Chapter-IV

Trends in Agricultural Productivity in West Bengal: An Overview of Districts

4.1 Introduction

Among the agriculturally progressive states in India, West Bengal emerged successfully as one of the leading states in terms of growth of agricultural production and productivity in foodgrain. In 2008-09, West Bengal contributed 7.6 percent of the total foodgrain production of the country and more than 15 percent of the rice was produced by West Bengal alone. The net sown area is 61 percent of the total geographical area of the state against the national average of 46 percent. The gross cropped area reached to 97.5 lakh hectares with cropping intensity of 184 percent. Small and marginal farmers account for over 95 percent of total farm population and they own about 80 percent of cultivated land. From 1980-81 to 2000-01, foodgrain production grew at a rate more than 3 percent per annum while growth of productivity of foodgrain during the same period remained close to 3 percent. Among the non-foodgrains, like potato, Rapeseeds & mustard and sesamum registered long term annual compound growth rate in production above 4 percent. Foodgrain production was primarily dominated by rice. The contribution of agriculture to Gross State Domestic Product at current prices declined from 42 percent in 1970-71 to 23. 5 percent 2009-10 but it remained much higher than the all-India figure of 17 percent. Importantly, the contribution of industry to Gross State Domestic Product at current prices in 2009-10 is 18.4 percent, which is much lower than the contribution of agriculture. This exhibits the dominance of agriculture in the economy of West Bengal. To substantiate further, around 72 percent of the population live in rural areas with over 95 percent as small and marginal farmers and till date agriculture continues to be the main source of sustenance for more than 50 percent of the rural populace.

4.2 West Bengal: A Physiographic Description

The state lies between 21° 25′ 24″ and 27 ° 13′ 15″ north latitudes and 85 ° 48′ 20″ and 89 ° 53′ 04″ east longitudes and shares her borders with three different countries and four Indian states – on the east by Bangladesh and north-east by the state of Assam, on the north by Bhutan and the state of Sikkim, and on the north-west by Nepal, on the west by the states of Bihar and Jharkhand Chattishgarh on the south by the Bay of Bengal and the south-west by the state of Orissa (Samanta & Mallik, 2004). The spread of the state over an area of 66752 sq km. accounts for 2.7 percent of the geographical area of the country and it has turned out

to be the most densely populated state in India as per Census 2001 (903 persons per sq km as against the national average of 325 persons per sq km). West Bengal stretches between Himalayas in the north and Bay of Bengal at south. The river Ganges enters West Bengal from west near Rajmahal and flows south-east to reach Bay of Bengal. It branches off into two near north of Dhulian in Murshidabad district. One of the branches flows eastward and enters Bangladesh while the other flows through West Bengal as Bhagirathi and Hoogly rivers in southern direction. Among 19 districts in West Bengal, the districts that are located north of the Ganges – Darjeeling, Jalpaiguri, Cooch Behar, Malda, North and South Dinajpur are often referred to collectively as North Bengal. Among the districts on the south of the Ganges- Bankura, Burdwan, Birbhum, Purulia are referred as paschimanchal and Murshidabad, Nadia, Howrah, Hoogly, Kolkata, North 24 Parganas, South 24 Parganas, East Midnapore and West Midnapore are known as gangetic Bengal. Kolkata has been excluded in this study because of its non availability of agricultural areas.

4.3 Agro-climatic Zones in West Bengal

West Bengal and the central Gangetic Bengal is the oldest agricultural settlement in India. Except the western region (Birbhum and Bankura) which contained laterite formation, rest of the West Bengal and central Bengal was identified as 'semi-aquatic rice plain' (Bose, 1987: 37-38). In fact, two-thirds of the total geographical area comes under flat alluvial plains. The river Ganges has divided the alluvial plain into north and south plain lands. The northern part of the plain was created by the deposition of silts carried by the rivers Teesta, Jaldhaka, Mahananda and their tributaries and the southern part was created by the silt primarily carried by the River Ganges. Many of the areas of the plains get inundated by floods. The extreme southern part of the state is having coastal saline lowlands and gets inundated by brackish water from the Bay of Bengal. As per the classification of Planning Commission, West Bengal falls within three agro-climatic regions, viz. Eastern Himalayan region, Lower Gangetic Plain region and Eastern Plateau and Hill region out of fifteen agro-climatic regions in the country. Except in the northern hilly region, the climate of the state is tropical and humid.

4.3.1 Eastern Himalayan Region

a. Hills Sub-Region

The district of Darjeeling except the Siliguri division and a narrow part in the north of Jalpaiguri district constitutes the hills sub-region. The river Tista has divided this

mountainous region into two parts: the Singalila and Darjeeling Ranges. The hilly region consists of brown forest soil which is acidic in nature (pH 3.5-5.0) and annual rainfall varies between 2500 and 3500 mm. Poor soil quality and lack depth work as deterrent to raise crop productivity.

b. Terai Sub-Region

'Terai' which means the moist land consists of whole of Jalpaiguri District and upper region of Cooch Behar District in West Bengal. The soils of this entire region is mostly sandy or sandy loams, porous and were created by gravel and pebbles laid down by the Himalayan rivers like the Teesta, Torsa, Raidak, Jaldhaka, Sankosh and several other small rivulets. The soils are acidic in nature (pH 4.2 to 6.2) and rainfall varies from 2000-3200mm. The Teesta has divided the area into two parts - the western part is known as the Terai whereas the eastern part is known as the Dooars or Duars. The plains in the south of Jalpaiguri and Cooch Behar districts are made of new alluvium deposited by general rivers.

4.3.2 Lower Gangetic Region

The Lower Gangetic region could be divided into old-alluvium sub-region, new-alluvium sub-region, coastal saline sub-region and red lateritic sub-region.

a. Old Alluvium Sub-Region

The North and South Dinajpur and eastern part of Malda districts are part of the Lower Gangetic region and Old Alluvium sub- region. The entire part of North and South Dinajpur is silt laden plain and the soils are fairly fertile over most of the sub-regions and mildly acidic to neutral in reaction (pH 5.2-7.0). The region receives average rainfall of 1500-2000mm. The river Mahananda divides the district of Malda into two parts. It is also known as *Barind* or *Barendrabhumi*. The western part is made up of new alluvium and part of Lower Gangetic region. In this part River Kalindi meets the Mahananda River. The part of Malda lying to the north of river Kalindi is known as *Tal*. This is low land and covered with swamps and small water bodies whereas the area to the south of the Kalindi is a very fertile land and is known as *Diara*.

b. New Alluvium Sub-Region

This sub-region of Lower Gangetic region consists of districts of Murshidabad, Nadia, Hoogly, Burdwan and North 24 Parganas. Soils are deep, fertile and neutral reaction (pH 5.5-7.0). The rainfall in this region varies from 1350mm 1450mm. The river Ganga flows

through this vast area and divides the entire plain into three distinct sub-regions – the old delta, the mature delta and the active delta. Districts of Murshidabad and Nadia are the part of the old delta. The districts of Hooghly, and Howrah and part of North 24-Parganas fall under mature delta region. However, the northern segment of South 24-Parganas district is experiencing the formation of delta by the river Ganges. Ganges enters West Bengal near Rajmahal and moves towards south-easterly direction. It gets divided into two branches near north of Dhulian in Murshidabad district. One branch enters Bangladesh which is identified as river Padma and the other branch flows through West Bengal as the Bhagirathi River and Hooghly River in southern direction. Finally it empties its water into Bay of Bengal near Sagar Island in the South 24-Parganas.

c. Coastal Saline Sub-Region

The districts of South 24 Parganas, Howrah and East Midnapore together form the coastal saline sub-region of Lower Gangetic region. A part of the district of East Midnapore along the Bay of Bengal constitutes the coastal plain. The Sundarbans delta is the largest mangrove forest in the world situated in the South 24-Parganas district. A large section of the area remains under water during incoming tides. Soils in this region are mostly of heavy clay type and mostly neutral (pH 6.5-7.5). The average rainfall of this region varies between 1600mm and 1800mm. Salinity and water clogging limits good crop productivity.

d. Red Lateritic Sub-Region

Red Lateritic sub-region which is commonly known as *Rarh* Bengal is the region that intervenes between the Western plateau and high lands and the Ganges Delta. Districts of Birbhum, Bankura, and West Midnapore constitute this region. This region is believed to be created from the soil from the Deccan plateau. The area is formed by the silt brought by the tributaries of the rivers Bhagirathi, Mayurakshi, Ajay, Damodar and Rupnarayan which flow through the western plateau region made up of laterite soil which is acidic (pH 5.5 to 6.2) in nature, red in colour and erosion prone. Average rainfall varies between 1100mm to 1400mm. Moisture holding capacity of the soil is low and poor in nutrient.

4.3.3 Eastern Plateau and Hill Region

The district of Purulia falls under the eastern fringes of the Chota Nagpur Plateau. The district is having undulating lands with isolated peaks and flat plains. The region falls under tropical dry sub-humid climatic zone having rainfall ranging from1100 mm to 1400mm which spread over only three months, mid-June to mid-September. This makes the district drought prone.

Soils are highly susceptible to erosion, acidic (pH 5.5 to 6.2) and having low water holding capacity.

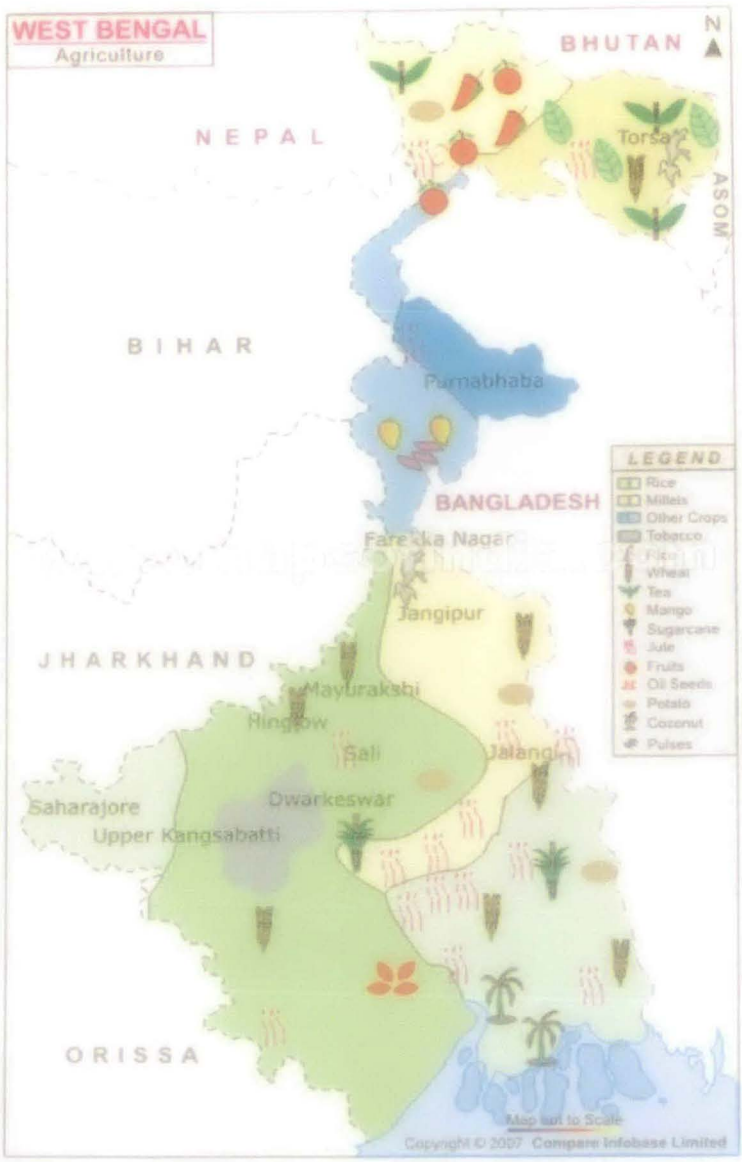
Therefore, it is evident that the major part of West Bengal is endowed with favourable agro-climatic condition for growth of agricultural production. However, various studies also revealed that growth of agricultural production continued to remain low in West Bengal as well as eastern part of India.

West Bengal: District Map

Map 1

Source: www.mapsofworld.com

West Bengal: Map-Agriculture



Source: www.mapsofworld.com

4.4 Performance of West Bengal in Agriculture: A Review

Most of the studies on trends in agricultural output during colonial period concluded that an absence of upward trend in foodgrain production became a common feature after 1930s. Much of the loss in foodgrain production was compensated by the rise in growth in non-foodgrains, more precisely the cash crops. The growth in foodgrain production stagnated absolutely during depression and war periods. An upward trend has observed only after 1952. At regional level, Punjab emerged as a progressive region on the contrary to agricultural production in Bengal and Bihar that had either deteriorated or stagnated (Shah, 1975: 20-22).

The trend continued even in post-independence period. Commenting on East India (comprising East UP, Bihar, West Bengal and Orissa) and analysing the economic scenario in 1977-78, A Vaidyanathan (1985: 2259) observed that 'not only is poverty incidence high in this region but its overall agricultural performance has been disappointing. The Green Revolution Technologies do not seem to have made much of an impact here. The overall growth rate in agricultural production has averaged barely 2 percent per annum over the last 20-30 years which is in fact less than the rate of population growth'. The stagnation of agricultural production in Eastern region was also identified by Barker and Pal (1979), Report of the Committee headed by S.R. Sen on Agricultural Productivity in Eastern India, Reserve Bank of India (1984), Report of Study Group on Agricultural Strategies for the Eastern Region of India, Planning Commission, Government of India (1985).It was noted in the Seventh Five-Year plan that the gap between the potential and actual yields of rice in eastern India was the highest in India (GoI, 1985).

An in-depth study was carried out by James Boyce (1987) to explore the nature and causes of agricultural stagnation in West Bengal and Bangladesh. He estimated that between 1949 and 1980, the agricultural output grew at a rate of 1.74 percent per annum and rural population and total population of West Bengal grew at 2.31 percent and 2.42 percent per annum during the same period. This created an impasse in agricultural production and had unfavourable distributive impact on the rural population. According to Boyce (*ibid.*), between 1949 and 1980, the productivity of aman grew at a nominal rate of 0.24 percent per annum and annual growth of area under aman rice was also found to be very low (0.57 percent per annum). The abysmal growth of aman rice was identified as the root cause of agricultural stagnation in West Bengal by Boyce. However, a turn around in agricultural growth occurred in eastern region, precisely in West Bengal since the 1980s. Studies by various scholars reaffirmed that the period of post1980s can conclusively be treated as end of 'agricultural impasse' in West Bengal. Studies of Mridula Saggar and Sundar Raghaban (1989) identified the increase in agricultural growth in eastern India in 1980s as most notable feature in India's agricultural scenario. Harris (1993) also observed a break in stagnation in agricultural production in West Bengal through his micro level studies of three villages in the districts of Birbhum and Burdwan. Abhijit Sen and Ranja Sengupta for West Bengal, Orissa and Bihar observed that a trend break was observed in the rate of growth production and productivity of rice and foodgrain in 1981-82 (Sen and Sengupta, 1995).

In another study conducted by Centre for Monitoring Indian Economy (CMIE,1993), it was observed that the rate of growth in foodgrain production in West Bengal was highest (6.5 percent per annum) among seventeen major states of India during the period 1980-81 to 1992-93. Saha and Swaminathan (1994) also concluded in their districtwise and crop-wise study on agricultural growth in West Bengal in 1980s that agricultural growth accelerated in West Bengal since 1980s except Darjeeling and Jalpaiguri district and index of aggregate crop production increased at a rate of 5 percent per annum between 1981-82 and 1990-91. Bhalla and Singh (1997) estimated the over all growth of agricultural production during the period 1980-83 to 1992-95 and the figure stood at 5.39 percent. Rogaly *et al.*, (1995:1864) concluded that there was rapid growth in agricultural output since 1980s with an average rate of 4 to 5 percent. Rawal and Swaminathan (1998) also had similar conclusions while estimating the growth in agriculture in West Bengal during 1950 to 1996. Manoj Kumar Sanyal, Pradip Kumar Biswas and Samaresh Bardhan (1998), while measuring the growth in foodgrain (disaggregated at district level) observed that between 1977-78 and 1993-94, all-crop production grew at an annual rate of 4.10 percent and yield per hectare grew at 4.97 percent and surpassed the growth of population and hence agriculture in West Bengal came out from long stagnation. They also showed that some western and central Bengal districts experiencing severe decline in agriculture during 1949-65 and a slow recovery during the period 1966-80 were finally placed at high growth trajectory. In a study that covers a period from 1977-78 to 1999-2000, it was estimated that the production of rice and foodgrains grew at a rate of 3.2 percent and 2.6 percent respectively. It was further observed that the growth rate was marginally higher for both rice and foodgrain (3.7 percent and 3.3 percent per annum respectively) between the period 1980-81 and 1999-2000 (Chattopadhyay, 2005).

Evidently, a turn around in West Bengal's agriculture took place during eighties. However, most of the studies regarding deciphering trend in growth in agricultural production and productivity remained confined to at state level in post-1980s barring from the studies made by Saha and Swaminathan (1994), Rawal and Swaminathan (1998), Sanyal *et al.*, (1998) and Chattopadhyay (2005). Among these studies, Rawal and Swaminathan have dealt with relatively longer period. In addition, sub-periods growth in tune with major institutional and policy changes did not receive adequate attention. Their studies mostly remain confined to examine the trend in productivity with an *a priori* assumption that turn around was caused by introduction of land reforms, operation *barga* and introduction of grass root level governance through panachayat.

To fill in the gaps in above studies, we intend to explore the changes in agricultural production, productivity of foodgrains, rice and select non-foodgrains in West Bengal as a whole and at district level. Here, 1970-71 has been chosen as the starting point and the time period continues till 2008-09. The whole period is divided into four sub-periods, viz. 1970-71 to 1979-80, 1980-81 to 1989-90, 1990-91 to 1999-2000 and 2000-2001 to 2008-09. Sub-periods have been created keeping the broad policy interventions in mind. If the 1970 to 1980 was identified as a decade of 'agricultural impasse', then decade of 1980s to 1990s has been indentified as end of 'agricultural impasse'. Here distributive measures like land reforms and tenancy reforms, famously known as operation *barga*, introduction of panchayat as a means of grass root level governance and resource mobilisation and generation at village level and introduction of Green Revolution technology in Bengal's agricultural practices. Finally, the period between introduction of economic reforms in 1991 and its onward journey till date, is divided into two sub-periods, 1990-91 to 1999-2000 and 2000-2001 to 2008-09. This has been done to unearth the initial euphoria or pessimism that the introduction of economic reforms created in India and to capture the impact of second generation reforms where in agriculture also got more closely linked with economic reforms.

It is known to us that erstwhile districts of 24 Parganas was split into two districts - South and North 24 Parganas in 1986, West Dianjpur was divided into North and South Dinapur in 1992 and the district of Midnapore was divided into West and East Midnapore in 2002. However, to maintain the temporal continuity of data, the above mentioned districts were taken as undivided unit. Hence, in our study, we consider 15 districts instead of 19 districts.

Among foodgrains and non-foodgrains in West Bengal, rice is considered both at state as well as district level and potato, jute, sugarcane, Rapeseeds and mustard, linseed and other oilseeds are considered for the state only.

4.5 Methodological Issues on Measurement of Growth

Calculation of growth in the sub-periods (dividing the whole period into sub-periods) has paramount importance in growth analysis. It helps researchers and policy makers to become more inquisitive to make an in-depth study on the impact of various policy interventions or occurrence of unforeseen events in bringing in changes in the growth rate. Three approaches are generally used by various researchers to measure the sub-period growth rates. Early scholars like Das (1978), Alagh and Sharma (1980), Rath (1980) etc., used separate growth functions for each sub-periods. It is pointed out by Srinivasan (1978) that since this method

estimates a large number of parameters, therefore loss of degrees of freedom is inevitable. Alternative to it, the most commonly used method is to fit a single trend equation with dummy variable. A log-linear trend equation with dummy variable for two sub-periods can be written as follows:

$$\ln Y_t = a + b_1 t + b_2 (t.D)$$

Here, D =0 for the first sub-period and D =1 for the second sub-period. Growth rates for first and second sub-periods will be b_1 and $(b_1 + b_2)$. A joint t test is carried on to test the significant differences between two sub-periods' growth rates (Chattopadhyay, 2001:33-34).

Boyce has suggested 'kinked exponential model' to estimate sub-periods growth rates. This also reduces discontinuity bias, provides better basis for growth rate comparison, reduces instability or cyclical fluctuations and uses full set of available information to estimate the growth rates for each sub-period in a single step.

A time series for the period t = 1, 2, ..., *n* can be disaggregated at a single point *k* and can be expressed in a single equation as follows:

$$\ln Y_t = a_1 D_1 + a_2 D_2 + (b_1 D_1 + b_2 D_2)t + u_t \text{ ----------(A)}$$

D_j is a dummy variable which takes the value 1 in the j^{th} sub-period and 0 otherwise.

Resultant discontinuity between trend lines of two sub-periods can be removed by imposing a linear restriction such that two trend lines intersect at point *k*:

$$a_1 + b_1 k = a_2 + b_2 k$$

$$\text{or, } a_2 = a_1 + b_1 k - b_2 k$$

Putting the value of a_2 in equation (A), we shall get the restricted form:

$$\ln Y_t = a_1 + b_1 (D_1 t + D_2 k) + b_2 (D_2 t - D_2 k) + u_t \text{ ----------(A1)}$$

If single kink is used, the kinked exponential model can also be specified by re-normalizing time such that t = 0 at the break point, *k*. Then equation (A1) can take the following form and which can be used to estimate the sub-period growth rates with a joint intercept:

$$\ln Y_t = a_1 + b_1 D_1 t + b_2 D_2 t + u_t \text{ ----------(A2) (Boyce, 1987: 267,268)}$$

To calculate the exponential growth rate simultaneously for the whole period (1970-71 to 2008-09) and for four sub-periods, we use kinked exponential model. Three kinks (k_1, k_2 and k_3) are introduced to measure the four pre-specified sub-periods.

Here three kinks are used, the kinked exponential model can also be specified by re-normalizing time such that t = 0 at the break point k_1, t =10 at the second break point k_2 and t =20 at the third break point k_3, then we shall have the following equation which can be used to estimate the growth rates for four sub-periods with a joint intercept:

$$\ln Y_t = a_1 + b_1 D_1 t + b_2 D_2 t + b_3 D_3 t + b_4 D_4 t + u_t \text{ ----------(A3)}$$

Where, $D_1 = 1$ for 1970-1971 to 1979-1980,

$= 0$ elsewhere.

$D_2 = 1$ for 1980-1981 to 1989-1990,

$= 0$ elsewhere.

$D_3 = 1$ for 1990-1991 to 1999-2000,

$= 0$ elsewhere.

$D_4 = 1$ for 2000-2001 to 2008-2009,

$= 0$ elsewhere.

Due to adjustment on the datasets, kinks arbitrarily placed on the break points (joining points of two consecutive sub-periods) will not lead to distortion in the estimated sub-period growth rates.

Multiplying estimated values of $D_1 t$, $D_2 t$, $D_3 t$ and $D_4 t$ we shall be having growth rates for four sub-periods, viz. 1970-71 to 1979-80, 1980-81 to 1989-90, 1990-91 to 1999-2000 and 2000-2001 to 2008-09.

4.6 Districtwise Foodgrain Production as Percentage of State's Foodgrain Production: The Changing Scenario

Before going into the trend analysis of production, productivity disaggregated at district level, it needs to be considered that how different districts are contributing to the state's foodgrain basket and whether the shares of various districts are changing over the years.

From the Table 4.1, it is evident that since 1970-71 to 2008-09, districts like Midnapore and Burdwan together are producing almost one-third of the foodgrain of the state. Contribution of Murshidabad and 24 Parganas continued to be around 18 to 19 percent. In 1970-71, the contribution of Birbhum to total foodgrain production of the state was 10.3 percent. However, during 1980s and 1990s the share gradually declined and in 2000-01, it reached to 6.5 percent, the share though increased to 8.1 percent in 2008-09. The contribution of West Dinajpur and Bankura to total foodgrain production continued to be between 7 and 8 percent

during the whole period under study (1970-71 to 2008-09). Malda and Nadia remain consistent in their lesser contribution from 4 to 5 and 5 to 6 percent respectively to total foodgrain production of the state since 1970-71 to 2008-09 with minimal variations. The contribution of Hoogly has shown improvement over the first decades, in 1970-71 the contribution was 4.7 percent, it increased to 6.3 percent in 1980-81, it declined to 5.6 percent in 1990-91, it further declined to 3.7 percent in 2000-01 and in 2008-09 the share reached to 5.4 percent. The contribution of Purulia, however, was around 4 percent from 1970-71 to 2008-09 and marginal increase has been observed in the 1980s and in 2008-09. Joint contribution of Jalpaiguri and Darjeeling district is however around 6 to 7 percent over the whole period. Darjeeling's contribution continued to be the lowest among all the districts of West Bengal and it is hovering around 0.8 percent to 1.2 percent during the whole period of 1970-71 to 2008-09. Difficult terrain and limited agricultural and inadequate irrigation facilities are the possible reasons behind negligible contribution to foodgrain production in these districts.

4.7 Share of Rice Production to Total Foodgrain Production: A Districtwise Comparison

It has been observed that in West Bengal, in terms of contribution to total foodgrain production in all the districts, rice has absolute dominance in most of the districts. If we accept the Boyce's argument of continuance of agricultural impasse till 1980 in West Bengal and also accept the findings of the studies conducted during late-80s and 90s where break of impasse was conclusively demonstrated, then rice should have and must have a dominant role to play. This is a historical fact that Bengal possesses vast stretch of alluvial plain created by the river Ganges that makes the region favourable for rice cultivation. We tend to focus on changing share of rice production disaggregated at district level from 1970-71 to 2008-09.

From Table 4.2, it could be seen in that 1970-71, production of rice as percentage of total foodgrain production was around 82 percent and it continued to increase and reached 92.27 percent in 2008-09. It is further evident from Table 4.2 that Burdwan, Bankura, Midnapore, Hoogly, 24 Pargans, West Dinajpur, Birbhum, Purulia, Jalpaiguri and Cooch Behar were primarily concentrating on producing rice than producing any other food crops. For all these districts, the production of rice as percentage of foodgrain was varying between 80 percent and closer to 96 percent. But the exceptional districts were Nadia, Murshidabad, Malda and Darjeeling. For these districts the production of rice as percentage of foodgrain was varying between 52 percent and 62 percent. Over the decades, the concentration of rice increased and reached closer to 99 percent of district's total foodgrain production. In 2008-09, production

of rice as percentage of foodgrain touched 99 percent mark for the districts of Burdwan, Midnapore, Bankura, Hoogly and Howrah.

It exceeds 90 percent mark for 24 Parganas, Birbhum and Purulia. For Nadia and Murshidabad, production of rice as percentage of foodgrain production increased from 52.9 percent and 52.4 percent to respectively 87.1 percent and 78.6 percent. However, the reverse trend was observed for the districts of West Dinapur, Jalpaiguri, Cooch Behar and Darjeeling. It has been observed that for the period 1970-71 to 2008-09, share of rice in total food grin production declined from 86.2 to 81 percent in West Dinajpur, from 98 to 85 percent in Jalpaiguri, from 94 to 87 percent in Cooch Behar and finally, from 60.4 to 53.1 percent for Darjeeling.

Table 4.1: Districtwise Share of Foodgrain Production to Total Foodgrain Production of West Bengal (1970-71 to 2008-09)

1970-71			1980-81			1990-91		
District	Share	Rank	District	Share	Rank	District	Share	Rank
Midnapore	15.3	1	Midnapore	15.6	1	Midnapore	13.8	1
Burdwan	11.1	2	Burdwan	12.4	2	Burdwan	12.7	2
Birbhum	10.7	3	24 Parganas	11.6	3	24 Parganas	10.5	3
Murshidabad	10.1	4	Birbhum	7.7	4	Murshidabad	8.8	4
24 Parganas	8.0	5	Bankura	7.4	5	Bankura	7.7	5
West Dinapur	7.9	6	West Dinapur	7.3	6	West Dinapur	7.5	6
Bankura	7.2	7	Murshidabad	7.2	7	Birbhum	7.5	7
Nadia	5.6	8	Hoogly	6.3	8	Nadia	7.4	8
Hoogly	4.7	9	Nadia	4.8	9	Malda	5.6	9
Malda	4.7	10	Malda	4.7	10	Hoogly	5.4	10
Cooch Behar	4.1	11	Purulia	4.3	11	Cooch Behar	3.8	11
Purulia	4.0	12	Jalpaiguri	3.9	12	Purulia	3.6	12
Jalpaiguri	4.0	13	Cooch Behar	3.7	13	Jalpaiguri	2.4	13
Howrah	1.5	14	Howrah	1.9	14	Howrah	2.1	14
Darjeeling	1.1	15	Darjeeling	1.2	15	Darjeeling	1.1	15

2000-01			2008-09		
District	Share	Rank	District	Share	Rank
Midnapore	19.1	1	Midnapore	16.9	1
Burdwan	11.5	2	Burdwan	11.6	2
24 Parganas	11.3	3	24 Parganas	10.3	3
West Dinapur	8.8	4	Murshidabad	8.8	4
Bankura	7.4	5	West Dinapur	8.8	5
Murshidabad	7.1	6	Birbhum	8.1	6
Birbhum	6.5	7	Bankura	6.3	7
Nadia	6.1	8	Nadia	5.6	8
Malda	5.0	9	Hoogly	5.4	9
Cooch Behar	4.2	10	Malda	5.0	10
Purulia	3.7	11	Purulia	4.7	11
Hoogly	3.7	12	Cooch Behar	3.5	12
Jalpaiguri	3.2	13	Jalpaiguri	2.8	13
Howrah	1.6	14	Howrah	1.3	14
Darjeeling	0.8	15	Darjeeling	0.8	15

Source: *Compiled from various volumes of West Bengal Economic Review, Government of West Bengal*

Table 4.2: Districtwise Production of Rice as percentage of Districtwise Foodgrain Production

Year/Dist	1970-71	1980-81	1990-91	2008-09
Burdwan	89.6	97.5	99.5	99.6
Birbhum	75.9	92.3	96.3	91.4
Bankura	95.3	96.5	97.4	99.2
Midnapore	94.5	97.4	98.1	99.2
Howrah	89.6	94.9	99.0	99.5
Hoogly	82.6	97.1	99.7	99.5
24 Parganas	89.6	95.8	97.3	97.9
Nadia	52.9	70.4	83.7	87.1
Murshidabad	52.4	70.3	78.9	78.6
West Dinapur	86.2	80.7	90.7	81.2
Malda	62.0	74.4	77.7	80.0
Jalpaiguri	98.1	92.2	90.7	85.8
Darjeeling	60.4	53.4	50.9	53.1
Cooch Behar	94.6	91.4	92.9	87.7
Purulia	93.3	96.0	92.3	97.2
West Bengal	81.94	90.15	92.58	92.27

Source: *Compiled from the data collected from various volumes of West Bengal Economic Review, Government of West Bengal*

4.8 Districtwise Variation in Rice Production as Percentage to State's Foodgrain Production (1970-71 to 2008-09)

Above depiction clearly reveals that rice has the overwhelming domination over the foodgrain production in West Bengal. Table 4.3 allows us to trace how different districts are performing between 1970-71 and 2008-09 towards the total production of the state. It has been observed that districts of Midnapore and Burdwan together have continued to produce almost one-third of the total rice production of the state. In 1970-71, the contribution of the districts of Birbhum, 24 Parganas, Bankura, West Dinajpur to the total rice production of the state was 35.2 percent. It marginally declined to 34.2 percent in 1980-81 and this was due to the fall in share of Birbhum and West Dinajpur.

The collective share remained static since 1991 at around 33 percent till 2008-09. For the district of Hoogly, the share increased by two percentage points in 1980-81 in comparison to 1970-71 (from 6.8 percent to 8.8 percent), while it continued to decline during 1990s and 2000-01 and marginally increased to 5.8 percent in 2008-09. For the district of Murshidabad, the share remained constant at 6.5 percent in 1970-71 and 1980-81. It increased to 7.5 percent in 1990-91 but in 2001 the share of the district to the total rice output of the state came down to 4.4 percent. However, an upsurge in production took place between 2000-01 and 2008-09 and the percentage share to total state's rice production reached 7.5 percent. The district Nadia, also improved its contribution from 1980-81 to 1990-91, to total rice output of the state reaching 6.7 percent from 3.8 percent. However, the share came down to 5.3 percent in 2008-09. The contribution of Purulia, Cooch Behar, Malda continued to remain low, mostly static and rather declined marginally over the periods.

Table 4.3: Districtwise Share of Rice Production to Total Rice Production of West Bengal

1970-71			1980-81			1990-91		
Districts	Share	Rank	Districts	Share	Rank	District	Share	Rank
Midnapore	17.6	1	Midnapore	16.8	1	Midnapore	14.7	1
Burdwan	12.2	2	Burdwan	13.4	2	Burdwan	13.6	2
Birbhum	9.9	3	24 Parganas	12.4	3	24 Parganas	11.1	3
24 Parganas	8.7	4	Bankura	7.9	4	Bankura	8.1	4
Bankura	8.3	5	Birbhum	7.8	5	Birbhum	7.8	5
West Dinapur	8.3	6	Hoogly	6.8	6	Murshidabad	7.5	6
Murshidabad	6.5	7	West Dinapur	6.5	7	West Dinapur	7.4	7
Hoogly	4.8	8	Murshidabad	5.6	8	Nadia	6.7	8
Jalpaiguri	4.7	9	Purulia	4.6	9	Hoogly	5.9	9
Cooch Behar	4.7	10	Jalpaiguri	3.9	10	Malda	4.7	10
Purulia	4.6	11	Malda	3.8	11	Cooch Behar	3.9	11
Nadia	3.6	12	Nadia	3.8	12	Purulia	3.6	12
Malda	3.5	13	Cooch Behar	3.7	13	Jalpaiguri	2.4	13
Howrah	1.7	14	Howrah	2.0	14	Howrah	2.2	14
Darjeeling	0.8	15	Darjeeling	0.7	15	Darjeeling	0.6	15

2000-01			2008-09		
Districts	Share	Rank	Districts	Share	Rank
Midnapore	20.8	1	Midnapore	18.2	1
Burdwan	12.6	2	Burdwan	12.5	2
24 Parganas	12.1	3	24 Parganas	11.0	3
West Dinapur	8.8	4	Birbhum	8.1	4
Bankura	8.0	5	West Dinapur	7.7	5
Birbhum	6.4	6	Murshidabad	7.5	6
Nadia	5.2	7	Bankura	6.8	7
Murshidabad	4.4	8	Hoogly	5.8	8
Malda	4.2	9	Nadia	5.3	9
Cooch Behar	4.2	10	Purulia	4.9	10
Hoogly	4.1	11	Malda	4.4	11
Purulia	3.8	12	Cooch Behar	3.3	12
Jalpaiguri	3.1	13	Jalpaiguri	2.6	13
Howrah	1.8	14	Howrah	1.4	14
Darjeeling	0.4	15	Darjeeling	0.5	15

Source: *Compiled from various volumes of West Bengal Economic Review, Government of West Bengal*

The picture depicted above clearly shows that rice dominates the foodgrain production of the state and bulk of the rice production is coming from Midnapore, Burdwan, Birbhum, 24

Parganas, Bankura, and West Dinajpur, albeit declining production in Birbhum, Bankura, and West Midnapore under red lateritic sub-region, which is less fertile in comparison to new alluvium zone of lower Gangetic region. Nadia and Hoogly are though falling under fertile new alluvium zone of lower Gangetic region, but in terms of their contribution to total rice output of the state, they are falling behind the aforementioned districts located in Red Lateritic sub-region. The table reveals that for the districts of West Dinapur, Jalpaiguri, Cooch Behar and Darjeeling, share of rice to districts' foodgrain production has declined. This indicates that farmers are either opting for other foodgrains or non foodgrains or cash crops. The reasons behind consistent decline in rice production in certain districts have not been delineated in this chapter. However, the answer has been attempted in Chapter-VI where crop diversification has been discussed at length. Wherein it has also been explored that in the districts where share of rice production has declined, whether the farmers switched to foodgrains like wheat and non foodgrains like jute, potato, oilseeds etc., or not.

However, it is necessary to mention that lower share to total output does not imply lower productivity because smaller geographical area may limit the land available for cultivation. Therefore, our thrust area automatically becomes the productivity and it is worthy to note that productivity also gets influenced either by pure yield effect or by area effect or simultaneous impact of both may influence the productivity in positive or negative direction.

4.9 Productivity Trend in Foodgrain and Rice (1970-71 to 2008-09): Inter-District Analysis

To understand the districtwise changes in absolute productivity of foodgrain production and rice since 1970-71 to 2008-09, (Table 4.4 and Table 4.5) six categories were created - high productivity (more than 2500 kg/ha), medium productivity (2000-2500 kg/ha), medium-low productivity (1500-2000 kg/ha), low productivity (1000-1500 kg/ha) and very low productivity (less than 1000 Kg/ha). In addition, figure 4.A and 4.B will provide us a comprehensive comparative picture of productivity of foodgrains and rice for India vis-à-vis West Bengal from 1970-71 to 2008-09.

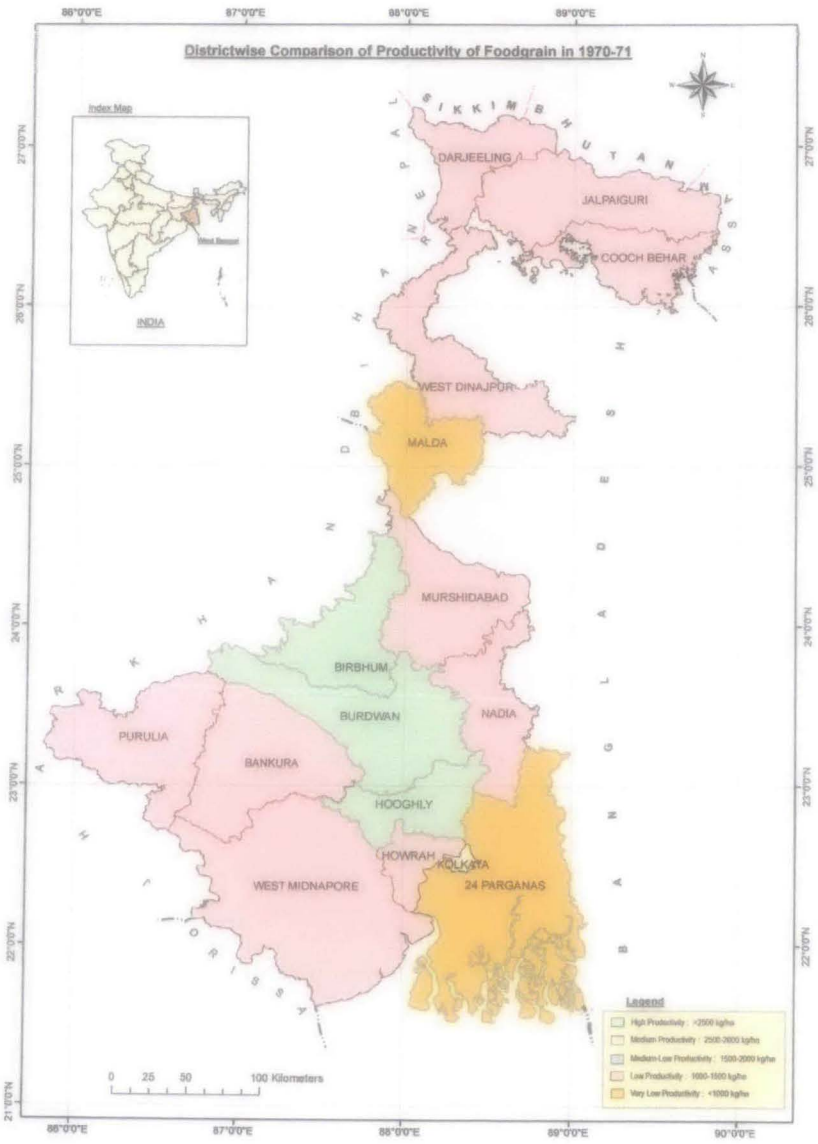
Table 4.4: Districtwise Comparison of Productivity of Foodgrain over the Decades

Range of Productivity / Year	1970-71	1980-81	1990-91	2000-2001	2008-09
High Productivity (Greater than 2500 kg/ha)				Burdwan, Hoogly	Birbhum, Hoogly, Burdwan, Murshidabad, Malda, Bankura, Nadia, West Dinajpur
Medium Productivity (2000-2500 kg/ha)			Burdwan, Hoogly, Birbhum,	Birbhum, Nadia, Midnapore, Murshidabad, Bankura, Howrah, Malda, West Dinajpur, 24 Parganas	Midnapore, Purulia, 24 Parganas, Darjeeling
Medium -Low Productivity (1500-2000 kg/ha)	Birbhum, Burdwan, Hoogly	Hoogly,Burdwan, Birbhum, Bankura	Bankura, Nadia Howrah, 24 Parganas, Midnapore, Purulia, Malda, Murshidabad	Howrah, Darjeeling, Cooch Behar, Purulia	Howrah, Jalpaiguri, Cooch Behar
Low Productivity (1000-1500 kg/ha)	Bankura, Murshidabad, Howrah, Midnapore, Jalpaiguri, West Dinajpur, Cooch Behar, Nadia	24 Parganas, Malda, Murshidabad, Midnapore, Purulia, Howrah, Nadia, Darjeeling, Jalpiaguri, West Dinajpur, Cooch Behar	Darjeeling, Jalpaiguri, West Dinajpur, Cooch Behar	Jalpaiguri	
Very Low Productivity (Less than 1000 kg/ha)	Malda, 24 Parganas				

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

It is evident from the Table 4.4 and 4.5, that in 1970-71, in foodgrain as well as in rice production, none of the districts in West Bengal has achieved medium productivity. For foodgrain, in Burdwan, Birbhum and Hoogly and for rice, Burdwan and Birbhum were having productivity between 1500 kg/ha and 2000 kg/ha and in terms of our classification it is falling under medium-low category segment. Exceptionally, 24 Parganas for foodgrain and rice and Malda for rice fell under very low productivity category (less than 1000 kg/ha), while rest of the districts achieved foodgrain productivity as well as productivity in rice between 1000 kg/ha to 1500 kg/ha. From the data available with the Directorate of Economics and Statistics, Government of India, in 1970-71, the all-India average of foodgrain productivity and rice productivity were 872 kg/ha and 1123 kg/ha vis-à-vis figures for West Bengal that stood at 1224 kg/ha and 1239 kg/ha respectively for foodgrain and rice. The over all scenarios on productivity front for foodgrain and rice did not change much in

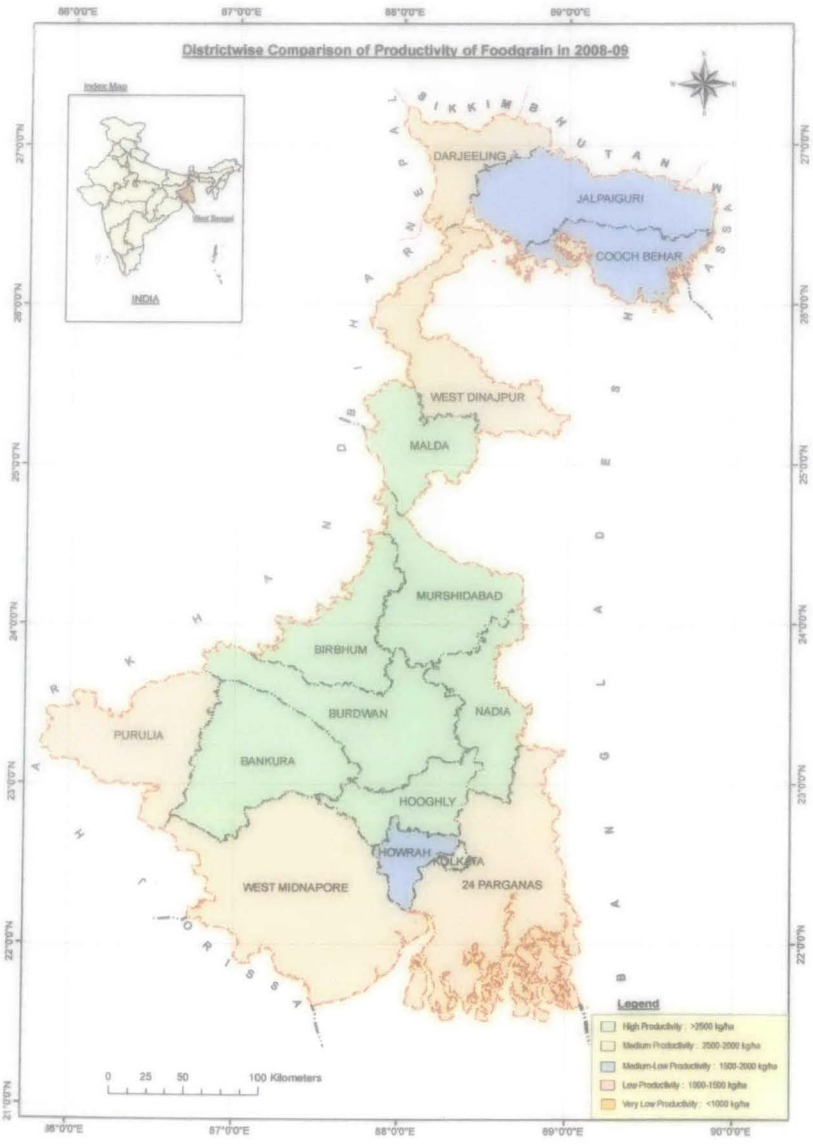
1980-81. In terms of foodgrain productivity, 24 Parganas and Malda shifted from very low productivity to low productivity category and Bankura from low productivity category to medium-low productivity category. For rest of the districts, the status remained unchanged. In terms of rice productivity, 24 Parganas, Malda, Bankura and Hoogly have made progress and had shown a rising trend. In the decade of the 1980s, foodgrain productivity and rice productivity in West Bengal remained higher than all-India average.



Map 3

Between 1980-81 and 1990-91, barring Darjeeling, Jalpaiguri, Cooch Behar and West Dinajpur, rest of the districts of West Bengal showed upward movement in productivity of foodgrain production. For the districts of Burdwan, Birbhum and Hoogly, foodgrain productivity has increased from 1500-2000 kg/ha to 2000-2500 kg/ha. 24 Paragans, Malda,

Murshidabad, Purulia and Nadia moved up from low productivity (1000-1500 kg/ha) to medium low productivity category (1500-2000 kg/ha). Increase in productivity was sharper for rice from 1980-81 to 1990-91. Rice productivity for Burdwan district crossed 2500 kg/ha. Murshidabad, Nadia, were in low productivity category (1000-1500 kg/ha) for rice in 1980-81 and these two districts reached medium productivity segment with productivity 2000-2500Kg/ha in 2000-01. Districts like 24 Parganas, Malda, Howrah, West Dinajpur, Midnapore and Cooch Behar also showed improvements in productivity and these districts moved up from low productivity segment to medium low productivity category. However, productivity for rice remained almost unchanged for the districts of Purulia, Jalpaiguri and Darjeeling.



Map 4

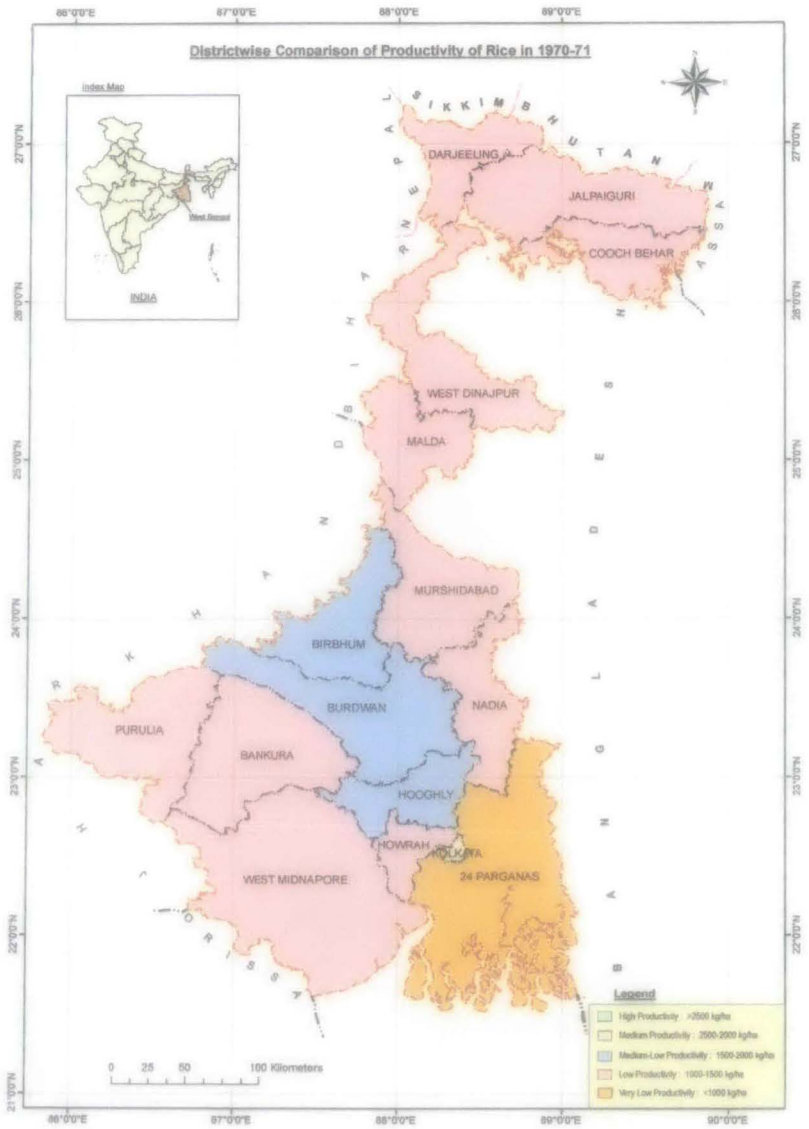
Table 4.5: Districtwise Comparison of Productivity of Rice over the Decades

Range of Productivity / Year	1970-71	1980-81	1990-91	2000-2001	2008-09
High Productivity (Greater Than 2500 kg/ha)			Burdwan	Nadia, Burdwan, Hoogly, Bankura, Birbhum	Birbhum, Malda, Nadia, Hoogly, Burdwan, Murshidabad, Bankura
Medium Productivity (2000-2500 kg/ha)		Hoogly	Murshidabad , Hoogly, Nadia Birbhum,	Murshidabad, Malda , Midnapore, West Dinajpu , 24 Parganas	Purulia, Midnapore, 24 Parganas, West Dinajpur
Medium -Low Productivity (1500-2000 kg/ha)	Birbhum, Burdwan, Hoogly	Burdwan, Birbhum, Bankura	Bankura, , Malda , Howrah, 24 Parganas, West Dinajpur Midnapore, Cooch Behar	Howrah, Purulia Cooch Behar,Darjeeling	Darjeeling, Howrah, Jalpaiguri, Cooch Behar
Low Productivity (1000-1500 kg/ha)	Bankura, Murshidabad, Howrah, Midnapore, Darjeeling, Jalpaiguri, West Dinajpur, Purulia, Cooch Behar, Nadia, Malda	24 Parganas, Malda, Murshidabad, Midnapore, Purulia, Nadia, Darjeeling, Howrah, Jalpiaguri, West Dinajpur, Cooch Behar	Purulia Jalpaiguri, Darjeeling	Jalpaiguri	
Very Low Productivity (Less than 1000 kg/ha)	24 Parganas				

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

The upward movement in productivity of foodgrain also continued between 1990-91 and 2000-01 for majority of the districts of West Bengal. Burdwan and Hoogly crossed the 2500 kg/ha mark in rice productivity. Bankura, Nadia, Howrah, 24 Parganas, Midnapore, Malda and Murshidabad moved from medium-low productivity segment to medium productivity segment. West Dinapur improved its foodgrain productivity substantially and it moved up from 1000-1500 kg/ha to 2000 kg/ha Even Darjeeling and Cooch Behar shifted from low productivity segment to medium-low productivity segment. However, Jalpaiguri, the only district of West Bengal stayed permanently in low productivity region in foodgrain productivity. The upward trend in rice productivity continued from 1990-91 to 2000-2001. Burdwan maintained consistency in rice productivity at 2500 kg/ha. The districts of Nadia, Hoogly and Birbhum joined in this category by moving up from medium productivity to the category of high productivity. Bankura showed most spectacular performance during this decade. It progressed from medium-low productivity segment to high productivity segment.

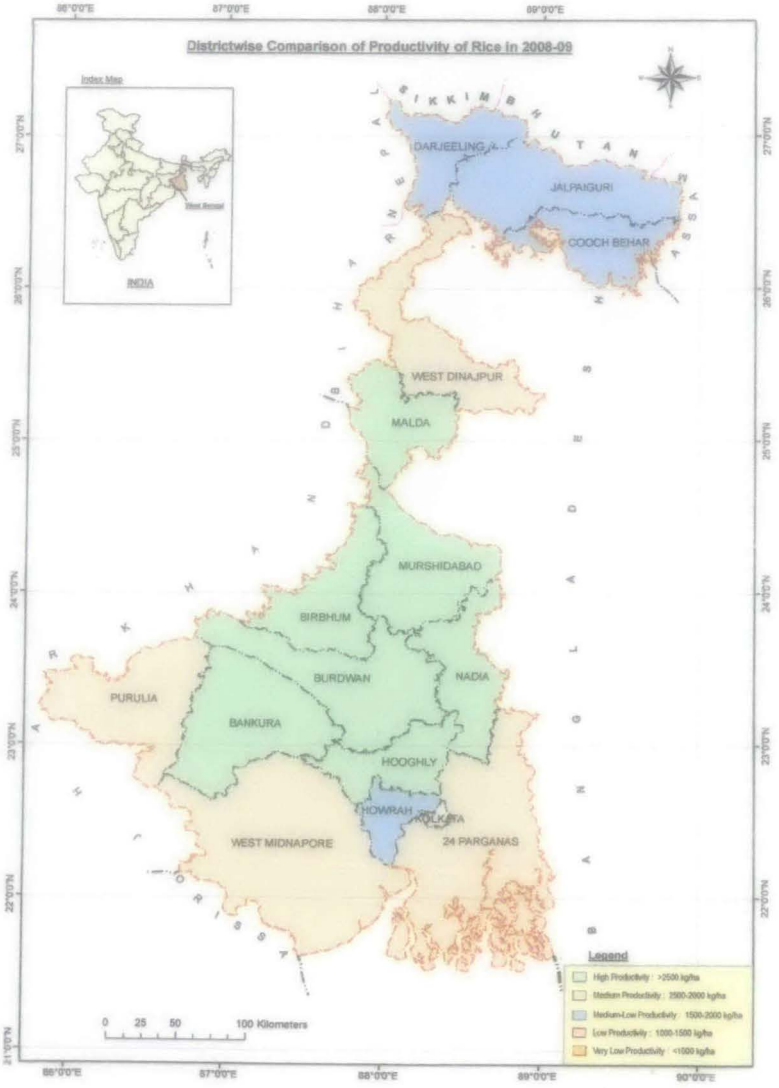
Malda, Midnapore, West Dinajpur and 24 Parganas also shifted from medium-low productivity to medium productivity range. Situation of Howrah and Cooch Behar remained unaltered. Purulia, Darjeeling also increased their productivity from medium-low productivity to medium productivity segment.



Map 5

The upward trend in foodgrain and rice productivity continued between 2000-01 and 2008-09. The statement gets substantiated on the ground that during 2000-01, only Burdwan and Hoogly were the two districts in West Bengal who achieved productivity greater than 2500 kg/ha. In 2008-09, along with Burdwan and Hoogly, Birbhum, Bankura, Malda, Murshidabad, Nadia and West Dinajpur also reached high productivity segment. In case of rice, Malda and Murshidabad moved to high productivity segment with the other consistent

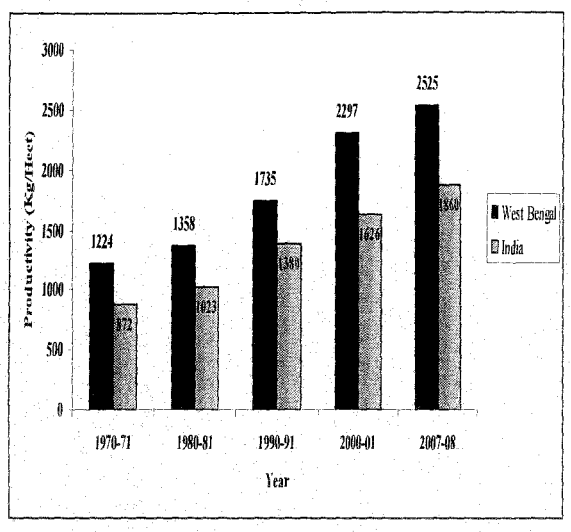
performer districts like Nadia, Burdwan, Hoogly, Birbhim, Bankura. However, Midnapore, Purulia, 24 Parganas and Darjeeling could increase their foodgrain productivity and remained at medium productivity (2000-2500 kg/ha) segment with Howrah, Jalpaiguri and Cooch Behar. In case of rice productivity, Midnapore, Purulia, 24 Parganas and West Dinajpur failed to cross the productivity level of 2500 kg/ha and continued to be in medium productivity category. Darjeeling, Howrah, Cooch Behar also failed to improve their productivity over 2000-01 and remained at medium-low productivity segment till 2008-09. Jalpaiguri improved its position and moved up from low productivity to medium-low productivity level.



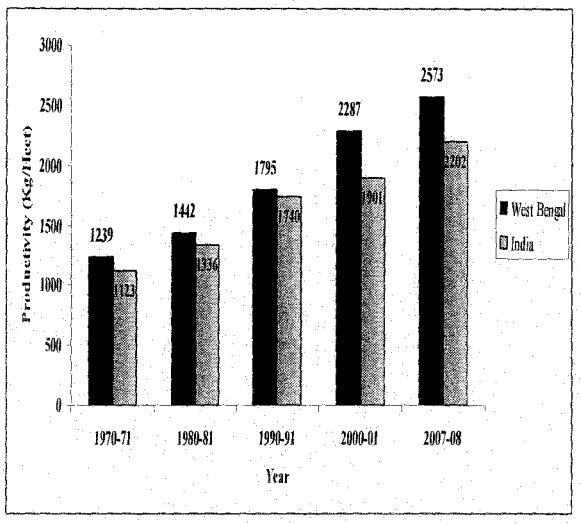
Map 6

Figure 4.A: Comparison of Foodgrain Productivity (kg/ha) between West Bengal and India

Figure 4.B: Comparison of Productivity (kg/ha) of Rice between West Bengal and India



4A



4B

Source: *Directorate of Economics and Statistics, Government of India*

4.10 Estimated Growth Rates in Agricultural Production: Cropwise and Districtwise Disaggregated Estimation

Growth trend in production or productivity of foodgrains, non-foodgrains, in different districts of West Bengal have undergone changes due to agro-climatic conditions, state government policies on or before reform period, and overall economic condition of the agricultural population. In consideration of the main objective of this study estimation of sub-period growth rates of foodgrains, rice and wheat in the districts has been undertaken to evaluate the performance of agriculture before and after reform period. The sub period growth rates have been estimated from the fitted kinked trend equations on the adjusted time series data, dividing the whole period into four sub-periods as mentioned earlier. Along with the sub-periods' growth rates, trend breaks have also been estimated to identify statistical difference between two sub-period growth rates. As it has been observed by Boyce that the estimated growth rates in each sub-period may be higher or lower than that in the period as a whole. The primary reason is that trend estimates are mostly affected by the extreme observations (generally considered as outlier) those at the beginning and end of the series and trend estimates are seldom affected by the values at or near the midpoint of the time series. Therefore, in case of agriculture, extreme bad or very good crop years occur near the mid-point of the time series; estimated growth rate for the whole period will hardly be affected but if the same happens at the beginning or end of any sub-periods, (if the whole period is divided into various sub-periods), then the estimated growth rates for sub-periods are bound

to differ significantly from the whole series. Therefore, growth rates for different sub-periods suffer from 'discontinuity bias.'

4.10.1 Inter-District Comparison of Growth in Production and Productivity of Foodgrain in West Bengal

Over the whole period 1970-71 to 2008-09, the exponential growth of foodgrain production for West Bengal stood at 2.6 percent per annum and significant at 1percent level (Table 4.6). Districtwise exponential growth rates of foodgrain production from 1970-71 to 2008-09, reveal that Burdwan, Bankura, Midnapore, Howrah, Nadia, Murshidabad, West Dinapur and Purulia achieved more than 2.5 percent growth per annum and as per t-statistics growth rates for these districts are statistically significant at 1percent level. Among these districts Nadia and Bankura achieved growth rate of 3 percent. Again, foodgrain production grew at an exponential rate between 2 to 2.5 percent in Birbhum, Malda, 24 Parganas and Cooch Behar. Jalpaiguri and Darjeeling registered lowest rate of growth in foodgrain production at 1.3 percent and 1.1 percent respectively.

To capture the changes in growth rates over different sub-periods for foodgrain production in the districts of West Bengal, the study considered four different sub-periods. The first sub-period is 1970-71 to 1979-80. This period has unanimously been identified by all the researchers as the period of absolute agricultural stagnation. And our results reiterated the fact that for almost all the districts excepting Howrah and 24 pargans the growth rates are negative for all the districts.

A massive turn around has been observed in the growth rate in foodgrain production since 1980-81. In sub-period II i.e., between 1980-81 and 1989-90, foodgrain production in West Bengal grew at an exponential rate of 4 percent per annum. Among the districts, most impressive growth was achieved by Purulia where foodgrain production grew at a rate of 6.2 percent, highest among all the districts in West Bengal. Bankura, Midnapore, Howrah and Nadia achieved growth rates between 5 and 6 percent. Growth of foodgrain production in districts like Birbhum, West Dinajpur, Burdwan were observed to be 3.5 percent to 5 percent. For Malda, Cooch Behar and 24 Parganas, foodgrain production grew at 3 to 3.5 percent, where as for Hoogly, Darjeeling and Murshidabad the growth figures stood at between 2 and 3 percent. Lowest growth rate was achieved by Jalpaiguri district (less than 2 percent). The values of trend break help us to specify the extent of gain or loss in growth rates for a particular sub-period in comparison to previous sub-period. Trend break-I reveals that in sub-period II, highest gain in growth of foodgrain production over sub-period: I was achieved by

Purulia (10 percent). Significant gains in growth rates were also achieved by Bankura (7 percent), Midnapore (6.4 percent), Birbhum (5.7 percent), Howrah (5 percent), West Dinajpur (4.6 percent) and Nadia (4.3 percent). All the districts in West Bengal had positive trend break excepting the district of Darjeeling which showed a loss in growth rate of 0.2 percent over sub-period-I. For West Bengal a net gain of 4.3 percent was achieved in sub-period II (1980-81 to 1989-90) in comparison to sub-period I (1970-71 to 2008-09).

Table 4.6: Districtwise Kinked Exponential Growth in Production of Foodgrain in West Bengal for (1970-71 to 2008-09), (1970-71 to 1979-80), (1980-81 to 1989-90), (1990-91 to 1999-2000) and (2000-01 to 2008-09)

Dist/Sub-period Growth	Whole Period (1970-71 to 2008-09)	Sub-Period I (1970-71 to 1979-80)	Sub-Period II (1980-81 to 1989-90)	Sub-Period III (1990-91 to 1999-2000)	Sub-Period IV (2000-01 to 2008-09)	Trend break I	Trend break II	Trend break III	DW	R^2
Burdwan	2.8	0.5	3.8	4.0	2.9	3.4	0.2	-1.1	1.5	0.9
	(14.9)*	(0.5)	(4.4)*	(11.1)*	(12.5)*					
Birbhum	2.4	-2.1	3.6	3.4	3.1	5.7	-0.2	-0.3	1.6	0.8
	(9.5)*	(-1.5)	(2.9)*	(6.4)*	(9.1)*					
Bankura	2.7	-1.7	5.2	4.7	3.2	7.0	-0.5	-1.5	1.9	0.8
	(9.4)*	(-1.1)	(3.9)*	(8.3)*	(8.6)*					
Midnapore	3.0	-1.0	5.3	4.4	3.6	6.4	-0.9	-0.8	1.6	0.9
	(14.0)*	(-0.9)	(5.1)*	(10.0)*	(12.6)*					
Howrah	2.6	0.9	5.9	3.8	2.8	5.0	-2.1	-1.1	1.3	0.8
	(9.1)*	(0.6)	(4.0)*	(6.2)*	(7.0)*					
Hoogly	2.2	-0.6	2.7	3.2	2.6	3.3	0.5	-0.7	2.1	0.8
	(11.4)*	(-0.5)	(2.8)*	(7.8)*	(9.6)*					
24 Parganas	2.6	1.8	3.4	3.4	2.6	1.6	0.0	-0.8	1.5	0.8
	(12.3)*	(1.4)	(3.0)*	(7.0)*	(8.3)*					
Nadia	3.0	1.3	5.6	4.4	3.0	4.3	-1.2	-1.4	1.0	0.9
	(12.8)*	(1.1)	(5.2)*	(9.7)*	(10.3)*					
Murshidabad	2.6	-0.4	2.9	3.4	3.0	3.3	0.5	-0.4	1.8	0.9
	(13.0)*	(-0.3)	(3.0)*	(8.4)*	(11.5)*					
West Dinajpur	3.0	-0.9	3.7	3.9	3.6	4.6	0.2	-0.3	2.0	0.9
	(17.6)*	(-1.2)	(5.2)*	(13.0)*	(18.7)*					
Malda	2.5	0.9	3.5	3.5	2.6	2.6	0.0	-0.9	1.5	0.9
	(16.2)*	(1.1)	(4.6)*	(10.8)*	(12.6)*					
Jalpaiguri	1.3	-1.2	1.3	1.3	1.9	2.5	0.0	0.6	1.9	0.7
	(6.4)*	(-1.0)	(1.3)	(3.0)*	(6.7)*					
Darjeeling	1.1	2.9	2.6	2.4	0.4	-0.3	-0.2	-2.0	1.3	0.6
	(2.7)*	(1.8)**	(1.8)**	(4.0)*	(1.1)					
Cooch Behar	2.0	0.6	3.0	2.1	2.3	2.4	-0.9	0.3	1.4	0.8
	(13.0)*	(0.7)	(3.6)*	(5.8)*	(10.2)*					
Purulia	2.7	-3.8	6.2	4.1	3.9	10.0	-2.1	-0.3	2.4	0.7
	(7.8)*	(-1.9)**	(3.5)*	(5.6)*	(8.2)*					
West Bengal	2.6	-0.3	4.0	3.7	3.0	4.3	-0.3	-0.7	1.5	0.9
	(16.0)*	(-0.4)	(5.1)*	(11.2)*	(14.0)*					

T stats are shown in parenthesis

**Significant at 1% level, ** Significant at 5% level, ***Significant at 10% level*

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

However, in sub-period III and IV, majority of the districts failed to maintain the high growth rates in foodgrain production achieved in sub-period II. In sub-period III (1990-91 to 1999-2001), a fall in growth rates of foodgrain production between 1 and 2 percentage points was observed for Purulia, Bankura, Midnapore, Howrah, Nadia and Cooch Behar. Marginal

increase in growth rate was observed for Burdwan, West Dinajpur, Murshidabad and Hoogly. For Malda and Jalpaiguri, growth rates remained constant. Finally, in sub-period IV (2000-01 to 2008-09) growth of foodgrain production further declined for almost all the districts in West Bengal. Marginal fall (less than 0.5 percent) was observed for Purulia, Birbhum, West Dinajpur and Murshidabad. Darjeeling, Bankura, Burdwan, and Nadia experienced a fall in growth rate in foodgrain production between 1 and 2 percent. Malda, 24 Parganas and Hoogly observed a decline in growth rates of foodgrain production closer to 1 percent in comparison to sub-period III (1990-91 to 1999-2000). Marginal increase however was observed for Cooch Behar and Jalpaiguri. For the state as a whole, a fall of 0.7 percent was observed in the growth rate in foodgrain production.

During 1970-71 to 2008-09, foodgrain productivity (Table 4.7) in West Bengal grew at an exponential rate of 2.5 percent per annum and the growth rate was found to be statistically significant at 1 percent level. Districts like Midnapore, Nadia and West Dinajpur achieved 3 percent growth rate per annum over the whole period. Foodgrain productivity grew between 2.5 percent and 2.8 percent for Burdwan, Bankura, Howrah, Mursidabad, 24 Parganas and Malda. The growth rates of foodgrain productivity ranges between 2 percent and 2.4 percent for Birbhum, Hoogly and Cooch Behar. Jalpaiguri and Darjeeling occupied the lowest rung compared to other districts from 1970-71 to 2008-09 and stood at less than 2 percent.

However, the growth of productivity of foodgrain in first sub-period remained negative and insignificant for Birbhum, Bankura, Midnapore, Howrah, Hoogly, Murshidabad, West Dinajpur, Cooch Behar and Purulia. For Hoogly, Murshidabad, 24 Parganas and Darjeeling, growth rate in foodgrain productivity was found to be positive but insignificant. Only three districts, Burdwan, Nadia and Malda achieved growth rates of productivity respectively 1.6 percent, 2.2 percent and 2.7 percent, which were found to be significant. For the state, as a whole, the growth rate in productivity was only 0.2 percent and statistically insignificant.

Major turn around in growth in foodgrain productivity was observed from 1980-81 to 1989-90 or sub-period: II. Bankura, Midnapore, Howrah and Nadia experienced statistically significant (at 1 % level) exponential growth rate which was more than 5 percent per annum. Birbhum and West Dinajpur also experienced impressive growth rates of productivity and grew at rates lying between 4 and 4.9 percent. 3 to 4 percent growth rates in productivity for foodgrains was observed for Burdwan, 24 Parganas, Murshidabad, Malda and purulia. Hoogly, Jalpaiguri and Cooch Behar experienced growth rates between 2 and 3 percent.

Darjeeling achieved growth rate of 1.7 percent which was lowest among all the districts of West Bengal. In West Bengal, the growth rate stood at 3.9 percent.

Table 4.7: Districtwise Kinked Exponential Growth in Productivity of Foodgrain in West Bengal for (1970-71 to 2008-09), (1970-71 to 1979-80), (1980-81 to 1989-90), (1990-91 to 1999-2000) and (2000-01 to 2008-09)

Dist/Sub-period Growth	Whole Period (1970-71 to 2008-09)	Sub-Period I (1970-71 to 1979-80)	Sub-Period II (1980-81 to 1989-90)	Sub-Period III (1990-91 to 1999-2000)	Sub-Period IV (2000-01 to 2008-09)	Trend break I	Trend break II	Trend break III	DW	R^2
Burdwan	2.2	1.6	3.1	2.9	2.1	1.6	-0.2	-0.8	1.3	0.9
	(15)*	(1.9)**	(4.4)*	(9.8)*	(11.0)*					
Birbhum	2.4	-0.7	4.4	3.4	2.8	5.1	-1.0	-0.6	1.5	0.9
	(13)*	(-0.7)	(4.7)*	(8.7)*	(11.2)*					
Bankura	2.7	-0.9	5.0	4.0	3.2	5.9	-0.9	-0.9	1.8	0.9
	(13.2)*	(-0.8)	(5.0)*	(9.7)*	(11.8)*					
Midnapore	2.6	-0.7	5.2	3.7	3.1	5.8	-1.5	-0.6	1.6	0.9
	(13.9)*	(-0.6)	(5.6)*	(9.6)*	(12.4)*					
Howrah	2.0	-0.2	5.3	2.9	2.3	5.5	-2.4	-0.6	1.7	0.7
	(8.6)*	(-0.2)	(4.6)*	(6.1)*	(7.5)*					
Hoogly	1.8	0.3	2.8	2.5	2.0	2.5	-0.3	-0.5	2.2	0.9
	(14.1)*	(0.3)	(4.1)*	(8.8)*	(10.9)*					
24 Parganas	2.4	1.7	3.2	2.9	2.5	1.6	-0.3	-0.4	1.6	0.8
	(13.4)*	(1.4)	(3.1)*	(6.8)*	(9.0)*					
Nadia	2.9	2.2	5.1	3.9	2.8	2.9	-1.2	-1.0	1.5	0.9
	(16.7)*	(2.6)*	(6.7)*	(12.2)*	(13.8)*					
Murshidabad	2.4	0.5	3.2	3.5	2.6	2.7	0.3	-0.8	1.7	0.9
	(14.4)*	(0.5)	(4.3)*	(11.2)*	(13.1)*					
West Dinapur	3.0	-0.9	4.0	4.1	3.6	4.9	0.1	-0.5	2.1	0.9
	(18.3)*	(-1.2)	(5.9)*	(14.2)*	(19.4)*					
Malda	3.3	2.7	3.6	3.6	3.3	0.9	0.0	-0.3	1.6	1.0
	(32.2)*	(4.2)*	(6.3)*	(15.0)*	(21.5)*					
Jalpaiguri	1.5	-2.4	2.0	1.9	2.3	4.4	-0.1	0.3	2.5	0.8
	(7.6)*	(-2.4)*	(2.3)*	(5.3)*	(9.6)*					
Darjeeling	1.7	1.7	1.7	2.9	1.5	-0.1	1.2	-1.4	1.7	0.7
	(6.1)*	(1.2)	1.3	(5.5)*	(4.4)*					
Cooch Behar	2.0	-0.7	2.6	2.2	2.6	3.3	-0.5	0.4	1.6	0.9
	(13.9)*	(-0.9)	(4.1)*	(8.1)*	(14.8)*					
Purulia	2.4	-2.0	4.7	3.0	3.3	6.6	-1.7	0.3	2.5	0.8
	(9.2)*	(-1.3)	(3.5)*	(5.3)*	(9.1)*					
West Bengal	2.5	0.2	3.9	3.3	2.8	3.7	-0.5	-0.6	1.6	0.9
	(18.8)*	(0.2)	(6.0)*	(12.3)*	(15.9)*					

T stats are shown in parenthesis

**Significant at 1% level, ** Significant at 5% level, ***Significant at 10% level*

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

It is observed that the period from 1980-81 to 1989-1990 (sub-period II), was identified as period of agricultural turn around in West Bengal. Significant rise in growth of foodgrain was observed during this period and rise in productivity thus a natural corollary. In West Bengal, the growth of productivity increased from 0.2 percent in sub-period I (1970-71 to 1979-80) to 3.9 percent in sub-period II (1980-81 to 1989-90). Bankura, Midnapore, Howrah and Nadia achieved growth rate in productivity at 5 percent and above. Foodgrain productivity in districts of Birbhum and West Dinajpur grew at exponential rates of 4.4 percent and 4 percent per annum respectively. Burdwan, 24 Parganas, Murshidabad, Malda and Purulia improved their growth performance in foodgrain productivity and grew at rates between 3 and 4 percent. Hoogly, Jalpaiguri, Cooch Behar achieved a growth rate between 2 and 3 percent and Darjeeling continued reeling at the bottom with growth rate in foodgrain productivity of less than 2 percent. From the values of trend break-I, it was found that Purulia made highest addition (6.1 percent) to the growth rate in productivity from 1980-81 to 1989-90 over its previous decade of 1970-71 to 1979-80. The addition to growth in productivity for Bankura was 5.9 percent, for Midnapore it was 5.8 percent, for Howrah and Birbhum the addition to growth were respectively 5.5 percent and 5.1 percent. The district of Jalpaiguri, inspite of being placed at almost at the bottom of the productivity growth table, made a gain of 4.4 percent in growth of foodgrain productivity. Darjeeling not only achieved lowest growth in productivity in sub-period II (1.7 percent) but its growth rate remained constant over the previous decades.

In sub-period III, excepting Murshidabad, West Dinajpur and Malda and Darjeeling, decline in growth in foodgrain productivity was observed for all the districts as well as for the state. In fact, for Darjeeling, the growth in productivity increased by1.2 percent in sub-period III in comparison to sub-period II. Decline was more prominent for Howrah (by 2.4 percent), Midnapore (by 1.5 percent), Nadia (by 1.2 percent) and Birbhum (by 1 percent); for rest of the districts the decline in growth rates was marginal and less than 1 percent. Declining growth in foodgrain productivity continued into sub-period IV (2000-01 to 2008-09). The proportion of decline was varying between 0.1 percent and 0.9 percent for most of the districts, for Darjeeling and Birbhum the growth rates declined by 1.4 percent and 1 percent respectively. For the state of West Bengal, a decline in growth of productivity was observed at 0.6 percent.

4.11 Inter-Districts Comparison of Growth in Production and Productivity of Rice in West Bengal

Rice being the dominant crop in the state as well as for the districts, it is expected that the growth in production and productivity of rice would strongly influence the foodgrain production and productivity. In the following section attempted is made to validate or invalidate the above hypothesis. Looking at Table 4.8 and considering the sub-period I (1970-71 to 1979-80), exponential growth rates in production of rice were positive and significant in the districts of Nadia (4.5 percent per annum) and Malda (2.2 percent per annum). Growth of rice production was found to be positive but insignificant for the districts of Burdwan, Howrah, Hoogly, 24 Parganas and Murshidabad. Districts of Birbhum, Bankura, Midnapore, West Dinajpur, Darjeeling and Cooch Behar achieved growth rates in rice production which were negative and insignificant. For Jalpaiguri and Darjeeling the growth rates of rice productivity were not only negative but also statistically significant. For the state as a whole, growth rate in rice production was found to be negative and insignificant. Therefore, the decade of 1970s experienced absolute stagnation in growth of rice production. In Sub-period II (1980-81 to 1989-90), a significant turn around in growth of rice production was observed for the state of West Bengal as well as for most of the districts as it happened for growth of foodgrain production. Thus, it can be stated that a significant improvement in the production of rice have led to higher growth rates in the production of total foodgrains. A close look reveals that in districts of Nadia, Howrah, Purulia, Birbhum and Midnapore, rice production grew at exponential rates of 7 percent, 6.9 percent, 6.3 percent, 5.8 percent and 5.7 percent respectively. Rice production in districts of Birbhum, Burdwan, Murshidabad, West Dinajpur, Malda and Cooch Behar grew at exponential rates between 4 percent and 5 percent. 24 Parganas and Hoogly registered growth rates in rice production at 3.8 percent and 3.3 percent and Darjeeling and Jalpaiguri remained at the bottom with growth rates of 2.1 percent and 1.9 percent respectively. From the values of trend break-I, it could further be seen that Purulia made highest gain of 10 percent in growth rate in sub-period II over sub-period I. Bankura, Midnapore, Howrah, West Dinajpur, Cooch Behar and Purulia also gained in growth rate in rice production by more than 6 percent. Rest of the districts also made positive gain in growth of rice production in sub-period II in comparison to sub-period I.

Table 4.8: Districtwise Kinked Exponential Growth in Production of Rice in West Bengal for (1970-71 to 2008-09), (1970-71 to 1979-80), (1980-81 to 1989-90),(1990-91 to 1999-2000) and (2000-01 to 2008-09)

Dist /Sub-period Growth	Whole Period (1970-71 to 2008-09)	Sub-Period I (1970-71 to 1979-80)	Sub-Period II (1980-81 to 1989-90)	Sub-Period III (1990-91 to 1999-2000)	Sub-Period IV (2000-01 to 2008-09)	Trend break I	Trend break II	Trend break III	DW	R^2
Burdwan	3.1	1.2	4.3	4.3	3.1	3.1	0.1	-1.2	1.6	0.9
	(16.2)*	(1.2)	(4.9)*	(11.9)*	(13.3)*					
Birbhum	2.9	-0.4	4.4	3.9	3.3	4.8	-0.6	-0.6	1.7	0.8
	(12.3)*	(-0.3)	(3.6)*	(7.5)*	(10.0)*					
Bankura	2.2	-1.7	5.8	5.1	3.4	7.5	-0.7	-1.7	1.9	0.8
	(10.1)*	(-1.1)	(4.3)*	(9.0)*	(9.4)*					
Midnapore	3.2	-0.8	5.7	4.6	3.7	6.5	-1.1	-0.9	1.7	0.9
	(14.7)*	(-0.7)	(5.4)*	(10.5)*	(13.2)*					
Howrah	3.0	0.9	6.9	4.4	3.2	6.0	-2.5	-1.3	1.4	0.8
	(9.6)*	(0.5)	(4.5)*	(6.8)*	(7.5)*					
Hoogly	2.6	0.5	3.3	3.6	2.8	2.8	0.3	-0.8	2.2	0.9
	(13.3)*	(0.4)	(3.2)*	(8.4)*	(10.1)*					
24 Parganas	2.8	2.1	3.8	3.7	2.8	1.7	-0.1	-0.9	1.6	0.8
	(12.7)*	(1.6)	(3.2)*	(7.4)*	(8.6)*					
Nadia	4.4	4.5	7.0	5.9	4.0	2.5	-1.1	-2.0	1.3	0.9
	(14.1)*	(3.0)*	(5.3)*	(10.7)*	(11.0)*					
Murshidabad	3.9	1.9	4.8	4.9	3.9	2.9	0.1	-0.9	1.8	0.9
	(14.1)*	(1.1)	(3.2)*	(7.9)*	(9.9)*					
West Dinapur	3.4	-1.6	4.9	4.8	4.0	6.5	-0.1	-0.8	2.1	0.9
	(16.1)*	(-1.6)	(5.7)*	(13.2)*	(17.1)*					
Malda	3.1	2.2	4.6	4.2	3.0	2.4	-0.4	-1.2	1.7	0.9
	(16.1)*	(2.2)*	(5.1)*	(11.2)*	(12.4)*					
Jalpaiguri	1.2	-2.8	1.9	1.6	2.0	4.7	-0.3	0.4	2.1	0.6
	(5.4)*	(-2.3)*	(1.8)**	(3.7)*	(7.0)*					
Darjeeling	0.6	-0.3	2.1	0.5	0.8	2.3	-1.6	0.3	1.2	0.2
	(2.1)*	(-0.2)	(1.4)	(0.8)	(2.1)*					
Cooch Behar	2.2	-1.5	4.9	3.1	2.8	6.4	-1.8	-0.2	1.8	0.9
	(11.9)*	(-1.5)	(5.5)*	(8.2)*	(11.9)*					
Purulia	2.9	-3.7	6.3	4.3	4.0	10.0	-2.0	-0.3	2.4	0.7
	(8.2)*	(-1.9)**	(3.6)*	(5.8)*	(8.5)*					
West Bengal	3.0	0.0	4.8	4.3	3.3	4.8	-0.5	-0.9	1.6	0.9
	(17.1)*	(0.1)	(5.8)*	(12.3)*	(14.9)*					

T stats are shown in parenthesis

**Significant at 1% level, ** Significant at 5% level, ***Significant at 10% level*

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

In sub-period III (1990-91 to 1999-2000) and sub-period IV (2000-01 to 2008-09), most of the districts and the state as a whole, experienced deceleration in growth rate in production of rice. For the state, the exponential growth rate reduced to 4.3 percent in sub-period III and reached at 3.3 percent in sub-period IV in comparison to 4.8 percent in sub-period II. The fall in growth is sharper during the period 2000-01 to 2008-09. At district level, in sub-period III, growth rate remained unchanged for the district of Burdwan with respect to sub-period II, Hoogly and Murshidabad showed marginal increase and for rest of the districts, fall in growth rates was observed. Fall was sharp for the districts of Howrah (2.5 percent), Purulia (2.0 percent), Cooch Behar (1.8 percent), Darjeeling (1.6 percent), Nadia (1.1 percent) and Bankura (1.1 percent). In sub-period IV, Darjeeling and Jalpaiguri experienced marginal increase in growth rate and rest of the districts experienced decline in growth rates in production. Decline is quite significant for the districts of Nadia (2 percent), Bankura (1.7 percent) and the fall in growth rates by more than 1 percent was observed for districts of

Burdwan, Howrah, and Malda. Therefore, it is evident that in sub-period IV, growth of production for rice has not only declined for the state but also most of the high growth districts experienced a decline.

Considering the growth of production of rice to productivity of rice at state level and at district level (Table 4.9), it has been observed that over the whole period (1970-71 to 2008-09), highest growth rate in rice productivity (4.4 percent) was achieved by Nadia. Murshidabad followed with growth rate of 3.9 percent per annum, followed by West Dinajpur with 3.4 percent, Malda and Burdwan with 3.1 percent and Howrah 3 percent. From 1970-71 to 2008-09, productivity of rice for districts of Hoogly, 24 Parganas and Purulia grew at rates of 2.9 percent, 2.8 percent and 2.6 percent respectively. Cooch behar, Jalpiguri and Darjeeling were placed at the bottom in descending order in terms of their growth rates of rice productivity. As far as the productivity of rice was concerned, sub-period: I (1970-71 to 1979-80) presented gloomy picture for the state as well as for the districts. Rice productivity for the state as a whole stood at 0.3 percent and statistically insignificant. As many as nine districts of the state (Birbhum, Bankura, Midnapore, Howrah, Jalpaiguri, Darjeeling, Cooch Behar and Purulia) for which the growth rates of productivity of rice were found to be negative and insignificant between 1970-71 and 1979-80. The districts of Hoogly, 24 Parganas and Murshidabad though achieved positive growth rates, however, proved to be statistically insignificant. Nadia achieved the highest growth rate in rice productivity at 4.4 percent (also significant at 1 % level as per T statistics) per annum during sub-period I and Burdwan and Malda also achieved growth rates of 1.8 percent and proved to be statistically significant.

In sub-period II, a significant rise in growth rate in rice productivity was observed both for the state of West Bengal and her districts. Productivity of rice in districts of Bankura, Midnapore, Howrah, Nadia and Purulia grew at more than 5 percent per annum. Birbhum, West Dinajpur, Malda and Cooch Behar achieved 4 percent plus growth rate in rice productivity. 24 Parganas, Murshidabad achieved growth rate in rice productivity more than 3 percent in sub-period II and productivity grew closer to 3 percent for the district of Burdwan. Rice productivity in Jalpiguri grew at an exponential rate of 2.2 percent and Darjeeling failed to add to its growth rate in rice productivity. In sub-period II, the districts which make substantial addition to their growth rate in rice productivity (as given by trend break-I) were Purulia (7.5 percent), Bankura (6 percent), Cooch Behar (6 percent), Midnapore (5.6 percent), West Dinajpur (5.5 percent), Howrah (5.4 percent) and Jalpaiguri (5.1 percent). For the state

of West Bengal, the growth in rice productivity increased from 0.2 percent in sub-period I (1970-71 to 1979-80) to 4.0 percent in sub-period II (1980-81 to 1989-90) and therefore a net addition of 3.8 percent has been achieved during sub-period II over sub-period I.

Table 4.9: Districtwise Kinked Exponential Growth in Productivity of Rice in West Bengal for (1970-71 to 2008-09), (1970-71 to 1979-80), (1980-81 to 1989-90), (1990-91 to 1999-2000) and (2000-01 to 2008-09)

DIST/Sub-period Growth	Whole Period (1970-71 to 2008-09)	Sub-Period I (1970-71 to 1979-80)	Sub-Period II (1980-81 to 1989-90)	Sub-Period III (1990-91 to 1999-2000)	Sub-Period IV (2000-01 to 2008-09)	Trend Break I	Trend break II	Trend break III	DW	R^2
Burdwan	3.1	1.8	2.9	2.8	2.0	1.1	-0.1	-0.8	1.3	0.9
	(16.2)*	(2.2)*	(4.0)*	(9.1)*	(10.1)*					
Birbhum	2.9	-0.3	4.2	3.2	2.8	4.5	-1.0	-0.5	1.4	0.8
	(12.3)*	(-0.3)	(4.2)*	(7.7)*	(10.2)*					
Bankura	2.9	-0.9	5.1	4.1	3.2	6.0	-1.0	-0.9	1.8	0.9
	(10.1)*	(-0.8)	(4.9)*	(9.5)*	(11.6)*					
Midnapore	3.2	-0.6	5.1	3.6	3.0	5.6	-1.5	-0.6	1.6	0.9
	(14.7)*	(-0.5)	(5.3)*	(9.0)*	(11.7)*					
Howrah	3.0	-0.1	5.3	2.7	2.1	5.4	-2.6	-0.5	1.9	0.7
	(9.6)*	(0.0)	(4.2)*	(5.1)*	(6.3)*					
Hoogly	2.6	0.5	2.7	2.5	2.0	2.2	-0.3	-0.5	2.3	0.9
	(13.3)*	(0.6)	(3.8)*	(8.2)*	(10.2)*					
24 Parganas	2.8	1.8	3.1	2.8	2.5	1.3	-0.3	-0.4	1.7	0.8
	(12.7)*	(1.4)	(2.9)*	(6.3)*	(8.4)*					
Nadia	4.4	4.0	5.3	4.0	3.0	1.3	-1.3	-1.1	1.4	0.9
	(14.1)*	(4.0)*	(6.0)*	(10.9)*	(12.5)*					
Murshidabad	3.9	1.9	3.2	3.7	2.9	1.2	0.5	-0.8	1.7	0.9
	(14.1)*	(1.6)	(3.0)*	(8.3)*	(10.2)*					
West Dinajpur	3.4	-1.2	4.4	4.4	3.7	5.5	0.0	-0.7	1.9	0.9
	(16.1)*	(-1.4)	(5.8)*	(13.8)*	(18.0)*					
Malda	3.1	1.8	4.1	3.8	3.5	2.3	-0.2	-0.3	1.6	1.0
	(16.1)*	(2.3)*	(6.0)*	(13.5)*	(19.4)*					
Jalpaiguri	1.2	-3.0	2.2	2.1	2.4	5.1	-0.1	0.3	2.5	0.8
	(5.4)*	(-2.9)*	(2.4)*	(5.4)*	(9.6)*					
Darjeeling	0.6	-0.2	0.0	0.8	1.7	0.2	0.7	0.9	1.8	0.7
	(2.1)*	(-0.2)	(0.0)	(1.8)**	(6.1)*					
Cooch Behar	2.2	-2.0	4.0	2.8	2.9	6.0	-1.1	0.1	1.6	0.9
	(11.9)*	(-2.4)*	(5.4)*	(9.4)*	(14.9)*					
Purulia	2.9	-2.3	5.2	3.1	3.4	7.5	-2.1	0.3	2.5	0.8
	(8.2)*	(-1.5)	(3.9)*	(5.5)*	(9.2)*					
West Bengal	3.0	0.2	4.0	3.4	2.8	3.8	-0.6	-0.6	1.6	0.9
	(17.0)*	(0.3)	(5.7)*	(11.4)*	(14.8)*					

T stats are shown in parenthesis

*Significant at 1% level, ** Significant at 5% level, ***Significant at 10% level*

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

Therefore, it is quite evident that the turn around that took place in foodgrain production in West Bengal took place during 1980s, much of it contributed by the growth in rice production and productivity in the state. In sub-period III and IV, a deceleration in growth of rice productivity was observed for the state as well as for most of the districts. The growth rate in productivity for the state declined to 3.4 percent and 2.8 percent in sub-period III (1990-91 to 1999-2000) and IV (2000-01 to 2008-09) from 4.0 percent in sub-period II (1980-81 to 1989-90). In sub-period III, the growth in productivity of rice marginally increased for the district of Murshidabad which is remained constant for West Dinajpur. For rest of the districts, the

growth rates declined. From the values of trend break-II, it was observed that fall in growth was prominent in Howrah, Purulia, Midnapore, and Nadia. In sub-period IV growth in productivity declined for all the districts excepting Jalpaiguri, Darjeeling and Cooch Behar. For these districts marginal rise was observed.

4.12 Inter-District Comparison of Growth in Production and Productivity of Wheat in West Bengal

The contribution of West Bengal to total wheat production of the country was 1.32 percent in 1970-71 and in 2007-08, it reduced to 1.17 percent only, making it evident that wheat is not a major crop in West Bengal. From Table 4.10, it is evident that the share of wheat in total foodgrain production in West Bengal reduced substantially in 2008-09 in comparison to 1970-71. If we look at districts, the same trend is visible for all the districts in West Bengal. The districts of Nadia and Murshidabad have shown an increase in their share of wheat in total foodgrain production in the state in 1985-86 and 2000-01.

Table 4.10: Districtwise Wheat Production as percentage of State's Foodgrain Production

Year/Dist	Burdwan	Birbhum	Bankura	Midnapore	Howrah	Hoogly	24 Parganas	Nadia
1970-71	0.94	2.37	0.23	0.35	0.10	0.71	0.41	1.64
1975-76	0.99	1.51	1.01	0.79	0.11	0.72	0.68	1.67
1980-81	0.21	0.40	0.19	0.13	0.02	0.15	0.19	0.87
1985-86	0.23	0.42	0.31	0.23	0.03	0.13	0.19	1.74
1990-91	0.05	0.22	0.11	0.08	0.00	0.01	0.17	0.72
1995-96	0.07	0.34	0.10	0.18	0.01	0.02	0.09	0.86
2000-01	0.11	0.56	0.15	0.23	0.02	0.03	0.29	1.07
2008-09	0.03	0.60	0.05	0.04	0.00	0.02	0.12	0.52

Year/Dist	Murshidabad	West Dinapur	Malda	Jalpaiguri	Darjeeling	Cooch Behar	Purulia	West Bengal
1970-71	3.35	0.67	0.63	0.01	0.01	0.15	0.02	11.59
1975-76	2.92	1.20	0.85	0.48	0.06	0.49	0.33	13.82
1980-81	1.43	1.09	0.47	0.20	0.03	0.24	0.03	5.64
1985-86	2.62	0.93	0.69	0.18	0.02	0.31	0.05	8.08
1990-91	1.55	0.60	0.79	0.15	0.03	0.20	0.02	4.70
1995-96	2.16	0.54	0.75	0.19	0.02	0.23	0.07	5.63
2000-01	2.70	0.81	0.90	0.34	0.05	0.36	0.05	7.66
2008-09	1.58	0.66	0.74	0.20	0.02	0.10	0.01	4.69

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

From Table 4.11 and Table 4.12, a clearer picture emerges regarding the growth of wheat production and productivity in the state as well as in the districts during the period of study i.e., 1970-71 to 2008-09 as well as for four sub-periods, viz. sub-period I (1970-71 to 1978-80), sub-period II (1980-81 to 1989-90), sub-period III (1990-91 to 1999-2000) and sub-

period IV (2000-2001to 2008-09). Over the whole period of study i.e., 1970-71 to 2008-09, exponential growth in wheat production and productivity are found to be less than 1 percent and statistically insignificant. Among the districts, in sub-period I, Jalpaiguri and Darjeeling achieved impressive and significant growth rate in production and in case of productivity, along with Jalpaiguri and Darjeeling, Cooch Behar also achieved a significant growth. For rest of the districts, growth of production and productivity remained either negative and significant or positive and insignificant. In sub-period II, growth rate for production of wheat for Jalpaiguri, Darjeeling and Cooch Behar however turned out to be negative. Nadia, Murshidabad and Malda reversed their negative growth rates and achieved positive and significant growth in wheat production. However, their growth of productivity although remained positive but statistically insignificant. Therefore, the growth of production possibly has increased because of the positive growth of area or through area expansion under wheat cultivation. Positive and significant growth in productivity has also been observed for the districts of Birbhum and Bankura.

Table 4.11: Districtwise Kinked Exponential Growth in Production of Wheat in West Bengal for (1970-71 to 2008-09), (1980-81 to 1989-90), (1990-91 to 1999-2000) and (2000-01 to 2008-09)

DIST/Sub-period Growth	Whole Period (1970-71 to 2008-09)	Sub-Period I (1970-71 to 1979-80)	Sub-Period II (1980-81 to 1989-90)	Sub-Period III (1990-91 to 1999-2000)	Sub-Period IV (2000-01 to 2008-09)	Trend Break I	Trend break II	Trend break III	DW	R^2
Burdwan	-6.93	-10.1	-12.1	-10.6	-5.9	-2.0	1.5	4.8	0.8	0.9
	(-9.72)*	(-2.9)*	(-3.9)*	(-8.1)*	(-6.9)*					
Birbhum	-0.67	-12.9	-3.1	-1.3	2.0	9.8	1.8	3.3	1.0	0.6
	(-0.86)	(-3.8)*	(-1.0)	(-1.0)	(2.5)*					
Bankura	-2.54	-1.4	-6.1	-4.8	-3.4	-4.6	1.3	1.4	1.2	0.5
	(-3.45)*	(-0.4)	(-1.9)**	(-3.6)*	(-3.9)*					
Midnapore	-1.70	-7.4	-6.3	-1.3	-0.8	1.1	5.0	0.4	1.1	0.3
	(-2.26)*	(-1.7)	(-1.6)	(-0.8)	(-0.8)					
Howrah	-7.53	-10.6	-22.1	-12.6	-6.6	-11.5	9.5	5.9	0.9	0.7
	(-5.91)*	(-1.5)	(-3.5)*	(-4.8)*	(-3.9)*					
Hoogly	-10.96	-10.0	-15.8	-15.9	-11.0	-5.8	0.0	4.8	1.5	0.9
	(-12.62)*	(-1.9)**	(-3.4)*	(-8.1)*	(-8.7)*					
24 Parganas	-1.43	-3.5	-1.9	-3.2	-0.5	1.6	-1.3	2.7	1.2	0.4
	(-2.81)*	(-1.2)	(-0.7)	(-3.0)*	(-0.8)					
Nadia	0.15	-2.1	2.1	0.7	0.6	4.2	-1.4	-0.1	1.1	0.0
	(0.39)	(-0.8)	(0.9)	(0.7)	(1.0)					
Murshidabad	1.28	-2.5	1.2	2.0	1.9	3.7	0.8	-0.1	1.0	0.5
	(4.22)*	(-1.4)	(0.7)	(3.0)*	(4.4)*					
West Dinapur	1.20	4.4	-2.3	-1.0	0.9	-6.8	1.3	2.0	1.7	0.4
	(3.28)*	(2.2)*	(-1.3)	(-1.3)	(1.9)**					
Malda	2.87	-0.4	2.7	4.1	3.2	3.1	1.4	-0.9	1.0	0.7
	(8.78)*	(-0.2)	(1.6)	(5.7)*	(6.9)*					
Jalpaiguri	4.97	33.8	-8.0	-1.7	-0.2	-41.8	6.3	1.5	0.5	0.6
	(4.28)*	(6.2)*	(-1.7)***	(-0.8)	(-0.1)					
Darjeeling	3.17	32.9	-18.8	-3.1	-2.6	-51.7	15.6	0.5	1.4	0.7
	(2.88)*	(7.3)*	(-4.7)*	(-1.9)**	(-2.4)*					
Cooch Behar	0.69	17.4	-6.0	-3.5	-2.1	-23.4	2.5	1.4	0.7	0.3
	(0.86)	(3.9)*	(-1.5)	(-2.1)*	(-2.0)**					
Purulia	-1.29	-1.2	-7.6	-2.6	-1.3	-6.4	5.0	1.3	1.1	0.1
	(-1.29)	(-0.2)	(-1.3)	(-1.1)	(-0.8)					
West Bengal	0.16	-2.6	-1.4	-0.1	0.8	1.2	1.4	0.8	0.7	0.2
	(0.46)	(-1.3)	(-0.8)	(-0.1)	(1.6)					

T stats are shown in parenthesis

*Significant at 1% level, ** Significant at 5% level, ***Significant at 10% level*

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

In sub-period III, Birbhum, Murshidabad and Malda made an impressive growth in wheat production whereas in productivity, positive and significant growth was achieved by Burdwan, Birbhum, Midnapore, Murshidabad, West Dinajpur and Malda. Finally in sub-period IV, Birbhum, Murshidabad, West Dinajpur and Malda made positive and significant growth in wheat production and in productivity front, Burdwan, Birbhum, Bankura, Midnapore, Murshidabad, West Dinajpur, Malda, Jalpaiguri and Purulia registered positive and statistically significant growth.

Table 4.12: Districtwise Kinked Exponential Growth in Productivity of Wheat in West Bengal for (1970-71 to 2008-09), (1970-71 to 1979-80)(1980-81 to 1989-90), (1990-91 to 1999-2000) and (2000-01 to 2008-09)

DIST/Sub-period Growth	Whole Period (1970-71 to 2008-09)	Sub-Period I (1970-71 to 1979-80)	Sub-Period II(1980-81 to 1989-90)	Sub-Period III (1990-91 to 1999-00)	Sub-Period IV (2000-01 to 2008-09)	Treand break I	Treand break II	Treand break III	DW	R^2
Burdwan	0.23	-2.5	-0.1	0.4	0.7	2.4	0.5	0.3	1.6	0.3
	(1.09)	-2.1*	-0.1	1.0	2.6*					
Birbhum	1.33	-2.0	1.7	2.1	1.8	3.7	0.4	-0.3	1.2	0.8
	(7.85)*	-2.2*	2.2*	6.6*	8.6*					
Bankura	0.86	-2.8	3.4	1.3	0.6	6.2	-2.1	-0.7	1.9	0.2
	(1.86)***	-1.8**	2.5*	2.3*	1.7***					
Midnapore	0.12	-5.4	1.5	1.3	1.0	6.8	-0.2	-0.3	1.6	0.3
	(0.43)	-3.5*	1.1	2.3*	2.8*					
Howrah	0.03	1.2	-2.9	-2.7	0.4	-4.2	0.3	3.0	2.4	0.3
	(0.06)	0.4	-1.2	-2.6*	0.6					
Hoogly	-0.24	-1.2	-1.0	-0.4	0.0	0.2	0.5	0.4	2.3	0.1
	(-0.97)	-0.7	-0.7	-0.8	-0.1					
24 Parganas	0.21	0.8	0.9	-0.1	0.2	0.2	-1.1	0.3	1.5	0.1
	(0.99)	0.6	0.8	-0.2	0.7					
Nadia	-0.11	-1.4	1.1	0.3	0.1	2.5	-0.7	-0.2	1.3	0.0
	(-0.52)	-1.1	0.9	0.6	0.3					
Murshidabad	0.40	-1.8	0.9	1.1	0.7	2.7	0.2	-0.4	1.4	0.2
	(2.05)***	-1.5	0.9	2.4*	2.5*					
West Dinapur	0.60	-2.2	1.0	1.3	1.0	3.1	0.3	-0.3	1.9	0.2
	(2.37)**	-1.4	0.7	2.3*	2.7*					
Malda	1.06	0.7	0.4	1.2	1.1	-0.3	0.8	-0.1	1.3	0.4
	(4.78)*	0.5	0.3	2.2*	3.1*					
Jalpaiguri	0.73	3.5	-3.3	-0.7	0.3	-6.8	2.6	1.1	1.6	0.4
	(2.74)**	2.4*	-2.5*	-1.3	0.9					
Darjeeling	0.35	8.7	-5.0	-2.2	-1.0	-13.8	2.9	1.2	2.0	0.7
	(0.87)	3.9*	-2.6*	-2.6*	-1.9*					
Cooch Behar	-0.03	1.8	-2.5	-1.0	-0.3	-4.2	1.5	0.7	1.7	0.2
	(-0.12)	1.4	-2.2*	-2.1*	-0.9					
Purulia	0.80	0.8	-1.3	0.6	0.7	-2.2	1.9	0.2	1.8	1.8
	(2.73)**	0.5	-0.8	0.8	1.7***					
West Bengal	0.23	-1.5	0.7	0.9	0.5	2.2	0.1	-0.4	1.6	0.1
	(0.92)	-1.0	0.6	1.6	1.3					

T stats are shown in parenthesis

**Significant at 1% level, ** Significant at 5% level, ***Significant at 10% level*

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

4.13 Conclusion

Aforementioned empirical investigations reveal that rice dominates the foodgrain production of the state. Burdwan and Midnapore and 24 Parganas continue to remain as most consistent performer in terms of their contribution to total foodgrain and rice production in the state. A stable upward trend in production and productivity for foodgrain and rice was maintained by these districts over the entire decade of eighties and nineties and performed relatively better in comparison to rest of the districts during the era of agricultural stagnation in West Bengal. Birbhum, which was the major contributor in foodgrain and rice production in the state with steady rate of growth in production and productivity started loosing its strength in terms of its share in foodgrain production as well as growth of production and productivity since 1990s and onwards. Hoogly's performance however remained relatively unsatisfactory. It was adequately evident that the turn around in agriculture that occurred in West Bengal during eighties and onwards was driven by the fact that few districts performed poorly because of agro-climatic barriers or other economic and non-economic factors till 1980s, but from 1980 and onwards their growth performances improved tremendously. Purulia, Howrah, Bankura, Nadia, West Dinajpur, Cooch Behar, Murshidabad and Malda were among those districts. Birbhum, one the major contributors in foodgrain and rice production in the state, however, started losing its strength in terms of its share in foodgrain production and growth of production and productivity since 1990s and onwards. Darjeeling and Jalpaiguri continued to remain at the bottom of the ladder in terms of both production and productivity of foodgrain and rice. It is also observed that percentage share of wheat production in the state remained low and declined further over the decades. However, production of wheat remained statistically significant for Murshidabad, West Dinajpur, Malda, Jalpaiguri and Darjeeling. Another important feature that emerged from above analysis is that, the productivity of foodgrain and rice in absolute terms continued to grow even in the decade of nineties as well as between 2000-01 and 2008-09. In other words, more number of districts has been successful to overcome the agro-climatic barrier to enhance productivity. Therefore, the empirical results as depicted above reaffirmed two major observations on agriculture in West Bengal. First, the persistence of stagnation due to negligible growth in agricultural production and productivity was observed from 1970-71 to 1980-81 and second, an overwhelming turn around from stagnation in agricultural production and productivity in West Bengal since late-eighties. Since this study has moved well beyond the decade of 1980s and estimated the growth trend till 2008-09, the question as to, how far the success of agricultural turn around

achieved during the decade of eighties could be sustained, can well be validated. The overall agrarian scenarios that emerged during post-1990 period were indeed not encouraging. For the state as well as for the districts growth rate in production and productivity has reduced. Reduction was prominent especially in Purulia, Howrah that attained addition in growth rates of production and productivity in foodgrain and rice from 1980-81 to 1989-90. All major rice producing districts experienced reduction in growth rates both in production and productivity in the decade of 1990s and post-90s except Murshidabad and the districts placed at the bottom of growth tables displayed marginal improvements in their growth performance. This scenario makes it imperative to probe deeper into couple of issues. First, since foodgrain is mostly dominated by rice, therefore, reduction in growth is closely associated with the changes occuring in production and productivity in three rice growing seasons in West Bengal. Decline in growth is pronounced but rate of change in growth rate would provide a measure to gauge the long term impact on the agrarian scenario in West Bengal and the districts. It also becomes imperative to see whether the changes in growth of agricultural production and productivity are bringing stability or instability in agricultural production in the state as well as in the districts. Finally, non-foodgrain component needs to be looked into along with foodgrains because that indicates the changing approach of farmers towards cash crops. These issues have been taken up for further empirical investigations in the following Chapter.

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