Study No. 162

Determinants of Stagnation in Productivity of Important Crops in West Bengal

K.M.B. Rahim
D. Majumder
R.K. Biswas

Agro-Economic Research Centre
Visva-Bharati
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PREFACE

In a country like India we are faced with a wide regional diversities in agro-climatic specifications, resource endowment and population density which gives rise to uneven agricultural development across the country. In West Bengal also we do find a wide cross section of agro-climatic zones that poses a spectrum of hurdles for a rapid agricultural development in the state.

In the 60's new technology in the form of seed-water-fertilizer package was introduced in order to achieve self sufficiency in food grain production in the country. However, the pace of agricultural development throughout the country was not uniform depending upon varied physical and social resource endowments. In West Bengal, however, the so called 'green revolution' have had little impact in revolutionizing agricultural production. An impotant development in later half of 80's was the spread of new technology to the eastern Indian states of Bihar, West Bengal, Orissa and Assam. But the pace of growth did not last long. After a period of growth acceleration, agricultural productivity in the state experienced stagnation during the later years of the 90's.

In the light of these facts, the present study entitled "Determinants of Stagnation in Productivity of Important Crops in West Bengal" has been taken up as a common study at the instance of the Directorate of Economics and Statistics, Ministry of Agriculture, Government of India.

The study was carried out by Professor Kazi M. B. Rahim, Mr. Debanshu Majumder and Mr. Ranajan Biswas. Mr. Debanshu Majumder and Mr. Ranjan Biswas have collected, tabulated the secondary and shouldered the responsibility of analyzing the data and preparation of tables. Drafting of the report was done by Professor Kazi M. B. Rahim, Mr. Debanshu Majumder and Mr. Ranjan Biswas. The secretarial assistance was provided by Mr. N. Maji, Munsi A. Khaleque, Mr. D. Mondal, Mr. D. Das, Mr. P. Hazra and Mr. S. Sadhu. Duplicating of the report was done by Mr. A. Patra.

On behalf of the center, the undersigned takes this opportunity to thank the officials of the Directorate of Agriculture, Government of West Bengal and officials of the Bureau of Applied Economics and Statistics, Government of West Bengal and other concerned departments for their co-operation they extended in course of the study.

Santiniketan
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Debashis Sarkar
Professor & Director

I INTRODUCTION

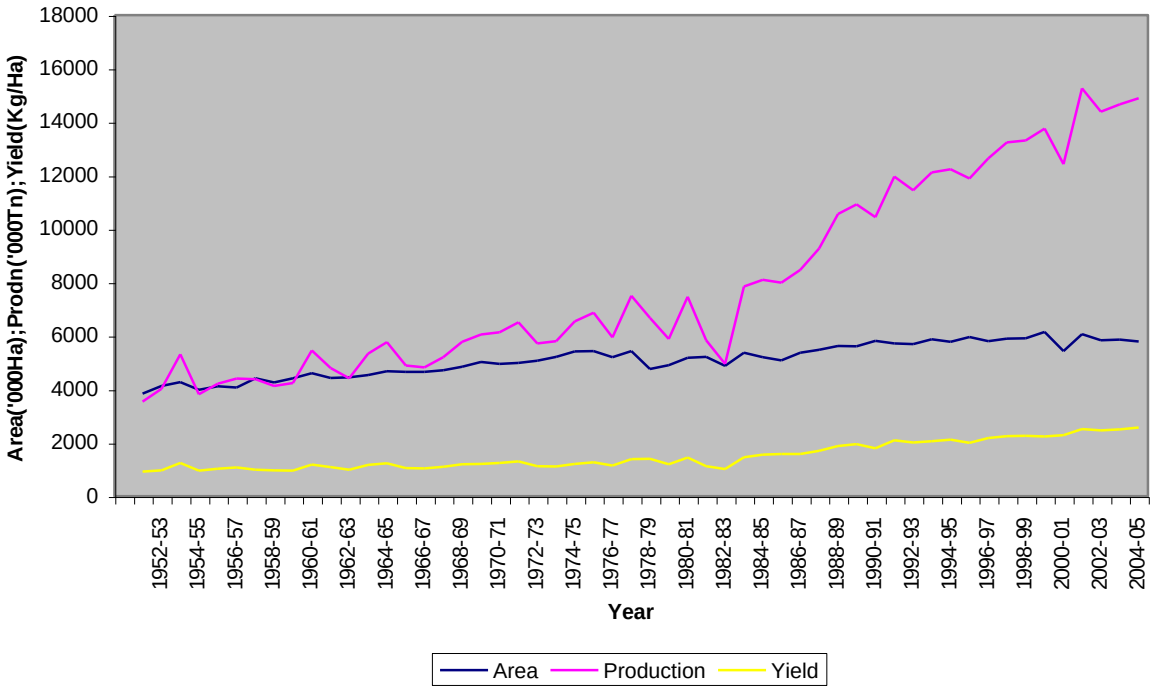
1.1 Introduction

In a country like India we are faced with a wide regional diversities in agro-climatic specifications, resource endowment and population density which gives rise to uneven agricultural development across the country. Within such an envelop of diversity Indian agriculture has experienced significant variation of growth and development since independence.

In the 60's new technology in the form of seed-water-fertilizer package was introduced in order to achieve self sufficiency in food grain production in the country. However, the pace of agricultural development throughout the country was not uniform depending upon varied physical and social resource endowments. The new HYV technology which resulted in appreciable increases in the yield of wheat was more or less confined only to Punjab, Haryana and western Uttar Pradesh.

In West Bengal, however, the so called 'green revolution' have had little impact in revolutionizing agricultural production. Rice, the main crop covering over 60 percent of gross cropped area, reveals that practically 1983-84 (almost after two decades of 'green revolution') marks the take-off of agricultural production in the state. But around mid 90's the rate of growth of agricultural production showed signs of deceleration. With increasing marginalizaion of holding structure it posed a threat for the tiny holders in terms of their food security. More alarmingly, the productivity does not demonstrate a sharp upward trend.

Figure 1 : Rice in West Bengal

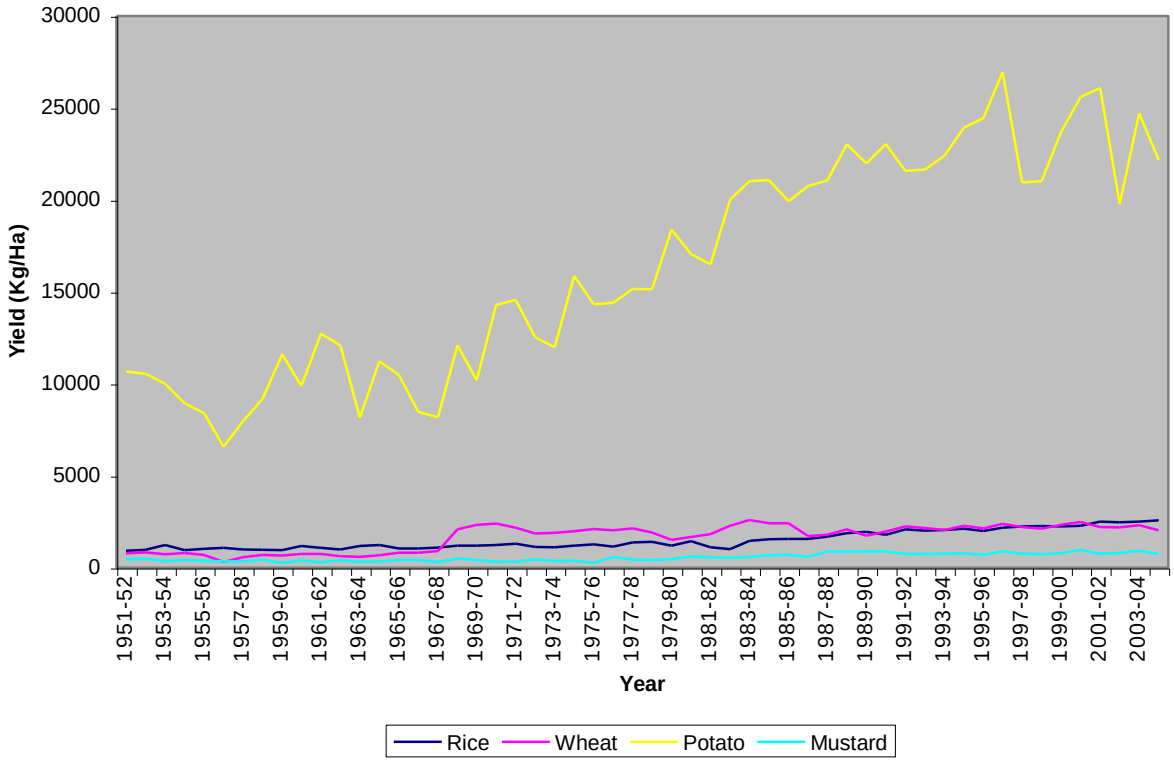


1.2 Need for the Present Study

An impotant development in later half of 80's was the spread of new technology to the eastern Indian states of Bihar, West Bengal, Orissa and Assam. This has, for the first time, extensively increased the productivity and output levels in the densely populated eastern states of India. In the early years of green revolution eastern states like West Bengal did not respond largely to the new technology, apart from a few exceptions like Barddhaman where HYV rice made a breakthrough. But mid 80's started with a high note. Researchers finally accepted that the agrarian impasse (Boyce 1987) in West Bengal that continued till early 80's was eventually ended.

Unfortunately this rising trend did not sustain for a long period. Since mid 90's the agricultural output and productivity reflected a plateau. Four important crops (Rice, Wheat, Potato and Mustard) in West Bengal the productivity over the years seems to stagnate. Productivity for Potato demonstrate decreasing trend since mid 90's.

Figure 2 : Yield Rates of Some Important Crops in West Bengal



In the meantime economic liberalization came into fore. But these reforms put more stress on the poor Indian peasantry. The Situation Assessment Survey of the Indian peasantry was its 59th. round by NSSO. The results showed acute distress among the farmers (Bhalla 2006). In the face of stagnating agricultural productivity, again the question of food security among agrarian population became a burning issue before the policy makers that required immediate intervention.

It is in this context the present study derives its significance. It is time to look into the causes of such a deceleration in the agrarian sector.

1.3 Objectives

The broad objectives of the study are:

a. To analyse the growth pattern of production and productivity of important crops across the districts and Stat.
b. To study the regional variations in productivity of important crops (specifically bringing out the districts with differentiated growth behaviour) and to map out the regions with acute stagnation.
c. To trace the determinants for changes in productivity and stagnation of important crops.
d. To suggest district level interventions to overcome the problems of stagnation.

1.4 Organization of the study

The present study is based on secondary data collected from official sources of Government of West Bengal, Bureau of Applied Economics and Statistics, CSO etc. In West Bengal, however, there are certain difficulties regarding district level data for two districts namely Dinajpur and Medinipur. Dinajpur has been divided into two districts Uttar (North) Dinajpur and Dakshin (South) Dinajpur. Similarly, Medinipur into Purba (East) Medinipur and Paschim (West) Medinipur. It is this changes in the district boundaries that pose some difficulty in getting district level time series data for them. However, for the present context we have taken both Dinajpur and Midnapur in a combined way and necessary adjustments have been made as regard to time series data.

In this study, both State and district level analyses have been made to identify the constraints for increasing the agricultural productivity.

II. RECENT DEVELOPMENT IN AGRICULTURE IN THE STATE

2.1. Introduction

West Bengal, historically, has been a state with high population density (it is 903 per square kilometer as per 2001 census) on a fertile land and a large section of population dependent on agriculture for their livelihood. Since independence till date the situation has remained more or less the same with over seventy two percent (72.03%, 2001 census) of total population living in rural areas. The figure can be compared with the percentage for 1991, which was 72.52. It appears that there has been a marginal shift of population from rural to urban agglomerations. Proportion of cultivators and agricultural labours taken together has come down from 54.25 percent in 1991 to 44.15 percent in 2001. But proportion of other workers within total workforce between the time span has risen from 41.51 percent to 48.48 percent. At the same time in the face of continuous marginalization of holding the average holding size has declined from 0.9 acres in 1990-91 to 0.82 in 2000-01. The average family income from all sources per farmer household was Rs.2079.00 that was lower than the national average of Rs.2115.00 (Bhalla 2006). And there remain 44.15 percent of population on the whole who are still illiterate (2001 census). It is in this background we take up the study to identify the factors posing hindrance for a rapid increase in crop productivity.

2.2 Rainfall

In terms of annual rainfall the eighteen districts of the state can be categorized into three major segments i.e. High, Medium and Low rainfall areas. We have taken normal rainfall data for 2006 for categorizing the districts. The mean normal rainfall for 2006 was 1615 mm. Taking standard deviation for normal rainfall of 2006 we constructed the class intervals for defining areas with high, medium and low annual rainfall.

It is observed that there are three districts namely, Jalpaiguri, Darjeeling and Cooch Behar that come under heavy rainfall zone within the state with around 3000mm rainfall per annuam on an average. These are the districts within Himalayan and Terai region. The districts of South Bengal mostly come under low rainfall zone (Table 2.1).

It is revealed from the annual rainfall data that it is subject to annual fluctuations across regions. There have been years like 1975-79 when the general rainfall was low throughout the state. Moreover, rainfall is heavy during June-September and scanty in rest of the months.

The normal rainfall data for 2006 suggests that districts like Hoohly, Nadia, both South and North Dinajpur, Bankura and Purulia annual rainfall is low. Within these districts Purulia and Bankura seem to suffer most in terms of agricultural production. The terrain in these two districts that come under Red and Laterite belt is such that the bulk of annual precipitation is wasted as run off. And sub soil water is scarce. On the other hand Nadia and Hoogly are situated in Gangetic Alluvial Plains where water retention in sandy-loam soil is much higher than laterite soil of Purulia or Bankura. Moreover, in former districts underground water could be tapped easily for cultivation.

Table 2.1 : Average Annual Rainfall in the State 1960-61 to 2005

Districts	1960-62	1969	1970-74	1975-79	1980-84	1985-89	1990-94	1995-99	2000-04	2005
High RF >2189mm										
Jalpaiguri	3258.7	2906.4	3153.2	2581.2	3323.7	3773.4	3352.6	3861.8	3527.2	3073.0
Darjeeling	3112.7	2616.9	2701.0	2307.1	2583.3	3152.0	3175.0	3148.4	2945.2	2490.0
Cooch Behar	3004.3	3717.7	3056.3	2537.7	3147.5	3568.4	2763.4	3179.0	2911.6	3274.0
Medium RF >1615-≤2189mm										
South 24 Parganas	-	-	-	-	-	-	Na	2164.6	1668.4	2155.0
24Pgs (Combined)	1355.7	1638.7	1846.7	1572.8	1735.2	1742.5	-	-	-	-
Medinipr(East)	-	-	-	-	-	-	-	1674.2	1560.0	2259.0
Low RF >1041-≤1615mm										
Birbhum	1081.0	1086.4	1172.9	1199.1	1493.8	1355.0	1374.2	1648.8	1496.0	1264.0
Howrah	Na	Na	234.0	825.0	1604.9	1440.8	1558.6	1549.0	1366.4	1612.0
Burdwan	1056.3	1287.8	1325.5	917.2	1332.4	1274.2	1350.0	1529.6	1397.8	1224.0
Midnapore(West)	-	-	-	-	-	-	-	1531.8	1521.2	1660.0
Murshidabad	1141.3	1272.4	1494.2	975.1	1467.3	1469.6	1357.8	1543.0	1406.2	1172.0
Malda	1364.0	1306.7	1111.3	950.7	1459.7	1645.0	1500.8	1900.0	1601.8	1579.0
North 24Parganas	-	-	-	-	-	-	Na	1593.6	1400.2	1262.0
Bankura	1048.0	1499.2	1422.0	885.2	1367.2	1446.4	1480.8	1458.2	1304.6	1213.0
Purulia	1254.7	1073.1	1064.3	1181.7	1210.5	1278.2	1428.6	1522.8	1266.0	1079.0
Dinajpur (North)	-	-	-	-	-	-	1521.0	2420.8	1928.2	1826.0
Midnapore (Combined)	1385.3	1508.4	1658.9	1320.7	1543.5	1471.7	1811.8	-	-	-
Dinajpur (South)	-	-	-	-	-	-	1081.0	2017.2	1596.4	1965.0
Dinajpur (Combined)	Na	64.4	899.0	719.1	1851.3	2315.8	-	-	-	-
Nadia	1018.0	1401.5	1448.3	1359.1	1359.1	1434.6	1335.0	1517.2	1353.2	1195.0
Hoogly	1343.3	Na	192.4	1476.7	1476.7	1501.4	1373.8	1527.0	1267.0	1198.0
V Low RF ≤1041mm										
	-	-	-	-	-	-	-			

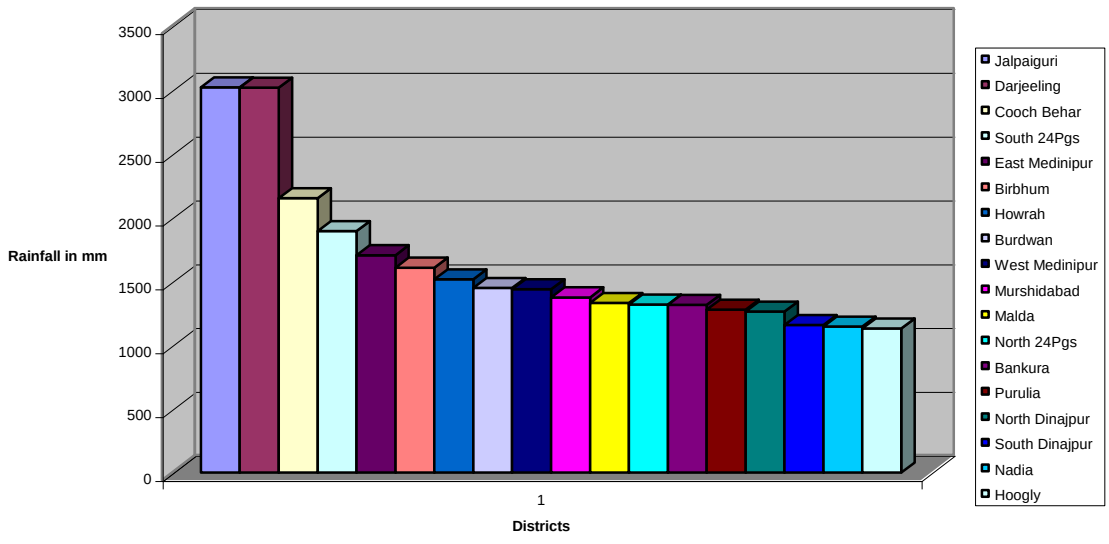
Source : Statistical Abstract, BEAS, GoWB

Table 2.2 : Drought-prone Regions of the State

Name of Districts			
High	**Medium**	**Low**	**Very Low**
Purulia	Birbhum	Malda	Jalpaiguri
Bankura	Burdwan	Howrah	Darjeeling
Midnapore(West)	Murshidabad	Midnapore(East)	Cooch Behar
	Hoogly	South 24Parganas	
	Nadia	24Parganas (Combined)	
	North 24Parganas	Dinajpur (S)	
	Midnapore (Combined)	Dinajpur (Combined)	
		Dinajpur (North)	

Source : Statistical Abstract, BEAS, GoWB

Figure 3 : Normal Rainfall 2006



Fluctuations in annual rainfall give rise to drought situation in different districts of the State. Purulia, Bankura and West Midnapore are supposed to be more prone to drought situation as compared to the rest of the districts as per official sources. In these districts sub soil water is scarce and agriculture is dependant primarily on annual rainfall. When the rainfall is scanty possibility of crop failure increases giving rise to a situation of drought.

There are other districts too like Birbhum, Murshidabad and a part of Midnapur and Burdwan, that are also drought prone, though at a lesser degree as compared to three districts mentioned earlier. In West Bengal, however, tube well irrigation have had made a breakthrough since mid 80's of which we shall discuss later. Shallow tube wells installed by relatively wealthier farmers in the agrarian sector of the State have reduced the dependence on monsoon at least to a certain degree and in some of the districts.

2.3 Irrigation Status

So far is irrigation is concerned it is really difficult to get access to secondary source data regarding the status of irrigation in the state. However, it appears that since 1962 the command area under government canals shows over two fold increase (Table 2.3). But when one goes in the field level s/he is faced with the reality that supply of water through canals is erratic most of the time. Generally it is during Kharif season i.e. the monsoon, canals are capable of supplying water for Aman Paddy. But in a situation of heavy rain in general these canal play only a supplementary role in irrigation scenario of Kharif season. Moreover, when the rainfall is scanty even during monsoon canals could hardly cater the demands. But even though it is a fact that the canal irrigation is the cheapest among all sources of irrigation in West Bengal, farmers are unable to depend on it as a dependable source. It is far more difficult for the farmers of the bottom end of these canals to get access to surface water. This very nature of irrigation has compelled the farmers to depend of more costly ground water when that is available.

Ground water in the agrarian sector of West Bengal has developed under the auspices of the private sector. Farmers who are capable of installing shallow tube wells have made their own arrangements of assured irrigation exploiting the ground water sources. As this development has almost entirely been by the small entrepreneurs it is difficult to estimate the total coverage of such development And at the secondary level very little data is available. However, in a span of two decades from 1980-81 to 2000-01 the command area under shallow tube wells has increased about ten times. This development in last two decades have had made a breakthrough in agricultural production. The crop which has made a large scale entry in the cropping pattern is the high yielding Summer Paddy of which we shall be discussing later on. It is apparent that net irrigated area as a percentage of net sown area has increased steadily over the years.

Table 2.3 : Irrigation from different sources and proportion of Net Irrigated Area from Different sources of Irrigation Triennium Ending Average (TE) 1962-63 to 2002-03

(area in '000 ha)

	TE62-63	TE72-73	TE82-83	TE92-93	2000-01	2001-02	2002-03
Govt.Canals	497.8	779.5	833.6	1045.8	1141.3	1033.9	1075.3
Private Canals	387.7	NA	NA	0.0	0.0	0.0	0.0
Total Canals	885.5	779.5	833.6	1045.8	1141.3	1033.9	1075.3
Tanks	334.1	NA	NA	NA	NA	NA	NA
Tubewells	0.0	NA	146.0	112.0	1353.0*	NA	NA
Wells	16.0	NA	NA	NA	28.0*	NA	NA
Other Sources	185.9	NA	245.7	130.2	385.4*	NA	NA
NIA	1421.5	NA	1225.3	1288.0	2907.3	NA	NA
NSA	5454.2	5448.8	5457.3	5477.2	5417.4	5521.6	5354.2
NIA/NSA %	26.1	14.3	17.7	23.5	53.7	-	-
Source of Irrigation : Percentage to Net Irrigated Area							
Govt.Canals	35.0		68.0	81.2	39.3		
Pvt.Canals	27.3						
Tanks	23.5						
Tubewells	0.0		11.9	8.7	45.5		
Wells	0.01				0.01		
Other Sources	13.1		20.1	10.1	13.3		

Source : Statistical Handbook, Bureau of Applied Economics & Statistics Govt. of West Bengal.

* Data collected from 3rd Minor Irrigation Census in West Bengal 2000-01

2.4 Land Use Pattern

Land use pattern over the years shows that the gross cropped area has increased significantly over the years while net sown area has remained more or less the same as reflected in the triennium averages. But year wise data since 2001-02 would suggest that net sown area has declined as compared to the earlier decade. In fact having a declining trend in the 90's net sown area has remained more or less constant in the new millennium. We have said earlier that West Bengal features a high population density on a fertile land. This phenomenon has acquired most of the marginal lands into agricultural use. A thorough look into the land use pattern suggest that since mid 80's the gross cropped area has risen significantly revealing a change in cropping practice till 2001-03. During 2004-05, however, it has declined marginally (Table 2.4). While current and other fallow show a decline, area put to non-agricultural uses seem to rise, signifying transfer of land from agriculture to other uses while forest area remained constant over the years. As a result even in a situation of increasing cropping intensity net sown area reveals a decline.

Table 2.4 : Changes in the Land Use Pattern (area in '000 ha)

	TE62-63	TE72-73	TE82-83	TE92-93	2001-03	2004-05
Forests	1104.0	1101.1	1082.1	1101.1	1189.9	1174.8
Barren and un-cultivable land	NA	NA	42.6	NA	26.6	25.8
Area under non-agricultural use	NA	NA	1308.7	NA	1576.7	1674.2
Cultivable waste land	NA	NA	393.1	NA	37.5	35.6
Permanent pasture & other grazing land	NA	NA	1.9	NA	4.7	4.5
Land Under Misc. trees	NA	NA	144.1	NA	55.7	58.5
Current fallow land	367.7	330.3	111.2	NA	335.4	314.0
Other fallow land	NA	NA	63.7	NA	27.3	25.3
Net sown area	5454.2	5448.8	5457.3	5478.2	5437.9	5374.7
Gross cropped area	6403.0	6960.3	7661.6	8622.9	9644.6	9522.9
Geographical area	8852.1	8852.1	8852.1	8852.1	8852.1	8852.1
Percentage to Total Geographical Area						
Forests	12.5	12.4	12.2	12.4	13.4	13.3
Barren and un-cultivable land			0.5		0.3	0.3
Area under non-agricultural use			14.8		17.8	18.9
Cultivable waste land			4.4		0.4	0.4
Permanent pasture & other grazing land			0.0		0.1	0.1
Land Under Misc. trees			1.6		0.6	0.7
Current fallow land	4.2	3.7	1.3		3.8	3.5
Other fallow land			0.7		0.3	0.3
Net sown area	61.6	61.6	61.7	61.9	61.4	60.7
Gross cropped area	72.3	78.6	86.6	97.4	109.0	107.6

Source : Statistical Handbook, Bureau of Applied Economics & Statistics
Govt. of West Bengal.

2.5 Changing Pattern of Land Holding

Structure of land holding suggests that there has been a continuous marginalization of operated area in West Bengal in last three decades. In terms of number the marginal farmers cultivating area below 1 hectare has more than doubled from 2528485 in 1970-71 to 5462089 in 2000-01 (Table 2.5). Similarly area under such marginal holdings has also been doubled. At the same time small holders also reflect an increasing trend both in terms of number and area. On the contrary semi-medium and medium farmers reveal a decline in number as well as area under operation quite sharply. However, large farmers though declined in number show increase in area under operation. Average size of holding has declined from 1.2 acres to 0.82 acres. From section 2.4 and 2.5 it becomes clear that the total area under cultivation remained almost constant over the years but population pressure and other facts such as inheritance laws etc. have resulted in marginalization of holing size.

Table 2.5 : Changing Structures of Land Holding and Area Operated 1970-71 to 2000-1 (area in Ha)

Size of holdings	1970-71	1980-81	1990-91	2000-01	1970-71	1980-81	1990-91	2000-01
	No.	No.	No.	No.	Area	Area	Area	Area
Marginal	2528485	4096001	4639055	5462089	1087248.55	1638400.4	2041184.2	2785665.39
(Below 1 ha)								
Small	941753	1148936	1107006	1009328	1299619.14	1734893.36	1693719.18	1604831.52
(1-1.99 ha)								
Semi-medium	558023	519445	457150	282992	1467600.49	1402501.5	1270877	783887.84
(2-3.99 ha)								
Medium	184456	111859	79284	34797	973927.68	601801.42	425755.08	178160.64
(4-9.99 ha)								
Large	3610	1408	1291	785	231762	203484.16	202661.18	218975.75
(10 & above)								
Total	4216327	5877649	6283786	6789991	5059592.4	5583766.55	5655407.4	5567792.62
Average					**1.2**	**0.95**	**0.9**	**0.82**

Source : Agricultural Census, Govt. of West Bengal

2.6 Changes in Cropping Pattern

It is obvious from table 2.6 that in West Bengal agrarian scenario cropping pattern is dominated by Paddy or Rice. Though over the years the proportion of gross area under Rice seems to decline slightly while total Oilseeds increases (Table 2.6), none the less Rice is still the major crop in rural West Bengal. Wheat also shows some increase from early 60's to the new millennium. Area under Jute remained almost the same over the years while Pulses declined sharply. Potato and Jute are the two main cash crops in the State. While proportion of area under Potato has increased significantly, that is not the situation for Jute. In a small farm dominant economy like West Bengal, it is obvious that the tiny operators would try to ensure their food security by growing cereals as much as possible. Cropping decision in any region primarily depends on the food habit of the people unless they have alternative avenues for marketing their products at a large scale. Specially in an economy with prevalent domination of small and marginal farmers the crop decision centers around Rice followed by Rice. It is for this very reason that Rice has a clear edge over other crops.

Table 2.6 : Changes in the Cropping Pattern (in '000 Ha)

Year	TE62-63	TE72-73	TE82-83	TE92-93	TE02-03
	% to GCA	% to GCA	% to GCA	% to GCA	% to GCA
Total Rice	70.1	71.9	66.3	66.6	61.1
Wheat	0.7	5.5	3.3	3.1	4.5
Tot Cereals	72.7	79.4	71.1	70.6	66.1
Potato	0.9	1.0	1.5	2.5	3.3
Total Oilseeds	2.4	2.4	4.5	6.2	6.2
Jute	6.2	5.9	6.8	6.1	6.7
Total Pulses	11.8	8.7	5.9	3.3	2.7
S. Cane(Gur)	0.6	0.5	0.2	0.2	0.2
GCA	6403.0	6960.3	7661.6	8622.9	9468.6

Source : Calculated from Statistical Abstract, BAES, GoWB

2.7 Area, Production and Yield of few crops in West Bengal

In West Bengal the scenario of agricultural production and productivity reflect a mixed pattern. In the early years of 60's (i.e. 1960-61 to 1966-67) compound growth rate for area under Rice was only 0.6, while growth rates for production and productivity was in fact negative (Table 2.7). But since then till 2004-05 the compound growth rates for area, production and productivity have always been positive. Area growth has been very low over the years. Only during 80's growth in area under Rice shows an increase. This may have been due to increase in the area under high yielding boro. Because, during this period (i.e. 1980-81 to 1989-90) production and yield of Rice show a phenomenal increase. But since then the rates of growth of production and yield of Rice are found to be lower.

Area increase of Wheat was maximum since mid 60's to late 80's. But yield of Wheat has declined over the years. It was in fact negative during 1980-81 to 1989-90. The situation for the Pulses is very poor in West Bengal. Though Pulses have never been major crops in the State, none the less area, production and productivity seem to decline continuously with negative compound growth rates. Only during 80's growth rate for yield was 3.5.

Jute and Potato, the two major cash crops of the State show a mixed pattern. Crop decision of these crops depends on the market prices of the previous year. And hence, they reflect wide variability. However, Potato showed an increasing trend in terms of area till 1989-90. But in the last decade and a half the growth rates of area, production and

yield seem to decline. Potato cultivation in one hand is price sensitive and on the other it depends heavily on the warehousing facilities. Lately Potato cultivators are going through a tuff time in managing cold storage space for their output. Jute, on the other hand, is sensitive to the support price declared by the government. Moreover, the demand for Jute is faced with severe market competition with polymer products.

Table 2.7 : Average Annual Compound Growth Rates of Area(A), Production(P) and Yield(Y) of Major Crops in Different period in West Bengal.

	1960-61 to 1966-67			1967-68 to 1979-80			1980-81 to 1989-90			1990-91to 2004-05		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
Total Rice	0.6	-0.2	-0.9	0.5	1.4	0.9	1.1	6.9	5.7	0.1	2.2	2.1
Wheat	3.7	5.9	2.1	13.7	14.8	1.0	3.6	2.9	-0.7	3.8	4.2	0.4
Total Pulses	0.5	6.4	5.9	-1.8	-1.9	-0.1	-4.7	-1.3	3.5	-1.1	0.2	1.3
Total Oilseeds	0.4	5.1	4.7	2.9	3.8	0.8	5.7	13.7	7.6	1.5	2.2	0.7
Jute	3.2	2.7	-0.6	2.0	3.3	1.3	-2.5	1.3	3.9	1.7	3.5	1.7
Potato	5.7	2.3	-3.3	6.7	11.3	4.4	6.9	10.0	2.9	3.6	3.8	0.2
Sugar Cane	-1.3	-3.8	-2.4	-0.7	6.8	7.6	-5.1	-2.9	2.3	3.2	31.9	27.7

Source : Calculated from Statistical Abstract, BAES, GoWB

2.8 Changes in Input Use

We have said earlier that the mid 60's attempted to make a breakthrough in agriculture with introduction of new technology. However, the benefits were restricted to certain states and a few crops. Wheat was the main crop that marked a breakthrough in production. Paddy, however, could not achieve the acceleration. West Bengal, being predominantly a paddy growing area, could not reap the benefit of high yielding technology. As we have discussed earlier that West Bengal characterized a state with high population density on a fertile land, average size of holding was unfavourable for such a change in productive forces. Moreover, poverty ridden agrarian society of West Bengal had little to invest for agricultural development in the backdrop of existing production relation. Small farm dominant agriculture was primarily guided by subsistence needs. But things changed for betterment with Left Front assuming State power in late 70's. Some changes in the production relation in agriculture was brought about by the Left Front with enforcing the land and tenancy reforms act. After the next Assembly election Left Front again assumed the office giving farmers the assurance of a stable government. Since 1982-83 the wheel turned in the agricultural sector of West Bengal. Farmers having surplus came along with investment for improved agriculture. Main investment centered around making provision for water. Shallow tubewells were installed at a large scale that ensured controlled irrigation, which is the key point for high yielding technology. West Bengal was prepared for a change. Consumption of chemical fertilizers and pesticides along with the high yielding seeds increased. It is apparent that

total fertilizer consumption increased over twelve times in a span of thirty years. But the rate of increase has slowed down after 1992-93.

Table 2.8a : Fertilizer Consumption (in '000 tonnes)

Period	TE 72-73	TE 82-83	TE 92-93	TE 02-03
N	52.6	163.3	408.1	570.6
P	15.8	63.2	210.0	322.7
K	19.7	41.3	128.6	250.4
Total	88.1	267.8	746.6	1143.6
Fertilizer Consumption per ha (Kg/ha)	12.7	35.0	86.6	118.6

Source : Calculated from Statistical Abstract, BAES, GoWB

Table 2.8b : Major Input Use

Year	GCA	HYV Area	Fertliser (in MT)		Pesticide *	Farm Machanisation	
		Paddy&Wheat	Total	Kg/Ha	Qty(in MT)	Tractor	Oil Engn
1970-71	6955.25	na	72826	10.47065	na	na	na
1980-81	7661.6	1418.9	282834	36.91579	na	na	na
1990-91	8662.28	3525.9	753008	86.92954	4040	2406	358361
1997-98	9233.03	5338.7	975386	105.6409	3930	16900	500324
2003-04	9661.32	5659.9	1116222	115.5351	4000	29687	545730

Source : Economic Review, GoWB

* Data not available for the period 1951-52 to 1989-90

It is apparent from table 2.8b that in comparison with fertilizer, pesticides in terms of quantity does not change within a span of twelve years. However, the number of tractors and oil engines reflect an appreciable change. It is true that West Bengal started from a low base of agricultural development before 80's. But the pace of development improved in the decade from mid 80's to mid 90's. However, after that sluggishness in the rate of growth is observed. Since 1997-98 consumption as regard to chemical fertilizer increased rather slowly in comparison to prior periods. Same pattern is observed as regard to use of tractors and diesel pump sets. It is also observed from the area under HYV Paddy and Wheat that till 1997-98 increment in area under HYV had been substantial. However, after 1997-98 area increase faced a deceleration.

2.9 Changing Cost Structures of Principal Crops

In West Bengal, as we said earlier, that Paddy is the major crop covering 60.7 percent of GCA in 2004-05 while area under Wheat was 4.3 percent in 2002-03. Hence, any change in productivity of Paddy would naturally have a great impact in the agricultural sector. It is evident from table 2.9a that over the decades area under HYV paddy has increased substantially marking a breakthrough in production. But it is noted that after 2000-01 the proportion of area under HYV Paddy has decreased. It may have been due to withdrawal of farmers from costly Summer Paddy cultivation. The Summer Rice, which is popularly known as Boro, involves high cost for irrigation, chemical fertilizer, insecticides etc. Moreover, it requires intensive labour employment in the process of cultivation. Naturally cost of production in case of Summer Rice is substantially higher than that of Autumn and Winter Rice. At the same time the price situation has turned worse. Farm Harvest Price of Paddy, of which we shall discuss later on, reveals slow growth rate. Under the circumstances farmers are found opting out of Boro cultivation. Contrarily, Wheat, though a minor crop in West Bengal context, shows an increase in HYV area despite a shock in early 90's.

Table 2.9a : Area under Principal HYV Crops

Crops	TE 82-83	TE 92-93	TE 00-01	TE 04-05
Paddy	1616.20 (21.10)	3351.10 (38.86)	5311.87 (56.93)	5204.17 (54.25)
Increase over previous triennium (%)	-	107.34	58.51	-2.03
Wheat	254.40 (3.32)	263.07 (3.05)	385.87 (4.14)	410.37 (4.28)
Increase over previous triennium (%)	-	3.41	46.68	6.35
GCA	7661.5*	8622.93	9330.98	9592.13

Source : Economic Review, GoWB

* Figure relates to 1981

Figures in parentheses indicate percentage with respect to Gross Cropped Area

In West Bengal, however, availability of systematic data on cost components is a real problem. Especially for the period prior to 1990 we had been handicapped due to non-availability of information as regards to the various components of cost of production of various crops. In West Bengal over sixty per cent of gross cropped area comes under Paddy. Other crops such as Wheat, Mustard, Potato or Jute account for 4.28 percent, 4.80 percent, 3.37 percent and 5.98 percent respectively. Hence, we for our purpose have analysed the cost components over time. Within Paddy Autumn variety accounts for only 3.37 percent of gross cropped area while Winter and Summer varieties cover 42.91 percent and 14.45 percent of gross cropped area in 2004-05. It is the Summer variety of high yielding Paddy which made a breakthrough in productivity in mid 80's.

Table 2.9b reveals that in course of time since 1990-91 there has been little change in the share of traditional vis-à-vis modern inputs in Paddy cultivation. Proportion of manure has declined since 2000 while share of human and animal labour has increased. On the other hand fertilizer use and use of pesticides remain mostly unaltered while proportion of machine labour and irrigation in total cost experienced increment.

It is evident from table 2.9c that between ten years from 1990-91 to 1999-00 growth of modern inputs like pesticides, chemical fertilizers and machine labour show high rates of growth. In addition to this, traditional inputs like seed and human labour, which are the two key inputs of agriculture, showed equally high rates of growth. Therefore, paid out cost (A1) and total cost (C3) also revealed high growth rates. Bullock labour seems to be replaced by machine labour. But since 2000-01 the scenario seems to change. During 2000-01 and 2005-06 the growth rates of modern inputs declined sharply. Growth rates for fertilizers, irrigation are found negative. It signifies a deceleration in the use of such modern inputs. Very poor growth is observed for machine labour and pesticides. Among the traditional inputs bullock power seem to decline. Seed, manure and human labour experience slow growth rates.

It appears that the cost structure has gone through a change due to exogenous factors like price hike, which has resulted in declining use of such inputs.

On the whole the situation is grave. Hike in the prices of chemicals, fertilizers, electricity charges for irrigation and over and above all the wage rate associated with low output price have had a negative impact on farming activities. Though the overall picture from 1990-91 to 2005-06 represents relatively a better picture but the scenario since 2000-01 isn't that rosy.

Table 2.9b : Changing Cost Structure for Paddy (Proportion of Total Cost)

Cost components	1990-91 to 1999-00	2000-01 to 2005-06	1990-91 to 2005-06
Traditional Inputs			
Seed	**2.9**	**2.7**	**2.8**
Manure	**2.8**	**1.6**	**2.2**
Human Labour	**36.7**	**39.2**	**38.0**
Bullock Labour	**8.2**	**12.1**	**10.2**
Modern Inputs			
Pesticides/Chem.	**0.8**	**0.9**	**0.8**
Irrigation	**3.3**	**4.8**	**4.1**
Fertilizers	**6.1**	**6.3**	**6.2**
Machine Labour	**1.5**	**3.0**	**2.2**
Others	**1.4**	**1.6**	**1.5**
Paid out Cost A1	**48.2**	**53.1**	**50.6**
Fixed Cost	**35.5**	**27.6**	**31.6**
Total Cost C3	**100.0**	**100.0**	**100.0**

Source : Report on Cost and Prices, Govt. of India

Table 2.9c : Compound Growth Rates of Inputs for Paddy

Cost components	1990-91 to 1999-00	2000-01 to 2005-06	1990-91 to 2005-06
Traditional Inputs			
Seed	13.5	3.8	8.0
Manure	12.3	7.3	3.5
Human Labour	15.1	1.6	9.8
Bullock Labour	7.4	-7.1	9.9
Modern Inputs			
Pesticides/Chem.	26.6	0.7	14.9
Irrigation	59.8	-1.7	31.6
Fertilizers	13.1	-2.8	8.6
Machine Labour	19.2	0.6	17.8
Others	13.5	-1.2	9.5
Paid out Cost A1	13.3	-1.0	9.4
Fixed Cost	9.7	5.0	5.3
Total Cost C3	12.7	1.0	8.4

Source : Report on Cost and Prices, Govt. of India

2.10 Trends in Agricultural Prices

When we look into the changes that have taken place in he prices of the crops it is observed that the compound growth rate of wholesale price for Paddy has increased from 70's to 80's. During 1975-76 to 1979-80 it was 7.3 which increased to 9.0 in the period 1980-81 to 1989-90 (Table 2.10). But again the growth rate slowed down in 1990-91 to 2004-05. This trend for Paddy is evident also for farm harvest price despite the fact that the minimum support price declared by the government shows an increasing rate of growth. Compound growth rates of WPI, FHP and MSP for Wheat, on the other hand, reveal an increasing trend barring the fact that WPI remained more or less constant in the 80's and 90's. It was rather interesting to find that despite increasing trend of minimum support price for Jute the WPI and FHP are subject to mixed pattern of changes. This might have been due to market fluctuations for prices of Jute which is price sensitive. Compound growth rates of price for Mustard on the whole reflects a decreasing pattern with the only fact that the MSP in 1990-91 to 2004-05 show marginal increment over previous period.

Table 2.10 : Average Annual compound Growth Rates of WPI, FHP and MSP of Major Crops in different periods

Crop/Yr	1975-76 to 1979-80			1980-81 to 1989-90			1990-91 to 2004-05		
	WPI	FHP	MSP	WPI	FHP	MSP	WPI	FHP	MSP
Paddy	7.3	-0.4	6.6	9.0	8.9	5.5	4.3	4.1	7.3
Wheat	0.8	3.6	2.6	6.7	5.0	4.5	6.5	5.1	7.5
Jute	4.8	7.5	3.8	11.5	8.8	6.4	6.7	5.8	7.7
Mustard	11.6	15.0	na	5.6	5.8	6.1	3.6	5.2	7.0

Source : Statistical Abstract, GoWB; Agricultural Situation in India, GoI
WPI – Wholesale Price Index, FHP – Farm Harvest Price, MSP – Minimum Support Price

2.11 Capital Formation in Agriculture

State budgetary allocation figures reveal that the proportion of development expenditure in the last decade has actually decreased from 60.23 percent in 1995-96 to 45.19 percent in 2005-06 (Table 2.11a). Within the development budget social services gets more priority than economic services. In 1995-96 the proportion of budgetary allocation towards social services was 65.91 percent while economic services accounted for only 34.09 percent. More recently allocation in social services increased to 71.14 percent in 2005-06 while economic services came down to 28.86 percent. Agriculture and allied activities accounted for 24.17 percent of total allocation in economic activities while the respective proportions as regard to rural development, special area programme and irrigation and flood control were 30.94, 5.77 and 13.40 percent respectively in 1995-96. The share of agriculture and allied sector increased in the period 1996-2000. But since then the proportion of allocation in this sector is found decreasing. Rural development, on the contrary, suffered a decline in the early years of the new millennium. But after 2002 is found having increased allocation. Very interestingly proportion of allocation in sector like irrigation and flood control remained more or less same from 1995 to 2006 while special area programme over the years gained importance.

However, when we look into a greater details of budgetary allocation it appears that proportion of allocation in crop husbandry has actually increased over the years from 17.31 percent in 1995-96 to 24.8 percent in 2005-06 (Table 2.11b). On the contrary proportion of allocation towards minor increased marginally with 45.9 percent in 1995-96 to 48.4 percent in 2005-06 while major and medium irrigation remained unaltered with 35.1 percent in 1995-96 and 35.7 percent in 2005-06. However, irrigation and flood control in general accounted for around thirteen percent. During the years from 1999 to 2003 flood control was given emphasis to cope up with the flood situation arose during 1999-2000. It appears that development of irrigation has gained low priority in the last decade. We discussed earlier development of minor irrigation in West Bengal has been under the leadership of wealthier farmers where public participation was rather poor.

It is in this background we look into the district level situation to identify the major hurdles for slowing down productivity in agriculture.

Table 2.11a : State Budgetary Allocation over the Years

(in Rs. Crores)

	1995-96	1996-97	1997-98	1999-2000	2000-2001	2001-2002	2002-2003	2003-04	2004-05	2005-06
	(Actual)	(Revised)	(Budget)	(Actual)	(Actual)	(Revised)	(Budget)	(Actual)	(Revised)	(Budget)
Total Revenue Accounts Exp	8626.27	10733.57	12032.91	19498.44	22103.45	24834.1	25695.92	25757.47	29323.47	31137.59
Devolopmental Expenditure	5195.65	6544.77	7267.43	11214.8	12169.99	13017.55	13122.08	11080.25	12974.86	14070.43
	60.23	60.97	60.40	57.52	55.06	52.42	51.07	43.02	44.25	45.19
A. Social Services	3372.52	4256.34	4982.51	8188.86	8415.36	9011.56	9120.72	8035.8	9327.3	10010.01
	64.91	65.03	68.56	73.02	69.15	69.23	69.51	72.52	71.89	71.14
B. Economic Services	1823.13	2288.43	2284.92	3025.94	3754.63	4005.99	4001.36	3044.45	3647.56	4060.42
	35.09	34.97	31.44	26.98	30.85	30.77	30.49	27.48	28.11	28.86
1.Agriculture and Allied Activities	440.65	584.73	647.17	829.68	916.04	996.99	978	734.38	848.14	901.11
	24.17	25.55	28.32	27.42	24.40	24.89	24.44	24.12	23.25	22.19
2.Rural Development	564.06	792.1	625.87	738.46	768.02	972.19	1266.37	736.26	947.27	1287.03
	30.94	34.61	27.39	24.40	20.46	24.27	31.65	24.18	25.97	31.70
3.Special Areas Programme	105.19	151.1	200.7	226.34	359.71	395.83	368.57	302.72	346.44	353.8
	5.77	6.60	8.78	7.48	9.58	9.88	9.21	9.94	9.50	8.71
4.Irrigation and Flood Control	244.27	320.13	334.07	536.21	718.3	646	545.53	443.75	487.98	554.96
	13.40	13.99	14.62	17.72	19.13	16.13	13.63	14.58	13.38	13.67

Figures in bold indicate pecentage.
Source: Budget Publication, GoWB

Table 2.11b : Details of State Budgetary Allocation (Total Expenditure)

(in Rs. Crores)

	1995-96	1996-97	1997-98	1999-2000	2000-2001	2001-2002	2002-2003	2003-04	2004-05	2005-06
	(Actual)	(Revised)	(Budget)	(Actual)	(Actual)	(Revised)	(Budget)	(Actual)	(Revised)	(Budget)
Agrl. and Allied Activities	440.65	584.73	647.17	829.68	916.04	996.99	978	734.38	848.14	901.11
(1) Crop Husbendry	76.29	98.35	123.92	163.97	181.98	221.04	125.12	160.33	190.54	223.24
(2) Animal Husbendry	54.54	76.35	84.16	124.6	139.29	146.13	146.95	119.89	143.45	142.64
(3) Dairy Development	93.52	106.82	112.86	114.37	122.39	152.04	155.55	117.83	138.24	142.42
(4) Fisheries	26.95	43.77	59.91	65.01	69.97	56.67	57.57	28.21	34.28	31.92
(5) Forestry,Wild Life and Plantation	87.63	113.9	99.85	158.73	162.91	179.71	159.73	126.26	143.99	147.7
(6) Food,Storage and Warehousing	40.16	53.95	56.99	85.5	97.51	105.86	103.88	78.17	83.7	87.27
(7) Co-operation	18.9	30.21	36.94	42.89	38.51	46.28	46.21	33.92	39.3	44.71
(8) Others	42.66	61.38	72.54	74.61	92.48	89.26	92.99	69.77	74.64	81.21
Irrigation and Flood Control	244.27	320.13	334.07	536.21	718.3	646	545.53	443.75	487.98	554.96
(1) Major and Medium Irrigation	85.63	88.27	94.52	171.89	190.87	174.08	172.39	142.18	176.71	197.96
(2) Minor Irrigation	112.23	182.93	186.94	258.55	331.95	286.91	259.84	241.01	244	268.57
(3) Flood Control	44.75	47.08	50.55	102.31	191.64	180.12	108.25	56.82	52.97	84.13
(4) Others	1.66	1.85	2.06	3.46	3.84	4.89	5.05	3.74	4.3	4.3

Source : Budget Publication, GoWB

III MEASUREMENT OF GROWTH AND STAGNATION IN CROP PRODUCTIVITY

3.1 Introduction

There has been much debate among academicians about the state of agriculture and the emerging trends of production and productivity of crops in the state of West Bengal**.** The history before independence was a history of colonial exploitation. After independence, this situation improved to some extent but did not change fundamentally due to a number of factors. First and foremost was presence of intermediaries and the grip of the parasitic landlords, money lenders in the village economy. At that time the leading industry in West Bengal was Jute industries. With partition the industry suffered a setback. This was because jute was mainly cultivated in East Bengal while the factories were in West Bengal. With partition, the source of raw materials for the jute industries in West Bengal was cut off, leading to a crisis in this industry. As a result the economy of West Bengal was faced with tremendous crisis both in the agrarian sector as well as the industrial sector. With the Left Front Government coming to power in the state in 1977, there was a significant turnaround in the performance of the West Bengal economy. With land and tenancy reforms there was a change in the production relations in the agrarian sector. Despite these facts the agricultural sector did not gain pace till mid 80's. Since mid 80's to late 90's was the period of growth for West Bengal agriculture. After a period of growth acceleration, agricultural productivity in the state experienced stagnation.

3.2 Literature Review on Agricultural Productivity

Ramachandran, V.K. et al (2003) revealed in their paper "*Food Security and Crop Diversification: Can West Bengal Achieve Both Simultaneously?"* that West Bengal's rural economy was characterized by rapid growth in the 1980s and early 1990s. The major features of growth, which was particularly marked in the rice economy of the State, were rapid growth in aggregate production, growth in yields per hectare, particularly in the boro (or rabi) season, but also in the aman (or kharif) season; and an overall narrowing of the gap between districts with respect to production and yield performance.

The West Bengal path to agricultural growth has been unique in post-Independence India. In those parts of the rest of India that saw a rapid and substantial growth in agricultural incomes, the major sources of surplus accumulation were capitalist landlords, rich peasants, and, in general, the rural rich. In West Bengal, by contrast, the moving force of agricultural change and of the dynamism of the rural economy in the 1980s and 1990s were small cultivators. Agricultural growth in West Bengal was made possible because of the removal, by means of land reform and the establishment of panchayati raj, of institutional fetters to growth. It has been pointed out that "the West Bengal example, where value added has grown faster than gross output, contrary to the trends elsewhere, suggests that greater efficiency in input use is possible through reform and devolution" (Sen 1992).

Abhijit Sen (1992) has noted that "West Bengal, with a growth rate of over 7 per cent per annum in agricultural value added -- more than two-and-a-half times the national average -- can be described as the agricultural success story of the eighties".

In 2005-06, with a production of 14.5 million tonnes, West Bengal was the largest producer of rice in the country, followed by Andhra Pradesh and Uttar Pradesh. West Bengal accounted for 15.8 per cent of all-India rice production in 2005-06.

It has been observed that while over a 26-year period, rice production in the State grew at a remarkable 3.5 per cent per annum, the growth spurt of the 1980s has petered out. The growth rate over the last decade was only 1.7 per cent. The rate of growth of production of rice in West Bengal continues to be greater than the rate of growth of population. Nevertheless, with population growing at 1.04 per cent in this decade (2001 to 2006), the slowdown is a matter of serious concern.

The slowdown in production growth is primarily on account of a slowdown in the growth of yields. Yields have grown at less than 2 per cent per annum over the last ten years. It is of note that the average yield of rice in West Bengal, although above the all-India average, is below the yields reported for Andhra Pradesh, Punjab, Haryana, and Karnataka and Tamil Nadu. Rice yields in West Bengal are below the averages reported for various countries in Asia including Vietnam, China and Japan.

There is clearly scope for increasing rice yields in West Bengal, in relation to the actual yields obtained in other parts of the country, in relation to yields obtained in other rice growing regions and countries and in relation to potential yields obtained in field trials.

In terms of absolute levels of rice yields in 2006-07, the districts of West Bengal can be categorized into four groups viz. 1.5 to 2, 2 to 2.5, 2.5 to 3 and Above 3 tonnes per hectare. There were three districts with yields above 3 tonnes per hectare (with Birbhum at the top) and three districts of North Bengal with very low rice yields (below 2 tonnes per hectare). The latter three districts, however, account for less than 10 per cent of area under rice cultivation.

The Effect of Operation Barga on Productivity: a review of the evidence

Banerjee, A.V.et al (2002) has analyzed in their paper “Empowerment and Efficiency: Tenancy Reform in West Bengal”, in the journal of political economy, the effect of agricultural tenancy laws offering security of tenure to tenants and regulating the share of output that is paid as rent on farm productivity. Theoretically, the net impact of tenancy reform is shown to be a combination of two effects: a bargaining power effect and a security of tenure effect. Analysis of evidence on how contracts and productivity changed after a tenancy reform program was implemented in the Indian state of West Bengal in the late 1970s suggests that tenancy reform had a positive effect on agricultural productivity there.

The approach undertaken to estimate the effect of the change in property rights brought about by Operation Barga on agricultural productivity in West Bengal was the uses of the number of registered sharecroppers in a district as a measure of program intensity and compares the growth in productivity in districts in which Operation Barga was implemented intensely to districts in which the program was implemented less intensely.

Comparison with Bangladesh

Bangladesh, which did not introduce tenancy reform, provides a good comparison to West Bengal. Prior to independence, Bangladesh and West Bengal were parts of the same state in undivided India. Except for religion and political boundaries, the two regions are very similar in most respects. This includes agro climatic conditions, prevalence of tenancy, and agricultural technology (Boyce 1987). Hence it can be expected that technological shocks to agricultural yields to be similar between these two regions. The fact that Operation Barga was implemented in West Bengal but not in Bangladesh can be largely attributed to an exogenous shock. Operation Barga could be implemented only because a left-wing government unexpectedly came into power in West Bengal in 1977. This was a result of a nationwide wave against the Congress Party, which had ruled in most states since independence. In the mid 1970s, a severe political crisis led the Congress-dominated central government to suspend civil liberties. In the subsequent elections in 1977, the voters punished the Congress Party for this: the Left in West Bengal was the beneficiary of this anti-Congress wave. Thus the timing of Operation Barga did not reflect what was then happening in West Bengal but rather what was happening in the rest of India.

In the period before Operation Barga, agricultural productivity was growing at almost identical rates in the two states. Rice is the main component of agricultural production in West Bengal and Bangladesh and is planted in over 70 percent of cropped area. Between 1969 and 1978, a period covering the decade before Operation Barga, rice yields increased by 9.3 percent in West Bengal and by 11 percent in Bangladesh.

In the period after Operation Barga was introduced (1979–93), rice yields in West Bengal increased by 69 percent compared to 44 percent in Bangladesh. Until 1979, the first real year of Operation Barga, rice yields are approximately the same for the two countries. In the post–Operation Barga period, rice yields in West Bengal are substantially higher in all years except for 1981 and 1982, when West Bengal experienced two successive years of severe droughts, among the worst experienced in the century (Government of West Bengal, *Economic Review,* 1983, pp. 13–14).

During the period of study, agricultural productivity in both regions (and much of eastern India) grew in part as a result of three common factors: the belated arrival of the Green Revolution permitted by the spread of a locally suited high yielding variety (HYV) of rice, a fall in the price of fertilizers, and an increase in small-scale private irrigation (Harriss 1993). However, even though the rate of adoption of HYV rice was faster in Bangladesh than in West Bengal, the rate of growth in rice productivity was higher in West Bengal. This difference is what we shall attribute to the implementation of Operation Barga.

Thus, it has been concluded from theoretical analysis that tenancy laws that lead to improved crop shares and higher security of tenure for tenants can have a positive effect on productivity. Evidence based on aggregate district-level data from the Indian state of

West Bengal suggests that the tenancy reform program called Operation Barga explains around 28 percent of the subsequent growth of agricultural productivity there.

Bardhan, P. and Mookherjee, D. (2006) have found effects of Operation Barga on rice yields and farm value added per acre, somewhat smaller in magnitude compared with Banerjee-Gertler-Ghatak (2002), using data from an independent source at a disaggregated farm level, with controls for endogeneity of program implementation and other concurrent panchayat programs. The quantitative magnitudes of these effects were small compared to those of agricultural kits, credit and local irrigation facilities delivered by panchayats. It was evidence that the program raised yields on tenant farms, but this evidence was less reliable, owing to the low incidence of leasing. The impact of the program on growth of farm yields was smaller than the impact of farm input supply programs owing partly to the small scale of the program, related in turn to the low incidence of leasing.

The results therefore support the conclusions drawn by Banerjee-Gertler-Ghatak concerning the benign impact of tenancy reform on farm productivity. The quantitative estimate of the effect is somewhat smaller than theirs. This is likely for two reasons. One, they were predicting yields at a much higher level of aggregation, therefore including effects of the reforms on composition of farms between different size categories and tenurial status. Second, many other programs administered by local governments had been controlled that were correlated with implementation of Operation Barga.

At the same time the results also provide support to those who are skeptical that Operation Barga could have explained much of the observed rise in agricultural yields in West Bengal between the late 1970s and mid-1990s. The predicted impact of the program on average farm yields at the level of the village was only 5%, substantially smaller than the effect of farm input supply programs administered by local governments. Tenancy registration was indeed associated with a significant productivity effect on tenant farms, which diffused to other farms in the village. But the incidence of leasing being very low, the aggregate impact of this was small. The larger effects of the farm input supply programs stemmed from the much larger scale of those programs, since they were not restricted to tenant farms alone.

The results also provide again a different interpretation of the effects of tenancy reform. Traditional literature has focused on the Marshall-Mill incentive effects alone. Wider impacts of tenancy reform need to be incorporated and studied. We were surprised by the large spillover effects of the reforms to non-tenant farms; they need to be better understood. We have not yet found any evidence of pecuniary externalities operating through possible effects of the program on credit access of the poor. Such effects should have been manifested by larger impacts of the program on smaller farms that ought to be more credit-constrained than large farms; such differential impacts were not observed. Neither was there any tendency for seed prices to decline following stepped up implementation of any of these programs.

Learning from neighbors could represent an alternative source of spillovers from tenants

to owner-cultivated farms. We have found some evidence that the program raised yields of tenant farmers: these could have diffused to other farms in the village. More research is needed to explore this in greater detail.

Yet other spillovers could arise from changes in governance in the village resulting from a changed balance of political power between big landowners and small or marginal landowners, which may have helped reduce elite capture of panchayats, and directed resources preferentially in favor of more productive small farms. Including controls for the pro-poor targeting ratios of farm input supply programs, however, did not change the results. Moreover, the changes in farm productivity witnessed seemed to arise more or less uniformly across different farm sizes. The changed balance of political power within the village may also have resulted in lower bribes paid to non-panchayat or outside input suppliers (such as fertilizer distribution centers or banks) that may be colluding with local elites or panchayat officials. The data available makes it difficult to assess these kinds of channels of impact.

The programs may also have led to improvements in the management of common property resources which would generate benefits to a wide cross-section of farms in the village. Improved management of irrigation facilities is a possible example of this. It is well known that this period witnessed substantial increase in tube well irrigation, many in the form of small private cooperatives. Enhanced access to credit among registered tenants may have encouraged the formation of such irrigation cooperatives.

Land Reform and Agricultural Productivity in India: a review of the evidence

Ghatak, M. and Roy, S. (2007) pointed out that tenancy reform had a direct positive effect on tenants who were directly affected by it, but the indirect effects of this reform on the rural land market and, in turn, on productivity is less clear.

It has been found that in India, on average, land - reform legislation had a negative and significant effect on agricultural productivity. This appears not to be the case for West Bengal only. The reason for this is likely to be a combination of two factors. First, during the period under study, tenancy reform and no land-ceiling legislation was the key source of variation of the land-reform measure in the case of West Bengal relative to other states (Besley and Burgess, 2002). Second, tenancy laws were implemented thoroughly in West Bengal, thereby bypassing the potentially negative effects that could arise due to efforts to evade the law. The analysis therefore suggests that states that saw rigorous and effective implementation of reform(s) performed better than their poorly implementing counterparts, but this heterogeneity of experience might be lost when the impact is analyzed at the aggregate level.

Thus, the analysis provides suggestive but far from conclusive evidence that effective implementation is likely to be a key determinant of the *nature* of the effect of land reform on productivity, and is responsible for introducing considerable heterogeneity across states on this count. However, the studies under discussion are based on aggregate data (state or district level) and cannot distinguish between the direct and indirect effects of

land reform. Only micro-level studies can throw more light on this question. In this respect, the recent study by Bardhan and Mookherjee (2007) is noteworthy. They use village-level (as opposed to district-level) data in West Bengal, and follow a methodology similar to that used by Banerjee *et al*. (2002). They continue to find significant impact of tenancy registration on rice yields—the effects are somewhat smaller, but of the same order of magnitude. They, however, argue that the estimated positive impact of tenancy registration in West Bengal on yields is actually a part of broader village-wide general equilibrium effects of local governance implementing various agrarian reforms (including land reforms), rather than partial equilibrium effects of tenancy reforms alone, following improved effort or investment incentives of farmers directly affected by them. For example, these could affect the prices of complementary inputs, such as credit or fertilizer, or could affect the balance of political power and consequently how collective-action problems are resolved. However, they cannot empirically identify the channel given the data. This clearly highlights an important area of future research.

The land reform is clearly driven by political factors. One important ingredient is the strength of left-wing parties in the state. We can think of the support for left-wing parties as 'demand' for land reform. The 'supply' of land reform seems to depend on the electoral success of left-wing parties, as well as how tight the electoral competition is. West Bengal, perhaps, provides an example where all these factors came together to ensure proper implementation of land reform.

Under the revision of the economic arguments in favour of land reform it has been showed that they are based on frictions in the allocation of land. These frictions could either be due to agency costs or imperfect property rights. The evaluated evidence on land reforms in India, which suggests considerable heterogeneity in their effect on productivity across states, for which difference in intensity of implementation might be a possible reason. The evidence also provided that tenancy reform has actually increased inequality in operational land holdings in India. Most of the existing work uses aggregative data from which it is hard to understand the microeconomic mechanism through which land reform affects agricultural productivity. In particular, future work should focus on disentangling the direct from the indirect effects of land reform, ideally with more micro-level data.

Public Investment and Agricultural Productivity: a review of the evidence

"*Investment in agriculture is a necessary, if not sufficient, condition for increasing agricultural production and productivity and thereby to ensure the availability and accessibility of food to the population*" (FAO, 1999:2)

Empirical works on agricultural investment in the Indian economy assumed greater importance since the late eighties, most of them debating over the issue of complementarities between public and private investments. The issue arose in the context

of the decline in public and private investments in the first half of the eighties and the rise in private investment since the mid-eighties despite the continued fall in public investment. This behavior of agricultural investment made researchers to investigate the true relationship between public and private investments, which were till then considered as complementary. Moreover, some of the studies also debated on the items to be included in the public investment series for analyzing the trend in public investment and its relationship with private investment. Though all these studies emphasized on the role of public investment as a major factor in determining agricultural production and productivity, an in depth analysis of the long-run relationship between the two received very little attention.

Most of the studies were based on the data on agricultural investment provided by the National Accounts Statistics of the Central Statistical Organization. Nevertheless, the investment series of the C.S.O was questioned by scholars like Chand (2000) and Gulati and Bathla (2001, 2002). Chand (2000) relied on the Finance Accounts of the States and Union Territories and constructed a new public investment series both at all India and state levels to explore the relationship between public and private investment in agriculture. He also examined the effect of public investment on productivity. With the help of cross section multiple regression, the study observed a significant positive relationship between public investment and agricultural productivity across the states. Further, Chand refuted any complementarities between public and private investments.

Gulati and Bathla (2002) further redefined the public investment series given by Chand. They observed that public capital formation explained more than 90 per cent of the variation in private investment and also these two have significant impact on Agricultural Gross Domestic Product. According to them, public sector investments in canals and power do remain important for their inducement effect on private investment. They found that the growth rates of the real value of output of cereals and pulses decreased from 2.16 per cent per annum during the 1980s to 1.84 per cent per annum during the 1990s. The decline in the cereals and pulses during the 1990s, to them, might be due to the fall in public investment during the 1980s. However, the period selected by Gulati and Bathla for creating the public investment series differed across states based on the availability of data. Also, they did not venture into state specific examination of the long-run relationship between public investment and productivity.

Roy and Pal (2002), in their study on investment, agricultural productivity and rural poverty, examined the relationship between investment and productivity for the period from 1965-’66 to 1998-’99 based on the Finance Accounts data. Using a simultaneous equation model the authors observed that both public and private investments have positive relationship with agricultural productivity. They also found that the effect of investment on productivity is stronger than the effect of subsidies.

The overview of the existing literature public investment and agricultural productivity points to the fact that there are many factors that influence agricultural output and productivity growth. They include, credit, subsidy, rainfall, population, technology, modern farm inputs, private farm investments, public investments in human and physical

capital, irrigation, extension services and also infrastructural facilities like rural roads, electrification and marketing facilities. However, most of these factors are in one way or the other related to public investment. Moreover, externalities in certain heads of investment like major and medium irrigation and infrastructure like roads and markets make public investment imperative. In the Indian context, investments on the part of private hands mostly depend upon the behavior of public investment. Therefore it may be hypothesized that the agricultural productivity in India depends solely upon the acts of public investment. There is hardly any study, which examines the long run impact of public investment on foodgrain productivity in the Indian states. Therefore, the study entitled "*Public Investment and Agricultural Productivity: A State-wise Analysis of Food grains in India*" by Shyjan, D. (2002) was an attempt to fill this gap. The specific objectives of the study were to examine:

- the growth in foodgrain productivity and its variations across states;
- the growth of public investment and its interstate variation; and
- the long-run relationship between public investment and foodgrain productivity across states.

The selection of foodgrains for the analysis was based on two reasons: one, almost 3/4th of the total irrigated area in India is used for foodgrain production; and two, more than 80 percent of the total public investment in agriculture is constituted by irrigation. The study was confined to fifteen major states and ten food crops. These states, taken together, constitute about 97 per cent of the total area under cultivation of foodgrains. The period of analysis was from 1974-'75 to 2001-'02. The choice of the period was mainly on the consideration of availability of comparable data. The data on state-wise public investment in a comparable classification was available only from 1974-'75 onwards.

The study under discussion by Shyjan, D. (2002) aimed at examining the growth of foodgrain productivity and public investment and the long-run relationship between the two in fifteen major states in India for the period 1974-'75 to 2001-'02. In order to examine the long-run impact of public investment on foodgrains productivity, the analytical tool like Koyck's Autoregressive Distributed Lag model (ADL) had been used. This model was applied to capture the gestation lag of the explanatory variable (public investment) in influencing the dependent factor (foodgrain productivity).

The study showed that foodgrain productivity increased during 1974-'75 to 2001-'02. The rate of growth at all India level as well as in the majority of the states increased during the Sixth and the Seventh Plans, but decelerated during the Eighth and Ninth Plans. But the growth rate had not been uniform in all the states. The analysis of the levels of foodgrain productivity across states also revealed significant interstate differences. While some of the states registered productivity levels above the national average during all the plan periods, the others had been below the national average. In other words, states which had higher levels of initial productivity, maintained their position throughout and states which lower levels of initial productivity had continued to be so.

The analysis of growth in public investment showed a sharp decline between 1980-'81 and 1992-'93 after registering a significant increase during 1974-'75 to 1980-'81. But during 1993-'94 to 2001-'02, public investment showed positive growth both at all India level and in the majority of the states. Analysis of the levels of investments in the different states showed that Kerala and Punjab had levels of investment above the national average during all the plan periods. In the case of foodgrains productivity too these states stood above the national average during all the plan periods. On the contrary, Madhya Pradesh and Rajasthan registered lower levels of investment than the national average during all the plan periods. These states had also been below the national average in foodgrain productivity during all the plan periods.

The examination of the long-run relationship between public investment and foodgrain productivity showed that there is no contemporaneous effect of the former on the latter, but there exists significantly positive lagged effect for all the states. The length of the lag varies across the states. The lag had been longer in Andhra Pradesh, Assam, Kerala and Punjab, where the productivity levels had also been higher than the national average, and shorter in Madhya Pradesh, Maharashtra and Rajasthan, where the productivity levels had been lower than the national average during all the plan periods. We have also seen that the length of the lag had been higher in those states where the share of cereals in total foodgrain is higher compared to the other states.

One interesting observation was that most of the states, which showed productivity levels above the national average during all the plan periods, were specifically those states which had public investment above the national average in either the Fifth or the Sixth Plan. It may be inferred, given the lag between public investment and foodgrain productivity that the better performance of these states in foodgrain productivity might have been due to the higher initial levels of per hectare public investment. However, some of these states fell below the national average level of per hectare public investment during the Eighth and Ninth Plans. There was even a decline in the absolute levels of per hectare public investment during the Eighth or the Ninth Plan in some of the states. Further, some other states, which had been having productivity levels below the national average during all the plans, had investment levels higher than the national average during the last two plan periods. They also went up in absolute levels of per hectare public investment. This would imply the possibility of these states showing better performance in foodgrain productivity in the near future, given the shorter lag between public investment and foodgrain productivity in the majority of these states.

The interstate variations in lag length that public investment takes to accomplish its result in productivity might be due to a number of state-specific characteristics, which have not been explored in the study and needs further enquiry. The following hypotheses may be put forwarded, on the basis of the findings, as the possible explanations for the interstate differences in lag length.

- The difference in gestation lag may be due to the difference in the composition of the total irrigation investment, that is, difference in the share of minor irrigation and major irrigation in each state. It might be possible that states with relatively

larger share of minor irrigation may register quicker effect in productivity compared to others with relatively larger share of investment in major and medium irrigation. This is because of the fact that investments in major and medium irrigation will take more time in implementation compared to minor irrigation.

- The lag in the completion of public investment, especially irrigation, may cause private investment and other complementary inputs to come delayed, and hence the result of public investment on productivity might get delayed.
- It is possible that the interstate differences in the lag length between public investment and productivity might be due to the difference in the quality of the soil in each state. For states having better quality soil, a little bit of investment would be enough to show its impact on productivity in relatively lesser time compared to states with poor quality soil.
- Lastly, the issue of higher lag in highly productive states may be because of the fact that, once a threshold level or the biologically possible level of productivity has been reached, the response to inputs would be slow. That means, the increase of yield for paddy from 2 tonnes per hectare to 3 tonnes per hectare may be faster than raising it from 4 tonnes per hectare to 5 tonnes.

Nevertheless, our observation of the positive and lagged impact of public investment implies that the reduction in foodgrain productivity at all India level during the Nineties might have been due to the decline in public investment during the Eighties. Moreover, it highlights the need for sustained and secular increase in public investment. States registering poor performance in foodgrain productivity over the plan periods should give more preference in raising public investment in agriculture. Since the time lag between public investment and productivity has been observed to be low in these states, the results of the investments might be quicker accomplished.

A Tale of Two States: Maharashtra and West Bengal

In this paper, Lahiri, A. and Kei-Mu Yi (2005), have contrasted the development paths of two Indian states, West Bengal and Maharashtra, between 1960 and the mid-1990s. Starting from an initial position of about 5 percent greater per capita output than Maharashtra, West Bengal's per capita output had dropped to about 69 percent of Maharashtra by 1993. Manufacturing, in particular, appeared to lose ground in West Bengal. The relative levels accounting suggests that differences in TFP account for about 60 percent of the gap between West Bengal and Maharashtra, relative to their positions in 1961. Human capital accounts for a little more than 20 percent of the gap and physical capital accounts for the remainder.

Turning to model-based diagnostic tests, as per building on the work of Cole and Ohanian; Chari, Kehoe, and McGrattan; and Mulligan, it has been suggested that productivity differences - attributable to both TFP and human capital - account for about 3/4 of the gap between the states. The remainder was likely to be due to problems in the labor market in West Bengal. In particular, there appeared to have been some factor(s) that raised wages in West Bengal above the levels dictated by the neoclassical growth

model's first order conditions. The strong correlations of the estimated labor market and productivity wedges with the vote share of the Leftist parties in West Bengal suggested that increasing labor power during this period in West Bengal may have been the proximate cause of the diverging economic performance of the two states.

While the diagnostic exercises in the paper suggested that the problems were likely to be in the labor market, in order to assess the quantitative importance of this margin one needs to formalize and quantify a political-economy model in which declining investment and output can co-exist with rising labor power for relatively sustained periods of time in a voting environment. This was the subject of future work in this area.

Patterns of Changes in Agricultural Productivity (State-level): a review of the evidence

According to a recent study, the growth rate in the value of agricultural output in eastern India has changed drastically over time (Bhalla and Singh 2001). Using the triennium 1970-72 as the baseline, the growth rate in the value of agricultural output during the triennium 1980-82 was low and below the rate of growth in population in most of the eastern Indian states. Bihar even registered a negative rate of growth in the value of agricultural output. However, relative to the triennium 1980-82, the performance improved substantially in several states of eastern India during 1992-94.

West Bengal experienced a dramatic growth in agricultural output of 5.39 percent per year during the intervening periods. Even in Bihar, the performance improved substantially. While the improvement in the performance of Madhya Pradesh was driven mainly by the growth in output of oilseeds and pulses, rapid growth in the output of rice was the major source of growth in West Bengal and Uttar Pradesh. Despite this impressive performance, the growth rate actually decelerated in Assam and Orissa. On the whole, the overall improvement in the growth performance of eastern India has been an important development that has positively affected the overall performance of the Indian agriculture during the late 1980s and early 1990s. A part of this growth in the value of agricultural output can be accounted for by the increase in cropping intensity. The cropping intensity thus, increased in all states although West Bengal again led other states of eastern India on this account. The growth in cropping intensity is low in Bihar where both the gross and net sown area declined over time. Bihar is the only state in eastern India where even the gross sown area declined as the area under fallow and waste land increased. In West Bengal, the rapid growth in the area of Boro rice was the main factor for an increase in the cropping intensity. The emergence of Boro rice is important as it changed the cropping season from a risky kharif to relatively safer rabi season. Moreover, the productivity of Boro rice is at least double the kharif rice yield. Similarly, the introduction of short duration modern rice varieties facilitated an increase in cropping intensity in other states too. This made a positive change on cropping pattern. Rice dominated the cropping pattern in most of the states. It has been observed that on the whole rice occupies more than two-thirds of the cropped areas in the eastern India, with an exception of Uttar Pradesh. In Uttar Pradesh, rice is dominant in the eastern Uttar Pradesh.

Inter-District Disparity in Rice Productivity

It is amazing that despite the dominance of rice in the cropping pattern, the disparity in productivity is highly conspicuous. Historically, the average rice yield was in the range l-2 tonnes / ha in 90 percent of the rice area of eastern India during 1970-79. But during 1990-97, this has changed substantially, whereby only 47 percent of the rice area was in this yield range, and 51 percent of the area increased yield levels higher than 2 tonnes / ha. Despite this achievement at the aggregate level, the growth has been non-uniform across regions. Because, during 1990-97, more than 60 percent of the areas in Bihar and eastern Madhya Pradesh had rice yield in the range of 1-2 tonnes / ha. On the other hand, eastern Uttar Pradesh had no districts in this yield range and West Bengal had only three hilly districts; Coochbehar, Darjeeling and Jalpaiguri in the northern part of the state, in this yield range, accounting for only 10 percent of rice area of the state. In most area of these latter two states the rice yield has exceeded 2 tonnes / ha. Therefore, as Bihar, eastern Madhya Pradesh and Orissa accounting for over 50 percent of the total rice area in eastern India, productivity improvement in these states will have positive impact on overall productivity performance of eastern India.

A critical examination of the performance of the districts over time suggests that the yield growth accelerator has been widespread in eastern Uttar Pradesh and West Bengal. In Assam, yield has continued to stagnate within the 1-2 tonnes / ha range in the four districts of Darrang, Goalpara, Kamrup and Lakhimpur. These districts represent North Bank Plains zone and the Lower Brahmaputra Valley zone. Chronic incidence of flood may be a major cause of low productivity in these zones. In Bihar, only three districts Gaya, Patna and Shahabad belonging to South Bihar Plains zone moved from 1-2 tonnes / ha yield bracket during 1970-79 to 2-3 tonnes / ha yield interval during 1990-97. Rice productivity growth in other districts of Bihar remained too low. The coastal districts of Ganjam and Puri and the inland districts of Sambalpur and Bolangir are the only four districts that have made some change in yield in Orissa. In the case of eastern Madhya Pradesh (now Chhattisgarh), Raipur is the only district that has made this transition.

On the whole, the overall picture indicates that a fairly broad-based yield growth occurred in West Bengal and eastern Uttar Pradesh. In other states of eastern India, growth is limited to selected pockets only. While favorable conditions have led to growth in some districts, productivity growth in other districts has been modest. This differential performance might have resulted from the variations in bio-physical conditions (e.g., soil type, rainfall patterns, etc.), investments in irrigation and other infrastructures, and institutional set up across districts and states.

Further analysis reveals that, at the All India level, also the picture of rice productivity is identical to that of eastern India emerged in the recent years. Depending on the clear picture that emerged, which categories the number of districts in five productivity classes viz., high productivity, medium productivity, medium low productivity, low productivity, and very low productivity. Ironically, even after the four decades of green revolution, the productivity level of rice in 224 out of 511 districts is less than 1.5 tonnes / ha, which is

below the national average. It is to be noted that more than half (numbering 134) of these districts belong to eastern India. Eastern India has a total 251 out of 511 districts in the country. Among the high performing districts, 24 out of 57 districts belong to northern zone and 57 out of 91 districts in southern zone and the lowest number of 12 out of 251 districts in the eastern zone. It thus speaks of the urgent need for policy to focusing on productivity improvement in the poor performing eastern India. The problem of rice cultivation in the rainfed areas is accentuated due to lack of the alternative options (technology and / or other policy incentives) to the farmers to choose the better one from.

The inter-district variation in productivity sharpen the contradiction that the high productivity areas subjected to severe externality of intensive agriculture and the low and risky productivity in the vast rainfed rice areas in eastern India suffered due to lack of appropriate rice technology and policy alternatives. The suspected externality due to cereal intensification (such as soil degradation, depletion of ground water and water tables), led to a strategy of diverting some prime rice growing areas in favour of crop diversification. At the same time, low and uncertain production condition has been perpetuating the rural poverty. Under the circumstances, unless, adequate alternative options are made available in promoting and developing modern rice production technology in the rainfed areas, the country is likely to face severe set-back in rice production in future.

Explaining Inter-District Variations in Rice Yield

Inter-district variations in yield may result either from the differences in agro climatic factors or from differences in crop management practices. Agro climatic factors such as rainfall and soil types define natural conditions of agricultural production, which are normally not subjected to management controls (Pandey, S. et al. 2000). Crop management practices reflect human adaptations to these natural conditions as well as the socio-economic conditions of the farmers. Therefore, models to explain spatial variations in yield should contain these factors. A host of variables simultaneously influence inter-district variations in yield. The explanatory variables are grouped into five major categories, viz., economic and institutional factors (population density, farm size), environmental factors (rainfall, incidence of flood, incidence of drought, soil properties), technological factors (chemical fertilizers, HYV, mechanical inputs), management factors (cropping intensity), and infrastructures (road, credit, markets) (Rao et al 1985).

However, there are some inherent problems of obtaining the relevant disaggregate data for all districts, apart from the problem of multicolinearity among the most explanatory variables. For example, the use of HYV and fertilizers tend to be highly correlated as farmers apply more fertilizers to HYV than to the local varieties. Similarly, the use of fertilizers tends to be correlated with infrastructural variables. Hence, a careful selection

of proxy variables needed to specify the model. Fertilizer use was considered to be a good proxy variable to represent several factors: the adoption of HYV, the area under irrigation and the infrastructural variables.

Apparently, the districts having low level of fertilizer use represent a combination of unfavorable agro climatic conditions and unwillingness or inability of farmers to apply the chemical fertilizer, a critical component of improved rice technology. While reverse is true in the better off districts.

To separate out the effect of agro climatic conditions, dummy variables can be used in the regression equation in explaining variations in yield. It has been observed that a single critical factor, the quantity of fertilizers alone explains nearly 40 percent of the variations in rice yield across the districts pertaining to a wide range of socio-economic and environmental conditions. The explanatory power of the model increases as dummy variables representing the state or the agro climatic zones are added. Significant coefficient of fertilizer indicates that it explained the inter-district variations in rice yield as well as the differential adoption of improved technologies.

3.3 Methodology for Measuring the Stagnation in Productivities across the Crops/States

Crop yield per area (amount of crop harvested per amount of land planted) is the most commonly used index for measuring productivity of crops. Changes in yield rates over time could be a measure to assess the trend in productivity growth. Yield rate for a crop might depend on several exogenous factors like rainfall etc. Impact of such factors on yield rate has to be taken into consideration.

Kumar, P and Rosegrant, M.W (1994) used the method of estimating Total Factor Productivity to assess the growth of agricultural sector. According to them 'increased use of inputs, to a certain extent, allows the agricultural sector to move along the production surface … technological change is embodied in them.' Hence, they have used the method of Total Factor Productivity which implies estimation of an index of output per unit of total inputs, holding all inputs constant. This method was also used by Desai, M.D and Namboodiri, N.V. (1997).

On the other hand Rawal, V and Swaminathan, M (1998) used exponential growth equation to estimate the growth trend of foodgrain sector of West Bengal agriculture from 1950 to 19996.

IV TRENDS AND PATTERN IN PRODUCTION AND PRODUCTIVITY : DISTRICT LEVEL ANALYSIS

4.1 Introduction

In our previous discussion we have so far discussed that West Bengal has suffered a deceleration in the growth of productivity in the agricultural sector since late 90's and early 2000. Our analysis reveals that in this period the slowdown in growth is pronounced in respect of almost all the crops and Paddy in particular. As Paddy is the most important crop that is being cultivated by our farmers, the deceleration in the growth of its productivity has an adverse effect on livelihood of our farming community.

4.2 Rationale for methodology

The State of West Bengal reflects a wide variation in agro-climatic specificities. From hilly tracts of Darjeeling to coastal South and North 24 Parganas diversified climatic and soil quality is observed across the state. Districts such as Jalpaiguri, Cooch Behar and Dinajpur come under Terai region while Purulia, Bankura, Birbhum and a part of Medinipur signify semi arid Red and Laterite zone. On the other hand the districts situated in the gangetic plane and having benefit of alluvial soil are Burdwan, Murshidabad, Malda, Hoogly, Nadia, Howrah and a part of Medinipur. Agro-climatic specificities have clear bearing on productivity of various crops. Availability of water for irrigation plays the decisive role in determining the level of productivity in the districts. However, for the present context we take up crop specific analysis across different districts from varied agro-climatic regions to get an overview of trends in growth pattern.

4.2 District Wise Growth of Production and Productivity

Rice

The districts of gangetic plane have the advantage of fertile loam and sandy loam soil and a clear edge of having both surface and sub-soil irrigation over other regions of the state. It is suitable for Paddy cultivation. Burdwan, Howrah, Hoogly, Nadia, Malda, Murshidabad and a part of Midnapore comes under this agro-climatic zone. Moreover, Burdwan has been one of the areas of IADP launched in 1962.

In Burdwan, the productivity of Rice between the two time periods i.e. 1990-91 to 1999-00 and 2000-01 to 2004-05 has increased substantially despite growth in area has decelerated between the two periods (Table 4.1). Compound growth rate of production also show an increase. Midnapur, however reveals a sharp increasing trend for Rice in respect of yield across all the time periods. Compound growth rate in respect of area seem to decline in the second period (i.e. 2000-01 to 2004-05). Production also decelerated in the same time span but at a lesser degree. Rice in Murshidabad reveal a steady increase over the fifteen years time span. In Malda, Hoogly and Howrah productivity of Rice has mostly revealed a positive rate of growth In Malda the rate of growth of production and productivity of Rice was 0.71 and 2.64 in 1990-91 to 1999-00 that increased to 5.5 and 6.16 respectively in 2000-01 to 2004-05. On the whole the rates

were 1.12 and 2.98 respectively. Hooghly reveals a compound rate of growth of productivity of Rice to the tune of 1.07 in 1990-91 to 2004-05. But the rate has increased from 0.99 during 1990-91 to 1999-00 to 1.98 during 2000-01 to 2004-05.

Howrah has historically been a district with more industrial enterprises than agriculture. During British governance large number of Jute mills and other industries were set up in the banks of the Ganges. District's proximity to Kolkata metropolitan city gives it a locational advantage for such industrial development. In such a district it was interesting to see a definite increase in the compound growth in respect of area, production and productivity for Rice during years from 2001-05.

Table 4.1 : Crop-wise Average Annual Growth Rates of Area (A), Production (P) and Yield (Y) across districts in different periods
Crop - Rice

Agro-climatic region/ Districts	1990-91 to 1999-00			2000-01 to 2004-05			1990-91 to 2004-05		
	A	P	Y	A	P	Y	A	P	Y
Alluvial									
Burddwan	2.65	4.03	1.34	1.64	4.20	2.60	1.15	2.19	1.02
Midnapore	0.53	2.62	1.70	-0.70	1.68	16.66	0.23	2.65	8.02
Nadia	1.61	2.05	0.42	3.51	1.92	-1.54	0.80	1.81	1.01
Murshidabad	0.56	2.19	1.62	13.11	17.15	3.57	0.76	2.57	1.80
Malda	-1.19	0.71	2.64	-0.62	5.50	6.16	-1.42	1.12	2.98
Hoogly	1.17	-2.54	0.99	20.06	10.49	1.98	-0.03	1.20	1.07
Howrah	-0.80	-0.85	-0.06	4.71	7.94	3.06	-0.05	1.36	1.41
Laterte									
Birbhum	1.24	4.16	2.89	3.56	5.99	2.35	0.67	2.99	2.30
Bankura	-0.40	2.06	2.46	-5.56	-4.07	1.58	-1.64	0.58	2.26
Purulia	-0.29	2.60	2.78	2.00	5.62	3.54	-0.57	3.20	3.93
Coastal									
North 24 Parganas	1.34	1.72	0.24	-2.75	-0.61	2.21	-0.25	0.51	0.70
South 24 Parganas	0.70	2.32	1.99	-0.98	0.68	1.58	0.05	2.93	3.10
Terai									
Dinajpur	-7.15	-5.13	2.71	-0.46	3.06	3.53	-3.78	-2.25	2.56
Jalpaiguri	-0.87	0.77	1.25	-1.47	-1.29	0.21	-0.24	2.45	2.71
Cooch Behar	-1.14	-0.13	1.01	-1.70	-0.80	0.93	-0.94	1.86	2.83
Hills									
Darjeeling	-4.58	-6.26	-1.38	0.33	-1.08	-1.34	-2.79	-1.48	1.33

Source : Computed from Statistical Abstract, BAES, GoWB

Agro-climatic specificities in the Red and laterite region are entirely different from the situation in the alluvial plain. The soil is mostly sandy to sandy-loam. Water retention capacity is rather poor. Moreover the undulated terrain in Purulia and some parts of Bankura is such that most of the rain water is wasted as run-off. However, situation in Birbhum is somewhat different. Areas are there where under ground water is available and farmers can go for cultivation of Summer Rice. In Bankura also there are a few areas

where shallow tube well irrigation is feasible. In terms of sub soil irrigation Purulia still remains utterly poor, though efforts are being made in this respect. Here check dams have also been constructed to get access to surface water of the small streams. There still exist vast areas in Purulia which depend on rainfed agriculture.

With advantage over other two districts within same agro climatic specificities, Birbhum reveals a positive growth rates in respect of area, production and productivity of Rice over the years. It is evident from the calculated compound growth rates. Bankura, however, the exhibits a slowdown along the time line in respect of area, production and productivity. In Purulia, on the contrary, the period from 2001-05 has been one of steady growth in contrast to preceding years.

In West Bengal the coastal districts suffer from problems of soil salinity and sippage of saline water from Bay-of-Bengal. North and South 24 Parganas are the two districts having coastal proximity. In terms of area and production of Rice North 24 Parganas seemed to decelerate over the successive years. However, growth rate of productivity seemed to accelerate from 0.24 to 2.21 in two consecutive time periods. South 24 Parganas, on the contrary, exhibits a deceleration in growth rates of area, production and productivity of Rice over the years from 1990-91 to 1999-00 and 2000-01 to 2004-05.

Coming to the specificities of Terai region, the districts receive heavy to moderate rainfall during monsoon. Water retention in the soil is moderate. But there remains residual moisture during rabi season. Soil quality is mostly sandy. There is no proper mechanism of rain-water harvesting. Hence, rain-water gets lost as run-off into the rivers Tista and Mahananda. Kharif Paddy remains the main crop. Dinajpur, Jalpaiguri and Cooch Behar demonstrate such geo-morphological pattern.

In Dianjpur, Jalpaiguri and Cooch Behar an increase in the growth rate of productivity of Rice from 1990-91 to 1999-00 to 2000-01 to 2004-05. But growth of area has decline more sharply than the other districts while production exhibits a mixed pattern. In Dinajpur, however, growth rate of production of Rice declines while in Jalpaiguri and Cooch Behar it increases.

In Hilly tracts of Darjeeling Tea and Timber are the main products. There are horticultural crops too. But Terrace cultivation of Rice here is somewhat secondary in this district. Over the years the compound growth rate of area and production of Rice in Darjeeling have been negative. Productivity reflects meager increase since 1990-91.

In rural West Bengal, however, Rice dominates the consumption basket of families. It is the staple food for millions of people living in the rural areas. Moreover, in a small farm dominant economy like West Bengal, the crop decision in most of the cases is guided by livelihood requirement of the people involved in cropping. Hence, cultivation of Rice gets the top priority despite recent hike in the cost of production and low market price of output. There has been a slow down in all-round productivity growth since late 90’s. But extent of this slowdown has been lesser in case of Rice as compared to other crops particularly in the arid region of the state of which we shall be discussing.

Wheat

Wheat, in context of West Bengal, covers only around 3 per cent of total gross cropped area. As compared to Rice, its importance in cropping pattern in the state has been nominal.

Compound growth rates of area, production and productivity from 1990-91 to 1999-00 in districts of Alluvial plain illustrate a mixed pattern (Table 4.2). The growth rates for area under the crop demonstrate positive values for all districts other than Hoogly. However, the growth rates in respect of area in Midnapore and Howrah are substantially higher than that in other districts. Growth rates for productivity in these districts for the same time period exhibit similar pattern. In terms of yield Howrah along with Hoogly demonstrate negative growth rates.

In the laterite tract, however, Wheat shows a better performance during 1990-91 to 1999-00 with Birbhum and Purulia revealing positive growths in respect of area and production. For this time period, on the other hand, productivity has declined in Purulia while Birbhum and Bankura show positive growth. For the years from 2000-01 to 2004-05 there has been a decline in productivity in all three districts. In Birbhum, however, area and production of Wheat show a positive growth rates but at much lower rates in comparison with prior period. On the whole in a span of fifteen years from 1990-91 to 2004-05 area under the crop and its production and productivity in districts with latrerite soil presents a mixed scenario. While area and production have increased substantially in Birbhum and Purulia, productivity seems to remain stagnated or even declined.

The story of stagnation is also evident in districts like North and South 24 Parganas. With variations between two time periods the overall growth rates suggest that despite growth of area and production of Wheat in South 24 Parganas, productivity has in fact declined. On the other hand it remained more or less constant in Northern part of 24 Parganas.

Situation in districts of Terai region viz. Dinajpur, Jalpaiguri and Cooch Behar vary between districts. Jalpaiguri shows a steady rise in growth rate of productivity even with a negative growth of production during 2000-01 to 2004-05 compensated by a sharp decline in area under Wheat in this period. While in Dinajpur and Cooch Behar productivity of Wheat stagnated despite rise and fall in area and production in two time periods.

Hilly tracts of Darjeeling have never been an area of Wheat cultivation at a large scale. Even there area and production declined over the years and productivity stagnated.

Table 4.2 : Crop-wise Average Annual Growth Rates of Area (A), Production (P) and Yield (Y) across districts in different periods
Crop - Wheat

Agro-climatic region/ Districts	1990-91 to 1999-00			2000-01 to 2004-05			1990-91 to 2004-05		
	A	P	Y	A	P	Y	A	P	Y
Alluvial	1.42	3.13	1.53	-4.14	-7.05	-2.90	5.08	6.59	1.41
Burddwan	11.88	13.27	1.47	-7.10	-8.39	-1.04	6.36	6.86	1.13
Midnapore	3.46	4.61	1.10	-1.81	-5.71	-3.97	2.93	2.77	-0.15
Nadia	4.92	6.78	1.78	-0.98	-6.79	-5.87	3.57	4.01	0.42
Murshidabad	3.01	3.36	0.32	2.95	1.63	-1.31	2.27	2.90	0.61
Malda	-5.36	-6.83	-2.06	-29.96	-31.02	1.08	-3.58	-5.85	0.26
Hoogly	23.38	18.13	-0.89	-18.58	-12.77	5.31	8.51	11.76	4.92
Howrah									
Laterte	8.80	13.08	3.91	2.65	0.23	-3.17	8.04	10.51	2.18
Birbhum	-4.46	-2.31	1.79	-1.65	-8.96	-7.48	0.76	0.76	-0.03
Bankura	10.97	9.37	-1.08	-12.31	-16.23	-4.02	5.92	6.18	0.34
Purulia									
Coastal	-1.66	-3.33	-1.71	-18.10	-20.17	-1.63	1.81	1.87	0.04
North 24 Parganas	30.37	27.50	-4.08	3.36	5.97	2.58	29.79	30.04	-0.24
South 24 Parganas									
Terai	2.83	2.28	-0.61	5.45	5.37	-0.10	4.30	3.80	-0.64
Dinajpur	10.38	11.95	1.35	-7.65	-4.49	3.41	4.73	6.83	1.99
Jalpaiguri	3.93	4.19	0.29	-8.54	-9.58	-1.16	3.28	4.20	0.92
Cooch Behar									
Hills	-0.36	-4.15	-3.84	-8.09	-9.54	-2.15	-1.39	-1.31	0.08
Darjeeling									

Source : Computed from Statistical Abstract, BAES, GoWB

Total Cereals

In total cereals share of rice is maximum. In agrarian economy of West Bengal consumption of cereals occupies the lion's share in the food basket. In a small farm dominant agriculture with poor avenues of marketing of produce, crop decision is guided by consumption requirements of the families. About this we discussed earlier. It is a fact that increasing population pressure is giving rise to fragmentation of arable land. Despite increase in use of chemical fertilizers the productivity seem to stagnate.

With few exceptions of negative growth in respect of area, production and productivity for total Cereals in the two different periods the overall scenario is one of stagnation. Highest growth in productivity of cereal crops was registered in the district of Purulia followed by Malda, Cooch Behar and South 24 Parganas (Table 4.3). For the other districts of the state the growth rates are not worth mentioning.

Table 4.3 : Crop-wise Average Annual Growth Rates of Area (A), Production (P) and Yield (Y) across districts in different periods
Crop – Total Cereals

Agro-climatic region/ Districts	1990-91 to 1999-00			2000-01 to 2004-05			1990-91 to 2004-05		
	A	P	Y	A	P	Y	A	P	Y
Alluvial	2.66	4.03	1.34	1.58	4.12	2.49	1.18	2.21	1.02
Burddwan	0.61	2.70	2.08	-0.78	0.77	1.54	0.27	2.72	2.44
Midnapore	1.69	2.29	2.56	2.62	0.82	-1.75	1.06	1.95	1.78
Nadia	1.48	3.14	1.11	8.74	10.02	1.18	1.42	2.96	0.36
Murshidabad	-0.69	1.92	3.59	0.64	5.44	4.77	-0.94	1.86	3.17
Malda	1.15	2.14	0.98	8.19	10.34	1.99	0.50	1.58	1.07
Hoogly	-0.75	-0.83	-0.07	4.62	7.81	10.75	-0.03	1.38	1.02
Howrah									
Laterte	1.49	4.48	2.94	3.46	5.51	1.98	1.00	3.32	2.30
Birbhum	-0.52	1.93	2.46	-5.48	-4.15	1.41	-1.62	0.56	2.21
Bankura	-0.49	2.37	2.71	1.53	4.94	3.35	-0.60	3.35	3.90
Purulia									
Coastal	1.39	1.60	0.21	-3.36	-1.29	2.13	-0.11	0.56	0.68
North 24 Parganas	0.74	2.73	1.98	-0.94	0.71	1.66	0.10	3.20	3.10
South 24 Parganas									
Terai	-6.09	-3.53	1.28	1.01	4.88	3.84	-4.17	-1.72	1.90
Dinajpur	-0.20	1.75	-1.88	-1.06	-0.51	0.56	0.18	2.97	1.00
Jalpaiguri	-0.92	0.11	1.76	-2.05	-1.06	1.01	-0.71	2.04	3.12
Cooch Behar									
Hills	-3.71	-4.33	0.49	0.62	-1.87	-2.48	-2.86	-4.10	-0.77
Darjeeling									

Source : Computed from Statistical Abstract, BAES, GoWB

Total Pulses

Pulses cultivation in West Bengal reveals a dismal picture in general. There are few exceptions like Burdwan, Hoohly, Birbhum, Jalpaiguri and Darjeeling where growth rates in respect of area and production for the period from 190-91 to1999-00 have been positive (Table 4.4). Growth rate in respect of productivity in this period was highest in South 24 Parganas followed by Birbhum and Hoogly. But in South 24 Parganas, however, area under total Pulses declined sharply in this period.

Table 4.4 : Crop-wise Average Annual Growth Rates of Area (A), Production (P) and Yield (Y) across districts in different periods
Crop – Total Pulses

Agro-climatic region/ Districts	1990-91 to 1999-00			2000-01 to 2004-05			1990-91 to 2004-05		
	A	P	Y	A	P	Y	A	P	Y
Alluvial	19.51	20.35	1.28	-25.60	-29.08	-5.03	4.64	7.77	3.54
Burddwan	-4.90	-4.87	2.32	-4.65	-3.76	1.57	-2.51	-0.55	2.53
Midnapore	-5.23	-5.59	-0.40	-6.68	-1.64	5.49	-0.81	1.00	1.82
Nadia	-1.16	2.51	3.71	3.86	0.71	-3.12	2.43	2.97	0.54
Murshidabad	-11.09	-14.99	-4.35	-3.98	-1.30	-0.83	-4.72	-3.10	1.91
Malda	2.56	7.52	5.71	-5.98	-9.71	0.58	2.02	3.24	1.71
Hoogly	-22.16	-19.29	2.19	-18.78	-24.21	-9.40	-16.75	-14.25	1.88
Howrah									
Laterte	2.83	9.03	6.02	-6.10	-5.43	0.24	5.47	8.29	2.58
Birbhum	-9.68	-10.02	-0.76	-18.44	-11.45	3.88	-10.81	-9.64	1.23
Bankura	-2.19	-6.44	-4.35	-1.23	2.81	4.02	-1.97	-4.07	-2.14
Purulia									
Coastal	-4.69	-3.40	1.25	-13.02	-13.65	-3.18	-3.48	-2.49	0.69
North 24 Parganas	-9.50	-3.09	7.10	3.05	-3.46	-6.15	-0.88	3.57	4.44
South 24 Parganas									
Terai	-9.37	-11.79	-2.59	-9.91	-18.13	-9.24	-10.59	-10.22	0.38
Dinajpur	7.68	5.76	-1.96	-2.20	-5.78	-4.50	3.99	2.59	-1.33
Jalpaiguri	-0.22	-0.90	-0.67	-7.85	-9.29	-1.32	-0.84	-1.13	-0.40
Cooch Behar									
Hills	2.45	6.97	4.67	0.82	1.99	2.41	1.97	4.44	3.18
Darjeeling									

Source : Computed from Statistical Abstract, BAES, GoWB

On the contrary, in years from 2000-01 to 2004-05 growth rates in area under total Pulses have declined for most of the districts of the state with exception of, however, Murshidabad and South 24 Parganas. Growth of production in this period exhibits a gloomy situation. A growth rate of 2.88 is registered in Purulia followed by 1.99 in Darjeeling.

The over all scenario is also not encouraging. Positive growth to the tune of 4.44 is found in South 24 Parganas followed by 3.54 in Burdwan. There has been a general trend among the farmers to withdraw from Pulses cultivation across the state. Despite the price of Pulses have increased in a steady manner over the years the acreage under Pulses has declined. A previous study entitled Pulses Development and Identification of Constraints in Raising Their Production by Agro-Economic Research Centre, Visva-Bharati identified several obstacles. Firstly, yield level in case of Pulses remain poor due to non-use of improved seeds. That results in lower gross revenue from Pulses cultivation.

Secondly, Pulses in West Bengal is prone to be visualized as non-market crop. Hence, there is absence of developed marketing channels for Pulses. Thirdly, Pulses are grown in

rainfed regions and their productivity remains substantially lower than other cereal crops like Rice and Wheat. There is still ample opportunity for improving Pulses production and productivity in West Bengal in general.

Total Foodgrains

Area under Total foodgrains over the years remained more or less steady. As non-food crops in case of West Bengal have had not made a breakthrough in terms of either area or production, hence, the scenario remains mostly unaltered. The general pattern of growth in respect of area, production and productivity reflect a situation of slow growth. In a state where there exist barriers for alternative and remunerative crop cultivation the farmers are compelled to grow foodgrains as their last refuge. Hence, foodgrains production in fifteen years time span remained positive for most of the districts with exception of Darjeeling but with a poor growth rate (Table 4.5). However, in Bankura compound growth rate in respect of productivity is around 4.5 followed by Purulia and South 24 Parganas. The districts of laterite tract exhibit better growth in respect of productivity in comparison with the districts situated in other agro-climatic regons. It is increase in productivity of Rice that has contributed to such a growth. It might have been due to the fact that in Red and Laterite areas of West Bengal sub soil irrigation has have made headway in recent past.

Total Oilseeds

West Bengal has been an area where oilseeds particularly mustard was grown in a substantially large scale. But introduction of seed-fertilizer-water technology brought about a change in the cropping pattern in the agricultural sector. Introduction of new varieties of seed in respect of Rice can be held responsible for such a change. It is a fact that productivity of these high yielding seeds in summer (i.e. Boro Rice) has increased gross revenue of farmers from crop cultivation. It is for this reason a shift of area from oilseeds is observed throughout the state. Since early 90's proportion of area under total Oilseeds remained constant till triennium ending 2002-03.

A district wise break up of area, production and productivity demonstrate a bleak picture. Among districts of Alluvial plain only Nadia could register a significant growth in terms of area under oilseeds while growth rate of production is not very encouraging during 1990-91 to 1999-00 (Table 4.7). In districts like Burdwan, Malda and Hoogly growth rate of area under the crop were negative. Murshidabad, historically been an area of oilseed growers exhibits a poor growth in terms of area. Districts under different agro-climatic conditions do also expose meager growth rates. Production and productivity during these years reveal a similar picture.

Table 4.5 : Crop-wise Average Annual Growth Rates of Area (A), Production (P) and Yield (Y) across districts in different periods

Crop – Total Foodgrains

Agro-climatic region/ Districts	1990-91 to 1999-00			2000-01 to 2004-05			1990-91 to 2004-05		
	A	P	Y	A	P	Y	A	P	Y
Alluvial	2.76	4.06	1.37	1.42	4.05	2.59	1.20	2.22	1.02
Burddwan	0.52	2.64	4.40	-0.85	0.73	1.57	0.23	2.69	2.44
Midnapore	0.31	1.96	1.24	1.31	0.69	-0.60	0.47	1.90	1.11
Nadia	1.24	3.12	1.85	8.07	9.55	1.37	1.53	2.97	1.42
Murshidabad	-1.93	1.23	3.23	0.15	5.18	5.03	-1.42	1.62	3.08
Malda	1.15	2.14	0.98	8.10	10.31	2.05	0.51	1.58	1.07
Hoogly	-0.99	-0.89	-0.92	4.56	7.78	3.06	-0.17	1.35	1.72
Howrah									
Laterte	1.53	4.52	2.94	5.22	5.33	2.22	1.60	3.37	2.20
Birbhum	-0.56	1.91	3.74	-5.45	-4.16	1.41	-1.66	0.55	4.45
Bankura	-0.58	2.18	2.78	1.36	4.90	3.50	-0.67	3.22	3.92
Purulia									
Coastal	1.17	1.55	0.38	-3.70	-1.44	2.84	-0.23	0.54	0.83
North 24 Parganas	0.55	2.70	1.08	-0.86	0.69	1.56	0.07	3.20	3.33
South 24 Parganas									
Terai	-6.20	-3.61	1.74	0.77	4.70	3.90	-4.38	-1.79	2.91
Dinajpur	-0.07	1.78	1.85	-1.10	-0.56	0.53	0.23	2.97	2.73
Jalpaiguri	-0.90	0.10	1.00	-2.24	-1.15	1.12	-0.70	2.00	2.73
Cooch Behar									
Hills	-3.61	-4.26	-0.70	0.63	-1.83	-2.41	-2.76	-4.04	-1.31
Darjeeling									

Source : Computed from Statistical Abstract, BAES, GoWB

The situation for Oilseeds brightened in the following years from 2000-01 to 2004-05. Interestingly Cooch Behar led the improvement registering a growth rate of 28.38 per cent followed by South 24 Parganas with 14.31 per cent and Bankura with 10.14 per cent. However, in respect of production South 24 Parganas attracts attention. Cooch Behar was a close second. But growth of productivity does not seem to be much encouraging with exception of South 24 Parganas and Hoogly.

The overall scenario for the period from 1990-91 to 2004-05 is one of poor growth performance in respect of productivity of Total Oilseeds.

Table 4.6 : Crop-wise Average Annual Growth Rates of Area (A), Production (P) and Yield (Y) across districts in different periods
Crop – Total Oilseeds

Agro-climatic region/ Districts	1990-91 to 1999-00			2000-01 to 2004-05			1990-91 to 2004-05		
	A	P	Y	A	P	Y	A	P	Y
Alluvial	-6.52	-4.72	1.96	0.30	3.46	-5.15	-0.62	0.42	1.51
Burddwan	2.40	1.66	-0.73	9.81	8.23	3.17	2.97	4.54	2.95
Midnapore	8.03	2.69	-1.21	-0.46	0.99	1.47	2.92	3.10	-0.60
Nadia	0.22	0.98	1.54	8.40	7.15	-1.16	2.82	4.11	1.18
Murshidabad	-3.31	0.23	3.96	2.77	-2.76	-5.50	3.17	7.50	4.14
Malda	-2.75	-7.33	- 4.69	0.95	5.71	4.65	-1.17	-1.46	-0.29
Hoogly	-5.33	-6.73	-1.43	3.19	5.44	2.51	-0.87	1.26	2.13
Howrah									
Laterte	-6.68	-2.32	4.67	2.69	-3.75	-6.29	0.47	3.26	2.79
Birbhum	-3.41	-5.78	-2.46	10.14	4.06	-5.51	-1.03	-1.68	-0.64
Bankura	-5.90	-10.6	-3.95	6.36	6.98	0.46	-7.60	-7.31	0.42
Purulia									
Coastal	0.27	-2.09	-2.65	-6.21	-4.20	2.07	0.88	-0.11	-0.93
North 24 Parganas	1.35	-2.60	-3.71	14.31	25.82	10.07	3.38	3.60	0.32
South 24 Parganas									
Terai	-5.67	-9.64	-4.22	-2.68	-4.18	-1.56	-3.23	-4.40	-1.20
Dinajpur	0.28	-3.72	-3.95	3.90	6.09	2.03	0.64	0.47	-0.12
Jalpaiguri	2.64	1.91	-0.64	28.38	21.08	-5.69	5.36	4.48	-0.83
Cooch Behar									
Hills	-16.78	-19.9	-4.17	4.14	0	0.34	-11.1	-11.49	-0.38
Darjeeling									

Source : Computed from Statistical Abstract, BAES, GoWB

Jute

West Bengal had once been a Jute growing area. A number of Jute mills were situated in Howrah district by the side of the river Bhagirathi. Proximity with Kolkata was their locational advantage. But in course of time, affected by freight equalization the pace of growth of Jute industry decelerated. It resulted in a decline in Jute area. Moreover, Jute prices are subject to wide annual fluctuation that give rise to uncertainty for the Jute growers.

During 1990-91 to 1999-00, area under Jute and its production have been subject to a dismal growth (Table 4.7). Though in North 24 Parganas and Howrah compound growth rates for area and production was substantially high, none the less, growth of productivity had been rather slow. The situation continued to be the same during 2000-01 to 2004-05. The overall picture in respect of productivity of Jute has been one of poor performance.

Table 4.7 : Crop-wise Average Annual Growth Rates of Area (A), Production (P) and Yield (Y) across districts in different periods
Crop – Jute

Agro-climatic region/ Districts	1990-91 to 1999-00			2000-01 to 2004-05			1990-91 to 2004-05		
	A	P	Y	A	P	Y	A	P	Y
Alluvial	2.81	3.94	1.07	-1.27	-3.05	-1.81	1.87	3.59	1.68
Burddwan	-2.53	-0.59	0.87	-3.87	-13.76	-9.54	-2.64	-2.56	0.29
Midnapore	0.90	0.77	-1.84	-3.02	-0.69	2.41	0.74	1.28	0.53
Nadia	5.08	6.11	0.97	-0.64	0.94	1.59	3.16	4.08	0.90
Murshidabad	-1.80	-1.10	0.74	-0.22	4.64	4.87	-0.37	2.63	3.01
Malda	1.71	4.09	4.04	1.59	3.99	2.39	1.21	3.17	2.80
Hoogly	8.79	12.46	2.47	2.30	6.33	3.78	6.85	9.84	2.77
Howrah									
Laterte	-0.18	3.94	2.97	14.87	9.79	-2.51	-1.21	0.63	1.45
Birbhum	-3.77	-0.85	2.97	-10.05	-26.29	-2.51	-7.85	-12.42	1.45
Bankura	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Purulia	6.01	7.85	1.72	-2.93	3.40	6.74	4.02	6.51	2.39
Coastal									
North 24 Parganas	-7.70	-7.42	-0.42	-6.21	3.33	8.70	-0.20	-0.15	0.04
South 24 Parganas	2.11	2.40	2.62	1.77	7.63	5.76	2.00	3.54	2.88
Terai	1.93	5.67	3.68	-3.64	-2.75	0.94	0.28	4.67	4.38
Dinajpur	3.59	6.25	-1.24	-7.74	-7.52	0.19	0.69	3.84	2.80
Jalpaiguri	-5.53	-1.19	4.92	1.13	8.00	6.58	-1.10	2.28	3.45
Cooch Behar									
Hills									
Darjeeling									

Source : Computed from Statistical Abstract, BAES, GoWB

Potato

It is a known fact that area under potato is subject to year to year fluctuation depending on the market price of previous year. At the same time there exists scarcity of warehousing facilities for Potato in the state. But at the same time profitability of Potato cultivation is quite high due to its high yield. Cropping of the crop necessitates controlled multiple irrigation with ample use of chemical fertilizers. So, at producer's end cost of production is high.

With expansion of tube well irrigation potato cultivation has had made a breakthrough in West Bengal across most of the district. Though alluvial soil is best fitted for cultivation of Potato, we find potato growers in every district at a large scale.

It is interesting to find that in the districts of alluvial plain productivity growth of Potato have been rather slow during 1990-91 to 2000-01 (Table 4.8). Malda registered highest productivity. On the contrary the terai district viz. Dinajpur, Jalpaiguri and Cooch Behar were leaders in growth of productivity of Potato. From earlier periods Burdwan, Midnapore and Hoogly had been high Potato growing areas. Productivity growth of Potato decelerated in these districts.

Table 4.8 : Crop-wise Average Annual Growth Rates of Area (A), Production (P) and Yield (Y) across districts in different periods
Crop – Potato

Agro-climatic region/ Districts	1990-91 to 1999-00			2000-01 to 2004-05			1990-91 to 2004-05		
	A	P	Y	A	P	Y	A	P	Y
Alluvial	3.86	2.88	0.22	1.29	0.46	-0.80	1.04	2.98	0.55
Burddwan	6.47	2.39	0.09	-0.86	-5.07	-7.55	3.03	0.94	-0.23
Midnapore	8.64	10.61	1.82	2.95	1.24	4.06	4.23	7.52	14.09
Nadia	3.48	5.01	1.48	2.69	9.14	-1.37	2.88	5.54	12.77
Murshidabad	5.27	10.87	5.32	0.82	4.31	3.25	3.85	8.42	4.40
Malda	3.44	1.53	-1.85	3.38	-4.79	-7.63	2.51	0.27	-2.17
Hoogly	15.17	13.40	-1.43	-8.68	-10.48	-2.17	8.31	8.34	0.04
Howrah									
Laterte	7.37	7.82	0.44	-5.05	-6.91	-1.91	4.03	4.03	0.01
Birbhum	4.87	2.99	-1.78	1.31	-4.50	-5.75	2.22	1.06	-1.12
Bankura	1.41	4.78	3.32	21.52	24.01	1.29	1.51	4.35	2.72
Purulia									
Coastal	8.72	12.73	3.69	-7.69	-4.34	-0.01	5.22	6.80	13.87
North 24 Parganas	9.16	15.16	5.49	-4.82	-0.44	-0.01	11.18	15.69	12.74
South 24 Parganas									
Terai	7.52	22.40	13.84	5.92	6.26	26.44	7.11	17.69	15.43
Dinajpur	15.33	24.43	7.90	15.96	17.68	1.44	11.85	17.99	5.49
Jalpaiguri	14.58	25.97	9.94	6.25	8.20	1.99	6.83	13.30	6.06
Cooch Behar									
Hills	2.13	7.61	5.36	-1.85	0.59	2.26	1.72	5.89	4.10
Darjeeling									

Source : Computed from Statistical Abstract, BAES, GoWB

In the second phase i.e. from 2000-01 to 2004-05 the situation worsened across all districts leaving aside Dinajpur, where growth of productivity registered a compound growth of 26.44 per cent. On the whole in a span of fifteen years from 1990-91 to 2004-05 growth in respect of productivity of Potato seems to be high in two districts of alluvial plain viz. Nadia and Murshidabad, in North and South 24 Parganas of coastal belt and Dinajpur from terai region.

4.3 District-wise changes in Production and Productivity of Rice

In the previous chapter we discussed about the state level change that had taken place over the years in respect of growth of agricultural production and productivity. In the previous section of the present chapter we discussed at length the trends in production and productivity of a few crops. However, we have mentioned time and again that in West Bengal agrarian scenario Rice is the main crop that helps to achieve food security to millions of farmers. We also observed a marked deceleration in the 90's as regard to

production and productivity growth in comparison with previous periods. Here, in this section we have taken up changes that had occurred since 90's with respect to Rice. In course of our analysis we have taken two time frames, firstly, 1990-91 to 1999-00 the years of deceleration, and secondly, the millennium that followed i.e. 2000-01 to 2004-05. However, the second time span is a bit short for the special analysis, nonetheless it could throw some light to the emerging patterns.

It was found that during the period 1990-91 to 1999-00 only Birbhum and Burdwan recorded high growth rates in respect of production of Rice (Table 3.2). Midnapur, Purulia, South 24 parganas, Murshidabad, Bankura and Nadia showed moderate growth rate of production. Rice production in Jalpaiguri and malda seemed to stagnate while production of rice decelerated in Cooch Behar, Howrah, Hooghly, Dinajpur and Darjeeling. But in terms of growth of productivity none of the districts reflected high growth performance. Birbhum, Purulia, Dinajpur, Malda and Bankura showed moderate growth rate of productivity of Rice. In Dinajpur and Malda in particular withdrawal of area from Rice were sharp during 1990-91 to 1999-00. South 24 parganas, Medinipur, Murshidabad and Burdwan were among the areas that recorded low growth rates of productivity. In Hooghly, Nadia and North 24 Parganas productivity seemed to stagnate. In a word the 90's revealed a poor performance in the areas of production and productivity growth of Rice.

The scenario, however, changed with the turn of the new millennium. Districts like Hooghly, Murshidabad, Howrah came up with unprecedented pace of growth in terms of area, production and productivity of Rice with exception of Hooghly where productivity growth was low. It was followed by Birbhum, Purulia, Malda, Burdwan and Dinajpur where, growth of production of Rice was quite high. However, in terms of productivity, Midnapur led the way followed by Malda, Murshidabad, Dinajpur, Purulia and Howrah. Burdwan, Birbhum and North 24 Parganas reflected a moderate growth rate of productivity while in South 24 Parganas and Bankura it was low. Even under such an environment of growth two districts of North Bengal Terai viz. Jalpaiguri and Cooch Behar seemed to stagnate in terms of growth of productivity.

However, the overall scenario for the time period from 1990-91 to 2004-05 was not so encouraging. It is only Purulia that accounted for a high growth rate (3.2) of production of Rice. At the same time there has been no district that reflected high or moderate growth performance in terms of area under cultivation of Rice. In Nadia and Burdwan growth of area were low, Murshidabad, Birbhum, Midnapur and South 24 Parganas seemed to stagnate and the other districts recorded negative growth rates. Six districts from South Bengal viz. Birbhum, Nadia, South 24 Parganas, Midnapur, Murshidabad, Burdwan and Jalpaiguri of Terai region had moderate rate of growth of production within the time period from 1990-91 to 2004-05. Of these six districts of South Bengal plains four are situated in the Gangetic Alluvial region, one in Red and Laterite zone and the other in the Coastal area. In terms of growth of Rice productivity Medinipur recorded the maximum followed by Purulia, Nadia and South 24 Parganas. Other districts barring North 24 Parganas had moderate or low growth rates in respect of productivity. In North 24 Parganas the growth rate of productivity was very low. But the important observation lies in the fact that the acute deceleration of the 90's that had its impact on the production and productivity of Rice seemed to be changing for a betterment in early years of the new

millennium. It is true that the pace of growth has still along way to go nonetheless it is a good sign for the agrarian sector of West Bengal.

Table 4.9 : Performance of Rice across the regions in the state

Compound Growth Rates	1990-91 to 1999-00			2000-01 to 2004-05			1990-91 to 2004-05		
Accelerating	A	P	Y	A	P	Y	A	P	Y
High		Birbhum		Hooghly	Murshidabad	Midnapur		Purulia	Midnapur
>3		(4.16)		(20.06)	(17.15)	(16.66)		(3.2)	(8.02)
		Burdwan		Murshidabad	Hooghly	Malda			Purulia
		(4.03)		(13.11)	(14.49)	(6.16)			(3.93)
				Howrah	Howrah	Murshidabad			Nadia
				(4.71)	(7.94)	(3.57)			(3.32)
				Birbhum	Birbhum	Dinajpur			South24 Parganas
				(3.56)	(5.99)	(3.55)			(3.1)
				Nadia	Purulia	Purulia			
				(3.6)	(5.62)	(3.54)			
					Malda	Howrah			
					(5.5)	(3.06)			
					Burdwan				
					(4.2)				
					Dinajpur				
					(3.06)				
Moderate	Burdwan	Midnapore	Birbhum			Burdwan		Birbhum	Malda
>2-<=3	(2.65)	(2.62)	(2.89)			(2.6)		(2.99)	(2.98)
		Purulia	Purulia			Birbhum		Nadia	Cooch Behar
		(2.6)	(2.78)			(2.35)		(2.93)	(2.83)
		South24 Parganas	Dinajpur			North24 Parganas		South24 Parganas	Jalpaiguri
		(2.32)	(2.71)			(2.21)		(2.93)	(2.71)
		Murshidabad	Malda					Midnapore	Dinajpur
		(2.19)	(2.64)					(2.65)	(2.56)
		Bankura	Bankura					Murshidabad	Birbhum
		(2.06)	(2.46)					(2.57)	(2.3)
		Nadia						Jalpaiguri	Bankura
		(2.05)						(2.45)	(2.26)
								Burdwan	
								(2.19)	
Low	Nadia	North24 Parganas	South24 Parganas	Purulia	Nadia	Hooghly	Nadia	Cooch Behar	Murshidabad
>1-<=2	(1.61)	(1.72)	(1.99)	(2.0)	(1.92)	(1.98)	(1.37)	(1.86)	(1.8)
	North24 Parganas		Midnapore	Burdwan	Midnapur	South24 Parganas	Burdwan	Howrah	Howrah
	(1.34)		(1.7)	(1.64)	(1.68)	(1.58)	(1.15)	(1.36)	(1.41)
	Birbhum		Murshidabad			Bankura		Hooghly	Darjeeling
	(1.24)		(1.62)			(1.58)		(1.2)	(1.33)
	Hooghly		Burdwan					Malda	Hooghly
	(1.17)		(1.34)					(1.12)	(1.07)
			Jalpaiguri						Burdwan
			(1.25)						(1.02)
			Cooch Behar						
			(1.01)						

Table 4.9 : Performance of Rice across the regions in the state (contd.)

Compound Growth Rates	1990-91 to 1999-00			2000-01 to 2004-05			1990-91 to 2004-05		
Accelerating	A	P	Y	A	P	Y	A	P	Y
Stagnating	South24 Parganas	Jalpaiguri	Hooghly	Darjeeling	South24 Parganas	Cooch Behar	Murshidabad	Bankura	North24 Parganas
>0-<=1	(0.7)	(0.77)	(0.99)	(0.33)	(0.68)	(0.93)	(0.76)	(0.58)	(0.7)
	Murshidabad	Malda	Nadia			Jalpaiguri	Birbhum	North24 Parganas	
	(0.56)	(0.71)	(0.42)			(0.21)	(0.69)	(0.51)	
	Midnapore		North24 Parganas				Midnapore		
	(0.53)		(0.24)				(0.23)		
							South24 Parganas		
							(0.05)		
CGR	1990-91 to 1999-00			2000-01 to 2004-05			1990-91 to 2004-05		
Decelerating	A	P	Y	A	P	Y	A	P	Y
Low	Purulia	Cooch Behar	Howrah	Dinajpur	North24 Parganas		Hooghly		
>-1-<=0	(-0.29)	(-0.13)	(-0.06)	(-0.46)	(-0.61)		(-0.03)		
	Bankura	Howrah		Malda	Cooch Behar		Howrah		
	(-0.4)	(-0.85)		(-0.62)	(-0.8)		(-0.05)		
	Howrah			Midnapore			Jalpaiguri		
	(-0.8)			(-0.7)			(-0.24)		
	Jalpaiguri			South24 Parganas			North24 Parganas		
	(-0.87)			(-0.98)			(-0.25)		
							Purulia		
							(-0.57)		
							Cooch Behar		
							(-0.94)		
Moderate	Cooch Behar		Darjeeling	Jalpaiguri	Darjeeling	Darjeeling	Malda	Darjeeling	
>-1-<=-2	(-1.14)		(-1.38)	(-1.47)	(-1.47)	(-1.34)	(-1.42)	(-1.48)	
	Malda			Cooch Behar	Jalpaiguri	Nadia	Bankura		
	(-1.19)			(-1.7)	(-1.7)	(-1.54)	(-1.64)		
Severe	Darjeeling	Hooghly		North24 Parganas	Bankura		Darjeeling	Dinajpur	
>-2	(-4.58)	(-2.54)		(-2.75)	(-4.07)		(-2.79)	(-2.25)	
	Dinajpur	Dinajpur		Bankura			Dinajpur		
	(-7.15)	(-5.13)		(-5.56)			(-3.78)		
		Darjeeling							
		(-6.26)							

We had not taken into consideration the crops like Potato, Oil seeds, Jute, Pulses or Wheat, as these were less important in West Bengal context. Unlike Rice, these crops experienced a definite deceleration within one and a half decade from 1990-91 of which we have discussed earlier.

V. DETERMINANTS OF PRODUCTIVITY OF RICE

5.1. Introduction

So far we had discussed a declining trend in the growth rate of productivity of certain crops at the state level. However, feature for Rice has been somewhat different from the crops like Pulses, Jute, Oil seeds, Potato etc. Moreover, the district level disaggregate results also reveal that the slowdown during the 90's has changed in the early years of the present millennium. So a rate of increase in growth rate of productivity is observed in the districts with certain variability. It is in this background we try to find out the factors that influence the productivity.

5.2. Methodology

Certain variables like land area, seeds, human labour, animal labour, pesticides, tractor, irrigated area, hyv area, fertilizer consumption, electricity consumption etc. were identified that may have impact on productivity changes. Such variables including the intercept were twenty six in number. With productivity as independent variable a multiple regression model was to be built to analyse the impact of these independent variables on the dependent variable. So the linear regression model could be written as follows:

$Y = a + b_i X_i + U_i$

Where,

b_i = Co-efficients
Y= Dependent variable
X_i = Independent variables
U_i = Random error
i = 1 to 25

Analysis for the state as a whole for twenty seven variables including independent variable and the intercept would have to be carried out for the years 1966-67 to 1989-90 (twenty four years) and from 1990-91 to 2004-05 (fifteen years) separately. Moreover, at the district level the same exercise to be carried out at the district level from 1990-91 to 2004-05.

5.3. Limitation of data

In West Bengal, however, it is difficult to get systematic data on some of these variables as there has been a change in the district boundaries and also inavailability of data on certain variables. This limitation has compelled us to restrict our analysis to the state level for the time period from 1990-91 to 2004-05. In disaggregate level of districts there seems to no systematic data on these variables.

Moreover, as the number of observations were small (fifteen observations for 1990-91 to 2004-05) the number of independent variables had also to be restricted. We took area under total rice, area under hyv rice, net irrigated area, June-Aug rainfall, annual rainfall, per hectare cost on seed, manure, fertilizer, irrigation, insecticides, human labour, bullock power, machine labour as independent variables.

5.4 Results

Firstly, we calculated a correlation matrix for the independent variables to sort out the problem of multi co-linearity.

Table 5.1 Correlations Matrix

	AREARICE	HYVRICE	NIA	JARAIN	SEED	MANURE	HLABR	BLABR	INSEC	IRR	FERT	MLABR
AREARICE	1.00	.389	.087	.447	.339	.433	.216	-.191	.215	.201	.054	.056
HYVRICE		1.00	**-.593**	.469	**.966**	**.576**	**.970**	**.712**	**.923**	**.914**	**.897**	**.824**
NIA			1.00	-.041	-.516	-.239	-.639	-.631	-.453	-.508	-.767	-.627
JARAIN				1.00	.410	.805	.362	-.028	.518	.406	.286	.051
SEED					1.00	.538	.958	.686	.897	.897	.862	.831
MANURE						1.00	.455	.041	.574	.432	.392	.084
HLABR							1.00	.835	.938	.949	.952	.913
BLABR								1.00	.772	.762	.876	.894
INSEC									1.00	.931	.851	.771
IRR										1.00	.866	.857
FERT											1.00	.905
MLABR												1.00

Where : AREARICE – Area under total rice
HYVRICE – Area under HYV rice
NIA – Net Irrigated Area
JARAIN – June-Aug rainfall
SEED – Per hectare cost of seed
MANURE – Per hectare cost of manure
HLABR – Per hectare cost of human labour
BLABR – Per hectare cost of bullock labour
INSEC – Per hectare cost of insecticide
IRR – Per hectare cost of irrigation
FERT – Per hectare cost of fertilizer
MLABR – Per hectare cost of machine labour

It was found from the correlation matrix in table 4.1 that area under HYV rice has strong co-linearity with variables such as per hectare cost of seed, fertilizer, manure, Human labour, etc. So, it was decided to drop the independent variable ‘area under HYV rice’. However, we had regressed the variable area under HYV rice on productivity of rice.

We carried out bivariate regression analysis for all the variables to assess their independent impact on productivity of rice. The model for such an exercise was as follows :

$Y=f(X)$
Or, $Y_i = a + bX_i + U_i$

Where,
Y = Dependent variable productivity
X = Independent variables taken one at a time

Table 5.2 Regression Results

Regression 1 : Dependent = Yield; Independent=Total Area under Rice

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.137	.019	-.057	227.5020

a Predictors: (Constant), AREARICE

Coefficients

		Coefficients		t	Sig.
Model		B	Std. Error		
1	(Constant)	1149.908	2149.881	.535	.602
	AREARICE	.184	.368	.499	.626

a Dependent Variable: YIELD

Regression 2 : Dependent = Yield; Independent= Area under HYV Rice

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.857	.734	.714	118.4205

a Predictors: (Constant), HYVRICE

Coefficients

		Coefficients		t	Sig.
Model		B	Std. Error		
1	(Constant)	1103.955	189.103	5.838	.000
	HYVRICE	.247	.041	5.992	.000

a Dependent Variable: YIELD

Regression 3 : Dependent = Yield; Independent= Per hectare cost of seed

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.868	.754	.735	113.9225

a Predictors: (Constant), SEED

Coefficients

		Coefficients		t	Sig.
Model		B	Std. Error		
1	(Constant)	1673.567	91.747	18.241	.000
	SEED	1.107	.175	6.312	.000

a Dependent Variable: YIELD

Regression 4 : Dependent = Yield; Independent= Per hectare cost of manure

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.237	.056	-.017	223.1353

a Predictors: (Constant), MANURE

Coefficients

		Coefficients		t	Sig.
Model		B	Std. Error		
1	(Constant)	2040.374	214.598	9.508	.000
	MANURE	.471	.536	.879	.395

a Dependent Variable: YIELD

Regression 5 : Dependent = Yield; Independent= Per hectare cost of human labour

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.895	.800	.785	102.6539

a Predictors: (Constant), HLABR

Coefficients

		Coefficients		t	Sig.
Model		B	Std. Error		
1	(Constant)	1721.820	74.218	23.200	.000
	HLABR	7.523E-02	.010	7.216	.000

a Dependent Variable: YIELD

Regression 6 : Dependent = Yield; Independent= Per hectare cost of bullock labour

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.777	.603	.573	144.6341

a Predictors: (Constant), BLABR

Coefficients

		Coefficients		t	Sig.
Model		B	Std. Error		

1	(Constant)	1897.430	81.992	23.142	.000
	BLABR	.182	.041	4.447	.001

a Dependent Variable: YIELD

Regression 7 : Dependent = Yield; Independent= Per hectare cost of insecticide

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.747	.558	.524	152.6929

a Predictors: (Constant), INSEC

Coefficients

		Unstandardized Coefficients		t	Sig.
Model		B	Std. Error		
1	(Constant)	1921.562	84.005	22.874	.000
	INSEC	2.086	.515	4.051	.001

a Dependent Variable: YIELD

Regression 8 : Dependent = Yield; Independent= Per hectare cost of irrigation

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.846	.715	.693	122.5421

a Predictors: (Constant), IRR

Coefficients

		Coefficients		t	Sig.
Model		B	Std. Error		
1	(Constant)	1966.465	54.783	35.895	.000
	IRR	.351	.061	5.715	.000

a Dependent Variable: YIELD

Regression 9 : Dependent = Yield; Independent= Per hectare cost of fertilizer

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.875	.766	.748	111.0479

a Predictors: (Constant), FERT

Coefficients

		Coefficients		t	Sig.
Model		B	Std. Error		
1	(Constant)	1705.945	84.108	20.283	.000
	FERT	.468	.072	6.527	.000

a Dependent Variable: YIELD

Regression 10 : Dependent = Yield; Independent= Per hectare cost of machine labour

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.883	.779	.762	107.8876

a Predictors: (Constant), MLAB

Coefficients

		Coefficients		t	Sig.
Model		B	Std. Error		
1	(Constant)	1944.057	49.592	39.201	.000
	MLAB	.720	.106	6.776	.000

a Dependent Variable: YIELD

Regression 11 : Dependent = Yield; Independent= Annual Rainfall

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.327	.107	.038	217.0155

a Predictors: (Constant), ARAIN

Coefficients

		Unstandardized Coefficients		t	Sig.
Model		B	Std. Error		
1	(Constant)	2912.002	555.184	5.245	.000
	ARAIN	-.367	.294	-1.249	.234

a Dependent Variable: YIELD

It is evident from the regression results mentioned above that apart from total area under rice and annual rainfall, the other independent variables have a significant impact on changes in productivity of rice though each of the variables explaining partially the variability in productivity. As total area under rice and annual rainfall does not have significant impact on productivity we drop the variables. On the other hand as there exists strong multi co-linearity between area under HYV rice and per hectare cost of seed, manure, human labour, bullock labour, insecticides, irrigation, fertilizer and machine labour we drop area under HYV rice as independent variable.

We carried out multiple regression exercise to assess the impact of the independent variables on productivity of rice.

Table 5.3 Multiple Regression results

Regression 12 : Dependent = Yield;
Independent= Seed, Human Labour

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.895	.802	.769	106.4235

a Predictors: (Constant), HLABR, SEED

Coefficients

		Coefficients		t	Sig.
Model		B	Std. Error		
1	(Constant)	1708.544	88.137	19.385	.000
	SEED	.176	.571	.309	.763
	HLABR	6.409E-02	.038	1.702	.115

a Dependent Variable: YIELD

Regression 13 : Dependent = Yield;
Independent= Seed, Human Labour, Manure

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.924	.853	.813	95.7459

a Predictors: (Constant), MANURE, HLABR, SEED

Coefficients

		Coefficients		t	Sig.
Model		B	Std. Error		
1	(Constant)	1817.570	96.926	18.752	.000
	SEED	.616	.561	1.098	.296
	HLABR	4.694E-02	.035	1.341	.207
	MANURE	-.552	.282	-1.956	.076

a Dependent Variable: YIELD

Regression 14 : Dependent = Yield;
Independent= Seed, Human Labour, Manure, Bullock Labour

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.924	.854	.795	100.1153

a Predictors: (Constant), BLABR, MANURE, SEED, HLABR

Coefficients

		Coefficients		t	Sig.
Model		B	Std. Error		
1	(Constant)	1837.801	130.396	14.094	.000
	SEED	.485	.789	.615	.552
	HLABR	6.340E-02	.076	.833	.424
	MANURE	-.611	.381	-1.603	.140
	BLABR	-2.360E-02	.096	-.247	.810

a Dependent Variable: YIELD

Regression 15 : Dependent = Yield;
Independent= Seed, Human Labour, Manure, Bullock Labour, Insecticide

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.940	.883	.818	94.3706

a Predictors: (Constant), INSEC, MANURE, SEED, BLABR, HLABR

Coefficients

		Coefficients		t	Sig.
Model		B	Std. Error		
1	(Constant)	1662.144	169.687	9.795	.000
	SEED	.549	.745	.737	.480
	HLABR	8.434E-02	.073	1.154	.278
	MANURE	-.199	.452	-.440	.670
	BLABR	3.012E-02	.097	.310	.763
	INSEC	-1.736	1.156	-1.502	.167

a Dependent Variable: YIELD

Regression 16 : Dependent = Yield;
Independent= Seed, Human Labour, Manure, Bullock Labour, Insecticide, Irrigation

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.953	.908	.839	88.7189

a Predictors: (Constant), IRR, MANURE, BLABR, SEED, INSEC, HLABR

Coefficients

		Coefficients		t	Sig.
Model		B	Std. Error		
1	(Constant)	1605.844	164.012	9.791	.000
	SEED	1.252	.847	1.479	.177
	HLABR	-3.001E-02	.103	-.290	.779
	MANURE	.356	.567	.627	.548
	BLABR	.165	.129	1.279	.237
	INSEC	-3.291	1.513	-2.175	.061
	IRR	.326	.221	1.478	.178

a Dependent Variable: YIELD

Regression 17 : Dependent = Yield;
Independent= Seed, Human Labour, Manure, Bullock Labour, Insecticide, Irrigation, Fertilizer

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.953	.909	.817	94.6139

a Predictors: (Constant), FERT, MANURE, IRR, SEED, BLABR, INSEC, HLABR

Coefficients

		Coefficients		t	Sig.
Model		B	Std. Error		
1	(Constant)	1626.741	208.283	7.810	.000
	SEED	1.315	.964	1.363	.215
	HLABR	-4.637E-02	.141	-.328	.753
	MANURE	.254	.819	.310	.766
	BLABR	.148	.167	.881	.408
	INSEC	-2.984	2.318	-1.287	.239
	IRR	.323	.236	1.365	.215
	FERT	7.813E-02	.423	.185	.859

a Dependent Variable: YIELD

Regression 18 : Dependent = Yield;
Independent= Seed, Human Labour, Manure, Bullock Labour, Insecticide, Irrigation, Fertilizer, Machine labour

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.962	.925	.824	92.7410

a Predictors: (Constant), MLAB, MANURE, BLABR, IRR, SEED, FERT, INSEC, HLABR

Coefficients

		Coefficients		t	Sig.
Model		B	Std. Error		
1	(Constant)	1639.864	204.488	8.019	.000
	SEED	1.316	.945	1.392	.213
	HLABR	2.899E-02	.154	.189	.857
	MANURE	-.585	1.092	-.536	.611
	BLABR	.109	.168	.653	.538
	INSEC	-3.016	2.272	-1.328	.233
	IRR	.314	.232	1.353	.225
	FERT	.228	.435	.525	.618
	MLAB	-.720	.635	-1.134	.300

a Dependent Variable: YIELD

It is evident from the results presented above that independently all the variables have significant impact on productivity but taken together they show some differentiated impact. Nonetheless, these independent variables taken together explain 92.5 per cent of variability of the dependent variable.

There may be two reasons for such a behaviour of the explanatory variables. Firstly, as the number of observation is rather small the degrees of freedom goes down as we go on adding independent variables. Secondly, there exists some degree of multi co-linearity among the explanatory variables. It is a known fact that one can not rule out the possibility of co-relation among the inputs that are used in cropping activity. However, the explanatory variables do explain the variability of productivity of rice to a sufficient extent. Any change in one of the explanatory variables would have impact on the productivity of rice.

In the 90's on one hand the cost of production increased sharply and on the other the product price did not respond to the increasing cost. The result had a severe negative impact on impetus of the farmers. In over three decades of left governance the wage rate for the agricultural labourers rose steadily giving rise to production cost. It is a fact that the HYV cultivation which is centered around the Boro Paddy necessitates increased employment of human labour for intensive cultivation. Non remunerative output price thus had a withdrawal effect from Boro cultivation. At the same time prices of fertilizer, pesticides also rose substantially. On the contrary the minimum support price for Paddy remained low during 90's which had a negative impact. Till 1996-97 minimum support

price and wholesale price index for Paddy remained low and since 1998 it exhibited an increasing trend that continued in the new millennium. Market led impetus had an effect on increasing the growth rate of productivity of rice in recent period. It is true that the growth rate needs to be increased further nonetheless the new millennium starts in an optimistic tune for paddy cultivation.

VI SUMMARY AND CONCLUSION

6.1 Introduction

In the 60's new seed-water-fertilizer technological package was introduced in order to achieve self sufficiency in food grain production in the country. However, the pace of agricultural development throughout the country was not uniform depending upon varied physical and social resource endowments.

In West Bengal, however, the technological change has had little impact in revolutionizing agricultural production. With increasing marginalizaion of holding structure posed a serious threat for the tiny holders in terms of their food security.

6.2 Need for the Present Study

An impotant development in later half of 80's was the spread of new technology to the eastern Indian states of Bihar, West Bengal, Orissa and Assam. This has, for the first time, extensively increased the productivity and output levels in the densely populated eastern states of India. In the early years of green revolution eastern states like West Bengal did not respond largely to the new technology, apart from a few exceptions like Barddhaman where HYV rice made a breakthrough. But mid 80's started with a high note. Researchers finally accepted that the agrarian impasse (Boyce 1987) in West Bengal that continued till early 80's eventually ended.

Unfortunately this rising trend did not sustain for a long period. Since mid 90's the agricultural output and productivity reflected a plateau.

It is in this context the present study derives its significance. It is time to look into the causes of such a stagnation in the agrarian sector.

6.3 Objectives

The broad objectives of the study are:

e. To analyse the growth pattern of production and productivity of important crops across the districts and Stat.
f. To study the regional variations in productivity of important crops (specifically bringing out the districts with differentiated growth behaviour) and to map out the regions with acute stagnation.
g. To trace the determinants for changes in productivity and stagnation of important crops.
h. To suggest district level interventions to overcome the problems of stagnation.

6.4 Organization of the study

The present study is based on secondary data collected from official sources of Government of West Bengal, Bureau of Applied Economics and Statistics, CSO etc.

In this study, both State and district level analyses have been made to identify the constraints for increasing the agricultural productivity.

6.5 Recent Development in Agriculture in the State

West Bengal, historically, has been a state with high population density (it is 903 per square kilometer as per 2001 census) on a fertile land and a large section of population dependent on agriculture for their livelihood. Since independence till date the situation has remained more or less the same with over seventy two percent (72.03%, 2001 census) of total population living in rural areas. The figure can be compared with the percentage for 1991, which was 72.52. It appears that there has been a marginal shift of population from rural to urban agglomerations. Proportion of cultivators and agricultural labours taken together has come down from 54.25 percent in 1991 to 44.15 percent in 2001. But proportion of other workers within total workforce between the time spans has risen from 41.51 percent to 48.48 percent. At the same time the average holding size has declined from 0.9 acres in 1990-91 to 0.82 in 2000-01. The average family income from all sources per farmer household was Rs.2079.00 that was lower than the national average of Rs.2115.00 (Bhalla 2006). And there remain 44.15 percent of population on the whole who are still illiterate (2001 census).

It is in this background we take up the study to identify the factors posing hindrance for a rapid increase in crop productivity.

6.6 Rainfall

In terms of annual rainfall the eighteen districts of the state can be categorized into three major segments i.e. High, Medium and Low rainfall areas.

It is observed that there are three districts namely, Jalpaiguri, Darjeeling and Cooch Behar that come under heavy rainfall zone within the state with around 3000mm rainfall per annuam on an average. These are the districts within Himalayan and Terai region. The districts of South Bengal mostly come under low rainfall zone.

Fluctuations in annual rainfall give rise to drought situation in different districts of the State. Purulia, Bankura and West Medinipur are supposed to be more prone to drought situation as compared to the rest of the districts as per official sources.

6.7 Irrigation Status

So far is irrigation is concerned it is really difficult to get access to secondary source data regarding the status of irrigation in the state. However, it appears that since 1962 the command area under government canals shows over two fold increase. But when one goes in the field level s/he is faced with the reality that supply of water through canals is erratic most of the time. Generally it is during Kharif season i.e. the monsoon, canals are capable of supplying water for Aman Paddy. But in a situation of heavy rain in general these canal play only a supplementary role in irrigation scenario of Kharif season.

Moreover, when the rainfall is scanty even during monsoon canals could hardly cater the demands. Even though it is a fact that the canal irrigation is the cheapest among all sources of irrigation in West Bengal, farmers are unable to rely on it as a dependable source. It is far more difficult for the farmers of the bottom end of these canals to get access to surface water. This very nature of irrigation has compelled the farmers to depend of more costly ground water when that is available.

Ground water in the agrarian sector of West Bengal has developed under the auspices of the private sector. Farmers who are capable of installing shallow tube wells have made their own arrangements of assured irrigation exploiting the ground water sources. As this development has almost entirely been by the small entrepreneurs it is difficult to estimate the total coverage of such development And at the secondary level very little data is available. However, in a span of two decades from 1980-81 to 2000-01 the command area under shallow tube wells has increased about ten times. This development in last two decades have had made a breakthrough in agricultural production. The crop which has made a large scale entry in the cropping pattern is the high yielding Summer Paddy.

6.8 Land Use Pattern

Land use pattern over the years shows that the gross cropped area has increased significantly over the years while net sown area has remained more or less the same. Hence the cropping intensity has risen significantly. Current and other fallow show a decline, area put to non agricultural uses seem to rise signifying transfer of land from agriculture to other uses while forest area remained constant over the years.

6.9 Changing Pattern of Land Holding

Structure of land holding suggests that there has been a continuous marginalization of operated area in West Bengal in last three decades. In terms of number the marginal farmers cultivating area below 1 hectare has more than doubled from 2528485 in 1970-71 to 5462089 in 2000-01. Similarly area under such marginal holdings has also been doubled. At the same time small holders also reflect an increasing trend both in terms of number and area. On the contrary semi-medium and medium farmers reveal a decline in number as well as area under operation quite sharply. However, large farmers though declined in number show increase in area under operation. Average size of holding has declined from 1.2 acres to 0.82 acres.

6.10 Changes in Cropping Pattern

In West Bengal agrarian scenario, cropping pattern is dominated by Paddy or Rice. Though over the years the proportion of gross area under Rice seems to decline slightly nonetheless Rice is still the major crop in rural West Bengal. Wheat also shows some increase from early 60’s to the new millennium. Area under Jute remained almost the same over the years while Pulses declined sharply.

In a small farm dominant economy like West Bengal, it is obvious that the tiny operators would try to ensure their food security by growing cereals as much as possible. Cropping

decision in any region primarily depends on the food habit of the people unless they have alternative avenues for marketing their products at a large scale. Especially in an economy with prevalent domination of small and marginal farmers the crop decision centers around Rice followed by Rice. It is for this very reason that Rice has a clear edge over other crops.

6.11 Area, Production and Yield of few crops in West Bengal

In West Bengal the scenario of agricultural production and productivity reflect a mixed pattern. In the early years of 60's (i.e. 1960-61 to 1966-67) compound growth rate for area under Rice was only 0.6, while growth rates for production and productivity was in fact negative. But since then till 2004-05 the compound growth rates for area, production and productivity have always been positive. Area growth has been very low over the years. Only during 80's growth in area under Rice shows an increase. This may have been due to increase in the area under high yielding boro. Because, during this period (i.e. 1980-81 to 1989-90) production and yield of Rice show a phenomenal increase. But since then the rates of growth of production and yield of Rice are found to be lower.

Area increase of Wheat was maximum since mid 60's to late 80's. But yield of Wheat has declined over the years. It was in fact negative during 1980-81 to 1989-90. The situation for the Pulses is very poor in West Bengal. Though Pulses have never been major crops in the State, nonetheless area, production and productivity seem to decline continuously with negative compound growth rates. Only during 80's growth rate for yield was 3.5.

Jute and Potato, the two cash crops of the State show a mixed pattern. Crop decision of these crops depends on the market prices of the previous year. And hence, they reflect wide variability. However, Potato showed an increasing trend in terms of area till 1989-90. But in the last decade and a half the growth rates of area, production and yield seem to decline. Potato cultivation in one hand is price sensitive and on the other it depends heavily on the warehousing facilities. Lately Potato cultivators are going through a tuff time in managing cold storage space for their output. Jute, on the other hand, is sensitive to the support price declared by the government. Moreover, the demand for Jute is faced with severe market competition with polymer products.

6.12 Changes in Input Use

West Bengal characterized a state with high population density on a fertile land where average size of holding was unfavourable for such a change in productive forces. Moreover, poverty ridden agrarian society of West Bengal had little to invest for agricultural development in the backdrop of existing production relation. Small farm dominant agriculture was primarily guided by subsistence needs.

But things changed for betterment with Left Front assuming State power in late 70's. Some changes in the production relation in agriculture was brought about by the Left Front with enforcing the land and tenancy reforms act. Since 1982-83 the wheel turned in

the agricultural sector of West Bengal. Farmers having surplus came along with investment for improved agriculture. Main investment centered around making provision for water. Shallow tubewells were installed at a large scale that ensured controlled irrigation, which is the key point for high yielding technology. Consumption of chemical fertilizers and pesticides along with the high yielding seeds increased. But the rate of increase slowed down after 1992-93.

The number of tractors and oil engines reflected an appreciable change. It is true that West Bengal started from a low base of agricultural development before 80's. But the pace of development improved in the decade from mid 80's to mid 90's. However, after that sluggishness in the rate of growth is observed.

6.13 Changing Cost Structures of Principal Crops

In West Bengal, as we said earlier, that Paddy is the major crop covering 60.7 percent of GCA in 2004-05. Other crops such as Wheat, Mustard, Potato or Jute account for 4.28 percent, 4.80 percent, 3.37 percent and 5.98 percent respectively. Within Paddy Autumn variety accounts for only 3.37 percent of gross cropped area while Winter and Summer varieties cover 42.91 percent and 14.45 percent of gross cropped area in 2004-05. Hence, any change in productivity of Paddy would naturally have a great impact in the agricultural sector.

The Summer Rice, which is popularly known as Boro, involves high cost for irrigation, chemical fertilizer, insecticides etc. Moreover, it requires intensive labour employment in the process of cultivation. Naturally cost of production in case of Summer Rice is substantially higher than that of Autumn and Winter Rice.

As Paddy is the major crop in West Bengal, we for our purpose have analysed the cost components over time for Paddy only.

It is found that between ten years from 1990-91 to 1999-00 growth of modern inputs like pesticides, chemical fertilizers and machine labour show high rates of growth. In addition to this, traditional inputs like seed and human labour, which are the two key inputs of agriculture, showed equally high rates of growth. Therefore, paid out cost (A1) and total cost (C3) also revealed high growth rates. Bullock labour seems to be replaced by machine labour. But since 2000-01 the scenario seems to change. During 2000-01 and 2005-06 the growth rates of modern inputs declined. Growth rates for fertilizers, irrigation were found negative. Poor growth is observed for machine labour and pesticides. Among the traditional inputs bullock power seem to decline. Seed, manure and human labour experience slow growth rates.

6.14 Trends in Agricultural Prices

Compound growth rate of wholesale price for Paddy has increased from 70's to 80's. During 1975-76 to 1979-80 it was 7.3 which increased to 9.0 in the period 1980-81 to 1989-90. But again the growth rate slowed down in 1990-91 to 2004-05. This trend for Paddy is evident also for farm harvest price despite the fact that the minimum support price declared by the government shows an increasing rate of growth. Compound growth

rates of WPI, FHP and MSP for Wheat, on the other hand, reveal an increasing trend barring the fact that WPI remained more or less constant in the 80's and 90's. It was rather interesting to find that despite increasing trend of minimum support price for Jute the WPI and FHP are subject to mixed pattern of changes. This might have been due to market fluctuations of which Jute is very sensitive. Compound growth rates of price for Mustard on the whole reflects a decreasing pattern with the only fact that the MSP in 1990-91 to 2004-05 show marginal increment over previous period.

6.15 Capital Formation in Agriculture

State budgetary allocation figures reveal that the proportion of development expenditure in the last decade has actually decreased from 60.23 percent in 1995-96 to 45.19 percent in 2005-06. Agriculture and allied activities accounted for 24.17 percent of total allocation in economic activities while the respective proportions as regard to rural development, special area programme and irrigation and flood control were 30.94, 5.77 and 13.40 percent respectively in 1995-96. The share of agriculture and allied sector increased in the period 1996-2000. Proportion of allocation in sector like irrigation and flood control remained more or less same from 1995 to 2006 while special area programme over the years gained importance.

However, when we look into a greater details of budgetary allocation it appears that proportion of allocation in crop husbandry has actually increased over the years from 17.31 percent in 1995-96 to 24.8 percent in 2005-06. On the contrary proportion of allocation towards minor irrigation increased marginally with 45.9 percent in 1995-96 to 48.4 percent in 2005-06 while major and medium irrigation remained unaltered with 35.1 percent in 1995-96 and 35.7 percent in 2005-06. It appears that development of irrigation has gained low priority in the last decade. We discussed earlier development of minor irrigation in West Bengal has been under the leadership of wealthier farmers where public participation was rather poor.

6.16 District Wise Growth of Production and Productivity

In our previous discussion we have so far discussed that West Bengal has suffered a deceleration in the growth of productivity in the agricultural sector in the 90's. Our analysis reveals that in this period the slowdown in growth is pronounced in respect of almost all the crops, however, with some variation in case of Paddy.

The State of West Bengal reflects a wide variation in agro-climatic specificities. From hilly tracts of Darjeeling to coastal South and North 24 Parganas diversified climatic and soil quality is observed across the state. Districts such as Jalpaiguri, Cooch Behar and Dinajpur come under Terai region while Purulia, Bankura, Birbhum and a part of Medinipur signify semi arid Red and Laterite zone. On the other hand the districts situated in the gangetic plane and having benefit of alluvial soil are Burdwan, Murshidabad, Malda, Hoogly, Nadia, Howrah and a part of Medinipur. However, in all districts Paddy is the major crop that is being cultivated by farmers.

Burdwan, situated in the alluvial plain, has been one of the areas of IADP launched in 1962. In Burdwan, the productivity of Rice between the two time periods i.e. 1990-91 to 1999-00 and 2000-01 to 2004-05 has increased substantially despite growth in area has decelerated between the two periods. Compound growth rate of production also show an increase. Wheat, on the contrary reflects a marked slowdown. Area, production and productivity of pulses decreased sharply. Total oil seeds, Jute and Potato also follow a similar pattern

Midnapur, however reveals a sharp increasing trend for Rice in respect of yield across all the time periods. Compound growth rate in respect of area seem to decline in the second period (i.e. 2000-01 to 2004-05). Production also decelerated in the same time span but at a lesser degree. Yield of Wheat decelerated very sharply. Growth rate of yield of total food grains in general declined over the years. Situations for Jute and Potato were even worse. It was interesting to find that growth rate of oilseeds was found to accelerate after 2000-01. In a span of fifteen years from 1990-91 to 2004-05 Rice shows a substantial growth rate in terms of production and yield. In case of Potato the yield rate declined.

In Nadia, food grain crops such as Rice and Wheat seem to decline while Pulses reveal an increasing rate of growth. Jute and Oil seeds have also picked up in during 2000-05. It was important to find out that Potato in respect of area, production and yield experienced sharp rising pattern. On the whole Potato appears to perform the best in terms of production and productivity.

Rice in Murshidabad reveal a steady increase over the fifteen year time span. But striking is the growth rate of Potato, which increased at a rate over 12. Other crops such as Wheat, Pulses, Oil seeds and Jute, though exhibit a positive growth rate in respect of yield over a decade and a half have nonetheless decelerated in comparison to their respective growth rates in 90's.

In Malda the rate of growth of production and productivity of Rice was 0.71 and 2.64 in 1990-91 to 1999-00 that increased to 5.5 and 6.16 respectively in 2000-01 to 2004-05. On the whole the rates were 1.12 and 2.98 respectively. Oil seeds, Jute and Potato have also had good performance.

In Hooghly compound rate of growth of productivity of Rice had been 1.07 in 1990-91 to 2004-05. But the rate has increased from 0.99 during 1990-91 to 1999-00 to 1.98 during 2000-01 to 2004-05. Apart from Jute, the productivity growth for other crops has been slow. Oil seeds and Potato reveal a negative growth rate.

Howrah has historically been a district with more industrial enterprises than agriculture. In such a district it was interesting to see a definite increase in the compound growth in respect of productivity for most of the crops barring total Pulses.

Birbhum reveals a marked slowdown in growth rate of productivity in respect of all the crops under cosideration. It is evident from the calculated compound growth rates that the slowdown in case of Rice is rather less in comparison to the other crops.

In Bankura, however, the situation remain almost same as in Birbhum barring the fact that total Pulses have a positive increment in growth rate of productivity from –0.76 to 3.88 in the two subsequent periods from 1990-91 to 2004-05.

Purulia, reveals almost the same story. Only the difference is that the growth rate of productivity of Rice seemed to maintain a steady rate over the years. Total Pulses, on the contrary, remained fluctuating and Potato exhibits a decline.

In the coastal districts i.e. South and North 24 Parganas, however, Jute shows a high growth rate in respect of productivity, while Rice seemed to accelerate in Northern part and decelerated in the Southern part of the district. Potato, in general, reveals a marked slowdown in both the districts.

The case for Dianjpur exhibits an increase in the growth rate of productivity of Rice from 1990-00 to 2000-05. Wheat and particularly Pulses have declined between the two periods. Marked increase is observed in case of Jute and potato.

In the districts of Jalpaiguri and Cooch Behar, productivity of the main crop Rice have declined over the years. Wheat shows a little improvement while productivity of Potato declined sharply. In Jalpaiguri Jute declined and in Cooch Behar it improved marginally.

In the hilly tracts of Darjeeling Tea and Timber are two major products that attract attention. Terrace cultivation of Rice here is somewhat secondary. Productivity growth of Rice, however, stagnated since 1990-91.

In West Bengal, however, the food basket is dominated by Rice. It is the staple food for millions of people living in the rural areas. Moreover, in a small farm dominant economy like West Bengal, the crop decision in most of the cases is guided by livelihood requirement of the people involved in cropping. Hence, cultivation of Rice gets the top priority despite recent hike in the cost of production and low market price of output. There has been a slow down in all-round productivity growth since late 90's. But extent of this slowdown has been lesser in case of Rice as compared to other crops. In the new millennium productivity of rice is found to accelerate as compared to previous decade.

6.17 District-wise changes in Production and Productivity of Rice

Here, in this section we have taken up changes that had occurred since 90's with respect to Rice. In course of our analysis we have taken two time frames, firstly, 1990-91 to 1999-00 the years of deceleration, and secondly, the millennium that followed i.e. 2000-01 to 2004-05. However, the second time span is a bit short for the special analysis, nonetheless it could throw some light to the emerging patterns.

It was found that during the period 1990-00 only Birbhum and Burdwan recorded high growth rates in respect of production of Rice. Midnapur, Purulia, South 24 parganas, Murshidabad, Bankura and Nadia showed moderate growth rate of production. Rice production in Jalpaiguri and malda seemed to stagnate while production of rice decelerated in Cooch Behar, Howrah, Hooghly, Dinajpur and Darjeeling. But in terms of growth of productivity none of the districts reflected high growth performance. Birbhum, Purulia, Dinajpur, Malda and Bankura showed moderate growth rate of productivity of Rice. In Dinajpur and Malda in particular withdrawal of area from Rice were sharp during 1990-00. South 24 parganas, Medinipur, Murshidabad and Burdwan were among the areas that recorded low growth rates of productivity. In Hooghly, Nadia and North 24

Parganas productivity seemed to stagnate. In a word the 90's revealed a poor performance in the areas of production and productivity growth of Rice.

The scenario, however, changed with the turn of the new millennium. Districts like Hooghly, Murshidabad, Howrah came up with unprecedented pace of growth in terms of area, production and productivity of Rice with exception of Hooghly where productivity growth was low. It was followed by Birbhum, Purulia, Malda, Burdwan and Dinajpur where, growth of production of Rice was quite high. However, in terms of productivity, Midnapur led the way followed by Malda, Murshidabad, Dinajpur, Purulia and Howrah. Burdwan, Birbhum and North 24 Parganas reflected a moderate growth rate of productivity while in South 24 Parganas and Bankura it was low. Even under such an environment of growth two districts of North Bengal Terai viz. Jalpaiguri and Cooch Behar seemed to stagnate in terms of growth of productivity.

However, the overall scenario for the time period from 1990-91 to 2004-05 was not so encouraging. It is only Purulia that accounted for a high growth rate of production of Rice. At the same time there has been no district that reflected high or moderate growth performance in terms of area under cultivation of Rice. In Nadia and Burdwan growth of area were low, Murshidabad, Birbhum, Midnapur and South 24 Parganas seemed to stagnate and the other districts recorded negative growth rates. Six districts from South Bengal viz. Birbhum, Nadia, South 24 Parganas, Midnapur, Murshidabad, Burdwan and Jalpaiguri of Terai region had moderate rate of growth of production within the time period from 1990-91 to 2004-05. In terms of growth of Rice productivity Medinipur recorded the maximum followed by Purulia, Nadia and South 24 Parganas. Other districts barring North 24 Parganas had moderate or low growth rates in respect of productivity. In North 24 Parganas the growth rate of productivity was very low. But the important observation lies in the fact that the acute deceleration of the 90's that had its impact on the production and productivity of Rice seemed to be changing for a betterment in early years of the new millennium. It is true that the pace of growth has still along way to go nonetheless it is a good sign for the agrarian sector of West Bengal.

6.18 Determinants of Productivity of Rice

We carried out a regression analysis to assess the causal relation of productivity change..

6.19 Methodology

Certain variables like land area, seeds, human labour, animal labour, pesticides, tractor, irrigated area, hyv area, fertilizer consumption, electricity consumption etc. were identified that may have impact on productivity changes. So the linear regression models could be written as follows:

1. $Y=f(X)$, Or, $Y_i = a + bX_i + U_i$

Where,
Y = Dependent variable productivity
X = Independent variables taken one at a time

2. $Y = a + b_i X_i + U_i$

Where,
b_i = Co-efficients, Y= Dependent variable, X_i = Independent variables,
U_i = Random error, and i = 1 to 25

6.20 Results

It were firstly a bivariate and then a multivariate exercise.

Apart from total area under rice and annual rainfall, the other independent variables have a significant impact on changes in productivity of rice though each of the variables explaining partially the variability in productivity.

We carried out multiple regression exercise to assess the impact of the independent variables on productivity of rice.

The results express that independently all the variables have significant impact on productivity but taken together they show some differentiated impact. Nonetheless, these independent variables taken together explain 92.5 per cent of variability of the dependent variable.

There may be two reasons for such a behaviour of the explanatory variables. Firstly, as the number of observation is rather small and the degrees of freedom goes down as we go on adding independent variables. Secondly, there exists some degree of multi co-linearity among the explanatory variables.

6.21 A few words in the end

In the 90's on one hand the cost of production increased sharply and on the other the product price did not respond to the increasing cost. The result had a severe negative impact on impetus of the farmers.

In over three decades of left governance the wage rate for the agricultural labourers rose steadily giving rise to production cost.

It is a fact that the HYV cultivation which is centered around the Boro Paddy necessitates increased employment of human labour for intensive cultivation.

Non-remunerative output price thus had a withdrawal effect from Boro cultivation. At the same time prices of fertilizer, pesticides also rose substantially. On the contrary the minimum support price for Paddy remained low during 90's that had a negative impact. Till 1996-97 minimum support price and wholesale price index for Paddy remained low and since 1998 it exhibited an increasing trend that continued in the new millennium.

Market led impetus had an effect on increasing the growth rate of productivity of rice in recent period.

It is true that the growth rate needs to be increased further nonetheless the new millennium starts in an optimistic tune for paddy cultivation.

VII POLICY RECOMMENDATIONS

Policy for increasing the productivity has mainly two aspects. Firstly, there may be strategies at the state level to cope up with certain hurdles at the macro level. Secondly, there should be strategies addressed to district level specificities.

At the macro level variables like Minimum Support Price, institutional procurement, marketing channels, surface irrigation etc. to be taken care of.

- Minimum Support Price, as we had discussed earlier, showed an increasing pattern over the years. But the rate of increment in the recent past has been rather slow. Cost A1 for Paddy per hectare increased from Rs.3282.38 in 1990-91 to Rs.12606.70 in 2004-05 which is an increase to the tune of 3.8 fold while the Minimum Support Price for rice for the corresponding years were Rs.205 and Rs.560 per quintal which is around 2.7 times increase. It is thus important that the support price declared by the government should be remunerative to the farmers. At the same time institutional procurement should also be made timely to assist the small and marginal farmers going for distress sale of output.
- Jute and Potato are the two crops that are market sensitive. MSP for Jute exhibits a 2.8 fold increase from 1990-91 to 2004-05. But there were severe fluctuation in WPI during 2002-04. These market fluctuations are to be taken care of to protect the Jute farmers. The market for Potato is mainly controlled by merchants and *Aratdars*. There remains a wide difference between the market price and harvest price of Potato at the grass root level. Government procurement in this sector is insufficient. Policy should be formulated to protect the Potato farmers at the grass root.
- As we all know that surface irrigation is the cheapest one in view of the rising prices of diesel and electricity. West Bengal, on the other hand, has ample avenues to extend canal command area. State budgetary allocation towards major irrigation remained mostly unaltered from 1995-96 to 2005-06. There is a need for serious intervention in this regard.
- The agrarian sector of West Bengal exhibits an overwhelming predominance of small and marginal farmers who have little to invest for improved agriculture. In view of the rising prices of chemical fertilizers and pesticides a subsidy may be addressed to these section of farmers.

We have discussed at length that the districts in West Bengal represent varied agro-climatic specificities. Problems in the districts are different and demand special attention. Though non-availability of district level data for certain variables have refrained us from district level analysis as regards to the determinants of productivity of crops nonetheless a few problems are well known and need to be mentioned here. Special attention should be paid for provision of irrigation facility, proper marketing channels for product to facilitate the farmers.

- The geo-morphological situations are so varied in the districts that no uniform measures could be taken to take care of irrigation problem. For example Purulia needs construction of check dams, small water bodies fed by the surface flow water of small streams. Districts like Birbhum and bakura that are situated in Red and Laterite belt have a large number of tanks and water bodies in villages. Reclamation of such water bodies may facilitate lift irrigation as well as can increase the annual water recharge. On the other hand districts of gangetic plain have ample opportunities of canal and ground water irrigation. In the coastal districts there is acute problem of soil salinity and sippage of saline water. Non-salaine water requires deep boring and hence large capital investment. In Jalpaiguri and Cooch Behar, however, ground water is available in a very shallow boring. Here cheap treddle pumps could be utilized.
- Proper marketing channel is a problem that bothers the farmers of all regions. Particularly for the cash crops like Jute and Potato it remains essential. Potato is a quickly perishable product without a proper storage facility. The cold storages in most of the cases in rural West Bengal have developed under the auspices of private sector and the market being controlled by the merchants. Government intervention to provide warehousing and marketing facility is call of the hour. The village Panchayats can assume an importat role in this context.

An all round intervention to improve crop productivity and livelihood of rural people should be the slogan of the new millennium.

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Annexure I

Comments on the report "Determinants of Stagnation in Productivity of Important Crops in West Bengal" received from
Agricultural Development and Rural Transformation (ADRT) Centre,
Institute for Social and Economic Change, Bangalore

1. Title of the draft report examined: Determinants of Stagnation in Productivity of Important Crops in West Bengal

2. Date of receipt of the Draft report: 17 April 2010

3. Date of dispatch of the comments: 14 June 2010

4. Comments on the Objectives of the study: Objectives of the study have been addressed only partially

5. Comments on the methodology:

(i) The study has not adopted fully the common methodology proposed by the coordinating centre.

(ii) A chapter on "Measurement of Growth and Stagnation in Crop Productivity" is missing. Please refer to Chapter Scheme circulated by the coordinating centre.

(iii) Methodology proposed to calculate **Total Factor Productivity (TFP)** has not been incorporated. Please refer to two e-mails dated 07 August 2009 and also a letter posted on the same date for details. Results of this analysis should be presented in Chapter IV.

6. Comments on analysis, organization, presentation etc.:

(i) The report reads poor. Data were interpreted very casual way. There were repetitions of facts at several places. For instance, see P.14, in the first paragraph "…..paddy is the major crop….." and in the second paragraph "……paddy predominates…….". The report should be copy edited before submitting its final version.

(ii) See Table 2.1 for name of districts. There are discrepancies in spelling of names, e.g. Medinipur or *Midnapur (P.21, 22).* Officially accepted spelling should be used. Avoid using abbreviations in writing names. For instance in Table 2.1, 24Pgs (S), and 24Pgs (C), what do they stand for?. Also see Table 2.8b, P.13 for name of crops, "Pdy&Wht"

(iii) In Table 2.2, please mention only the districts according to the classification. There is no need to present the same data as in Table 2.1. Further, see P.7 when districts are listed under a particular group, avoid using *etc*. instead mention districts.

(iv) Mention unit of data presented in Table 2.5, P.10 and also GCA in Table 2.6, P.11

(v) Table 2.9b, P. 15 should be modified. Present the cost structure of crops in terms of percent share rather than growth rates. Cost structure should be provided for crops like paddy, rapeseed and mustard, jute and potato. Data on cost of cultivation of these crops are available from published CACP reports.

(vi) Please see Table 2.10, P. 16 and also Tables 3.1, explain what are "r' and 't' and their importance.

(vii) Table 2.11a and Table 2.11b should be modified according to the original Table plan. Table 2.11b should clearly indicate whether data pertain to revenue expenditure or capital expenditure or total expenditure (revenue + capital). In original table format, it was envisaged to provide information on capital expenditure.

(viii) Chapter III, should be completely re-oriented. It would be better to discuss growth in area, production and yield by crops across districts than by individual districts. Analysis of growth rates by crops across districts will provide meaningful results and better understanding of performance of different crops for suitable policy interventions. Please take districts instead of crops in the first column of all Tables 3.1. Give different Table number for each crop.

(ix) Refer Table 3.2, methodology and rationale for grouping of growth rates into different categories should be provided.

(x) Chapter IV should be completely modified. It was envisaged to estimate TFP by crops and use State level TFP (weighted) for assessing its determinants. Data on Cost of Cultivation shall be used for its estimation.

References: (a) Rosegrant, Mark W and Robert E Evenson (1992). "Agricultural Productivity and Sources of Growth in South Asia", *American Journal of Agricultural Economics*, 74:757-61, August.

(b) Desai, Bhupat M. and N.V. Namboodri (1997). "Determinants of Total Factor Productivity in Indian Agriculture", *Economic and Political Weekly*, 32(52):A165-A171, December 27-January 2.

(c) Kumar, Praduman and Mark W. Rosegrant (1994). "Productivity and Sources of Growth in Rice in India", *Economic and Political Weekly*, 29(53): A183-A188, December 31.

(xi) Typographical errors should be corrected. See P.4, "Ganjetic"; P.21, "rte"

(xii) Time series data should be updated to 2004-05 for whichever items possible.

7. Overall view on acceptability of report:

Report requires substantial revision.

Annexure II

Actions taken Report

A chapter on "Measurement of Growth and Stagnation in Crop Productivity" is missing. Please refer to Chapter Scheme circulated by the coordinating centre.	The Chapter has been incorporated
Methodology proposed to calculate **Total Factor Productivity (TFP)** has not been incorporated. Please refer to two e-mails dated 07 August 2009 and also a letter posted on the same date for details. Results of this analysis should be presented in Chapter IV.	Total Factor Productivity could not be estimated due to non-availability of required time series data.
There were repetitions of facts at several places. For instance, see P.14, in the first paragraph "…..paddy is the major crop….." and in the second paragraph "……paddy predominates……". The report should be copy edited before submitting its final version.	Taken care of.
See Table 2.1 for name of districts. There are discrepancies in spelling of names, e.g. Medinipur or *Midnapur (P.21, 22).* Officially accepted spelling should be used. Avoid using abbreviations in writing names. For instance in Table 2.1, 24Pgs (S), and 24Pgs (C), what do they stand for?. Also see Table 2.8b, P.13 for name of crops, "Pdy&Wht"	Taken care of
In Table 2.2, please mention only the districts according to the classification. There is no need to present the same data as in Table 2.1. Further, see P.7 when districts are listed under a particular group, avoid using *etc*. instead mention districts.	Table 2.2 has been restructured Taken care of
Mention unit of data presented in Table 2.5, P.10 and also GCA in Table 2.6, P.11	Taken care of
Table 2.9b, P. 15 should be modified. Present the cost structure of crops in terms of percent share rather than growth rates. Cost structure should be provided for crops like paddy, rapeseed and mustard, jute and potato. Data on cost of cultivation of these crops are available	Table 2.9b has been modified

from published CACP reports.	
Please see Table 2.10, P. 16 and also Tables 3.1, explain what are "r' and 't' and their importance.	Tables are restructured
Table 2.11a and Table 2.11b should be modified according to the original Table plan. Table 2.11b should clearly indicate whether data pertain to revenue expenditure or capital expenditure or total expenditure (revenue + capital). In original table format, it was envisaged to provide information on capital expenditure.	Tables 2.11a and 2.11b indicate total expenditure (revenue+capital)
Chapter III, should be completely re-oriented. It would be better to discuss growth in area, production and yield by crops across districts than by individual districts. Analysis of growth rates by crops across districts will provide meaningful results and better understanding of performance of different crops for suitable policy interventions. Please take districts instead of crops in the first column of all Tables 3.1. Give different Table number for each crop.	The chapter has been reoriented as suggested
Refer Table 3.2, methodology and rationale for grouping of growth rates into different categories should be provided.	Rationale for grouping growth rates have been incorporated
Chapter IV should be completely modified. It was envisaged to estimate TFP by crops and use State level TFP (weighted) for assessing its determinants. Data on Cost of Cultivation shall be used for its estimation.	TFP could not be estimated due to non-availability of required time series data
Typographical errors should be corrected. See P.4, "Ganjetic"; P.21, "rte"	Taken care of
Time series data should be updated to 2004-05 for whichever items possible.	Taken care of
Report requires substantial revision.	Report has been revised