 1.5% to 3.1% for yield over two sub-periods. So, this outcome proves that the latter sub-period, this district must be able to improve the performance foodgrains.

3.15 Birbhum- Finally, the growth rate of area, production and yield under foodgrains for the whole period from 1977-78 to 2013-14 are 0.2%, 3% and 2.8% respectively. It is clear in table 2 that the growth rate of area under foodgrains in Birbhum district is more unpleasant situation. The growth rate of area for the 1st sub-period is negative (-1%), it is the smallest growth rate among the districts of West Bengal. Whereas, it is far better position in growth rate (0.2%) of area under foodgrains in the period 1992-93 to 2013-14. The Birbhum district has been improved the land status for using in cultivation. This is because of the technological reforms.

The table 2 shows the growth rate of production is similar tendency. The growth rate of production in the same district is 3.1% in BRE compared to 0.9% in ARE. The growth rate of yield of foodgrains reduced from 4% in 1977-78 - 1991-92 to 0.7% in 1992-93 - 2013-14 respectively. The kinked exponential estimation, it shows that these growth rates are similar trend in table 3. However, using log-quadratic method, it has been seen in table 4 constant growth for area and production but a deceleration growth for yield rate over two sub-periods.

In brief, the growth rates of area of Burdwan, Midnapur, Hoogly, Birbhum,Howrah, Murshidabad and Purulia are positive during 1977-78 to 2013-14 .Though growth rate of production for all districts is positive from 1977-78 to 2013-14. However, the growth of yield is negative in only one district, namely, Hoogly for the same period.

Looking into sub-period investigation, the results are displayed by using the simple exponential estimation that the growth rate of area, production and yield under foodgrains for all districts decreased from 1st sub-period to 2nd sub-period. The peasantry faced two problems: (a) higher costs of production owing to the withdrawal of the fertilizer subsidy; and (b) selling products at viable prices. In a country where about 60 per cent of rural population is a seller of foodgrains, it leads to a loss of income for these peasant households (Bhattacharyya & Bhattacharyya, 2007). It is observed that the growth rate by kinked exponential method broadly reduced from BRE to ARE except three districts,

namely, Dinajpur, Jalpaiguri and Cooch Bihar. The log-quadratic estimation implied broadly deceleration growth rates over the years.

4. Recent Policies of State Government

The new economic policy implies a policy of a credit squeeze in agriculture. The New Government of West Bengal came to the power with large number of Assembly members in 2011 and took some policies for improving the agriculture sector. The author may be realised that the new government of West Bengal has introduced the state interventionist new policy for getting the institutional credit. The Govt of West Bengal has accepted the policy of Krisan Credit Card on 18.08.2011 so that they enjoy the formal credit against the collateral (KrisanCredit Card) up to fifty thousand for each Krisan household in rural economy. Recently, the state government has taken a lot of policies for the improvement of marketing systems for both farm produce and inputs, which necessitate strong back up by appropriate policy and legislative frameworks and effective government support services. Though, impact of these policies will be reviewed in future.

5. Summary and Conclusions

This study has tried to explain the growth of the agrarian economy for the districts of West Bengal over the thirty seven years from 1977-78 to 2013-14. The author tries to investigate a trend break. It is estimated by using simple exponential and kinked exponential methods. The first method is growth rate and second one implies a trend break. This article estimates trend of the parameters on the basis of log quadratic equation which gives the extent of instability over the years.

There is a trend break at 1992-93. This paper finds that the growth rate of area, production and yield under foodgrains constitutes positive for seven, fifteen and fourteen districts respectively for the whole period from 1977-78 to 2013-14. The growth rate of production is highest in Midnapur and lowest in Darjeeling district. However, the growth rate of yield is better performance in Malda and worse situation in Darjeeling district. On the other hand, the growth rate of area under foodgrains is higher in Burdwan and lowest in 24 Parganas for the same period.

There is a statistically significant decline at the break point. Though the growth rate under area of foodgrains of four districts (Birbhum, Murshidabad, Jalpaiguri and Dinajpur) is increasing for the period 1992-93 to 2013-14, but it is decreasing one for

eleven districts at this point in the same period. Similar trend of growth rate follows for yield rate. Though, one district namely, Dinajpur has positive one for yield rate, but it decreases for the remaining 14 districts for the period 1992-93 to 2013-14.

The present paper shows that the impact of national policy has extended to district level in West Bengal. The author finds deceleration growth rate for area, production and yield under foodgrains of different districts for the period 1992-93 to 2013- 14. It is the impact of liberalisation policy since the Central Government has withdrawn food and fertilizer subsidy. So, farmer earns negative revenue from their farm.

It is beyond the scope of this article to undertake a comprehensive analysis of the main reasons for deceleration growth rate during the post-reform era at the district level of West Bengal.

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APPENDIX: Analytical Result

Table 1: Growth Rate by Simple Exponential method for the period 1977-78 to 2013-14.										
Districts	**Variables**	**r**	**R^2**	**Adj R Squared**	**Standard Error**	**Constant**	**t-value**	**RC**	**t-value**	**F-test Value**
Burwan	Area	0.68	0.46	0.445	0.074	6.372(.013)	501.08*	.006(.001)	5.461*	29.822*
	Production	0.87	0.745	0.741	0.152	7.241(.026)	278.38*	.024(.002)	10.181*	103.795*
	Yield	0.88	0.767	0.760	0.107	7.777(.018)	426.70*	.018(.002)	10.73*	115.126*
Birbhum	Area	0.25	0.062	0.035	0.0905	5.987(.015)	387.307*	.002(.001)	1.516#	2.297#
	Production	0.62	0.388	0.371	0.4145	6.655(.071)	94.012*	.030(.006)	4.713*	22.214*
	Yield	0.61	0.377	0.359	0.3945	7.577(.067)	112.48*	.028(.006)	4.603*	21.191*
Bakura	Area	0.23	0.052	0.025	0.1372	5.978(.023)	254.945*	(-).003(.002)	(-)1.382#	1.909#
	Production	0.69	0.473	0.458	0.2500	6.652(.043)	155.796*	.022 (.004)	5.601*	**31.371***
	Yield	0.87	0.763	0.756	0.14963	7.583(.026)	296.766*	.024 (.002)	10.617*	112.775*
Midnapur	Area	0.82	0.679	0.67	0.0351	6.950(.006)	1158.445*	.005(.001)	8.608*	74.099*
	Production	0.89	0.792	0.786	0.17167	7.519(.029)	256.493*	.031(.003)	11.550*	133.412*
	Yield	0.88	0.768	0.761	0.1565	7.477(.027)	279.837*	.026 (.002)	10.763*	115.842*
Howrah	Area	0.25	0.06	0.033	0.095	4.779(.0160	294.62*	.002(.001)	1.498#	2.243#
	Production	0.7	0.483	0.468	0.2231	5.331(.038)	13995*	.020(.003)	5.715*	32.666*
	Yield	0.76	0.573	0.561	0.1656	7.460(.028)	263.90*	.017(.003)	6.851*	46.938*
Hooghly	Area	0.55	0.297	0.276	0.084	5.608(.014)	390.74*	.005(.001)	3.84*	14.756*
	Production	0.88	0.778	0.772	0.1332	6.394(.023)	281.10*	.023(.002)	11.08*	122.765*
	Yield	0.91	0.822	0.817	0.0907	7.695(.015)	496.88*	0.018*(0.001	12.72*	161.661*
24Parganas	Area	0.18	0.034	0.006	0.0599	6.580(.010)	643.24*	(-).001(.001)	(-)1.11#	1.233#
	Production	0.8	0.646	0.635	0.1666	7.134(.028)	250.68*	.020(.003)	7.98*	63.722*
	Yield	0.88	0.766	0.759	0.1306	7.462(.022)	334.48*	.022(.002)	10.69*	114.321*
Nadia	Area	0.03	0.001	(-).028	0.1052	5.916(.018)	329.32*	(-).000(.002)	(-).172#	.030#
	Production	0.79	0.621	0.611	0.1898	6.549(.032)	202.11*	.022(.003)	7.579*	57.449*
	Yield	0.9	0.805	0.8	0.121	7.541(.021)	364.91*	.022(.002)	12.04*	144.849*
Murshidabad	Area	0.23	0.054	0.027	0.0852	6.248(.015)	429.27*	.002(.001)	1.41#	1.991#
	Production	0.89	0.792	0.786	0.1397	6.880(.024)	288.25*	.025(.002)	11.55*	133.393*
	Yield	0.92	0.841	0.836	0.1098	7.540(.019)	402.03*	.023(.002)	13.60*	185.082*
Dinajpur	Area	0.05	0.002	(-).026	0.0412	6.285(.007)	895.18*	(-).000(.001)	(-).276#	.076#
	Production	0.57	0.326	0.307	0.3718	6.821(.063)	107.43*	.024(.006)	4.12*	16.944*
	Yield	0.56	0.313	0.294	0.386	7.444(.066)	112.92*	.024(.006)	4.10*	15.96*
Malda	Area	0.64	0.415	0.398	0.0879	5.778(.015)	384.74*	(-).007(.001)	(-)4.98*	24.799*
	Production	0.92	0.839	0.835	0.1163	6.324(.020)	318.49*	.024(.002)	13.52*	182.65*
	Yield	0.97	0.938	0.936	0.0872	7.457(.015)	500.81*	.031(.001)	23.06*	531.63*
Jalpaiguri	Area	0.71	0.502	0.488	0.0446	5.664(.008)	743.33*	(-).004(.001)	(-)5.94*	35.33*
	Production	0.88	0.776	0.77	0.1216	5.865(.021)	282.38*	.021(.002)	11.03	121.60*
	Yield	0.92	0.851	0.847	0.1136	7.108(.019)	366.29*	.025(.002)	14.14*	199.81*
Darjeeling	Area	0.77	0.593	0.581	0.1065	4.359(.018)	239.69*	(-).012(.002)	(-)7.14*	50.98*
	Production	0.1	0.01	(-).018	0.2597	4.840(.044)	109.16*	.002(.002)	.599#	.359#
	Yield	0.61	0.369	0.351	0.2025	7.388(.035)	213.7*	.014(.003)	4.52*	20.47*
Cooch Behar	Area	0.41	0.17	0.146	0.0620	5.776(.011)	545.60*	(-).003(.001)	(-)2.67*	7.15*
	Production	0.93	0.859	0.855	0.1991	6.049(.019)	324.71*	.025(.002)	14.59*	212.92*
	Yield	0.96	0.913	0.911	0.0917	7.181(.016)	458.83*	.027(.001)	19.18*	267.82*
Purulia	Area	0.09	0.008	(-).020	0.1377	5.695(.024)	242.22*	.001(.002)	.535#	.286#
	Production	0.73	0.535	0.521	0.2829	6.067(.048)	125.61*	.028(.004)	6.34*	40.19*
	Yield	0.84	0.712	0.704	0.1848	7.279(.032)	230.69*	.026(.003)	9.31*	86.61*

Note: Symbols *, ** and # indicate significant at 1% level, significant at 5% level and insignificant respectively. Figures in parentheses at right side of number show standard errors for 1 to 4 tables.

Table 2: Growth Rates by Simple Exponential method for two sub-periods 1977-78 to 1991-92 and 1992-93 to 2013-14

District	Variable	Period	r	R^2	Adj R Square	Standard Error	Constant	t-value	RC	t-value	F-test Value
Burwan	Area	Pd1	0.338	0.114	0.046	0.0688	6.301(.018)	354.67*	0.005(.004)	1.295	1.667
		Pd2	0.005	0.000	-0.05	0.0655	6.452(.014)	461.813*	.000(.001)	461.813*	0.000
	Production	Pd1	0.745	0.555	0.520	0.1556	7.011(.040)	174.284*	.037 (.009)	4.023*	16.185*
		Pd2	0.475	0.225	0.187	0.0902	7.519(.019)	390.821*	.004(.002)	2.412	5.820
	Yield	Pd1	0.767	0.588	0.557	0.1245	7.618(.032)	236.544*	.032(.007)	4.311*	18.585*
		Pd2	0.757	0.573	0.551	0.0423	7.975(.009)	884*	.004(.001)	5.176*	26.786*
Birbhum	Area	Pd1	0.557	0.31	0.257	0.067	5.962(.017)	344.478*	(-).01(.004)	(-)2.416 #	5.838#
		Pd2	0.224	0.050	0.003	0.0965	6.0159(.021)	292.125*	.002(.002)	1.027#	1.054#
	Production	Pd1	0.215	0.046	-0.027	0.6465	6.374(.167)	38.181*	.031(.039)	.792#	.627#
		Pd2	0.632	0.400	0.370	0.1397	6.999(.030)	234.847*	.009(.002)	3.652*	13.335*
	Yield	Pd1	0.283	0.08	0.009	0.6259	7.32(.162)	45.292*	.040(.037)	1.064#	1.131#
		Pd2	0.782	0.611	0.591	0.0728	7.894(.016)	508.095*	.007(.001)	5.603*	31.396*
Bankura	Area	Pd1	0.391	0.153	0.088	0.07415	5.979(.019)	312.268*	.007 (.004)	1.531#	2.345#
		Pd2	0.49	0.24	0.202	0.1521	5.951 (.032)	183.814*	(-).006(.003)	(-)2.511*	6.304*
	Production	Pd1	0.68	0.462	0.42	0.24567	6.432 (.063)	101.402	.049 (.015)	3.340*	11.156*
		Pd2	0.072	0.005	(-).045	0.1797	6.910(.038)	180.331*	(-).001(.003)	(-).323#	.104#
	Yield	Pd1	0.726	0.528	0.491	0.1856	7.362 (.048)	153.598*	.042 (.011)	3.812*	11.529*
		Pd2	0.781	0.61	0.591	0.05778	7.857(.012)	638.047*	.005(.001)	5.597*	31.326*
Midnapur	Area	Pd1	0.567	0.321	0.269	0.03493	6-901(.009)	765.135*	.005(.002)	2.481**	6.153**
		Pd2	0.268	0.072	0.025	0.02524	7.006(.005)	130.75*	.001(.000)	1.245#	1.549#
	Production	Pd1	0.766	0.587	0.555	0.1872	7.249(.048)	149.98*	.048(.011)	4.294*	18.439*
		Pd2	0.67	0.449	0.422	0.1234	7.858(.026)	298.62*	.008(.002)	4.039*	16.316*
	Yield	Pd1	0.764	0.583	0.551	0.1693	7.255(.044)	165.947*	.043(.010)	4.267*	18.207*
		Pd2	0.652	0.425	0.396	0.1245	7.759(.027)	292.385*	.008(.002)	3.843*	14.772*
Howrah	Area	Pd1	0.682	0.456	0.424	0.0826	4.747(.0210	222.55*	.017(.005)	3.364*	11.317*
		Pd2	0.585	0.343	0.31	0.0656	4.813(.014)	343.70*	(-).004(.001)	(-)3.229*	10.424*
	Production	Pd1	0.863	0.745	0.726	0.1786	5.173(.046)	112.15*	.066(,011)	6.168*	38.048*
		Pd2	0.194	0.038	(-)010	0.1636	5.537(.035)	158.76*	.002(.003)	.885#	.784#
	Yield	Pd1	0.821	0.673	0.648	0.1605	7.336(.041)	177.012*	.050(.010)	5.175*	26.784*
		Pd2	0.548	0.3	0.265	0.1231	7.633(.026)	29089*	.006(.002)	2.928*	8.575*
Hooghly	Area	Pd1	0.161	0.026	(-).049	0.0633	5.557(.016)	34028*	.002(.004)	.587#	.344#
		Pd2	0.165	0.027	-0.021	0.96	5.667(.020)	276.90*	.001(.002)	.750#	.563#
	Production	Pd1	0.731	0.534	0.498	0.141	6.192(.036)	170.04*	.033(.008)	3.862*	14.915*
		Pd2	0.621	0.386	0.355	0.1103	6.647(.024)	282.69*	.007(.002)	3.54*	12.562*
	Yield	Pd1	0.779	0.607	0.577	0.1132	7.543(.029)	258.01*	.030(.007)	4.48*	20.087*
		Pd2	0.877	0.768	0.757	0.0391	7.888(.008)	945.48*	.005(.001)	8.15*	66.378*
24Parganas	Area	Pd1	0.629	0.396	0.35	0.02267	6.469(.007)	952.71*	.005(.002)	2.92*	8.526*
		Pd2	0.777	0.604	0.584	0.0473	6.582(.010)	652.24*	(-)004(.001)	(-)5.52*	30.499*
	Production	Pd1	0.654	0.428	0.384	0.1985	6.936(.051)	135.31*	.037(.012)	3.12*	9.732*
		Pd2	0.356	0.127	0.083	0.0814	7.372(.017)	424.58*	.002(.001)	1.71**	2.906*
	Yield	Pd1	0.654	0.428	0.384	0.1985	7.275(.048)	152.34*	.032(.011)	2.93*	8.567*
		Pd2	0.859	0.738	0.725	0.0353	7.698(.011)	677.77*	.007(.001)	7.515*	56.471*
Nadia	Area	Pd1	0.472	0.223	0.163	0.0811	5.896(.021	281.55*	.009(.005)	1.93**	3.724**
		Pd2	0.601	0.361	0.329	0.0925	5.929(.020)	300.57*	(-).005(.002)	(-)3.36*	11.300*

In continuation - table 2.....

District	Variable	Period	r	R^2	Adj R Square	Standard Error	Constant	t-value	RC	t-value	F-test Value
Burwan	Area	Pd1	0.338	0.114	0.046	0.0688	6.301(.018)	354.67*	0.005(.004)	1.295	1.667
		Pd2	0.005	0.000	-0.05	0.0655	6.452(.014)	461.813*	.000(.001)	461.813*	0.000
	Production	Pd1	0.745	0.555	0.520	0.1556	7.011(.040)	174.284*	.037 (.009)	4.023*	16.185*
		Pd2	0.475	0.225	0.187	0.0902	7.519(.019)	390.821*	.004(.002)	2.412	5.820
	Yield	Pd1	0.767	0.588	0.557	0.1245	7.618(.032)	236.544*	.032(.007)	4.311*	18.585*
		Pd2	0.757	0.573	0.551	0.0423	7.975(.009)	884*	.004(.001)	5.176*	26.786*
Birbhum	Area	Pd1	0.557	0.31	0.257	0.067	5.962(.017)	344.478*	(-).01(.004)	(-)2.416 #	5.838#
		Pd2	0.224	0.050	0.003	0.0965	6.0159(.021)	292.125*	.002(.002)	1.027#	1.054#
	Production	Pd1	0.215	0.046	-0.027	0.6465	6.374(.167)	38.181*	.031(.039)	.792#	.627#
		Pd2	0.632	0.400	0.370	0.1397	6.999(.030)	234.847*	.009(.002)	3.652*	13.335*
	Yield	Pd1	0.283	0.08	0.009	0.6259	7.32(.162)	45.292*	.040(.037)	1.064#	1.131#
		Pd2	0.782	0.611	0.591	0.0728	7.894(.016)	508.095*	.007(.001)	5.603*	31.396*
Bankura	Area	Pd1	0.391	0.153	0.088	0.07415	5.979(.019)	312.268*	.007 (.004)	1.531#	2.345#
		Pd2	0.49	0.24	0.202	0.1521	5.951 (.032)	183.814*	(-).006(.003)	(-)2.511*	6.304*
	Production	Pd1	0.68	0.462	0.42	0.24567	6.432 (.063)	101.402	.049 (.015)	3.340*	11.156*
		Pd2	0.072	0.005	(-).045	0.1797	6.910(.038)	180.331*	(-).001(.003)	(-).323#	.104#
	Yield	Pd1	0.726	0.528	0.491	0.1856	7.362 (.048)	153.598*	.042 (.011)	3.812*	11.529*
		Pd2	0.781	0.61	0.591	0.05778	7.857(.012)	638.047*	.005(.001)	5.597*	31.326*
Midnapur	Area	Pd1	0.567	0.321	0.269	0.03493	6-901(.009)	765.135*	.005(.002)	2.481**	6.153**
		Pd2	0.268	0.072	0.025	0.02524	7.006(.005)	130.75*	.001(.000)	1.245#	1.549#
	Production	Pd1	0.766	0.587	0.555	0.1872	7.249(.048)	149.98*	.048(.011)	4.294*	18.439*
		Pd2	0.67	0.449	0.422	0.1234	7.858(.026)	298.62*	.008(.002)	4.039*	16.316*
	Yield	Pd1	0.764	0.583	0.551	0.1693	7.255(.044)	165.947*	.043(.010)	4.267*	18.207*
		Pd2	0.652	0.425	0.396	0.1245	7.759(.027)	292.385*	.008(.002)	3.843*	14.772*
Howrah	Area	Pd1	0.682	0.456	0.424	0.0826	4.747(.0210	222.55*	.017(.005)	3.364*	11.317*
		Pd2	0.585	0.343	0.31	0.0656	4.813(.014)	343.70*	(-).004(.001)	(-)3.229*	10.424*
	Production	Pd1	0.863	0.745	0.726	0.1786	5.173(.046)	112.15*	.066(,011)	6.168*	38.048*
		Pd2	0.194	0.038	(-)010	0.1636	5.537(.035)	158.76*	.002(.003)	.885#	.784#
	Yield	Pd1	0.821	0.673	0.648	0.1605	7.336(.041)	177.012*	.050(.010)	5.175*	26.784*
		Pd2	0.548	0.3	0.265	0.1231	7.633(.026)	29089*	.006(.002)	2.928*	8.575*
Hooghly	Area	Pd1	0.161	0.026	(-).049	0.0633	5.557(.016)	34028*	.002(.004)	.587#	.344#
		Pd2	0.165	0.027	-0.021	0.96	5.667(.020)	276.90*	.001(.002)	.750#	.563#
	Production	Pd1	0.731	0.534	0.498	0.141	6.192(.036)	170.04*	.033(.008)	3.862*	14.915*
		Pd2	0.621	0.386	0.355	0.1103	6.647(.024)	282.69*	.007(.002)	3.54*	12.562*
	Yield	Pd1	0.779	0.607	0.577	0.1132	7.543(.029)	258.01*	.030(.007)	4.48*	20.087*
		Pd2	0.877	0.768	0.757	0.0391	7.888(.008)	945.48*	.005(.001)	8.15*	66.378*
24Parganas	Area	Pd1	0.629	0.396	0.35	0.02267	6.469(.007)	952.71*	.005(.002)	2.92*	8.526*
		Pd2	0.777	0.604	0.584	0.0473	6.582(.010)	652.24*	(-)004(.001)	(-)5.52*	30.499*
	Production	Pd1	0.654	0.428	0.384	0.1985	6.936(.051)	135.31*	.037(.012)	3.12*	9.732*
		Pd2	0.356	0.127	0.083	0.0814	7.372(.017)	424.58*	.002(.001)	1.71**	2.906*
	Yield	Pd1	0.654	0.428	0.384	0.1985	7.275(.048)	152.34*	.032(.011)	2.93*	8.567*
		Pd2	0.859	0.738	0.725	0.0353	7.698(.011)	677.77*	.007(.001)	7.515*	56.471*
Nadia	Area	Pd1	0.472	0.223	0.163	0.0811	5.896(.021	281.55*	.009(.005)	1.93**	3.724**
		Pd2	0.601	0.361	0.329	0.0925	5.929(.020)	300.57*	(-).005(.002)	(-)3.36*	11.300*
	Production	Pd1	0.916	0.839	0.826	0.1192	6.337(.031)	205.86*	.059(.007)	8.22*	67.621*

Table 3:Growth Rates by Kinked Exponential method in 1977-78 to1991-92 and 1992-93 to 2013-14												
District	**Variables**	**r**	**R^2**	**Adj R Squared**	**Standard Error**	**Constant**	**t-value**	**RC Pd1**	**t-value**	**RC Pd2**	**t-value**	**F-test Value**
Burdwan	Area	0.720	0.519	0.490	0.0713	6.412(.023)	273.693*	.012(.003	3.956*	.003(.002)	1.334#	18.315*
	Prod	0.92	0.84	0.830	0.1232	7.394(.040)	182.819*	.046(.005	8.676*	.011 (.004)	3.013*	89.184*
	Yield	0.93	0.886	0.852	0.0838	7.889(.028)	286.426*	.034(.004	9.375#	.008 (.002)	3.388*	104.578*
Birbhum	Area	0.37	0.135	0.084	0.0881	5.945(.029)	205.295*	.004(.004	(-)1.02#	.006 (.003)	2.269#	2.655#
	Prod	0.63	0.399	0.363	0.4169	6.746(.137)	49.26*	.043(.018	2.414**	.022 (.012)	1.856**	11.278*
	Yield	0.63	0.402	0.367	0.3921	7.709(.129)	59.868*	.047 (.017)	2.790**	.017 (.011)	1.468#	11.444*
Bankura	Area	0.47	0.22	0.174	0.1263	6.073(.041)	146.34*	.011(.005	1.98**	(-).011(.004)	(-)3.09*	4.787**
	Prod	0.63	0.399	0.363	0.4169	6.746(.137)	49.26*	.043(.018	2.414**	.022(.012)	1.856**	11.278*
	Yield	0.63	0.402	0.367	0.3921	7.709(.129)	59.87*	.047(.017	2.79*	.017(.11)	1.468#	11.444*
Midnapur	Area	0.86	0.744	0.729	0.0318	6.976(.010)	667.41*	.008(.001)	6.7175*	.002(.001)	2.604*	49.471*
	Prod	0.92	0.846	0.837	0.1520	7.664(.049)	155.54*	.051(.005)	7.981*	.018(.004)	4.172*	93.255*
	Yield	0.9	0.815	0.804	0.1417	7.594(.047)	163.16*	.043(.005)	7.038*	.016(.004)	3.876*	74.936*
Howrah	Area	0.69	0.479	0.448	0.0718	4.885(.024)	207.23*	.017(.003)	5.59*	(-).007(.002)	(-)3.35*	15.626*
	Prod	0.83	0.689	0.67	0.1756	5.564(.058)	96.47*	.053(.007)	7.04*	(-).001(.005)	(-).12#	37.582*
	Yield	0.82	0.667	0.647	0.1484	7.589(.049)	155.70*	.003(.005)	5.643*	.006(.004)	1.48#	33.980*
Hooghly	Area	0.55	0.3	0.259	0.0850	5.617(.028)	201.07*	.004(.002)	1.75**	.004(.002)	1.689**	7.285*
	Prod	0.91	0.818	0.808	0.1223	6.489(.040)	16150*	.036(.005)	6.913*	.015(.004)	4.15*	76.541*
	Yield	937	0.878	0.871	0.0762	7.779(.025)	310.77*	.030(.003)	9.14*	.010(.002)	4.769*	122.212*
24Parganas	Area	0.71	0.508	0.479	0.0434	6.649(.014)	466.57*	.009(.002)	4.79*	(-)007(.001)	(-)5.65*	17.522*
	Prod	0.87	0.758	0.744	0.1396	7.290(.046)	158.98*	.043(.006)	7.16*	.007(.004)	1.74**	53.331*
	Yield	0.9	0.803	0.791	0.1216	7.548(.040)	189.04*	.034(.005)	6.51*	.014(.003)	4.013*	69.204*
Nadia	Area	0.56	0.312	0.272	0.0886	6.014(.029)	206.76*	.014(.004)	3.58*	(-).009(.003)	(-)3.42*	7.717*
	Prod	0.94	0.877	0.87	0.1096	6.808(.036)	189.18*	.059(.005)	12.50*	.000(.003)	(-).087#	121.621*
	Yield	0.97	0.931	0.927	0.0731	7.702(.024)	320.76*	.045(.003)	14.53*	.008(.002)	4.021*	229.344*
Murshidabad	Area	0.26	0.067	0.012	0.0858	6.231(.028)	220.91*	.000(.004)	(-).131#	.003(.002)	1.33#	1.324#
	Prod	0.91	823	0.812	0.1309	6.969(.043)	162.02*	.037(.006)	6.71*	.017(.004)	4.55*	78.905*
	Yield	0.95	0.894	0.888	0.0909	7.645(.030)	256.12*	.038(.004)	9.795*	.014(.003)	5.31*	143.674*
Dinajpur	Area	0.05	0.002	(-).056	0.0418	6.284(.014)	458.22*	.000(.002)	(-).195#	(-).000(.001)	(-).058#	.043#
	Prod	0.59	0.352	0.314	0.3699	6.701(.122)	55.15*	.006(.016)	.411#	.034(.11)	3.20*	9.231*
	Yield	0.59	0.337	0.298	0.3848	7.325(.126)	0.4173	.007(.016)	.417#	.034(.011)	3.08*	8.642*
Malda	Area	0.74	0.545	0.518	0.0789	5.847(.028)	226.31*	.003(.003)	.90#	(-).013(.002)	(-)5.62*	20.37*
	Prod	0.95	0.904	0.898	0.0912	6.450(.030)	215.24*	.042(.004)	10.69*	.014(.003)	5.18*	159.94*
	Yield	0.97	0.947	0.944	0.0823	7.511(.027)	278.28*	.039(.002)	11.01*	.026(.002)	11.14*	301.96*
Jalpaiguri	Area	0.71	502	0.473	0.0453	5.663(.015)	380.90*	(-).004(.00	(-)2.22*	(-).004(.001)	(-)3.04*	17.17*
	Prod	0.9	0.805	0.794	0.1152	5.729(.038)	153.16*	.010(.005)	2.11*	.027(.003)	8.13*	70.34*
	Yield	0.93	0.872	0.865	0.1068	7.037(.035)	200.67*	.015(.005)	3.32*	.031(.003)	10.06*	115.99*
Darjeeling	Area	0.83	0.695	0.678	0.0945	.4.448(.031)	144.91*	.001(.004)	.217#	(-).019(.003)	(-).722*	38.83*
	Prod	0.62	0.381	0.344	0.2084	4.104(.068)	74.57*	.040(.009)	4.48*	(-).020(.006)	(-)3.41*	10.45*
	Yield	0.74	0.54	0.513	0.1754	7.563(.058)	131.30*	.039(.007)	5.20*	(-).001(.005)	(-)21#	19.96*
Cooch Behar	Area	0.49	0.24	0.195	0.0601	5.806(.020)	293.77*	.002(.003)	.66#	(-).005(.002)	(-)2.97*	5.37*
	Prod	0.93	0.865	0.857	0.1081	6.010(.036)	169.24*	.019(.005)	4.13*	.028(.003)	8.96*	109.18*
	Yield	0.97	0.931	0.927	0.0830	7.112(.027)	261.01*	.017(.004)	4.90*	.033(.002)	13.84*	228.76*
Purulia	Area	0.44	0.195	0.148	0.1258	5.795(.041)	140.23*	.015(.005)	2.84*	(-).007(.004)	(-)2.06*	4.13*
	Prod	0.75	0.566	0.54	0.2771	6.189(.091)	68.00*	.045(.012)	3.80*	.017(.008)	2.13*	22.17*
	Yield	0.85	0.714	0.697	0.1869	7.302(.061)	118.91*	.030(.008)	3.73*	.025(.005)	4.56*	42.39*

Note: Prod indicates "Production"

Table 4: Trend estimation by Log-quardatic method for the period 1977-78 to1991-92 and 1992-93 to 2013-14.

District	Variable	r	R^2	Adj R Squared	Standard Error	Constant	t-value	RC Pd1	t-value	RC Pd2	t-value	F-test Value
Burdwan	Area	0.753	0.568	0.542	0.068	6.405(.016)	393.766	.008(.001)	6.640*	.000(.000)	2.91**	22.319*
	Prod	0.918	0.844	0.834	0.122	7.335 (.029)	250.469	.029(.002)	13.220*	-.001(.000)	-4.562*	91.67*
	Yield	0.918	0.842	0.833	0.089	7.838(.021)	365.49*	.021(.002)	13.018	-.001(.000)	-4.023*	90.63*
Birbhum	Area	0.319	0.102	0.049	0.09	5.968(.022)	276.103	.001 (.002)	.634#	.000(.000)	1.237#	1.931#
	Prod	0.63	0.397	0.362	0.418	6.705 (.100)	66,745*	.033 (.008)	4.337*	(-).000(.001)	(-).706#	11.198*
	Yield	0.629	0.396	0.360	0.394	7.646 (.095)	80.625*	.032(.007)	4.447*	(-).001(.001)	(-)1.028#	11.141*
Bankura	Area	0.432	0.186	0.138	0.129	6.029(.031)	194.197	.000(.002)	.018#	(-).000(.000)	(-)2.371*	3.890#
	Prod	0.790	0.634	0.612	0.211	6.790(.051)	133.509	.029(.004)	7.667*	(-) .001(.000)	(-)3.868*	29.430*
	Yield	0.918	0.842	0.833	0.124	7.670(.030)	257.406	.029 (.002)	13.060*	(-).001(.000)	(-)4.134*	90.822*
Midnapur	Area	0.600	0.740	724	0.032	6.965(.008)	901.58*	.006(.001)	9.468*	(-).000(.000)	(-)2.81*	48.298*
	Prod	0.920	0.846	0.837	0.15	7.607(.036)	210.97*	.036(.003)	13.04*	(-).001(.000)	(-)3.45*	93.487*
	Yield	0.903	0.816	0.805	0.141	7.548(.034)	22196*	.030(.003)	11.67*	(-).001(.000)	(-)2.98*	75.415*
Howrah	Area	0.676	0.457	0.425	0.073	4.841(.018)	274.73*	.006(.001)	4.30*	(-).001(.000)	(-)4.99*	14.323*
	Prod	0.817	0.667	0.647	0.182	5.464(.044)	125.01*	.027(.003)	8.25*	(-).001(.000)	(-)4.33*	34.004*
	Yield	0.808	0.652	0.632	0.142	7.532(.036)	206.57*	.022(.003)	7.82*	(-).001(.000)	(-)2.79*	31.883*
Hooghly	Area	0.551	0.304	0.263	0.085	5.616(.020)	275.15*	.005(.002)	3.54*	(-).000(.000)	(-).589#	7.414*
	Prod	0.904	0.817	0.806	0.123	6.450(.030)	21823*	.026(.002)	11.60*	(-).001(.000)	(-)2.6**	75.784*
	Yield	0.933	0.870	0.862	0.079	7.742(.019)	409.39*	.020(.001)	14.31*	(-).000(.000)	(-)3.548*	113.888*
24Parganas	Area	0.775	0.600	0.577	0.039	6.626(.009)	704.51*	.002(.001)	2.26*	(-).000(.000)	(-)6.94*	25.543*
	Prod	0.867	0.752	0.737	0.142	7.225(.034)	212.17*	.026(.003)	9.99*	(-).001(.000)	(-)3.81*	51.431*
	Yield	0.891	0.794	0.782	0.124	7.507(.030)	250.97*	.024(.002)	10.66*	(-).000(.000)	(-)2.16*	65.431*
Nadia	Area	608	0.369	0.332	0.085	5.980(.020)	293.12*	.003(.002)	2.192**	(-).001(.000)	(-)4.46*	9.954*
	Prod	937	0.878	0.871	0.109	6.706(.026)	254.78*	.031(.002)	15.63*	(-).001(.000)	(-)8.44*	122.078*
	Yield	0.958	0.918	0.914	0.08	7.633(.019)	398.93*	.028(.001)	19.15*	(-).001(.000)	(-)6.86*	191.200*
Murshidabad	Area	0.234	0.055	(-).001	0.086	6.250(.021)	300.57*	.002(.002)	1.27#	(-)000(.000)	(-).179#	.984#
	Prod	0.991	0.830	0.82	0.128	6.940(.031)	225.10*	.028(.002)	12.14*	(-).001(.000)	(-)2.76*	83.173*
	Yield	0.940	0.884	0.877	0.095	7.597(.023)	332.05*	.026(.002)	15.20*	(-)oo1(.000)	(-)3.56*	129.765*
Dinajpur	Area	0.144	0.021	(-).037	0.041	6.291(.010)	631.97*	.000(.001)	0.194#	(-).000(.000)	(-).801#	.359#
	Prod	0.593	0.352	0.314	0.37	6.748(.089)	75.83*	.019(.007)	2.88*	.001(.001)	1.167#	9.242*
	Yield	0.585	0.342	0.303	0.384	7.365(.092)	79.83*	.019(.007)	2.76*	.001(.001)	1.213#	8.823*
Malda	Area	0.695	0.483	0.452	0.084	5.808(.020)	287.84*	(-).005(.002	(-)3.29*	(-).000(.000)	(-)2.19*	15.88*
	Prod	0.945	0.892	0.886	0.097	6.395(.023)	275.10*	.028(.002)	15.97*	(-).001(.000)	(-)4.09*	140.81*
	Yield	0.974	0.949	0.946	0.08	7.494(.019)	388.39*	.033(.001)	22.67*	(-).000(.000)	(-)2.72*	317.91*
Jalpaiguri	Area	0.771	0.505	0.476	0.045	5.667(.001)	521.65*	(-).004(.001	(-)4.75*	(-).000(.000)	(-).421#	17.34*
	Prod	0.900	0.811	0.799	0.114	5.817(.027)	212.87*	.018(.002)	8.68*	.000(.000)	2.48*	72.77*
	Yield	0.938	0.881	0.874	0.103	7.057(.025)	284.37*	.022(.002)	11.63*	.000(.000)	2.91*	125.50*
Darjeeling	Area	0.805	0.648	0.628	0.1	4.399(.024)	182.07*	(-).009(.002	(-)5.18*	(-).000(.000)	(-)2.32*	31.36*
	Prod	0.472	0.223	0.178	0.233	4.961(.056)	88.35*	.009(.004)	2.19*	(-).001(.000)	(-)3.05*	4.89*
	Yield	0.686	0.47	0.439	0.188	7.470(.045)	164.96*	.019(.003)	5.48*	(-).001(.000)	(-)2.55*	15.09*
Cooch Behar	Area	0.446	0.199	0.152	0.062	5.787(.015)	389.31*	(-).002(.001	(-)1.68*	(-).000(.000)	(-)1.11#	4.21#
	Prod	0.936	0.876	0.869	0.104	6.011(.025)	240.77*	.022(.002)	11.83*	.000(.000)	2.16*	120.01*
	Yield	0.969	0.939	0.935	0.078	7.131(.019)	379.06*	.024(.000)	17.03*	.000(.000)	3.75*	259.68*
Purulia	Area	0.398	0.159	0.109	0.129	5.749(.031)	185.71*	.004(.002)	1.79**	(-).001(.000)	(-)2.47*	3.20*
	Prod	0.753	0.567	0.541	0.277	6.142(.067)	92.22*	.032(.002)	6.33*	(-).001(.000)	(-)1.59**	22.25*
	Yield	0.846	0.716	0.669	0.186	7.300(.045)	162.89*	.0289.003)	8.17*	(-).000(.000)	(-).66#	42.83

Note: Prod indicates "Production"