

# Trends in Agriculture and Agricultural Practices in Ganga Basin Part IV: West Bengal

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## GRB EMP : Ganga River Basin Environment Management Plan

*by*

Indian Institutes of Technology



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## Preface

In exercise of the powers conferred by sub-sections (1) and (3) of Section 3 of the Environment (Protection) Act, 1986 (29 of 1986), the Central Government has constituted National Ganga River Basin Authority (NGRBA) as a planning, financing, monitoring and coordinating authority for strengthening the collective efforts of the Central and State Government for effective abatement of pollution and conservation of the river Ganga. One of the important functions of the NGRBA is to prepare and implement a Ganga River Basin Management Plan (GRBMP).

A Consortium of 7 Indian Institute of Technology (IIT) has been given the responsibility of preparing Ganga River Basin Management Plan (GRBMP) by the Ministry of Environment and Forests (MoEF), GOI, New Delhi. Memorandum of Agreement (MoA) has been signed between 7 IITs (Bombay, Delhi, Guwahati, Kanpur, Kharagpur, Madras and Roorkee) and MoEF for this purpose on July 6, 2010.

This report is one of the many reports prepared by IITs to describe the strategy, information, methodology, analysis and suggestions and recommendations in developing Ganga River Basin Management Plan (GRBMP). The overall Framework for documentation of GRBMP and Indexing of Reports is presented on the inside cover page.

There are two aspects to the development of GRBMP. Dedicated people spent hours discussing concerns, issues and potential solutions to problems. This dedication leads to the preparation of reports that hope to articulate the outcome of the dialogue in a way that is useful. Many people contributed to the preparation of this report directly or indirectly. This report is therefore truly a collective effort that reflects the cooperation of many, particularly those who are members of the IIT Team. A list of persons who have contributed directly and names of those who have taken lead in preparing this report is given on the reverse side.

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## **1. Introduction**

In West Bengal, agriculture continues to play a predominant role both in terms of its contribution to the state's GDP as well as its share in total employment. Amongst the 16 major states, West Bengal ranks 10th according to the share of agriculture in the state's GDP. Although the state is said to have witnessed a structural transformation in recent years, as many as 45.6 percent of the total employed are absorbed in agriculture, thus positing the significance of agriculture in the State as a major source of livelihood (NSSO, 2006). West Bengal has a predominantly rural economy, where about 72 percent of the people live in rural areas (Table A2). The most disturbing feature of the State pertains to its high density of population, which stands at 903 per km<sup>2</sup> against an all India average of 325 (Table A1). With increasing demand for food in the State, attainment of higher agricultural growth remains an unaccomplished target.

While there is no denying the fact that agricultural growth must rise to feed the increasing population, the former brings in numerous challenges towards environmental sustainability including the sustainability of river water. River Ganga, which flows through the State, is said to have been the life line of the State. It supports varieties of gainful economic activities in the basin area including agriculture. As many as 10 districts (8 erstwhile undivided) out of 19 (15 erstwhile undivided) are located on the banks of Ganga river. Needless to say, river and agriculture are mutually interdependent in many different ways. While any unsustainable agricultural practices may create serious harm to river water, both in quantity and quality, lack of flow of water in the river may lead to water shortage in agriculture. It is thus pertinent to carry out agricultural practices that would be sustainable through time.

This report thus attempts to present the trends in agriculture and agricultural practices in West Bengal and its possible implications on the Ganga river basin. Accordingly, the objectives of the study are as follows. First, the study intends to examine the agricultural land use and land holding patterns in the state. Second, the trend of growth of agricultural output according to major crops is analyzed. Third, it tries to find out the sources of inputs used in agriculture with special reference to water and fertilizers. On the basis of the above studies, implications for Ganga river basin are assessed. Before the state of agriculture is presented, a brief profile of West Bengal is presented as follows.

## **2. Brief Profile**

West Bengal, one of the major states in the eastern part of the country, has predominantly an agrarian economy. It is endowed with rich natural resources and climatic conditions favourable for agriculture. These include large areas of good alluvial soil, abundant surface water and groundwater resources, and good rainfall. The climate of the region (other than in the hill regions) is tropical, hot and humid. Annual rainfall is between 1,300 mm and 1,750 mm. Despite these favourable conditions, the State has witnessed wide fluctuations in the growth of agricultural production (Rawal and Swaminathan, 1998). In line with the changing

trend across the country, West Bengal has experienced a structural shift in output front as the share of agriculture in the State's GDP is recorded to have come down from about 33 percent in 1999-00 to about 25 percent in 2007-08 (Table A3).

The river Ganga is considered the life line of West Bengal. It is a perennial source of water to the plains of West Bengal for irrigation as well as human and industry consumptions. The river is navigable and it acts as a major transport system in the State with heavy traffic flow. The entire State of West Bengal, except four districts namely Darjeeling, Cooch Behar, Jalpaiguri and Purulia fall under the lower Gangetic Plains region. The Ganges and its numerous distributaries have resulted in highly fertile soils in this region. Accordingly, agriculture has become the key to the economy of the State. A large section of the population derives their livelihood from agriculture. This region also covers many major tributaries of the Ganga.

The agro-climatic zone in West Bengal can be divided into four sub-zones, viz., Barind Plains, Central Alluvial Plains, Alluvial Coastal Saline Plains, and Rarh Plains. The zone of barind plains, that covers two districts namely West Dinajpur and Malda, has a relatively high rainfall. It has high Net Sown Area (NSA) but the irrigation facilities are not developed. The Central Alluvial Plains, on the other hand, is the largest sub-zone in the lower Gangetic plains covering around 3.5 million hectares i.e. about 40 percent of the total land. It covers the districts of Murshidabad, Nadia, Burdwan, Hooghly, Howrah and Medinipur. About 68 percent of the land of this zone is cultivated and over 60 percent of the cultivated land is irrigated resulting in a reasonably high cropping intensity. The alluvial coastal saline plains cover the districts of North and South 24-Parganas along with the metropolitan city of Calcutta. Only about 26 percent of the NSA of this is irrigated. The rarh plains that include Birbhum and Bankura districts are mostly rural and poorly developed. About two-thirds of the land in this zone is cultivated with 23 percent falling under forest cover. Poor irrigation facilities in this zone have resulted in a very low cropping intensity. Given this variations in agro-climatic zone in the lower Ganga Region that constitutes a large part of the State of West Bengal, what follows next is an attempt to examine state of agriculture in the State and its constituent districts.

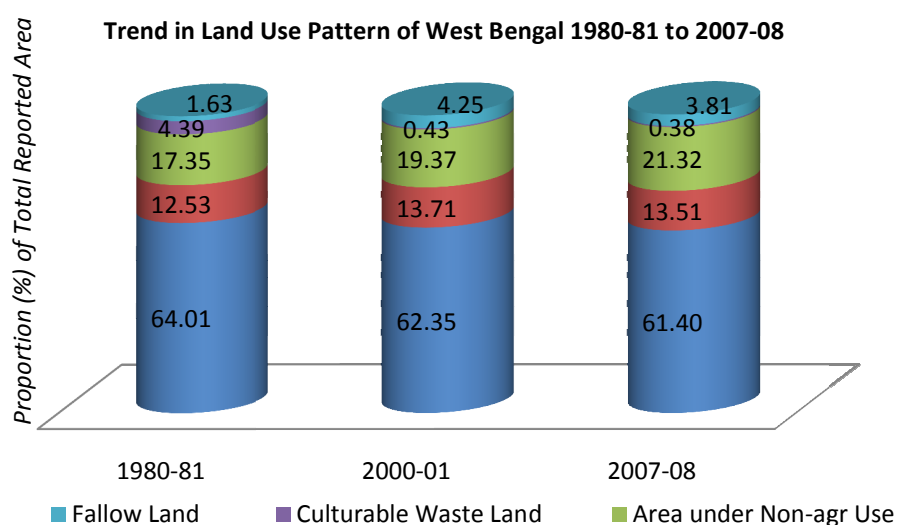
### **3. Land Use and Patterns of Land Holding**

The total geographical area of West Bengal is 8875.2 thousand hectares of which NSA constitutes approximately 5332 thousand hectares in 2007-08. As against this, GCA is recorded to be 9799 thousand hectares, indicating thereby that the State witnesses very high cropping intensity (Table 1). In West Bengal, the cropping intensity stands at 184 percent (Table 16). With increasing demand for food and other agricultural demands of the State's rising population, high cropping intensity appears to have been the only viable option. It indicates that over the years, NSA has come down, while GCA has recorded an increase (Figure 1). This indicates that with the passage of time, greater portions of the land



have been brought under multiple cropping in the State.

It is further important to note that the districts falling in close proximity to the river Ganga have by and large experienced higher cropping intensity as compared to their counterparts. While this may be considered as a welcome phenomenon from the point of view of attaining food security in the State, it may lead to serious environmental consequences. Rise in cropping intensity without proper crop diversification may lead to unsustainable use of agricultural land indicating greater demand for fertilizers, pesticides and insecticides, water, etc (Table 16).



**Figure 2: Trends in Land Use Pattern of West Bengal**

A comparison of the land use pattern across districts according to the proximity from the Ganga River reveals some interesting aspects. Some such aspects are presented below. For paucity of data for the earlier years, the data for the currently divided districts are presented against the undivided ones.

- NSA as a percentage of the total reported area is, on an average, found to be little higher in the river bank districts (62 percent) as compared to their counterparts (60 percent). However, for the entire State, the share of NSA of the total area reported is about 61.4 percent (Table 1).
- As compared to the NSA, GCA is quite large in districts closer to the river than their counterparts. Consequently, average cropping intensity of river bank districts stands at 194 percent, while that for the other districts stands at 168.47 percent (Table 16).
- It is noteworthy to mention that four categories of land use, namely, fallow other than current fallows, culturable waste land, permanent pasture and other grazing land, and barren and unculturable land are significantly low in the river basin districts in the State of West Bengal. Much of the barren and uncultivable land, culturable waste land and

fallows other than current fallow, whatsoever in existence, is concentrated in six districts, Birbhum, Bankura, Darjeeling, Paschim Medinipur, Purulia and Burdwan. The areas under forests are also limited in the State and are concentrated in a few regions namely Bankura, West Medinipur, Purulia, South 24 Parganas, Darjiling and Jalpaiguri. Of the total forested area of 11.73 lakh hectares, undivided 24 Parganas alone has a share of 4.26 lakh hectares. It is in this part of the State where the Sundarban delta is located.

It is further found that in West Bengal, the average size of operational holdings have declined significantly over the years. In 1980-81, the State had recorded average land holding size of 0.94 hectare, which has come down to 0.79 hectares in 2005-06. By and large, similar trend is noticed across the districts of West Bengal. Comparing across districts for the latter period, the average holding is the least in Howrah (0.45 hectare) followed by Midnapore-E (0.53 hectare), South 24 Parganas (0.59 hectare), Hoogly (0.63 hectare) and North 24 Parganas (0.66 hectare). Interestingly, all these districts fall in the close proximity of the Ganga River (Table 2).

A further analysis according to the size of holdings indicates that as many as 92.06 percent of the farming households in West Bengal are marginal farmers having land holding size less than 1 hectare. As against this, only about 5.7 percent of the households are small farmers having land holding size between 1-2 hectares, 1.4 percent are semi-medium farmers with 2 to 4 hectares of land holdings and meager 0.2 percent are medium farmers having land holding size between 4-10 hectares (Table 3). The skewed distribution of agricultural land holdings in the State is further evident from the estimates of the areas under different sizes of holdings. While as much as 58.23 percent of the operational areas are under marginal land holdings, only 25.71 percent are under small holdings and meager 1.88 percent and 4.02 percent are under semi-medium and medium land holdings respectively.

It is important to note that land reforms measures like *Operation Barga*, which was introduced in West Bengal leading to the distribution of surplus land and Panchayati Raj which diversified the rural activities (Chandrasekhar, 1993) is said to have brought about a significant change in the land distribution and land holding patterns in West Bengal. Interestingly, the number of operational land holdings has increased significantly (18.95 percent) over the period 1980/81 to 2005/06, whereas the area of operational land holdings has declined (-0.52 percent) irrespective of classes (Table 4). According to the size of the land holdings, there is phenomenal increase of the marginal land owners both in terms of number (38.54 percent) and area (72.82 percent) of holdings over the above said period. There is a decline in all size-classes of land holdings except marginal holdings. However, the percentage change is more for semi-medium and medium size-classes.

Table 1: Land use Pattern of West Bengal across the River and Non-River Bank Districts (Area in '000 ha)

Particulars	Total Reported Area			Net Sown Area			Gross Cropped Area			Forest Area			Area under Non-agr use			Culturable Waste land			Fallow land		
	1980-1981	2000-2001	2007-2008	1980-1981	2000-2001	2007-2008	1980-1981	2000-2001	2007-2008	1980-1981	2000-2001	2007-2008	1980-1981	2000-2001	2007-2008	1980-1981	2000-2001	2007-2008	1980-1981	2000-2001	2007-2008
<b>River Basin Districts</b>																					
24-Parganas*	1460	1346	1335	693.4	638.2	631.5	880.3	1052	1052	426.3	426.3	426.3	329.0	244.1	267.0	8.0	1.6	0.2	3.5	33.7	10.2
Burdwan	700.6	698.5	698.8	471.1	477.5	452.0	683.7	788.7	832.2	31.0	28.8	21.2	131.2	170.7	208.6	51.9	7.5	7.6	15.4	15.1	9.4
Hoogly	314.5	312.2	313.4	234.4	230.5	219.9	371.5	396.4	540.6	0.3	0.7	0.5	70.5	77.2	91.2	7.5	2.6	1.3	1.8	1.3	0.4
Howrah	145.1	136.0	138.7	96.7	87.0	80.7	129.2	165.3	162.9	N.A	N.A	N.A	43.3	44.2	53.4	3.4	0.3	0.2	1.6	5.6	4.3
Malda	360.5	371.1	370.9	283.9	222.2	210.3	396.2	459.6	391.1	1.4	1.7	1.7	67.1	87.9	92.8	7.1	0.1	0.1	1.1	58.5	66.0
Midnapore**	1360.6	1323.9	1325.2	862.0	874.3	887.7	1074.9	1438.6	1508.6	172.1	170.8	172.8	238.1	253.3	269.8	55.5	4.1	6.2	32.0	21.3	25.8
Murshidabad	536.7	532.5	532.5	426.8	393.0	398.8	677.2	754.9	976.3	0.8	0.8	0.8	94.2	147.3	131.8	7.9	0.7	0.8	4.2	2.7	0.3
Nadia	390.9	390.7	390.7	320.3	298.5	289.2	535.3	721.6	697.7	1.3	1.2	1.2	63.9	80.8	93.3	2.6	1.0	0.8	2.8	8.6	6.1
<b>Total</b>	<b>5269</b>	<b>5111</b>	<b>5105</b>	<b>3389</b>	<b>3221</b>	<b>3170</b>	<b>4748</b>	<b>5778</b>	<b>6161</b>	<b>633.0</b>	<b>630.2</b>	<b>624.5</b>	<b>1037</b>	<b>1106</b>	<b>1208</b>	<b>144</b>	<b>17.9</b>	<b>17.2</b>	<b>62.5</b>	<b>147</b>	<b>122</b>
<b>Non-River Basin Districts</b>																					
Bankura	685.6	688.1	688.0	379.5	344.1	345.4	447.0	499.2	565.8	139.6	148.4	148.9	83.4	124.5	153.1	63.9	6.7	2.1	19.3	64.5	38.5
Birbhum	451.4	451.1	451.1	341.9	337.5	318.5	450.0	458.7	560.8	15.7	16.0	15.9	50.8	85.1	98.1	31.9	3.4	3.9	6.8	9.1	14.7
Cooch Behar	341.4	331.4	331.6	264.4	264.9	248.1	417.8	508.4	547.1	5.7	3.8	4.3	58.9	56.9	76.7	11.8	0.8	1.0	0.5	5.8	1.5
Darjeeling	83.9	325.5	325.5	45.8	136.9	140.7	141.6	186.3	195.8	22.6	124.6	124.6	10.5	50.1	42.4	4.0	1.7	1.8	1.2	12.8	16.0
Dinajpur***	534.0	534.4	534.4	468.4	463.9	461.5	709.2	800.2	819.0	1.3	1.5	1.5	53.5	63.4	68.6	8.4	0.2	0.1	2.4	6.1	2.8
Jalpaiguri	616.1	622.7	622.7	317.7	336.5	334.6	435.7	560.7	564.4	172.6	179.0	179.0	89.9	100.2	94.1	32.5	0.2	0.1	3.5	3.5	14.9
Purulia	623.4	623.3	625.6	301.9	311.7	312.9	312.0	325.4	385.2	87.6	87.6	75.1	108.5	97.0	110.2	81.7	6.4	7.3	43.7	120.6	120.2
<b>Total</b>	<b>3336</b>	<b>3576</b>	<b>3570</b>	<b>2119</b>	<b>2196</b>	<b>2162</b>	<b>2913</b>	<b>3339</b>	<b>3638</b>	<b>445.0</b>	<b>560.8</b>	<b>549.2</b>	<b>455.4</b>	<b>577.2</b>	<b>643.2</b>	<b>234</b>	<b>19.3</b>	<b>16.2</b>	<b>77.4</b>	<b>222.3</b>	<b>209</b>
<b>West Bengal Total</b>	<b>8605</b>	<b>8688</b>	<b>8684</b>	<b>5508</b>	<b>5417</b>	<b>5332</b>	<b>7662</b>	<b>9117</b>	<b>9799</b>	<b>107</b>	<b>1191</b>	<b>1174</b>	<b>1493</b>	<b>1683</b>	<b>1851</b>	<b>378</b>	<b>37.1</b>	<b>33.4</b>	<b>140</b>	<b>369.0</b>	<b>331.0</b>

Source: Directorate of Agriculture (Evaluation), Government of West Bengal. Note: 24 Parganas\* includes North-24 Parganas and South-24 Parganas; Midnapore\*\* includes East & West Midnapore; Dinajpur \*\*\* includes Uttar and Dakshin Dinajpur; NA: Data Not Available

**Table 2: Average Area of Holdings (in Hectares)**

District	1980-81	1990-91	2000-01	2005-06
Burdwan	1.24	1.15	1.04	1.00
Birbhum	1.23	1.12	1.05	1.01
Bankura	1.13	1.12	1.05	1.00
Midnapore (E)	0.61	0.57	0.53	0.53
Midnapore (W)	1.03	1.02	0.75	0.73
Howrah	0.47	0.43	0.43	0.45
Hooghly	0.75	0.71	0.65	0.63
24 Parganas (N)	0.75	0.69	0.66	0.66
24 Parganas (S)	0.66	0.71	0.60	0.59
Nadia	0.97	0.96	0.87	0.84
Murshidabad	0.90	0.75	0.74	0.74
Dinajpur (U & D)	1.07	1.08	0.95	1.8
Malda	0.89	0.87	0.82	0.79
Jalpaiguri	1.67	1.62	1.24	1.20
Darjeeling	2.35	2.08	1.65	1.47
Cooch Behar	1.01	0.97	0.88	0.85
Purulia	1.18	1.05	0.86	0.82
West Bengal	0.94	0.90	0.82	0.79

Source: Agricultural Census, Directorate of Agriculture, Govt. of West Bengal.

**Table 3: Percentage Distributions of Operational Holdings, Ownership of Households, Area Owned over Five Broad Classes of Holding in India and West Bengal in 2006**

Particulars	Marginal (Below 1.0 ha)	Small (1.0-2 ha)	Semi medium (2.0 - 4 ha)	Medium (4.0 - 10.0 ha)	Large (Above 10 ha)
<b>All India</b>					
Operational Holdings (%)	69.8	16.2	2.0	4.2	0.8
Ownership of Holdings (%)	79.6	10.8	6.00	3.00	0.60
Area owned (%)	23.05	20.38	21.98	23.08	0
<b>West Bengal</b>					
Operational Holdings (%)	88.8	8.9	2.10	0.20	0.00
Ownership of Households (%)	92.06	5.70	1.40	0.2	0.00
Area owned (%)	58.23	25.71	1.88	4.02	0.00

Source: Bureau of Applied Economics & Statistics, Government of West Bengal, 2007

**Table 4: Estimated Number and Areas of Operational Holdings according to Size Class in West Bengal**

Size	Class	1980-81	2000-01	2005-06	Percentage Change over the Periods		
					1980/81-2000/01	2000/01-2005/06	1980/81-2005/06
Marginal (Below 1.0 ha)	No. of Holdings	4096001	5462089	5674788	33.35	3.89	38.54
	Area of Holdings (Ha)	1619657	2758843	2799071	70.34	1.46	72.82
Small (1.0 - 2 ha)	No. of Holdings	1148936	1009328	1005594	-12.15	-0.37	-12.48
	Area of Holdings (Ha)	1733512	1606686	1595340	-7.32	-0.71	-7.97
Semi-medium (2.0-4 ha)	No. of Holdings	519445	282992	282767	-45.52	-0.08	-45.56
	Area of Holdings (Ha)	1403246	783773	772428	-44.15	-1.45	-44.95
Medium (4.0- 10.ha)	No. of Holdings	111859	34797	27862	-68.89	-19.93	-75.09
	Area of Holdings (Ha)	594883	178298	137672	-70.03	-22.79	-76.86
Large (10.0 ha or above)	No. of Holdings	1408	785	652	-44.25	-16.94	-53.69
	Area of Holdings (Ha)	203484	218976	221303	7.61	1.06	8.76
All Size	No. of Holdings	5877649	6789991	6991663	15.52	2.97	18.95
	Area of Holdings (Ha)	5554782	5546576	5525814	-0.15	-0.37	-0.52
Average Size of Holdings		0.94	0.82	0.79	-12.77	-3.66	-15.96

Source: Agricultural Census, Directorate of Agriculture, Government of West Bengal

**Table 5: Distribution of Number and Area of Operational Holdings according to Size Class in West Bengal across River and Non-River Basin Districts**

		River Bank Districts	Non-River Bank Districts	West Bengal	River Bank Districts	Non-River Bank Districts	West Bengal
		Area of Holdings (in hectares)			No. of Holdings (in numbers)		
Large (more than 10 hec.)	1980-81	8551	194933	203484	520	888	1408
	2000-01	3287	215689	218976	174	611	785
	2005-06	2596	218707	221303	142	510	652
Medium (4-10 hec.)	1980-81	246159	348724	594883	46487	65372	111859
	2000-01	81675	96623	178298	326854	456919	783773
	2005-06	59392	78280	137672	11883	15979	27862
Semi Mdium (2-4 hec)	1980-81	632154	771092	1403246	234219	285226	519445
	2000-01	326854	456919	783773	118063	164929	282992
	2005-06	309516	462912	772428	112845	169922	282767
Small (1-2 hec.)	1980-81	844939	888573	1733512	556181	592755	1148936
	2000-01	780917	825769	1606686	496414	512914	1009328
	2005-06	765656	829684	1595340	477751	527843	1005594
Marginal (Below 1.0)	1980-81	857750	761907	1619657	2250235	1845766	4096001
	2000-01	1343344	1415499	2758843	2781458	2680631	5462089
	2005-06	1389134	1409937	2799071	2879521	2795267	5674788

Source: Bureau of Applied Economics &amp; Statistics, Government of West Bengal, 2007

## 4. Growth of Agriculture in West Bengal

The growth of agricultural production in West Bengal in the 1980s and early 1990s was very impressive particularly when that is compared with the earlier decades<sup>1</sup>. This high rate of growth of production was combined with a reasonably high rate growth in productivity<sup>2</sup>, especially during 1984-85 to 1995-96 that enabled the State to maintain a growth rate higher than the national average in the subsequent years. But, what is more important perhaps is that the State experienced a lower rate of growth of the sector in terms of its NSDP during 1994-95 to 2004-05 (Chand, *et al.*, 2007). This slowdown, as Chand *et al.* (2007) suggested, was largely due to stagnation in NSA, decline in power supply to the sector, lower rate of growth in fertilizer and slowdown in expansion of area under irrigation.

Bhattacharya and Bhattacharya (2007) attempted to examine growth of some important parameters of agriculture sector viz. area, production, yield, input use, credit and land reforms in a long-term perspective of 23 years from 1980-81 to 2002-03 by considering 1992-93 as the year of trend break<sup>3</sup>. Such a trend break is expected to capture the impact of the liberal policies such as reduction in subsidies in fertilizers, credit, etc. on the agriculture sector of the State during 1992-93 to 2002-03. Referring to their findings, it is observed that rate of growth of area under agriculture, production of the sector and its yield in the State as a whole was lower during 1992-2003 as compared to that during 1980-1992. The same can be said in case of input use viz. fertilizer, HYV seeds, etc. in the sector. This coupled with slowdown in the pace of land reforms as well as inadequate supply of institutional credit to the sector has resulted in lower rate of increase in cropping intensity in the State (Table 6).

**Table 6 Growth of Agriculture in West Bengal, 1980-81 to 2002-03**

Variables	Simple Exponential Growth Rates			Kinked Exponential Growth Rates	
	1980-81 to 1991-92	1992-93 to 2002-03	1980-81 to 2002-03	1980-81 to 1991-92	1992-93 to 2002-03
Area	0.80	0.29	0.52	0.75	0.22
Production	5.64	2.33	3.61	5.05	1.73
Yield	5.08	1.98	3.18	4.52	1.43
Fertilizer	10.9	5.63	6.93	9.23	4.01
HYV Area	5.36	2.84	4.52	5.61	3.09
Cropping Intensity	1.83	1.29	1.20	1.43	0.89
Credit	15.9	9.24	11.10	14.00	7.28
Land Reform	0.96	0.90	0.80	0.83	0.77

Sources: Bhattacharyya and Bhattacharyya (2007).

<sup>1</sup>The rate of growth of agricultural production between 1949 and 1980 was only 1.74 per cent per annum (Boyce, 1987). This growth rate of agriculture production was even less than the rates of growth of the rural population as well as total population of the state forcing a significant portion of the rural population living in abject poverty (Chattopadhyay, 2005).

<sup>2</sup> Per hectare production in West Bengal was the second highest in the country during the mid-1980s after Kerala (Chand *et al.*, 2007).

<sup>3</sup> It is assumed that, although process of economic reforms was initiated in July 1991, its effects were realised in 1992-93.

However, the growth experience of the agriculture in West Bengal varies across crops (Table 7). It is observed that area under aus rice has declined over the years and the rate of decline is quite substantial during 1992-2005. This has resulted in decline in total area under rice during 1970-81 as well as during 1992-2005. Although the total area under rice increased during 1981-92, this was largely on account of substantial increase in area under boro rice. Interestingly, area under wheat has increased in recent years resulting in increase in area under foodgrains in general and cereals in particular, though the rate of increase is marginal. On the other hand, the rate of growth of area under oilseeds and potato was positive, but it declined over time.

**Table7: Rate of Growth of Area under Major Crops in West Bengal, 1970-71 to 2004-05**

Crop	Growth Rate (%)		
	1970-71 to 1980-81	1981-82 to 1991-92	1992-93 to 2004-05
Aus rice	-2.63	-1.57	-4.25
Aman rice	0.07	0.51	-0.58
Boro rice	3.18	9.65	3.46
Total rice	-0.20	1.23	-0.16
Wheat	-2.07	-1.42	3.66
Total cereals	-0.31	0.97	0.31
Total pulses	-3.11	-6.04	-0.63
Total foodgrains	-0.51	0.57	0.27
Jute	2.84	-0.36	2.75
Mustard	3.73	9.81	-0.33
Total oilseeds	6.85	5.19	0.32
Potato	5.74	5.02	3.36

Source: Ghosh (2010)

The growth experience differs across crops in terms of production as well (Table 8). Production of most of the crops fluctuated over the years. But, while the rate of growth of potato and oilseeds produce continued to decline, that of boro rice increased during 1981-82 to 1991-92 and declined thereafter. Interestingly, production of aus rice and total pulses continued to decline. Further, although production of aman rice and mustard grew at a higher rate during 1981-82 to 1991-92, the rate of growth of production of these crops was negative during 1992-93 to 2004-05 indicating a decline in their total production.

As regards yield, it is observed that except mustard and potato, the rate of growth of yield of all the major crops increased in the 1980s and declined thereafter (Table 9). For most of the crops, the decline in the rate of growth of yield in the post-reforms era was quite high. For the crops like aus rice and jute, the increase in the rate of growth of yield in the 1980s was quite sharp. It should, however, be noted that although the area under boro rice and its production increased significantly in the 1980s, the growth of yield was marginal. The rate of growth of yield of mustard and potato, on the other hand, continued to decline over the years. The decline in the rate of growth of yield in the post-reforms era is likely to have implications on growth and sustainability of agriculture sector in West Bengal.

**Table 8: Rate of Growth of Production of Major Crops in West Bengal**

Crop	Growth Rate (%)		
	1970-71 to 1980-81	1981-82 to 1991-92	1992-93 to 2004-05
Aus rice	-4.37	4.47	-2.38
Aman rice	0.52	4.45	1.09
Boro rice	2.53	11.07	3.55
Total rice	0.51	5.31	1.77
Wheat	-3.18	-0.43	4.44
Total cereals	-3.23	7.18	2.15
Total pulses	-3.16	-4.31	0.35
Total foodgrains	0.35	4.52	1.94
Jute	-1.74	6.77	3.94
Mustard	9.76	12.18	0.86
Total oilseeds	10.72	9.79	0.21
Potato	8.84	7.37	3.35

Source: Ghosh (2010)

**Table 9: Rate of Growth of Yield of Major Crops in West Bengal, 1970-71 to 2004-05**

Crop	Growth Rate (%)		
	1970-71 to 1980-81	1981-82 to 1991-92	1992-93 to 2004-05
Aus rice	1.74	6.05	1.89
Aman rice	0.45	3.94	0.43
Boro rice	-0.65	1.42	0.08
Total rice	0.72	4.07	1.61
Wheat	-1.11	0.98	0.77
Total cereals	-2.92	6.21	1.84
Total pulses	-0.05	1.80	1.07
Total foodgrains	0.86	3.93	1.66
Jute	-4.58	7.23	1.03
Mustard	6.03	2.37	1.19
Total oilseeds	3.87	4.60	-0.11
Potato	3.10	2.35	-0.01

Source: Ghosh (2010)

It is, in this context, important to cite the findings of Ghosh (2010), who attempts to examine whether there has been acceleration or deceleration in the production of the major crops by fitting quadratic trend equation for each of the sub-periods. It is observed that the rate of growth of production of all the major crops except jute, mustard and potato decelerated in the 1970s (Table 10). Interestingly, although all types of rice show deceleration in growth of production in the 1970s, total production of rice shows acceleration. On the other hand, while production of majority of the crops accelerated in the 1980s, that of some important cash crops like pulses, mustard, and potato decelerated during this period. What is more important perhaps is that although the annual average rate of growth of production of boro rice was higher in the 1980s as compared to that in the 1970s, the deceleration continued. This means that production of boro rice increased at a declining rate during the period



under consideration. However, production of all the crops, except jute and wheat continued accelerating in the post-reforms era. Besides, although production of mustard and pulses decelerated in the 1980s, the post-reform era experienced acceleration in their production.

**Table 10: Acceleration/Deceleration of production of Major Crops in West Bengal**

Crop	1970-71 to 1979-80	1980-81 to 1991-92	1992-93 to 2004-05
Aman Rice	Deceleration	Acceleration	Acceleration
Boro Rice	Deceleration	Deceleration	Deceleration
Aus Rice	Deceleration	Acceleration	Acceleration
Total Rice	Acceleration	Acceleration	Acceleration
Wheat	Deceleration	Acceleration	Deceleration
Total Cereals	Deceleration	Acceleration	Acceleration
Total Pulses	Deceleration	Deceleration	Acceleration
Total Foodgrain	Deceleration	Acceleration	Acceleration
Jute	Acceleration	Acceleration	Deceleration
Mustard	Acceleration	Deceleration	Acceleration
Potato	Acceleration	Deceleration	Deceleration

Source: Source: Ghosh (2010)

#### 4.1. Growth of Agriculture across Districts of West Bengal

Tables 11, 12 and 13 present growth rates of area under major crops, their production and yield across the districts of West Bengal as computed by Sanyal *et al.* (1998). The growth rates are computed by fitting the exponential function  $Y_t = e^{\beta_0 + \beta_1 t}$ . It is observed that in most of the districts, the area under boro rice has increased at a significantly high rate during 1977-78 to 1993-94 (Table 11). The districts like Birbhum, Bankura and Howrah recorded a reasonable high rate of growth of area under aus rice, whereas it declined in many of the districts like Nadia, Murshidabad, West Dinajpur, Malda, Jalpaiguri and Coochbehar during this period and the decline was quite sharp in Malda and West Dinajpur. In most of the districts, area under the traditional crop of the State i.e. aman rice increased only marginally. More importantly, while majority of the districts recorded a very high rate of growth of area under rapeseed, possibly due to its low base, that under pulses and wheat declined significantly. This has largely undermined the rate of growth of area under non-food grains. Although the area under non-food grains increased at reasonably high rate in the districts like Burdwan, Hooghly, Birbhum, Midnapur, Bankura, Purulia, this was largely on account of sharp increase in area under potato or jute.

However, despite decline or marginal increase in area, production of rice in general and boro rice in particular has increased at a significantly high rate in most of the districts during 1977-78 to 1993-94 (Table 12). Further, like area, in majority of the districts, production of rapeseed also recorded a very high rate of growth, possibly due to its low base, whereas that of pulses and wheat declined quite sharply affecting the rate of growth of production of non-foodgrains. However, many of the districts like Burdwan, Hooghly, Malda, Midnapur,

Nadia, Bankura, Birbhum and Purulia recorded reasonably high rate of growth of production largely due to increase in production of potato at a high rate therein.

Table 11: Rate of Growth of Area of Crops by Districts, 1977-78 to 1993-94

District	Growth Rate (%)											
	Rice				Wheat	Pulses	Food grains	Jute	Rapeseed	Potato	Non-Food Grains	All Crops
	Aus	Aman	Boro	Total								
<b>River Bank Districts</b>												
Burdwan	1.9	0.2	6.2	1.2	-14.4	-16.9	0.3	3	12	2.5	3.4	1
Hooghly	1.3	0.5	2.7	1	-18	-20	0.4	-1.6	11.1	5.3	3.5	1.2
Howrah	3.4	0.1	12.5	2.8	-21.6	-12.8	1.8	-5.3	21.3	0.2	-0.2	1.6
Malda	-4.3	1.1	7.2	1	3.1	-0.4	0.5	-1.8	7.8	2	0.8	0.6
Midnapore*	1.7	-0.2	9.3	1	6.3	-6.9	0.6	0	17.5	8.6	6.8	1.2
Murshidabad	-1.9	2	8.9	1.7	-2.6	-7.4	-0.3	1.8	10.7	-0.7	2.2	0.3
Nadia	-1.8	1.4	10.3	2.3	0	-2.9	0.9	1	11.2	-0.6	2.2	1.3
24-Parganas*	0.5	-0.5	8.8	0.9	-3	-4.9	0.5	-3.8	11.7	0.2	1.4	0.7
Average	0.1	0.6	8.2	1.5	-6.3	-9	0.6	-0.8	12.9	2.2	2.5	1
<b>Non-River Bank Districts</b>												
Bankura	2.3	0.3	16.6	1.1	-6.7	-7.9	0.8	6.6	12.8	7.6	3.9	1.1
Birbhum	4.8	-0.3	6.2	0.3	-8.6	-9.1	-0.8	5.6	15.2	1.4	5.2	1.2
Coochbehar	-1.3	1.6		0.9	-3.6	0.4	0.5		-1.7	7.1	1.1	0.6
Jalpaiguri	-1.6	0.5		0	-1.8	-8.7	-0.4		1.1	6.6	0.7	-0.1
Purulia	3.8	1.3		1.3	-6.6	1.7	0.9		2.7	4.2	4.2	1.5
West Dinajpur *	-9.2	1.3	17.8	0.5	-3.2	-5.5	-0.3	-2.8	6.8	-0.6	-1	-0.4
Average	-0.2	0.8	13.5	0.7	-5.1	-4.9	0.1	3.1	6.2	4.4	2.4	0.7
West Bengal	-1.6	0.4	8.4	1	-2.5	-5	0.4	0	10.1	4.5	3.3	0.5

Table 12: Rate of Growth of Production of Major Crops by Districts

District	Growth Rate (%)											
	Rice				Wheat	Pulses	Food grains	Jute	Rapeseed	Potato	Non-Food Grains	All Crops
	Aus	Aman	Boro	Total								
<b>River Bank Districts</b>												
Burdwan	5	3.2	7.5	4.4	-15.2	-15.4	3.8	0.3	13.1	4.3	4.2	3.9
Hooghly	4	4.2	3.1	3.9	-16.2	-20.5	3.3	1.1	15.5	6.7	6.2	4.5
Howrah	8.4	4.3	13	6.8	-23.1	11.8	6	-3	17.8	3.4	2.4	5.4
Malda	-1.7	3.5	9.9	4.9	4.2	2.4	4	1	9.9	3.9	4.5	4.1
Midnapore*	6.7	3.6	9.7	5.1	-6.3	-2.3	4.8	0.3	24.7	11.8	10.5	5.9
Murshidabad	0.7	5.1	10.1	5.3	0	-6.3	3.1	5.8	12.5	2.4	4.3	3.8
Nadia	3	6.7	11.3	7.5	-0.1	-1.7	5.5	5.1	16.2	1	5.1	5.7
24-Parganas*	5.4	2.9	10.2	4.3	-1.8	-4.4	3.9	-1.1	18.6	1.9	2.9	3.8
Average	3.3	3.8	9.2	4.9	-7.5	-4.6	3.9	0.9	15.2	4.2	4.8	4.3
<b>Non-River Bank Districts</b>												
Bankura	8.1	3.9	19.7	5.2	-2.7	-5.9	4.8	-4.9	14.4	11.2	9.8	5.7
Birbhum	8.9	2.6	7.2	3.2	-7.3	-6.2	2.3	0.4	17.6	6.7	6.7	2.9
Coochbehar	4.5	3.5		4.2	-4.8	1.5	2.9		4.3	12	2.8	3
Jalpaiguri	2.4	2		2.2	-2.6	-6.8	1.5		6	11.5	1.5	1.5
Purulia	9.8	4.1		4.3	-7.8	3.9	4.2		8.7	7.2	5.2	4.2
West Dinajpur *	-3.5	4.2	20.9	4.9	-1.7	-4.2	3.8	1.4	13.3	1.1	1.5	3.6
Average	5	3.4	15.9	4	-4.5	-3	3.3	-1	10.7	8.3	4.6	3.5
West Bengal	3.2	3.6	9.4	4.6	-3.2	-3.2	3.6	2.6	13.9	6.8	4.7	4.1

Note: \* Data stands for undivided district; Source: Sanyal *et al.* (1998)

It is important to note that despite marginal increase or decline in area under many of the crops in majority of the districts, their production recorded a high rate of growth largely due to increase in yield at a very high rate. As it is seen in Table 13, yield of rice in general, and aus rice and aman rice in particular, as well as that of potato increased at reasonably high rate in majority of the districts. However, yield of wheat declined in some of the districts like Burdwan, Howrah, Midnapur, Nadia, Coochbehar, Jalpaiguri and Purulia. Further, although area under production of rapeseed increased at a very high rate in most of the district, the rate of growth of yield of this crop was very low in many of the districts.

**Table 13: Rate of Growth of Yield of Major Crops by Districts, 1977-78 to 1993-94**

District	Growth Rate (%)											
	Rice				Wheat	Pulses	Food grains	Jute	Rapeseed	Potato	Non-Food Grains	All Crops
	Aus	Aman	Boro	Total								
<b>River Bank Districts</b>												
Burdwan	6.3	6.3	3.7	6.8	-1.6	1.9	7.6	3.3	0.7	4	1.1	4.5
Hooghly	5.1	5.8	1.2	5.5	4.6	0	5.7	8.4	2.9	3.1	4.1	5.3
Howrah	7.3	3.4	1.6	6.2	-2.7	1.2	6.5	2.8	2.2	6.9	3.5	4.4
Malda	2.2	3.5	7.2	6	2.1	1.9	5	0.4	1.2	1.5	3.8	5.8
Midnapore*	6.3	5.2	1.1	6.1	-0.3	5.3	6.2	2.3	3.8	6	5.7	6.4
Murshidabad	3.2	5.4	3.4	6.3	13.2	1.1	5.6	2.5	1.3	4.8	3.1	5.2
Nadia	6.4	8.2	6.2	9.4	-0.2	1.2	7.3	4.1	3.3	3	4.4	7.2
24-Parganas*	9.3	4.8	4.6	5.4	2.3	0.6	5.2	4.2	4.4	3.1	1.8	4.5
Average	5.8	5.3	3.6	6.5	2.2	1.7	6.1	3.5	2.5	4.1	3.4	5.4
<b>Non-River Bank Districts</b>												
Bankura	9.4	5.7	7.5	6.6	4.7	2.2	6.5	3.4	1	7.5	7.6	5.6
Birbhum	8.3	5.3	2.5	5.5	2.5	3.8	5.6	4.7	1.7	8.3	1.3	2.1
Coochbehar	5	2.1		3.5	-2.3	1.3	2.8		2.7	4	2	2.5
Jalpaiguri	3.5	1.7		2.3	-1.3	2	2		2.5	4	1	1.9
Purulia	4.3	3.1		3.4	-8.5	2.2	3.3		3.2	1.2	1	2.9
West Dinajpur *	6.4	3.7	7.6	5.7	2.5	1.6	5.3	2.7	3.5	1.2	3	5
Average	6.2	3.6	5.9	4.5	-0.4	2.2	4.3	3.6	2.4	4.4	2.7	3.3
West Bengal	5.9	4.6	2.9	5.7	-2.4	1.9	5.1	3.1	2.4	4.5	3.6	5

Note: \* Data stands for undivided district; Source: Sanyal *et al.* (1998)

## 4.2. Crop Diversification in West Bengal

Sustainable growth of the agricultural sector depends considerably on the process of agricultural transformation, which in turn is well connected with shifts in production patterns i.e. on the extent of crop diversification<sup>4</sup>. A greater degree of diversification from the traditional wheat-paddy system helps in overcoming various ecological problems

<sup>4</sup> By crop diversification we generally refer to a gradual process of moving out of monoculture system of subsistence food crop production to a diversified production system with technological change in production.

including decline in soil fertility<sup>5</sup>. The importance of crop diversification becomes more pertinent particularly as a strategy to reduce variability in agriculture production and yield (Rahman, 2009). A diversified cropping pattern can be seen as a strategy to cope with production risks and uncertainties associated with climatic and biological vagaries (Shiyani and Pandya 1998)<sup>6</sup> and a correct crop mix can help the farmers to cope with the risks of crop loss due to climatic variations<sup>7</sup>. Farmers living in fragile ecosystem such as semi-arid and arid regions and those who are in subsistence economy more often than not adopt diversified cropping strategy because of the fear of crop failures due to pest attack or lack of sufficient water, etc. In essence, crop diversification helps the farmers in reducing variability in income (Guvele, 2001), sustaining a reasonable income level (Van den Berg *et al.*, 2007), and mitigating drought and enhancing water use efficiency (Kar *et al.*, 2004).

Contrary to this, in recent years, the growing demands for agricultural production has forced the farmers to adopt intensification of agriculture practices along with the increasing use of high yielding crop varieties for maintaining higher levels of production (Weinberger and Lumpkin, 2007). This has restricted the scope for crop diversification and hence efficient water use in agriculture.

Given this backdrop, attempts are made to examine the extent of crop diversification in West Bengal and its possible implications for the river basin. Two indices viz. Herfindahl Index ( $DI_H$ ) based on Berry (1971) and Entropy Index ( $DI_E$ ) as suggested by Hart (14) are computed. Berry's Index of crop diversification is computed by using the formula,

$$DI_H = \sum_{i=1}^n (s_{it})^2 \text{ with } s_{it} = \frac{A_{it}}{\sum_{i=1}^n A_{it}}$$

Here,  $A_{it}$  stands for area under the  $i^{\text{th}}$  crop in year  $t$  and  $n$  for total number of crops cultivated in the State in that year. We consider 40 crops cultivated in the State to compute these Indices in different years. Higher the value of the index, lower is the extent of crop diversification. When the entire GCA is confined to a single crop, value of the index  $DI_H$  is zero implying no crop diversification. As the GCA is distributed across more number of crops, value of the index  $DI_H$  declines indicating greater extent of crop diversification.

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<sup>5</sup>For example, a non-rice crop in sequence with rice that allows the soil to dry out, enhances soil nutrient supply and arrests pest build up can improve the productivity of the subsequent rice crop (Pingali and Rosegrant, 1995).

<sup>6</sup> Such production risks and uncertainties generally arise from various diseases of crops and pests along with variations in weather condition and irregular rainfall (Mandal, 2010).

<sup>7</sup> For example, the farmers in drought-hit Rajasthan areas adopt a mixed cropping system with a flexible production schedule as a response to varying rainfalls (Rathore, 2004). A large number of crops and their combinations are used to take care of climatic risks in such areas (Mandal, 2010).

On the other hand, the Entropy Index of crop diversification is computed by using the formula,

$$DI_E = \sum_{i=1}^n s_{it} * \ln\left(\frac{1}{s_{it}}\right)$$

However, unlike the Herfindahl index, a higher value of the entropy index indicates greater extent of crop diversification and vice versa.

Table 14 shows changing distribution of land in West Bengal across crops during 1970-71 to 2004-05. It is observed that, though declining over the years, around 80 percent of the GCA in the State is still under foodgrains and, more specifically, around 50 percent of this GCA is under aman rice. Further, the proportion of GCA under boro rice has increased significantly during this period. Although proportion of GCA under some of the major crops like oilseeds, potato, chillies, ginger, etc. has increased, that under the pulses and sugarcane has declined quite sharply over the years.

**Table 14: Changing Distribution of Land across Crops, 1970-71 to 2004-05**

Crops	1970-71	1980-81	1990-91	2004-05
Aus	11.45	8.37	7.73	4.06
Aman	56.88	57.38	54.55	49.26
Boro	2.67	4.72	11.35	16.59
Rice	71	70.48	73.63	69.91
Wheat	5.16	3.85	3.41	5.08
Other cereals	2	1.58	1.26	0.18
Total cereals	78.14	75.91	78.3	75.17
Gram	2.22	1.31	0.32	0.55
Arhar	0.37	0.31	0.07	0.04
Other pulses	7	5.52	3.57	2.3
Total pulses	9.59	7.14	3.98	2.9
Food grain	87.74	83.05	82.28	78.07
Rapeseed and mustard	1.55	1.78	4.79	5.4
Linseed	0.62	0.92	0.11	0.11
Til	0.15	1.47	1.26	1.34
Total oilseeds	2.41	4.32	6.5	8.18
Jute	5.83	8.31	6.34	7.41
Mesta	0.95	0.6	0	0.12
Cotton	0.02	0	0	0.01
Total fibre	6.83	8.94	6.48	7.57
Tea	1.27	1.28	1.28	1.31
Sugarcane	0.55	0.19	0.15	0.2
Tobacco	0.14	0.26	0.16	0.16
Potato	0.93	1.57	2.46	3.68
Chillies	0.11	0.34	0.62	0.72
Ginger	0.02	0.04	0.07	0.11
Total cropped area	100	100	100	100

Source: Ghosh (2010)

This highly skewed distribution of land towards the foodgrains is reflected in low extent of crop diversification in the State. Table 15 presents the Herfindahl index and entropy index of crop diversification in the districts of West Bengal. It is observed that three of the river-bank districts namely Malda, Nadia and Murshidabad have always been among the top five districts in respect of crop diversification. What is more interesting is that although increasing over the years, the extent of crop diversification is still low in some of the river basin districts like Burdwan, Howrah, Midnapur and 24-Parganas, particularly when compared with some of the non-river basin districts like Coochbehar, Darjeeling, Jalpaiguri and West Dinapur. The extent of crop diversification has increased in most of the districts over the years. However, the pace of increase is not very encouraging.

**Table 15: Extent of crop diversification across districts, 1970-73 to 2002-05**

District	Herfindahl-Hirschman Index				Entropy Index			
	1970 - 1973	1979 - 1982	1989 - 1992	2002 - 2005	1970 - 1973	1979 - 1982	1989 - 1992	2002 - 2005
<b>River Bank Districts</b>								
Burdwan	0.53	0.48	0.40	0.37	1.14	1.27	1.32	1.31
Hooghly	0.31	0.33	0.29	0.28	1.53	1.55	1.59	1.51
Howrah	0.45	0.49	0.33	0.38	1.30	1.18	1.16	1.22
Malda	0.18	0.18	0.22	0.21	1.95	1.89	2.02	1.84
Midnapore	0.58	0.62	0.48	0.40	0.99	0.95	1.18	1.31
Murshidabad	0.18	0.18	0.18	0.17	1.94	1.96	1.95	1.95
Nadia	0.17	0.16	0.15	0.15	1.97	1.97	2.02	2.02
24 Paraganas	0.58	0.56	0.48	0.42	1.02	1.07	1.19	1.31
Average	0.37	0.38	0.32	0.30	1.48	1.48	1.55	1.56
<b>Non-River Bank Districts</b>								
Bankura	0.63	0.64	0.52	0.49	0.87	0.91	1.15	1.18
Birbhum	0.40	0.56	0.50	0.44	1.31	1.08	1.17	1.24
Cooch Behar	0.33	0.30	0.33	0.33	1.39	1.50	1.49	1.56
Darjeeling	0.35	0.33	0.28	0.33	1.30	1.44	1.52	1.57
Jalpaiguri	0.42	0.36	0.40	0.37	1.20	1.40	1.35	1.65
Purulia	0.70	0.77	0.69	0.78	0.73	0.58	0.72	0.57
West Dinajpur	0.31	0.30	0.37	0.28	1.61	1.65	1.50	1.75
Average	0.44	0.45	0.43	0.42	1.25	1.26	1.31	1.40
West Bengal	0.36	0.37	0.34	0.30	1.55	1.54	1.59	1.67

Source: De and Chattopadhyay (2010)

In the face of the poor crop diversification in the State, a rise in cropping intensity (Table 16) may amount to suggest the following. The crops whose production has gone up in recent years are the ones which may have been more water and fertilizer intensive in nature. While a higher cropping intensity is desirable for the State, as the NSA is on the decline or stagnant, in the absence of a pattern of crop diversification, which would be ecologically sustainable, high cropping intensity may pose a serious threat to the river Ganga both in terms of water use and fertilizer consumption. The declining rate of growth of cropping

intensity in recent years may have been attributed to the paucity of water and other complementary inputs.

**Table 16: Changing Cropping Intensity by Districts, 1980-81 to 2007-08**

District	Cropping Intensity							Average	Coeff. of Variation	Growth Rate (%)
	1980-81	1985-86	1990-91	1995-96	1999-00	2005-06	2007-08			
<b>River-Bank Districts</b>										
Burdwan	145.1	147.1	161.9	165.7	191.1	181.4	184	176.2	0.1	0.8
Hooghly	158.5	171.5	203	215.8	219.7	241.6	246	216.3	0.1	1.3
Howrah	133.6	161.5	202.9	183.8	206.2	209.4	202	199.5	0.1	1
Malda	139.6	136.2	191.9	162.7	156.5	198.5	186	175.8	0.1	1.3
Medinipur	124.7	133.5	150.3	164.9	166.1	172.1	173	161.6	0.1	1
Murshidabad	158.7	168.8	183.3	190	210.3	233.7	245	209.7	0.1	1.4
Nadia	167.1	183.8	229.7	235.8	248.6	250.2	241	240.7	0.1	1.2
North 24 Parganas	127	180	163.1	179.8	209.2	190.3	201	186.8	0.1	1
South 24 Parganas	119.1	129.1	127.5	127.7	147.5	137.1	143	137.4	0.1	0.6
Average	141.5	156.8	179.3	180.7	195	201.6	202.3	189.3	0.1	1.1
<b>Non-River Bank Districts</b>										
Bankura	117.8	124.5	138.6	147.6	149.7	147.2	164	142	0.1	0.6
Birbhum	131.6	132.3	144	157.4	155.9	160.8	176	154.8	0.1	0.9
Coochbihar	158	176.3	183.8	190.9	202.6	207.5	220	192.8	0.1	0.6
Darjeeling	309.6	365.5	125	119.8	117.4	169.1	139	155	0.5	-3.9
Jalpaiguri	137.2	203.1	135.7	143.7	153.4	166.9	169	159.4	0.1	0.3
Purulia	103.4	120.5	106.1	109.3	110.1	106.8	123	108.2	0.1	0.3
West Dinajpur	151.4	157	160.7	159.4	170.9	171.8	177	167.9	0	0.5
Average	158.4	182.7	142	146.9	151.4	161.4	166.9	154.3	0.1	-0.1
West Bengal	139.1	147	158.6	164.3	174.4	180	184	169.9	0.1	0.9

Source: Computed by the authors

## 5. Agricultural Inputs

In the backdrop of the agricultural growth scenario in the State, it is important to present the nature and state of agricultural inputs that are in use in the State of West Bengal and their implications. Irrigation and fertilizer use are the two major inputs that have significant importance as far as their effects on the Ganga river basin in West Bengal are concerned. Agriculture is the dominant sector in West Bengal that put tremendous pressure on Ganga River in terms of the use of her water for irrigation and receiving run-offs from the cultivation. Hence, it is imperative to examine the trends of use of irrigation practices in the State for better understanding of implications of changing dynamics of irrigation practices and their further implications on the Ganga river basin.

### 5.1. Sources of Irrigation

With regard to the sources of irrigation system in West Bengal, there seems to be a significant difference between West Bengal and the rest of the country. A comparison of increase in net area irrigated (NIA) by different sources of irrigation between West Bengal

and India from 1976-77 to 1985-86 presents striking differences. For instance, in groundwater irrigation, tube wells showed a whopping 575 percent increase in NIA as compared to 60 percent in the country at large. As far as all the sources of irrigation are concerned, interestingly, the State witnessed an increase by about 74 percent during the above-said period as compared to only 20 percent increase at the all India level (Table 17). This clearly indicates the enormity of demand for water in the State.

**Table 17: Increase in NIA by Sources of Irrigation in West Bengal and India**

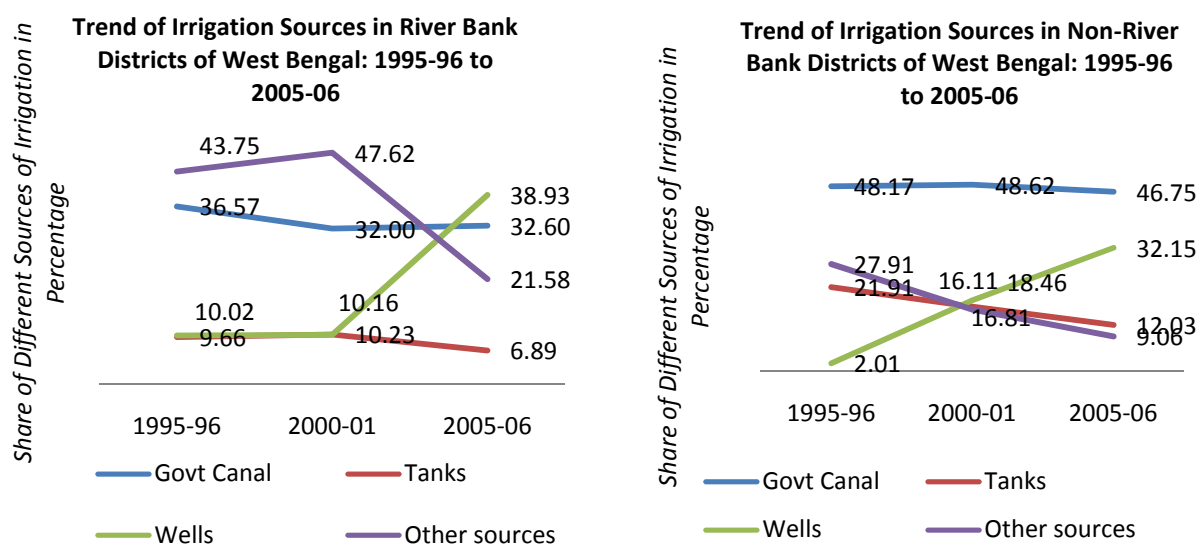
Source of Irrigation	Percentage Increase (1976-77 to 1985-86)	
	West Bengal	All-India
Canals	12.9	14.4
Tubewells	575.4	59.7
Tanks/ponds	44	(-) 22.0
Wells	(-) 34.0	13.7
Other sources	201	13.6
All sources	74	19.7

Source: Ray and Ghosh (2007)

The trends in irrigation sources in river bank districts clearly reveal that while the traditional irrigation systems such as tanks and ponds have shown sharply declining trend, the sources of irrigation by wells have registered substantial increase over the period 1995-96 to 2005-06. A slightly similar trend can also be observed in non-river bank districts as well. In the entire State, the share of tanks in the total irrigation has declined from 33 percent in 1960-61 to 11 percent in 1999-2000 (Table 18). This has serious implications on the flow of river Ganga because of overexploitation of groundwater in the basin area, as groundwater table and river flow are intricately connected.

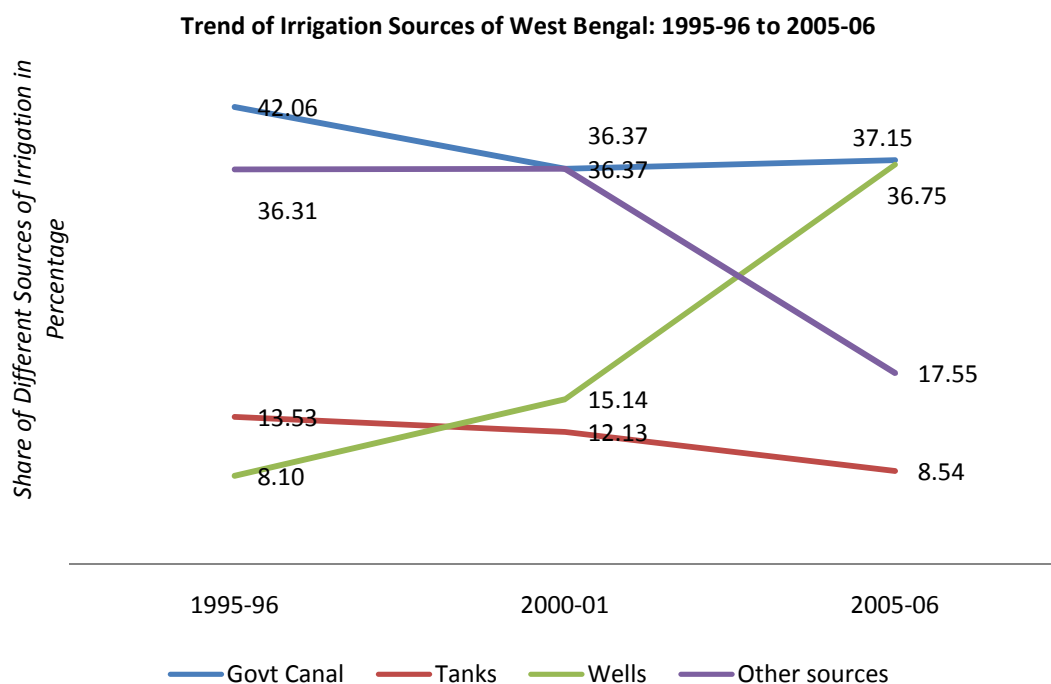
During the pre-colonial period, irrigation in West Bengal was based on ponds, bunds, shallow wells and other kinds of storage works (Rawal, 2001). However, extensive canal irrigation system was constructed during colonial period to irrigate land in dry season and also to supplement in monsoon. Today it constitutes one of the major sources of irrigation in West Bengal. In 1990-91, canal as a source of irrigation constituted about 54 percent of the GCA of the State, which however, has registered decline to 42 percent in 1999-2000. However, the distribution of canal irrigation in the State is highly skewed, as it is concentrated only in a few districts like Burdwan, Bankura, Birbhum, Midinapur, and Hoogly. The growth of area under canal irrigation has occurred in a few districts like Jalpaiguri, Darjeeling and Howrah. The growth of area irrigated by canals has slowed down in West Bengal over the years (Tables 18 and 19).





Source: Statistical Abstract of West Bengal, 2005.

Figure 3: Trends in Sources of Irrigation in River and Non-River Bank Districts of West Bengal



Source: Statistical Abstract of West Bengal, 2005.

Figure 4: Trends in Sources of Irrigation in West Bengal

Table 18: Irrigation Sources as a Percentage of Gross Irrigated Area

District	1960-61			1990-91			1999-2000		
	Canal	Tank	Ground water Structure	Canal	Tank	Ground water Structure	Canal	Tank	Ground water Structure
Burdwan	77.4	14.2	8.38	95.41	na	4.58	91.54	na	8.45
Birbhum	59.82	25.23	14.93	74.62	16.37	9	65.74	14.73	19.52
Bankura	16.89	78.03	5.07	69.13	21.13	9.73	52.35	11.37	36.27
Medinipur	29.1	26.62	44.26	55.13	13.85	31	37.51	11.44	51.03
Howrah	11.76	7.35	80.88	9.59	0	90.4	42.55	22.17	35.27
Hooghly	56.14	13.75	30.09	51.32	6.48	42.19	49.8	9.15	41.04
24 Parganas	na	88.57	11.42	43.3	50.78	5.91	9.64	1.09	89.26
Nadia	na	na	na	Na	na	Na	na	na	Na
Murshidabad	49.94	30.36	19.69	86.85	0	13.14	36.95	7.87	55.16
Dinajpur	na	90.12	9.87	Na	37.59	62.4	9.76	24.13	66.1
Malda	na	98.92	1.07	0	14.46	85.53	0	10.55	89.44
Jalpaiguri	61.44	10.84	27.71	60.24	7.46	32.28	71.2	2.99	25.8
Darjeeling	4.8	na	95.19	4.95	0	95.04	100	0	0
Coochbehar	na	na	na	2.7	8.6	88.69	1.24	9.53	89.21
Purulia	0.39	98.68	0.91	Na	na	Na	35.9	35.29	28.8
West Bengal	46.57	33.46	19.96	54.21	13.7	32.07	42.22	10.64	47.13

Source: Ray and Ghosh (2007)

Table 19: Growth in Irrigated Area according to Sources

District	1960-1967			1990-2000		
	Canal	Tank	Groundwater Structure	Canal	Tank	Groundwater Structure
West Bengal	4	-1.42	1.19	1.35	1.74	6.6
Burdwan	2.55	-1.19	1.61	0.73	Na	6.88
Birbhum	2.64	-2.19	0.1	-0.09	-2.52	12.92
Bankura	18.44	-1.94	0.8	-0.16	-2.76	16.51
Medinipur	6.32	-0.09	0.1	-12.7	5.98	13.33
Howrah	18.18	-4.9	-3.62	17.38	10.27	-24.65
Hooghly	3.76	-1.41	2.11	0.68	6.62	-2.32
24 Parganas	na	-0.82	33.09	4.39	1.3	28.28
Nadia	18.34	-4.1	10.73	Na	Na	2.12
Murshidabad	1.35	-0.55	2.49	0.13	-12.77	6.69
Dinajpur	na	2.38	8.9	0.09	-21.4	2.7
Malda	na	0.58	22.42	Na	1.72	8.72
Jalpaiguri	8.39	-9.46	1.86	35.23	15.3	23.11
Darjeeling	-0.34	na	-1.54	29.69	Na	27.7
Coochbehar	na	na	-1.55	0.43	11.28	11.16
Purulia	9.18	-1.65	5.59	3.41	12.96	-0.88

Source: Ray and Ghosh (2007)

In West Bengal, river water is also pumped out to irrigate agricultural field which constitutes one of the major sources of irrigation in some districts. According to the second census on minor Irrigation, there were 3,167 river lift irrigation schemes in West Bengal in 1995-96. The growth of river lift irrigation has been quite phenomenal since the late 1980s, and this growth has been registered mainly in Medinipur, Birbhum, Bankura, Bardhaman, Nadia, and Murshidabad and Hoogli district (Rawal, 2001)

**Table 20: Compound Annual Rate of Growth of Electrified Pumps, Various States, 1977 to 1993**

State	Growth of Electrified Pumps	State	Growth of Electrified Pumps
Orissa	12.98	Gujarat	7.42
West Bengal	11.28	Assam	7.28
Madhya Pradesh	10.04	Rajasthan	7
Andhra Pradesh	9.81	Himachal Pradesh	6.49
Kerala	9.51	Haryana	5.27
Maharashtra	8.75	Uttar Pradesh	5.26
Karnataka	8.36	Bihar	4.33
Jammu & Kashmir	8.2	Tamil Nadu	3.66
Punjab	7.44	All-India	7.2

Source: Rawal (2001)

Groundwater irrigation in the State is mainly from tube wells, which are owned privately as well as by the government. According to the data from the Censuses of Minor Irrigation, the GIA was about 993 thousand hectares in 1987-88 and about 1332 thousand hectares in 1994-95 (Rawal, 2001). It is also observed that the growth in the 1980s and 1990s was highest in the case of tube well irrigation, and it was also high in comparison with other states as well. West Bengal stands at the second place after Orissa in terms of rate of growth of electrified pumps (Table 20). The high growth in irrigation from tube well was primarily a result of the increase in the number of private shallow tube wells. It was estimated that between 1981 and 1987-88, the number of shallow tube wells increased by an average of 23.5 percent every year. According to data from West Bengal State Electricity Board, the number of electrified tube wells increased by an average of 18.3 percent every year between 1981 and 1987. According to Rawal (2001), there was a deceleration in the expansion of groundwater irrigation after the mid-1980s. The deceleration was higher for tube wells operated by diesel pumps than the tube wells operated by electric pumps.

According to some empirical studies on the agriculture practices in West Bengal, boro (a summer crop) paddy cultivation is absolutely dependent on irrigation and groundwater contributes the major share (77.11 percent) of the total supply (Ray and Ghosh, 2007). It is also found that the districts with boro area having registered greater average than the State average have irrigation systems that are essentially dependent on groundwater and receive minimum contribution from surface water schemes. Often summer rice production has been held responsible for widespread arsenic contamination in ground water sources (Zaman *et al.*, 2004). According to Ray and Ghosh (2007), around 69 blocks in the State are affected by arsenic problem and the cause of this problem is stated to be excessive exploitation of groundwater. Districts such as Murshidabad, Nadia and North 24 Parganas are worst affected. It is also observed that excessive withdrawals have resulted in declining groundwater levels in the state (Table 21).

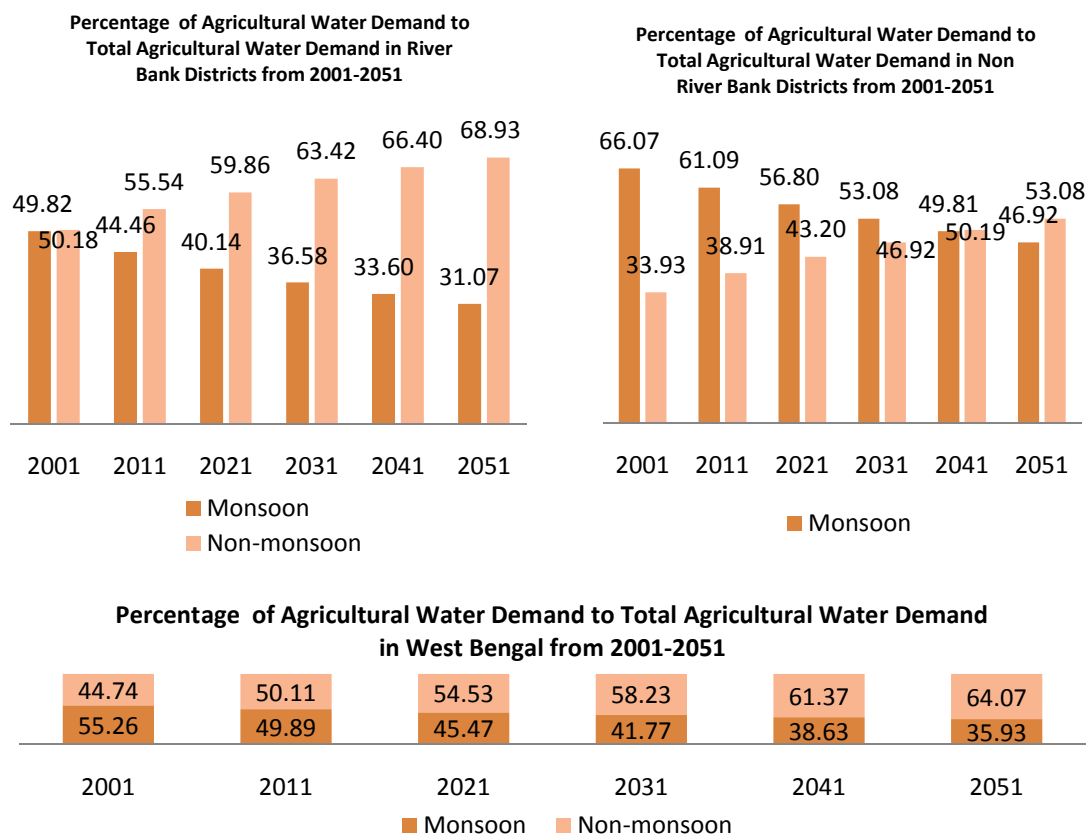
As the state embarks on the path of economic development, there are ever increasing agricultural and other economic activities, which are likely to demand more water in near

future. This may result in water stress in the state. Demand for water for agriculture activities is projected for the period 2001 to 2051 for both river and non-river basin districts of West Bengal. As can be observed from the projection, in the river basin districts the percentage of agricultural water demand during non-monsoon periods is likely to increase by 69 percent by 2051 (figure 5). This may lead to overexploitation of both ground and river water indicating continued pressure on the river in the State.

**Table 21: Arsenic Content Blocks in West Bengal**

Arsenic Affected Blocks	
District	Blocks
Burdwan	1
Hooghly	1
Howrah	3
Malda	5
Murshidabad	15
Nadia	15
North 24 Paraganas	19
South 24 Paraganas	10
<b>Total</b>	<b>69</b>

Source: Adapted from Ray and Ghosh (2007)



Source: Water Resource and its Quality in West Bengal, West Bengal Pollution Control Board, 2009.

**Figure 5: Projection of Agricultural Water Demand (Monsoon and Non-monsoon) in West Bengal across the River and Non-River Basin Districts from 2001-2051**

## 5.2. Use of Chemical Fertilizers

While water demand and its sources remain a critical challenge for the State in general and the river basin in particular, fertilizer consumption remains yet another area of concern for the river basin. Use of chemical fertilizer has significantly increased over time in West Bengal in general and in river basin districts in particular (Table 22). Fertilizer consumption per unit of gross cropped area is higher in river bank districts as compared to their counterparts. Among the traditional crops, paddy consumes greater amount of fertilizer. Fertilizer consumption in potato is also very high and has increased at a very faster rate in the 1990s. However, it is also observed that fertilizer consumption is relatively lower in jute crops. By and large, all the major crops are found to have recorded increasing consumption of fertilizer per hectare of GCA. The consumption of pesticides per hectare of land had registered a declining trend during 1990-91 to 2000-01 (Figure 6). However, since 2001-02, there has again been an increase in the use of pesticides in the State.

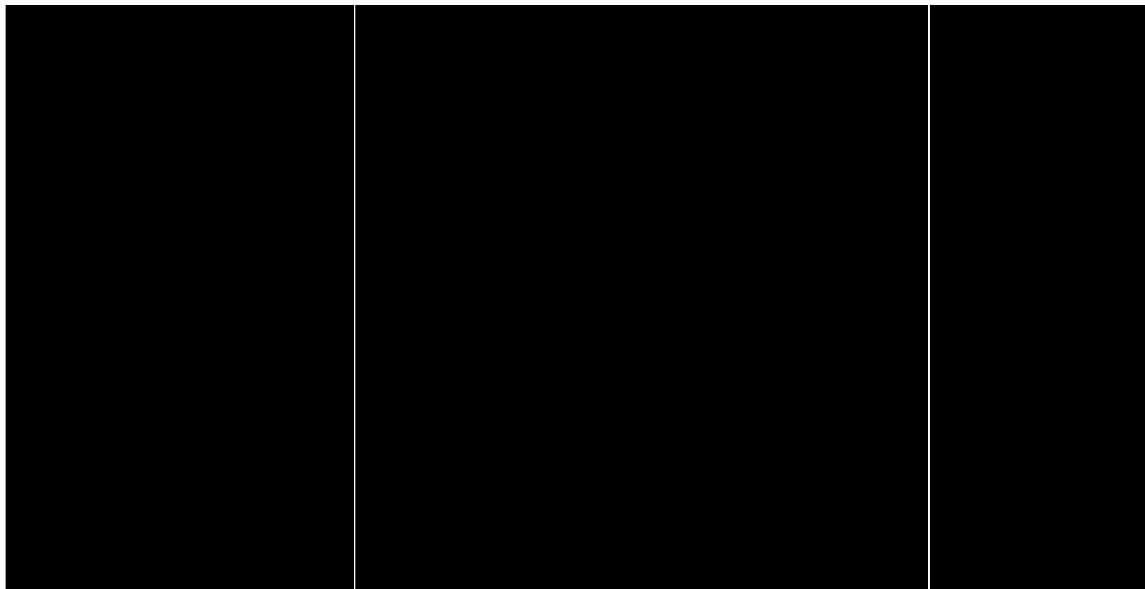
**Table 22: Consumption of Fertilizer per unit of GCA (in kg/ha)**

District	1990-91	2000-01	2002-03	2003-04	2004-05	2005-06	2006-07 (P)	2007-08 (P)
<b>River Bank Districts</b>								
Burdwan	115.15	149.73	144.27	138.19	154.16	153.45	205.43	219.41
Hooghly	170.13	258.12	205.59	199.85	219.21	197.85	271.76	265.08
Howrah	241.96	350.20	374.64	328.81	362.87	372.51	123.17	107.04
Malda	90.56	94.19	111.54	105.65	131.72	140.28	237.28	201.30
Midnapore	69.62	113.27	131.32	120.12	129.97	128.61	146.65	149.59
Murshidabad	74.36	68.38	63.90	57.87	66.52	71.23	145.24	135.15
Nadia	79.58	70.80	69.29	68.73	86.99	94.05	129.60	123.59
24-Parganas	85.03	120.60	135.86	129.82	160.05	152.01	96.35	113.77
<b>Average</b>	<b>115.80</b>	<b>153.16</b>	<b>154.55</b>	<b>143.63</b>	<b>163.94</b>	<b>163.75</b>	<b>169.44</b>	<b>164.37</b>
<b>Non-River Bank Districts</b>								
Bankura	63.72	109.28	125.74	117.42	123.44	111.16	137.40	142.96
Birbhum	110.00	140.85	126.14	125.94	127.10	124.19	147.68	159.57
Dinajpur	57.68	72.47	88.12	81.57	114.98	116.45	122.91	121.63
Jalpaiguri	51.20	95.89	102.47	103.18	118.02	119.44	79.70	76.03
Darjeeling	88.09	172.93	201.04	184.68	215.58	153.48	220.49	249.80
Cooch Behar	72.52	114.14	137.28	129.83	146.93	142.86	72.28	70.15
Purulia	77.19	144.27	159.51	118.64	128.82	131.05	37.98	33.71
<b>Average</b>	<b>74.34</b>	<b>121.40</b>	<b>134.33</b>	<b>123.04</b>	<b>139.27</b>	<b>128.38</b>	<b>116.92</b>	<b>121.98</b>
<b>West Bengal (Average)</b>	<b>86.93</b>	<b>119.02</b>	<b>122.77</b>	<b>115.54</b>	<b>132.47</b>	<b>130.05</b>	<b>141.69</b>	<b>140.98</b>

(P): Provisional ; Sources: (1) Agricultural (Inputs) Department, (2) Directorate of Agriculture, Evaluation Wing, GOWB.

A high correlation between irrigation and consumption of fertilizer per hectare has been observed in the State. For instance, an analysis of data by Ray and Ghosh (2007) for 1980-2002 for boro paddy shows that consumption of fertilizer per hectare has increased

considerably. Interestingly, output elasticity of fertilizer for one of the important paddy crops in the State, Boro, has declined considerably (Table 23), forcing farmers to use more fertilizers. According to Russel (1973), crops commonly use 30 to 70 per cent of added nitrogen, 10 to 30 per cent of added phosphorous and 50 to 80 per cent of added potassium in a moderate to good soil exchange capacity status. The residual amount gets deposited in the soil, passes on with the irrigated water as agriculture run-offs to surface water and reaches river, and even reaches groundwater underneath. The increased use of chemical fertilizer has several serious implications. First, it pollutes both ground and surface water sources, which causes serious human and animal health hazards. Second, the polluted water finally finds ways to river that damages flora and fauna in river ecosystem. Third, agriculture wastewater is considered one of the major sources of river pollution that is hard to track as it is a non-point source of pollution. The obvious policy implication is that if crops that require less use of chemical fertilizer can be identified and grown in the river basin areas, it will help reduce pollution load in the river.



Source: Directorate of Agriculture, Government of West Bengal Bureau of Applied Economics & Statistics, Government of West Bengal - Statistical Abstract.

**Figure 6: Consumption Pesticides in West Bengal across the River and Non-river Bank Districts**

**Table 23: Output Elasticity of Fertilizer for Boro Paddy in West Bengal**

Time-Period	Coefficient
1983-1986	0.22 (1.75)
1994-1998	0.26 (1.01)
1999-2002	0.13 (0.97)

Source: Ray and Ghosh (2007)

## 6. Implications

From the preceding analysis, the following important observations can be made, which may have significant bearing on the Ganga river basin.

- Average land holding is very low in the state and a significant proportion of farmers are marginal farmers. This may hinder agricultural productivity to rise and the production of crops highly uneconomical.
- There has been a significant increase in agriculture production in the State largely due to introduction of high-yielding boro rice cultivation that enabled the farmers to grow more than one crop in a year<sup>8</sup>. The area under boro rice and its production have increased over the years. Sourcing water for boro is made mainly through minor irrigation and hence amounting to high extraction of ground water, which poses a challenge. It may be worthwhile to mention here that the declining phase since the 1990s in agricultural growth may be largely attributed to the depletion of ground water level in the State. In such a situation, effective crop diversification may be considered to be the key to attain higher agricultural growth without, however, jeopardizing the ecological health of the region.
- It is also found that amongst the traditional crops, the fertilizer consumption in rice and potato cultivation is very high, while that in jute is relatively lower. There is thus a need to introduce crop diversification, which would economize the use of all resources including chemical fertilizers.
- Cropping intensity is substantially higher in river bank districts as compared to their counterparts indicating thereby possibility of unsustainable use of land and water as the current cropping pattern is more water and fertilizer intensive. It is thus important to promote traditional agricultural practices that economize the use of water and land. It is, in this context, pertinent to provide extension services that promote sustainable agricultural practices in the river basin districts.
- Turning to sources of irrigation, it is quite evident from the above findings that the number of tube wells has increased significantly over time in the river basin, which might have contributed to the depletion of groundwater and thereby river flow and river ecosystem at large. Therefore, it is imperative on the part of the government to bring law that promotes the use of tube wells in the basin area more judiciously.
- While the restrictions on the number of tube wells in the river basin may improve groundwater table, this may be implemented along with policy that creates incentive to encourage recharge of groundwater through percolation tanks/ponds in the region.
- In addition, constant monitoring of groundwater tables in the river basin districts is necessary for evaluating its status from time to time.

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<sup>8</sup> High rate of growth of agriculture in the 1980s was also attributed to land reforms (Sarkar, 2006).

- In order to utilize the groundwater resources for agricultural use and other development activities in the Ganga river basin on a sustainable fashion, it is necessary to ensure that extraction of groundwater is less than or equal to the rate of recharge. This will ensure that the groundwater resources are not overexploited.
- Before the advent of modern irrigation practices viz. the use of tube wells and canals, agricultural practices in West Bengal were completely based on traditional irrigation practices like tanks and ponds. Over the last couple of decades, these traditional sources of irrigation system in the state have declined dramatically and it is now imperative to revert back to the old system in order to restore the agricultural ecosystem.
- Another important implication is concerning the use of chemical fertilizer which has not only damaged the top soil but also polluted both surface (including river) water and groundwater with serious human and animal health hazards. This has serious negative impacts on river as well as agriculture ecosystem. It is also important to understand that growth of agricultural production is absolutely essential for livelihoods and food security of local communities in particular and nation as whole in general. However, efforts should be made to transit from inorganic farming practice to that of organic one for sustainable agricultural development as the current practices of chemical fertilizer may result in severe reduction in production in agriculture.

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## Appendix

## Relevant Data on Agricultural and Agricultural Practices

Table A.1: Population Growth, Density and Literacy in West Bengal and India

Particulars	1981		1991		2001	
	India	West Bengal	India	West Bengal	India	West Bengal
Population (in lakhs)	6833.29	545.81	8463.03	680.78	1028.37	801.76
Decennial percentage variation of population	24.66 (1971-81)	23.17 (1971-81)	23.85 (1981-91)	24.73 (1981-91)	21.56 (1991-01)	17.77 (1991-01)
Density of population (per sq km.)	216	615	273	767	325	903
Percentage of urban population to total population	23.34	26.47	26.13	27.48	27.81	27.97
Literacy (per cent)	43.56	48.64	52.19	57.7	64.82	68.64
Sex Ratio	933	911	927	917	933	934

Source: Census Reports; Economic Review 2008-09 Government of West Bengal

Table A.2: Some Important Demographic Features of West Bengal

Particulars	1971	1981	1991	2001
Total population (in lakhs)	443.12	545.81	680.78	801.76
Number of male population (in lakhs)	234.36	285.61	355.11	414.66
Percentage of male population to total population	52.89	52.33	52.16	51.72
Number of female population (in lakhs)	208.76	260.2	325.67	387.1
Percentage of female population to total population	47.11	47.67	47.84	48.28
Urban population (in lakhs)	109.67	144.47	187.08	224.27
Percentage of Urban population to total population	24.75	26.47	27.48	27.97
Rural population (in lakhs)	333.45	401.34	493.7	577.49
Percentage of Rural population to total population	75.25	73.53	72.52	72.03
Population of Kolkata Urban Agglomerations (in lakhs)	70.31	91.94	110.22	132.06
Percentage of population of Kolkata Urban Agglomerations to total urban population	64.11	63.64	58.92	58.88
Number of main workers (in lakhs)	123.69	154.24	205.81	230.24
Number of cultivators (in lakhs)	39.55	45.91	58.45	N.A
Number of agricultural labourers (in lakhs)	32.72	38.92	50.55	N.A
Percentage of cultivators to main workers	31.97	29.76	28.4	N.A
Percentage of agricultural labourers to main workers	26.45	25.23	24.56	N.A

Source: Census of India; Economic Review 2008-09, Government of West Bengal; NA-Data Not Available

Table A.3: Percentage Share of Different Sectors in Total NSDP (at 1999 - 2000 Prices)

Sectors	1999-00	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
Primary	32.77	30.17	29.47	28.22	27.2	25.69	24.9
Secondary	14.64	15.59	15.99	16.57	16.46	17.18	17.26
Tertiary	52.59	54.24	54.54	55.21	56.74	57.13	57.76
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Sources: Bureau of Applied Economics &amp; Statistics, Government of West Bengal Economic Review 2008-09

Table A.4: Land use Pattern of West Bengal across the River and Non-River Bank Districts (Area in '000 ha)

Particulars	Total Reported Area			Net Sown Area			Gross Cropped Area			Forest Area			Area under Non-agr use			Culturable Waste land			Fallow land		
	1980-1981	2000-2001	2007-2008	1980-1981	2000-2001	2007-2008	1980-1981	2000-2001	2007-2008	1980-1981	2000-2001	2007-2008	1980-1981	2000-2001	2007-2008	1980-1981	2000-2001	2007-2008	1980-1981	2000-2001	2007-2008
<b>River Basin Districts</b>																					
24-Parganas*	1460.2	1346.5	1335.2	693.4	638.2	631.5	880.3	1052.5	1051.7	426.3	426.3	426.3	329.0	244.1	267.0	8.0	1.6	0.2	3.5	33.7	10.2
Burdwan	700.6	698.5	698.8	471.1	477.5	452.0	683.7	788.7	832.2	31.0	28.8	21.2	131.2	170.7	208.6	51.9	7.5	7.6	15.4	15.1	9.4
Hoogly	314.5	312.2	313.4	234.4	230.5	219.9	371.5	396.4	540.6	0.3	0.7	0.5	70.5	77.2	91.2	7.5	2.6	1.3	1.8	1.3	0.4
Howrah	145.1	136.0	138.7	96.7	87.0	80.7	129.2	165.3	162.9	NA	NA	NA	43.3	44.2	53.4	3.4	0.3	0.2	1.6	5.6	4.3
Malda	360.5	371.1	370.9	283.9	222.2	210.3	396.2	459.6	391.1	1.4	1.7	1.7	67.1	87.9	92.8	7.1	0.1	0.1	1.1	58.5	66.0
Midnapore**	1360.6	1323.9	1325.2	862.0	874.3	887.7	1074.9	1438.6	1508.6	172.1	170.8	172.8	238.1	253.3	269.8	55.5	4.1	6.2	32.0	21.3	25.8
Murshidabad	536.7	532.5	532.5	426.8	393.0	398.8	677.2	754.9	976.3	0.8	0.8	0.8	94.2	147.3	131.8	7.9	0.7	0.8	4.2	2.7	0.3
Nadia	390.9	390.7	390.7	320.3	298.5	289.2	535.3	721.6	697.7	1.3	1.2	1.2	63.9	80.8	93.3	2.6	1.0	0.8	2.8	8.6	6.1
<b>Total</b>	<b>5269.0</b>	<b>5111.3</b>	<b>5105.2</b>	<b>3388.7</b>	<b>3221.2</b>	<b>3170.2</b>	<b>4748.3</b>	<b>5777.6</b>	<b>6161.0</b>	<b>633.0</b>	<b>630.2</b>	<b>624.5</b>	<b>1037.2</b>	<b>1105.5</b>	<b>1208.0</b>	<b>144.0</b>	<b>17.9</b>	<b>17.2</b>	<b>62.5</b>	<b>146.7</b>	<b>122.4</b>
<b>Non-River Basin Districts</b>																					
Bankura	685.6	688.1	688.0	379.5	344.1	345.4	447.0	499.2	565.8	139.6	148.4	148.9	83.4	124.5	153.1	63.9	6.7	2.1	19.3	64.5	38.5
Birbhum	451.4	451.1	451.1	341.9	337.5	318.5	450.0	458.7	560.8	15.7	16.0	15.9	50.8	85.1	98.1	31.9	3.4	3.9	6.8	9.1	14.7
Cooch Behar	341.4	331.4	331.6	264.4	264.9	248.1	417.8	508.4	547.1	5.7	3.8	4.3	58.9	56.9	76.7	11.8	0.8	1.0	0.5	5.8	1.5
Darjeeling	83.9	325.5	325.5	45.8	136.9	140.7	141.6	186.3	195.8	22.6	124.6	124.6	10.5	50.1	42.4	4.0	1.7	1.8	1.2	12.8	16.0
Dinajpur***	534.0	534.4	534.4	468.4	463.9	461.5	709.2	800.2	819.0	1.3	1.5	1.5	53.5	63.4	68.6	8.4	0.2	0.1	2.4	6.1	2.8
Jalpaiguri	616.1	622.7	622.7	317.7	336.5	334.6	435.7	560.7	564.4	172.6	179.0	179.0	89.9	100.2	94.1	32.5	0.2	0.1	3.5	3.5	14.9
Purulia	623.4	623.3	625.6	301.9	311.7	312.9	312.0	325.4	385.2	87.6	87.6	75.1	108.5	97.0	110.2	81.7	6.4	7.3	43.7	120.6	120.2
<b>Total</b>	<b>3335.8</b>	<b>3576.4</b>	<b>3578.9</b>	<b>2119.5</b>	<b>2195.5</b>	<b>2161.8</b>	<b>2913.3</b>	<b>3339.0</b>	<b>3638.0</b>	<b>445.0</b>	<b>560.8</b>	<b>549.2</b>	<b>455.4</b>	<b>577.2</b>	<b>643.2</b>	<b>234.1</b>	<b>19.3</b>	<b>16.2</b>	<b>77.4</b>	<b>222.3</b>	<b>208.5</b>
<b>West Bengal Total</b>	<b>8604.9</b>	<b>8687.7</b>	<b>8684.1</b>	<b>5508.2</b>	<b>5416.7</b>	<b>5332.0</b>	<b>7661.6</b>	<b>9116.6</b>	<b>9799.0</b>	<b>1078.0</b>	<b>1191.0</b>	<b>1173.7</b>	<b>1492.6</b>	<b>1682.7</b>	<b>1851.1</b>	<b>378.1</b>	<b>37.1</b>	<b>33.4</b>	<b>139.9</b>	<b>369.0</b>	<b>331.0</b>

Source: Directorate of Agriculture (Evaluation), Government of West Bengal. Note: 24 Parganas\* includes North-24 Parganas and South-24 Parganas; Midnapore\*\* includes East & West Midnapore; Dinajpur \*\*\* includes Uttar and Dakshin Dinajpur; NA - Data Not Available

Table A.5: Estimated Number of Operational Holdings According to Size Class in West Bengal Across Various Districts

District	Large (more than 10 ha.)			Medium (4-10 ha.)			Semi Medium (2-4 ha)			Small (1-2 ha.)			Marginal ( Below 1.0 ha )		
	1980-81	2000-01	2005-06	1980-81	2000-01	2005-06	1980-81	2000-01	2005-06	1980-81	2000-01	2005-06	1980-81	2000-01	2005-06
<b>River Bank Districts</b>															
24 Parganas*	94	22	31	10437	63927	1271	58419	23465	20151	149600	127861	115431	783791	887078	917729
Burdwan	216	60	81	12822	92627	5377	55125	32015	31761	101530	88410	89543	211236	325565	343359
Hooghly	11	15	NA	2037	24778	1169	18499	8377	7464	51607	38309	40363	241432	284330	293535
Howrah	_N.A	21	11	355	6472	95	4541	2768	888	17680	14550	12496	184260	218281	211654
Malda	164	22	1	6687	37859	991	27364	13224	15012	60545	52988	49860	240162	295805	310706
Midnapore**	163	37	24	14490	64246	1545	69250	23411	25337	168302	108853	121184	788298	1127637	1139415
Murshidabad	35	15	5	6916	67032	2100	38767	25556	25126	101125	97910	94306	352750	460025	473388
Nadia	_N.A	19	13	7233	34159	880	31504	12658	12443	74094	76386	75752	236604	310374	329150
Total	683	211	166	60977	391100	13428	303469	141474	138182	724483	605267	598935	3038533	3909095	4018936
<b>Non-River Bank Districts</b>															
Bankura	82	20	7	8481	101521	7423	39463	36870	36895	84938	84960	85292	204248	239365	258414
Birbhum	71	54	1	7329	65671	1891	34723	23114	26494	62480	63374	59972	135264	200265	213304
Cooch Behar	2	14	40	5219	57423	432	30686	20200	20789	65548	51459	50748	157838	235934	249437
Darjeeling	226	156	151	3006	8156	411	9059	2902	3807	17583	13876	13044	35217	74719	86284
Dinajpur ***	41	84	80	13454	73861	1622	50636	25849	29995	80574	83141	90096	235778	358855	376390
Jalpaiguri	185	219	196	4812	27455	1104	23289	10128	9854	49230	43501	47175	127236	230771	237307
Purulia	118	27	11	8581	58586	1551	28120	22455	16751	64100	63750	60332	161887	213085	234716
Total	725	574	486	50882	392673	14434	215976	141518	144585	424453	404061	406659	1057468	1552994	1655852
West Bengal	1408	785	652	111859	783773	27862	519445	282992	282767	1148936	1009328	1005594	4096001	5462089	5674788

Source: Agricultural Census, Directorate of Agriculture, Govt. of West Bengal. Note: 24 Parganas\* includes North-24 Parganas and South-24 Parganas; Midnapore\*\* includes East & West Midnapore Dinajpur \*\*\* includes Uttar and Dakshin Dinajpur; NA - Data Not Available

**Table A.6: Estimated Area of Operational Holdings According to Size (Class) in West Bengal Across Various Districts (Area in hectares)**

District	Large (more than 10 ha)			Medium (4-10 ha)			Semi Medium (2-4 ha)			Small (1-2 ha.)			Marginal ( Below 1.0 ha )		
	1980-81	2000-01	2005-06	1980-81	2000-01	2005-06	1980-81	2000-01	2005-06	1980-81	2000-01	2005-06	1980-81	2000-01	2005-06
<b>River Bank Districts</b>															
24-Parganas*	1889	246	401	54970	8490	6321	155396	63927	52371	212213	185631	176239	275262	395433	415134
Burdwan	3508	992	1500	67042	36993	27152	151281	92627	92275	153533	149896	154220	95610	191611	196271
Hooghly	194	304	NA	10749	5380	5476	49491	24778	20379	81157	61856	61311	93740	125391	128989
Howrah	_NA	393	220	1833	587	505	12129	6472	2105	26711	17910	16849	55814	77256	81177
Malda	2282	324	10	36855	8792	4864	75549	37859	40121	95176	90938	81798	88264	160936	171105
Midnapore**	2898	900	1226	78198	8479	7373	188180	64246	71013	254931	180648	194106	293892	569488	547622
Murshidabad	678	158	50	35823	15575	10252	107956	67032	68355	159666	144139	146560	145039	212183	213695
Nadia	_N.A	870	415	38887	5858	4822	80352	34159	33910	116483	130547	128679	104021	180534	182763
Total	8551	3287	2596	246159	81675	59392	632154	326854	309516	844939	780917	765656	857750	1343344	1389134
<b>Non-River Bank Districts</b>															
Bankura	1243	304	84	46625	30375	36707	105740	101521	97059	136826	133229	125064	91560	123280	128494
Birbhum	1411	707	173	39337	14788	8887	93359	65671	74614	96914	107247	100338	63884	118018	121202
Cooch Behar	85	259	2042	24828	8806	2094	77944	57423	57528	90139	79937	79525	68393	128277	132758
Darjeeling	66433	82829	82752	16968	2106	2250	25820	8156	9546	26266	20681	19400	17466	38604	38009
Dinajpur ***	648	5257	8799	69368	13802	7811	133541	73861	81753	110066	143840	145554	91771	212359	202470
Jalpaiguri	120418	124745	123478	24690	7111	5535	65458	27455	27158	70987	70640	74995	60106	125159	124369
Purulia	1797	688	153	48710	11156	7623	81050	58586	44241	102444	89547	90702	74835	100314	115013
Total	192035	214789	217481	270526	88144	70907	582912	392673	391899	633642	645121	635578	468015	846011	862315
West Bengal	203484	218976	221303	594883	178298	137672	1403246	783773	772428	1733512	1606686	1595340	1619657	2758843	2799071

Source: Agricultural Census, Directorate of Agriculture, Govt. of West Bengal. Note: 24 Parganas\* includes North-24 Parganas and South-24 Parganas; Midnapore\*\* includes East & West Midnapore; Dinajpur \*\*\* includes Uttar and Dakshin Dinajpur; NA - Data Not Available

Table A.7: Gross Area Irrigated (Area in '000 ha)

District	1995-96	2000-01	2005-06
<b>River Bank Districts</b>			
24-Pgs*	225.21	232.75	265.24
Burdwan	350.00	320.32	317.99
Hooghly	195.39	199.15	335.11
Howrah	25.10	27.36	51.57
Malda	94.29	112.89	125.38
Midnapur**	638.29	512.11	513.62
Murshidabad	115.41	227.85	204.66
Nadia	165.50	211.67	213.03
Total	1809.19	1844.10	2026.60
<b>Non-River Bank Districts</b>			
Bankura	407.60	332.76	273.56
Birbhum	282.40	273.60	291.80
Cooch Behar	25.93	64.78	106.50
Darjeeling	19.10	19.50	8.94
Dinajpur***	124.90	110.27	175.94
Jalpaiguri	44.05	84.22	93.58
Purulia	117.00	70.26	72.13
Total	1020.98	955.39	1022.45
West Bengal	2830.17	2799.49	3049.05

Source: District Statistical Handbook, Government of West Bengal (Various issues). Note: 24 Parganas\* includes North-24 Parganas and South-24 Parganas; Midnapore\*\* includes East & West Midnapore; Dinajpur \*\*\* includes Uttar and Dakshin Dinajpur

Table A.8: Distribution of Irrigated Land of West Bengal across Districts by Different Sources (Area In '000 ha)

District	Tank		HCDT		MCDT		LCDT		Shallow Tube well		River Lift Irrigation		Open Dug Well	
	2002-03	2006-07	2002-03	2006-07	2002-03	2006-07	2002-03	2006-07	2002-03	2006-07	2002-03	2006-07	2002-03	2006-07
<b>River Bank Districts</b>														
24-Parganas*	52.333	30.09	8.176	7.76	0.83	1.259	1.57	11.25	131.201	129.016	7.888	46.078	N.A	N.A
Bardwan	40.5	25.28	20.96	19.75	0.56	2.25	1.9	1.74		0.12	12.08	11.79	N.A	N.A
Hoogly	33.341	37.45	12.834	13.162	1.215	1.011	0.203	0.236	129.546	139.512	39.99	42.88	N.A	N.A
Howrah	8.39	8.39	3.57	0.941	1.16	1.226	N.A	N.A	1.8	2.04	2.5	2.1	N.A	N.A
Malda	1.308	1.316	6.15	6.498	0.242	0.269	0.641	0.7	78.499	82.647	8.8	9.247	N.A	N.A
Midnapore**	48.34	51.56	14.48	14.63	38.85	52.23	0.52	0.59	174	182.18	19.18	19.59	9.64	10.57
Murshidabad	7.87	7.84	13.98	10.46	2.47	0.29	0.2	0.47	3.61	0.53	11.44	10.57	N.A	N.A
Nadia			22.07	24.21	0.64	0.56	1.28	0.96	165.11	171.32	10.32	10.98	N.A	N.A
Total	192.082	161.926	102.22	97.411	45.967	59.095	6.314	15.946	683.766	707.365	112.198	153.235	9.64	10.57
<b>Non-River Bank Districts</b>														
Bankura	24.86	33.47	1.06	0.53	1.5	1.49	6.58	1.35	37.84	45.91	3.31	5.08	2.7	2.49
Birbhum	NA	NA	NA	NA	0.9	3.71	0.88	NA	NA	45.68	2.15	2.07	2	0.62
Cooch Behar	5.85	5.87	17.7	15.84	4.32	3.3	NA	NA	15.68	51.01	14.19	11.26	4.47	6.56
Darjeeling	NA	NA	NA	NA	NA	NA	NA	NA	0.32	2.23	2.48	4.16	0.24	0.17
Dinajpur***	25.19	15.63	9.61	14.65	0.3	3.05	0.04	1.61	134.94	131.43	9.5	20.75	0	0
Jalpaiguri	2.25	2.1	6.12	1.76	NA	NA	NA	NA	3.15	8.84	13.15	11.14	0.54	3.68
Purulia	22.8	28.83	NA	NA	NA	NA	NA	NA	NA	NA	1.43	0.97	1.02	0.97
Total	80.95	85.9	34.49	32.78	7.02	11.55	7.5	2.96	232.68	285.1	46.21	55.43	10.97	14.49
West Bengal (Total)	273.032	247.826	136.71	130.191	52.987	70.645	13.814	18.906	916.446	992.465	158.408	208.665	20.61	25.06

Source: (1) Principal Agricultural Officer (2) Irrigation and Waterways Directorate, Govt. of West Bengal. Note: 24 Parganas\* includes North-24 Parganas and South-24 Parganas; Midnapore\*\* includes East & West Midnapore; Dinajpur \*\*\* includes Uttar and Dakshin Dinajpur; NA - Data Not Available

Table A.9: Distribution of Area Irrigated by Government Canals in West Bengal Across Various Districts (Area in '000 ha)

District	1980-81	1990-91	2000-01	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
<b>River Bank Districts</b>									
24-Parganas*	NA	23.8	16.1	10.4	9	NA	52.4	52.4	52.4
Bardwan	319.4	312.4	292.7	307	300.9	287.8	283.7	296	308.5
Hoogly	1001.1	95	79	96.4	101.9	104	99.8	90.6	111.6
Howrah	4	5	10.1*	9.5	9.8	36.0**	30	29.3	30.6
Malda	NA	NA	NA	NA	NA	NA	NA	NA	NA
Midnapore**	158.2	177.4	0	149.5	132	0	217.4	224.3	226.4
Murshidabad	58.4	48.9	50.2	52.7	45.5	34.5	32.9	50.1	44.7
Nadia	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total	1541.1	662.5	438	625.5	599.1	426.3	716.2	742.7	774.2
<b>Non-River Bank Districts</b>									
Bankura	163.9	207.4	151.0*	182.3	180.7	177.2	176.3	180.4	195.9
Birbhum	191.6	196	185.7	169.2	192.6	184	159.9	184.7	196.6
Cooch Behar	NA	0.6	1.6	0.8	0.8	0.5	NA	NA	NA
Darjeeling	0.8	0.6	9.0+	4.3	4.7	3.3	2.4	4.9	7.7
Dinajpur***	NA	NA	6	7.6	6.5	1.8	2.6	4.6	11
Jalpaiguri	6.2	5	57.7+	61.8	58.4	48.6	81	62.5	NA
Purulia	14.6	24	27.3	23.8	29.1	24.1	22.2	28.8	28.9
Total	377.1	433.6	220.6	449.8	472.8	439.5	444.4	465.9	440.1
West Bengal (Total)	1918.2	1096.1	658.6	1075.3	1071.9	865.8	1160.6	1208.6	1214.3

Source: Directorate of Irrigation and Waterways, Govt. of West Bengal. Note: Figures include area irrigated under Kharif, Rabi & Boro Cultivation. \* Area reduced due to less Storage of the Kangsabati Reservoir; + The sharp increase in the figures for Jalpaiguri and Darjeeling in 2000-01; \*\* There is an additional actual coverage in area under irrigation through back water flow; 24 Parganas\* includes North-24 Parganas and South-24 Parganas ; Midnapore\*\* includes East & West Midnapore; Dinajpur \*\*\* includes Uttar and Dakshin Dinapur; NA - Data Not Available



**Table A.10: Average Annual Rainfall in West Bengal across Districts (in Millimeter)**

District	1980	1990	2000	2007
<b>River Bank Districts</b>				
24-Parganas*	1573	2208	N.A	3648
Bardwan	1427	1557	1830	1813
Hoogly	1582	1571	1530	1606
Howrah	1291	1953	1465	2025
Malda	1558	1526	1500	1716
Midnapore**	1391	2152	1381	4282
Murshidabad	1823	1538	1753	1722
Nadia	1521	1685	1571	1612
<b>Total</b>	<b>12166</b>	<b>14190</b>	<b>11030</b>	<b>18424</b>
<b>Non-River Bank Districts</b>				
Bankura	1344	1640	1235	1803
Birbhum	1924	1542	2015	1711
Cooch Behar	3454	1357	3123	2537
Darjeeling	2510	3810	3733	3806
Dinajpur***	N.A	N.A	N.A	3029
Jalpaiguri	3025	3434	1033	3488
Purulia	1448	1811	3961	1614
<b>Total</b>	<b>13705</b>	<b>13594</b>	<b>15100</b>	<b>17988</b>
<b>West Bengal</b>	<b>25871</b>	<b>27784</b>	<b>26130</b>	<b>36412</b>

Source: (1) Agricultural Meteorologist, (2) Directorate of Agriculture Government of West Bengal. Note: NA-Data Not Available; 24-Parganas\* includes North & South 24 Parganas; Midnapore\*\* includes East & West Midnapore; Dinajpur\*\*\* includes Uttar and Dakshin Dinajpur

**Table A.11: Creation and Utilization of Irrigation Potential in West Bengal**

Year	Potential created upto the year ('000 ha)	Potential utilized during the year ('000 ha)	Percentage utilization over creation
1996-97	4424.54	3559.41	80.45
2001-02	5096.95	3985.22	78.19
2006-07	5430.14	4375.62	80.58
2007-08	5501.12	4492.49	81.66

Sources: (1) Water Investigation and Development Department, Government of West Bengal; (2) Irrigation & Waterways Directorate, Government of West Bengal; (3) Economic survey, 2008-09, Government of West Bengal

Table A.12: Agricultural Water Demand of West Bengal across Districts in the Next Few Decades (in Million Cubic Meters)

Districts	2001		2011		2021		2031		2041		2051	
	Monsoon	Non-monsoon	Monsoon	Non-Monsoon	Monsoon	Non-Monsoon	Monsoon	Non-Monsoon	Monsoon	Non-Monsoon	Monsoon	Non-Monsoon
<b>River Bank Districts</b>												
24-Parganas*	5404.20	3762.10	5404.20	4667.00	5404.20	5571.80	5404.20	6476.80	5404.20	7381.60	5404.20	8286.40
Bardwan	4006.80	4232.20	4006.80	5250.10	4006.80	6268.00	4006.80	7286.00	4006.80	8303.90	4006.80	9321.80
Hoogly	1827.00	2293.40	1827.00	2845.00	1827.00	3396.60	1827.00	3948.20	1827.00	4499.80	1827.00	5051.40
Howrah	713.50	943.30	713.50	1170.20	713.50	1397.00	713.50	1623.90	713.50	1850.80	713.50	2077.70
Malda	1556.90	1824.10	1556.90	2262.80	1556.90	2701.60	1556.90	3140.30	1556.90	3579.10	1556.90	4017.80
Midnapore**	7458.50	5714.00	7458.50	7088.30	7458.50	8462.60	7458.50	9837.00	7458.50	11211.30	7458.50	12585.70
Murshidabad	2528.60	3185.50	2528.60	3951.70	2528.60	4717.90	2528.60	5484.10	2528.60	6250.30	2528.60	7016.50
Nadia	1609.30	3329.00	1609.30	4129.70	1609.30	4930.40	1609.30	5731.10	1609.30	6531.80	1609.30	7332.50
Total (RBD)	25104.80	25283.60	25104.80	31364.80	25104.80	37445.90	25104.80	43527.40	25104.80	49608.60	25104.80	55689.80
<b>Non-River Bank Districts</b>												
Bankura	NA	1397.70	3170.40	1733.90	3170.40	2070.10	3170.40	2406.20	3170.40	2742.40	3170.40	3078.60
Birbhum	2944.90	1648.80	2944.90	2045.40	2944.90	2442.00	2944.90	2838.60	2944.90	3235.20	2944.90	3631.80
Cooch Behar	1878.00	960.10	1878.00	1191.00	1878.00	1421.90	1878.00	1652.80	1878.00	1883.70	1878.00	2114.60
Darjeeling	330.40	288.20	330.40	357.50	330.40	426.90	330.40	496.20	330.40	565.50	330.40	634.80
Dinajpur***	3649.60	2880.30	3649.60	3573.00	3649.60	4265.80	3649.60	4958.60	3649.60	5651.30	3649.60	6344.10
Jalpaiguri	2077.40	931.70	2077.40	1155.70	2077.40	1379.80	2077.40	1603.90	2077.40	1828.00	2077.40	2052.10
Purulia	2678.10	484.30	2678.10	600.80	2678.10	717.30	2678.10	833.80	2678.10	950.30	2678.10	1066.80
Total (NRBD)	13558.40	8591.10	16728.80	10657.30	16728.80	12723.80	16728.80	14790.10	16728.80	16856.40	16728.80	18922.80
Total West Bengal	38663.20	33874.70	41833.60	42022.10	41833.60	50169.70	41833.60	58317.50	41833.60	66465.00	41833.60	74612.60

Source: State of Environment Report on Water Resource and its Quality in West Bengal 2009; Note: NA - Data Not Available; 24-Parganas\* includes North and South 24 Parganas; Midnapore\*\* includes East & West Midnapore; Dinajpur\*\*\* includes Uttar and Dakshin Dinajpur

**Table A.13: Agricultural Demand of Water and Supply of Water and Supply of Rainwater in West Bengal Across Various Districts (Average over 1994-95 to 2003-04) (in Million Cubic Meters)**

Particulars	Area	Cultivable area 2004-05 (sqkm)	Water demand for agriculture (mcm)	75% assured rainfall (mcm)	Average rainfall (mcm)	Water for agriculture (mcm)	75% assured rainfall (mcm)	Average rainfall (mcm)	Water for agriculture (mcm)	75% assured rainfall (mcm)	Average rainfall (mcm)
<b>River Bank Districts</b>											
24-Parganas*	14054	6691	5405	7577	8380	3536	2339	3065	8940	10404	11444
Burdwan	7024	4915	4007	4995	5770	3978	1689	2092	7984	7216	7862
Hoogly	3149	2302	1827	2500	2781	2155	785	1016	3983	3481	3797
Howrah	1467	941	713	1051	1168	887	314	425	1600	1433	1593
Malda	3733	2853	1557	3119	3731	1714	898	1161	3271	4431	4893
Midnapore**	14081	9127	7464	10315	11189	5370	3001	4080	12829	13578	15268
Murshidabad	5324	4089	2529	4055	4773	2994	1244	1577	5523	5726	6350
Nadia	3927	3145	1609	3159	3697	3129	1044	1359	4738	4602	5056
Total (RBD)	52759	34063	25111	36771	41489	23763	11314	14775	48868	50871	56263
<b>Non-River Bank Districts</b>											
Bankura	6882	3958	3170	4077	4591	1314	1222	1534	4484	5795	6125
Birbhum	4545	3441	2945	3423	3933	1550	1061	1322	4495	4853	5255
Cooch Bihar	3387	2694	1878	6287	7014	902	1492	1798	2780	8413	8812
Darjeeling	3149	1622	330	3273	3607	271	701	856	601	4186	4463
Dinajpur***	5359	4763	3650	7431	8217	2707	1838	2313	6356	9540	10529
Jalpaiguri	6227	3648	2207	8282	9016	876	1693	2207	2953	10674	11222
Puruliya	6259	4614	2678	4539	5366	455	1278	1588	3133	6180	6954
Total (NRBD)	35808	24740	16858	37312	41744	8075	9285	11618	24802	49641	53360
Total (West Bengal)	88567	58803	41969	74083	83233	31838	20599	26393	73670	100512	109623

Source: State of Environment Report on Water Resource and its Quality in West Bengal 2009 and Statistical Abstracts 1995-2004, West Bengal; Note: NA - Data Not Available; 24-Parganas\* includes North & South 24 Parganas; Midnapore\*\* includes East & West Midnapore; Dinajpur\*\*\* includes Uttar and Dakshin Dinajpur

Table A.14: Deficit of Water for Agriculture in the Districts of West Bengal

District	Total area (sq. km)	Cultivable area (sq. km)	Culturable command area of minor irrigation, 2000-01 ha			Culturable command area of major non-monsoon irrigation (ha)	% of cultivable area covered by minor irrigation (2000-01)			% of cultivable area covered by major non-monsoon irrigation (2004-05)	Sum of %'s cultivable area covered by minor & major non-monsoon irrigation	Deficit in non-monsoon rainfall as % of annual rainfall	Replenishable groundwater as percentage of average annual rainfall
			Ground water	Surface water	Total		Ground water	Surface water	Total				
<b>River Bank Districts</b>													
24-Parganas	14054	6691	118993	86316	205309	NA	42	23	23	NA	65	13	43
Burdwan	7024	4915	168363	36410	204773	61747	34	7	61754	13	54	24	27
Hoogly	3149	2302	93718	29581	123299	14984	41	13	14997	7	60	30	29
Howrah	1467	941	8184	58326	66511	257	9	62	319	NA	71	29	13
Malda	3733	2853	97477	24352	121829	NA	34	9	43	N.A	43	11	20
Midnapore	14081	9127	211479	89601	3011089	24291	46	20	24311	4	70	24	31
Murshidabad	5324	4089	170701	24834	195535	4033	42	6	4039	1	49	22	28
Nadia	3927	3145	119775	18797	138572	NA	38	6	6	NA	44	35	31
Total (RBD)	52759	34063	988690	368217	4066917	105312	287	145	105491	24	456	189	223
<b>Non-River Bank Districts</b>													
Bankura	6882	3958	50966	102289	153255	28329	13	26	28355	7	46	-4	18
Birbhum	4545	3441	50169	54946	105115	17423	15	16	17439	5	36	4	22
Cooch Bihar	3387	2694	62944	8826	71770	NA	23	3	27	NA	27	-10	19
Darjeeling	3149	1622	8144	14632	22776	NA	5	9	14	NA	14	-13	5
Dinajpur	5359	4763	169369	31264	200633	NA	68	15	83	NA	83	5	41
Jalpaiguri	6227	3648	45734	32280	78014	NA	13	9	21	NA	21	-12	12
Puruliya	6259	4614	5003	102366	107369	7840	1	22	7862	2	25	-16	7
Total (NRBD)	35808	24740	392329	346603	738932	53592	138	100	53801	14	251	-46	125
West Bengal(Total)	88567	58803	1381019	714820	4805849	158904	424	245	159292	38	707	143	347

Source: State of Environment Report on Water Resource and its Quality in West Bengal 2009; Note: NA - Data Not Available

Table A.15: Agricultural Machinery and Implements in Numbers

District	Animal operated implements	Plant protection equipments	Hand operated implements	Tractor and other power operated implements
<b>River Bank Districts</b>				
24-Parganas*	134306	484059	245649	30878
Burdwan	260505	208108	322668	41905
Hoogly	78221	39173	184315	23793
Howrah	2745	30	35211	3962
Malda	120695	232802	138057	3611
Midnapore**	501813	158813	540862	23184
Murshidabad	205696	115415	210734	22068
Nadia	NA	336550	110051	5364
<b>Total (RBD)</b>	<b>1303981</b>	<b>1574950</b>	<b>1787547</b>	<b>154765</b>
<b>Non-River Bank Districts</b>				
Bankura	422754	249172	330542	6008
Birbhum	344279	90435	244563	4609
Cooch Bihar	116024	105848	89308	1127
Darjeeling	25963	126457	95172	1036
Dinajpur***	280130	3323633	223810	3638
Jalpaiguri	129802	564046	124883	1574
Puruliya	368423	121600	155903	2910
<b>Total (NRBD)</b>	<b>1687375</b>	<b>4581191</b>	<b>1264181</b>	<b>20902</b>
<b>West Bengal(Total)</b>	<b>2991356</b>	<b>6156141</b>	<b>3051728</b>	<b>175667</b>

Source: Directorate of Animal Resources & Animal Health, Government of West Bengal. Note: The figures for 2003 are projected; NA - Data Not Available; 24-Parganas\* includes North & South 24 Parganas; Midnapore\*\* includes East & West Midnapore; Dinajpur\*\*\* includes Uttar and Dakshin Dinajpur

**Table A.16: Consumption of Fertilizers and Pesticides in West Bengal**

Year	Total Fertilizer Consumption in tones			Fertilizer	Pesticide Consumption		Ingredient Active
	N	P	K	Consumption (in kg) per unit of Gross Cropped Area (kg/ha)	Quantity consumed in MT	Coverage (lakh hectares)	Per ha in kg
1980-81	167321	70844	44669	—	—	—	—
1990-91	411896	206782	134330	86.93	4040	46.48	0.47
2000-01	561880	296959	226252	119.02	3180	49.00	0.44
2001-02	586841	329785	261556	120.48	3170	52.00	0.42
2002-03	562998	341244	263377	122.77	3780	53.00	0.38
2003-04	581565	304177	230080	115.54	4000	51.00	0.44
2004-05	630995	339615	290894	132.47	4100	51.23	0.42
2005-06	611000	358000	271000	—	—	—	—
2006-07	678000	386000	301000	—	—	—	—
2007-08	685000	386000	304000	150	—	—	—

Source: Directorate of Agriculture, Government of West Bengal Bureau of Applied Economics & Statistics, Government of West Bengal - Statistical Abstract 2005

**Table A.17: Use of Chemical Fertilizers in West Bengal Across Various Districts (in '000 tones)**

District	1980-81	1990-91	2000-01	2007-08
<b>River Bank Districts</b>				
24-Pgs	28174	73563	126840	119336
Burdwan	41778	85790	118086	182587
Hooghly	36590	76600	102312	143300
Howrah	13929	41627	57902	17433
Malda	13424	44240	43284	78734
Midnapur	32337	87734	162946	210550
Murshidabad	24003	55143	51623	131943
Nadia	24235	52510	51091	86237
Total	214470	517207	714084	970120
<b>Non-River Bank Districts</b>				
Bankura	13202	34549	54555	80884
Birbhum	19473	54411	64603	89480
CoochBehar	6805	32984	58034	38378
Darjeeling	3349	15146	32223	48919
Dinajpur	14949	39323	60871	91064
Jalpaiguri	4832	23709	53768	42910
Purulia	6114	27579	46948	12983
Total	68724	227701	371002	404618
West Bengal	283194	744908	1085086	1374738

Source: Directorate of Agriculture, Govt of WB.

**Table A.18: Total Main Workers and Its Percentage Distribution in West Bengal and India**

Category	Rural			Urban			Total		
	Person	Male	Female	Person	Male	Female	Person	Male	Female
<b>Main workers</b>	<b>16106580</b>	<b>13551865</b>	<b>2554715</b>	<b>6217003</b>	<b>5943106</b>	<b>973897</b>	<b>23023583</b>	<b>19494971</b>	<b>3528612</b>
<b>Percentage distribution of Main Workers</b>									
I. Cultivators	19.53	17.95	1.58	0.25	0.21	0.09	19.79	18.17	1.62
II. Agricultural labourers	19.3	15.48	3.32	0.34	0.29	0.05	19.64	16.26	3.38
III. Household industries	4.72	2.42	2.30	1.52	0.96	0.56	6.24	3.38	2.86
IV. Other workers	26.40	22.51	3.09	27.92	24.35	3.52	54.32	46.95	7.47

Source: Census Reports: Economic Review 2008-09 Government of West Bengal

**Table A.19: Number of Workers in West Bengal Across Various Districts**

District	Cultivators	Agricultural labours	Main workers	Marginal workers
<b>River Bank Districts</b>				
24-Parganas*	300930	406931	2623352	364808
Burdwan	361687	734022	1902334	548907
Hoogly	277901	452114	1528040	331447
Kolkata	6376	4378	1623779	93955
Howrah	74935	146492	1224972	213902
Malda	279276	411862	967143	373563
Midnapore**	1054924	1192363	2530112	1220945
Murshidabad	375172	561874	1672311	332863
Nadia	320464	375541	1405724	209981
<b>Total (RBD)</b>	<b>3051665</b>	<b>4285577</b>	<b>15477767</b>	<b>3690371</b>
<b>Non-River Bank Districts</b>				
Bankura	439957	503214	944216	483056
Birbhum	260955	416949	831699	296798
Cooch Bihar	361840	285426	754311	212394
Darjeeling	88194	58350	478851	90591
Dinajpur***	466545	593039	1187670	360582
Jalpaiguri	269944	230163	1025433	277703
Puruliya	352712	406223	645506	481982
<b>Total (NRBD)</b>	<b>2240147</b>	<b>2493364</b>	<b>5867686</b>	<b>2203106</b>
<b>West Bengal (Total)</b>	<b>5291812</b>	<b>6778941</b>	<b>21345453</b>	<b>5893477</b>

Source: Census of India, 2001 Government of India. Note: 24-Parganas\* includes North &amp; South 24 Parganas; Midnapore\*\* includes East &amp; West Midnapore; Dinajpur\*\*\* includes Uttar and Dakshin Dinajpur

**Table A. 20: Area under Principal Crops (Food Grains) in West Bengal (Area in '000 ha; Production in 000 tonnes)**

Sl. No.	Crops	1980-81	1990-91	2000-01	2004-05	2005-06	2006-07	2007-08
<b>Food grains : Cereals -</b>								
1.	Rice	5176.2	5812.9	5435.3	5783.6	5782.9	5687.0	5719.8
	(i) Aus	615.1	610.3	394.0	320.8	288.1	283.9	281.6
	(ii) Aman	4214.6	4306.5	3639.5	4086.4	4112.9	4001.9	3926.6
	(iii) Boro	346.5	896.1	1401.8	1376.4	1381.9	1401.2	1511.6
2.	Wheat	283.0	269.1	426.0	400.1	366.7	350.6	352.6
3.	Barley	35.4	10.3	3.5	2.4	2.4	2.9	2.0
4.	Maize	52.6	64.6	35.3	64.6	71.8	85.4	77.2
5.	Other Cereals	27.8	24.9	18.3	17.7	17.4	17.9	17.9
<b>Total Cereals</b>		<b>5575.0</b>	<b>6181.8</b>	<b>5918.4</b>	<b>6268.4</b>	<b>6241.2</b>	<b>6143.8</b>	<b>6169.5</b>
<b>Pulses -</b>								
6.	Gram	96.2	25.6	54.7	38.0	40.0	31.2	25.1
7.	Tur (Arhar)	22.6	5.8	8.9	1.5	1.8	2.0	1.1
8.	Mung	29.2	15.5	1.2	11.7	11.5	12.6	16.5
9.	Masur	94.6	73.8	76.0	62.7	61.5	64.2	58.7
10.	Khesari	134.7	44.8	40.4	35.0	33.3	32.2	33.5
11.	Other Pulses	147.0	148.5	83.3	77.5	74.5	77.4	66.0
<b>Total Pulses</b>		<b>524.3</b>	<b>314.0</b>	<b>274.5</b>	<b>226.4</b>	<b>222.6</b>	<b>219.6</b>	<b>200.9</b>
<b>Total Food grains (Total Cereals+ Total Pulses)</b>		<b>6099.3</b>	<b>6495.8</b>	<b>6192.9</b>	<b>6494.8</b>	<b>6463.8</b>	<b>6363.4</b>	<b>6370.4</b>

Sources: (1) Directorate of Agriculture, Evaluation Wing, Govt. of West Bengal (2) Tea Board. (P) Provisional; (a) '000 bales of 180 kg each; (c) '000 kg; (b) Figure related to calendar year

**Table A. 21: Area under Principal Crops (Non-Food Grains) in West Bengal (A in '000 ha; P in 000 tonnes)**

Sl. No.	Crops	1980-81	1990-91	2000-01	2004-05	2005-06	2006-07	2007-08
<b>Non - Food Grains : Oilseeds</b>								
1	Rapeseed and Mustard	131.1	378.1	436.0	457.5	421.5	421.5	407.5
2	Linseed	67.8	8.5	11.9	5.3	6.7	5.0	5.9
3	Sesame (Til)	108.1	99.3	107.2	148.3	148.6	200.4	203.1
4	Sunflower	2.2	0.6	0.2	8.5	12.5	13.7	16.0
5	Other Oilseeds	8.2	26.7	43.3	53.5	54.2	62.8	74.9
	<b>Total Oilseeds</b>	<b>317.4</b>	<b>513.2</b>	<b>598.6</b>	<b>673.1</b>	<b>643.5</b>	<b>703.4</b>	<b>707.4</b>
<b>Fibers</b>								
6	Jute	610.4	500.2	613	569.2	558.9	594.9	609.8
7	Mesta	44.4	9.1	10.9	8.6	10.4	9.6	7.4
8	Other Fibers	2.1	2.0	2.7	2.5	2.8	7.0	9.3
<b>Total Fibers</b>		<b>656.9</b>	<b>511.3</b>	<b>626.6</b>	<b>580.3</b>	<b>572.1</b>	<b>611.5</b>	<b>626.5</b>
<b>Miscellaneous Crops :</b>								
9	Sugarcane	14.3	12.2	21.6	15.6	15.0	16.6	16.9
10	Potato	115.6	194.5	299.7	320.6	354.5	407.9	400.8
11	Tobacco	18.9	12.7	10.5	15.1	13.9	12.0	11.7
12	Tea	93.5	101.2	107.5	114	114.5	114.8 (P)	114.8 (P)

Sources: (1) Directorate of Agriculture, Evaluation Wing, Govt. of West Bengal (2) Tea Board; (P) Provisional; (a) '000 bales of 180 kg each; (c) '000 kg; (b) Figure related to calendar year



Table A.22: Yield Rates of Some Selected Crops in West Bengal and India

Crops	1980-81		1990-91		2000-01		2005-06		2006-07		2007-08	
	WB	India	WB	India	WB	India	WB	India	WB	India	WB	India
Rice	1442	1336	1795	1740	2287	1901	2509	2102	2593	2131 (R)	2573	2203
Wheat	1672	1630	1970	2281	2485	2778	2109	2619	2281	2708 (R)	2602	2785
Gram	578	657	584	712	917	744	1024	815	768	845 (R)	983	780
Jute	1310	1245	1978	1833	2182	2026	2572	2362	2545	2342 (R)	2425	2246
Rapeseed & Mustard	605	560	889	904	956	935	909	1117	803	1099 (R)	888	1009
Potato	17	13	23	16	26	18	21	17	12	15	25	—
Tea	1424 (b)	1491 (b)	1480 (b)	1794 (b)	1689 (b)	1682 (b)	1899 (R)	1708 (R)	2091 (P)	1716 (P)	1983 (P)	1664 (P)

Source: Directorate of Agriculture, Evaluation Wing, Government of West Bengal

Table A.23: Agricultural Production in West Bengal Across Various Districts  
(Production in thousand tones)

District	1980-81	1990-91	2000-01	2006-07	2007-08	2008-09
<b>River Bank Districts</b>						
24-Parganas*	1927	2376	3129	3344	3164	3382
Burdwan	2057	2855	3186	3950	3733	3767
Hoogly	1049	1225	1017	1703	1694	1762
Howrah	319	470	453	490	522	416
Malda	773	1266	1377	1271	1335	1643
Midnapore**	2578	3117	5278	5758	5382	5496
Murshidabad	1200	1990	1960	2745	3036	2861
Nadia	797	1660	1687	1639	1747	1837
<b>Total (RBD)</b>	<b>10700</b>	<b>14959</b>	<b>18087</b>	<b>20900</b>	<b>20613</b>	<b>21164</b>
<b>Non-River Bank Districts</b>						
Bankura	1228	1733	2033	2307	2366	2069
Birbhum	1270	1688	1784	2599	2669	2654
Cooch Bihar	608	865	1149	1023	1220	1142
Darjeeling	198	242	229	217	246	259
Dinajpur***	1205	1694	2432	2427	2739	2860
Jalpaiguri	639	550	883	955	879	912
Puruliya	716	807	1032	1521	1568	1531
<b>Total (NRBD)</b>	<b>5864</b>	<b>7579</b>	<b>9542</b>	<b>11049</b>	<b>11687</b>	<b>11427</b>
<b>West Bengal(Total)</b>	<b>16564</b>	<b>22538</b>	<b>27629</b>	<b>31949</b>	<b>32300</b>	<b>32591</b>

Source: Directorate of Agriculture, Evaluation Wing, Government of West Bengal. Note: 24-Parganas\* includes North &amp; South 24 Parganas; Midnapore\*\* includes East &amp; West Midnapore; Dinajpur\*\*\* includes Uttar and Dakshin Dinajpur

**Table A.24: Area of Production under Rice and Wheat in West Bengal Across Various Districts (in thousand hectares)**

District	1980-81	1990-91	2000-01	2008-09	1980-81	1990-91	2000-01	2008-09
<b>River Bank Districts</b>								
24-Pgs*	639.80	705.30	699.80	690.50	9.00	9.50	16.80	9.00
Burdwan	549.40	560.00	582.60	666.50	10.40	2.70	6.30	2.00
Hooghly	253.20	275.30	199.30	305.70	6.40	0.80	1.60	1.60
Howrah	90.30	133.00	113.30	115.30	0.80	0.10	1.00	0.10
Malda	202.90	263.80	221.70	221.70	24.60	37.60	49.40	44.40
Midnapur**	903.30	1024.90	1108.50	1125.70	8.80	5.60	30.10	5.00
Murshidabad	302.60	353.90	224.10	398.40	86.70	92.20	135.50	101.80
Nadia	208.40	285.00	229.20	277.20	44.00	41.50	60.40	35.90
<b>Total</b>	<b>3149.90</b>	<b>3601.20</b>	<b>3378.50</b>	<b>3801.00</b>	<b>190.70</b>	<b>190.00</b>	<b>301.10</b>	<b>199.80</b>
<b>Non-River Bank Districts</b>								
Bankura	380.90	434.80	395.60	371.10	10.20	7.80	8.80	3.90
Birbhum	356.60	376.70	318.20	394.00	20.50	14.20	26.90	34.90
Cooch Behar	272.70	305.70	291.90	309.80	12.60	13.60	49.80	16.60
Darjeeling	43.10	55.30	34.20	32.20	1.50	3.70	3.30	2.00
Dinajpur***	457.30	477.80	493.90	489.80	37.00	28.00	47.70	41.50
Jalpaiguri	264.70	275.40	260.80	235.50	8.80	10.60	26.60	15.90
Purulia	251.00	285.00	262.20	301.00	1.70	1.20	2.90	0.90
<b>Total</b>	<b>2026.30</b>	<b>2210.70</b>	<b>2056.80</b>	<b>2133.40</b>	<b>92.30</b>	<b>79.10</b>	<b>166.00</b>	<b>115.70</b>
<b>West Bengal</b>	<b>5176.20</b>	<b>5811.90</b>	<b>5435.30</b>	<b>5934.40</b>	<b>283.00</b>	<b>269.10</b>	<b>467.10</b>	<b>315.50</b>

Source: Agriculture Evaluation Wing, Government of India; Note: 24-Parganas\* includes North & South 24 Parganas; Midnapore\*\* includes East & West Midnapore; Dinajpur\*\*\* includes Uttar and Dakshin Dinajpur

**Table A.25: Area, Production and Yield rate of Food grains in West Bengal Across Various Districts**

<b>Food grains</b>												
District	Area (in thousand ha.)				Production (in thousand tons)				Yield rate (in kgs. per ha.)			
	1980-81	1990-91	2000-01	2008-09	1980-81	1990-91	2000-01	2008-09	1980-81	1990-91	2000-01	2008-09
<b>River Bank Districts</b>												
24-Parganas*	700	743	738	699	964	1188	1566	1693	2800	3355	4290	4774
Burdwan	578	566	595	669	1028	1428	1593	1884	1780	2522	2679	2804
Hoogly	268	277	202	308	525	613	508	881	1958	2212	2512	2859
Howrah	107	138	115	115	160	235	227	208	1496	1705	1977	1786
Malda	309	374	314	277	NA	NA	NA	NA	NA	NA	NA	NA
Midnapore**	969	1054	1923	1129	1609	1834	1695	1338	2445	2410	3817	3827
Murshidabad	513	504	421	507	386	633	689	821	1249	1693	2195	2762
Nadia	356	405	347	316	600	995	980	1430	1169	1974	2328	2628
<b>Average (RBD)</b>	<b>475</b>	<b>508</b>	<b>582</b>	<b>503</b>	<b>659</b>	<b>866</b>	<b>907</b>	<b>1032</b>	<b>1612</b>	<b>1984</b>	<b>2475</b>	<b>2680</b>

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Food grains												
District	Area (in thousand ha.)				Production (in thousand tons)				Yield rate (in kgs. per ha.)			
	1980-81	1990-91	2000-01	2008-09	1980-81	1990-91	2000-01	2008-09	1980-81	1990-91	2000-01	2008-09
<b>Non-River Bank Districts</b>												
Bankura	402	449	407	376	523	727	795	988	1493	1923	2283	2516
Birbhum	408	400	366	429	614	867	1017	1034	1528	1932	2499	2753
Cooch Bihar	295	332	328	329	635	844	892	1327	1557	2108	2438	2977
Darjeeling	86	105	64	62	99	121	115	129	1148	1151	1790	2048
Dinajpur***	542	529	556	561	662	836	1091	1337	2310	2548	3478	4043
Jalpaiguri	287	296	297	263	N.A	N.A	495	536	N.A	N.A	2199	2458
Puruliya	280	324	299	310	N.A	N.A	1385	1819	N.A	N.A	2285	2569
<b>Average (NRBD)</b>	<b>329</b>	<b>348</b>	<b>331</b>	<b>333</b>	<b>362</b>	<b>485</b>	<b>827</b>	<b>1024</b>	<b>1148</b>	<b>1380</b>	<b>2425</b>	<b>2766</b>
<b>Average West Bengal</b>	<b>407</b>	<b>433</b>	<b>465</b>	<b>423</b>	<b>520</b>	<b>688</b>	<b>870</b>	<b>1028</b>	<b>1396</b>	<b>1702</b>	<b>2451</b>	<b>2720</b>

Source: Directorate of Agriculture, Evaluation Wing, Government of West Bengal. Note: 24-Parganas\* includes North & South 24 Parganas; Midnapore\*\* includes East & West Midnapore; Dinajpur\*\*\* includes Uttar and Dakshin Dinajpur

**Table A.26: Area, Production and Yield Rate of Cereals in West Bengal Across Various Districts**

Cereals												
District	Area in thousand ha				Production in thousand tons				Yield rate in kg per ha.			
	1980-81	1990-91	2000-01	2008-09	1980-81	1990-91	2000-01	2008-09	1980-81	1990-91	2000-01	2008-09
<b>River Bank Districts</b>												
24-Parganas*	649	714	717	699	940	1177	1548	1677	2957	3466	4381	4882
Burdwan	561	563	589	669	1021	1426	1587	188	1820	2532	2694	2813
Hoogly	260	276	201	308	521	612	507	880	2008	2217	2526	2863
Howrah	91	133	114	115	153	233	226	207	1678	1746	1981	1794
Malda	253	315	278	277	349	595	659	803	1374	1889	2374	2904
Midnapore**	914	1032	1124	1129	1273	1540	2616	2745	1394	1492	4662	4744
Murshidabad	404	451	362	507	554	965	924	1407	1371	N.A	N.A	N.A
Nadia	255	332	290	316	355	780	799	891	2141	2553	2754	2162
<b>Average (RBD)</b>	<b>423</b>	<b>477</b>	<b>459</b>	<b>503</b>	<b>646</b>	<b>916</b>	<b>1108</b>	<b>1100</b>	<b>1843</b>	<b>1987</b>	<b>2672</b>	<b>2770</b>
<b>Non-River Bank Districts</b>												
Bankura	394	446	406	376	610	856	1051	1034	1549	1940	2504	2754
Birbhum	379	392	346	429	621	839	875	1312	1638	2140	2536	3055
Cooch Bihar	287	323	318	329	299	427	568	566	1041	1323	1786	1720
Darjeeling	85	104	62	62	N.A	N.A	493	535	N.A	N.A	2229	2416
Dinajpur***	502	506	543	561	681	957	830	1020	2317	2808	4051	4663
Jalpaiguri	279	290	290	263	315	272	437	454	1131	937	1507	1722
Puruliya	262	303	280	310	351	390	509	759	1337	1285	1817	2445
<b>Average (NRBD)</b>	<b>313</b>	<b>338</b>	<b>321</b>	<b>333</b>	<b>411</b>	<b>534</b>	<b>680</b>	<b>811</b>	<b>1288</b>	<b>1490</b>	<b>2347</b>	<b>2682</b>
<b>Average West Bengal</b>	<b>372</b>	<b>412</b>	<b>395</b>	<b>423</b>	<b>536</b>	<b>738</b>	<b>909</b>	<b>965</b>	<b>1584</b>	<b>1755</b>	<b>2520</b>	<b>2729</b>

Source: Directorate of Agriculture, Evaluation Wing, Govt. of West Bengal. Note: 24-Parganas\* includes North & South 24 Parganas; Midnapore\*\* includes East & West Midnapore; Dinajpur\*\*\* includes Uttar and Dakshin Dinajpur; NA - Stands for Data Not Available

**Table A.27: Area, Production and Yield rate of Pulses in West Bengal Across Various Districts**

Pulses												
District	Area in thousand ha				Production in thousand tons				Yield rate in kgs. per ha			
	1980-81	1990-91	2000-01	2008-09	1980-81	1990-91	2000-01	2008-09	1980-81	1990-91	2000-01	2008-09
<b>River Bank Districts</b>												
24-Parganas*	50	38	22	22	24	12	17	15	940	815	1597	1383
Burdwan	17	3	5	3	8	1	6	2	447	497	1110	552
Hoogly	268	277	202	308	3	1	1	1	393	539	662	773
Howrah	16	5	0	1	7	2	0	1	429	494	952	795
Malda	56	59	36	21	37	39	30	18	665	650	820	868
Midnapore**	56	22	21	13	16	19	20	4	286	860	1980	819
Murshidabad	109	53	59	37	46	30	56	29	420	558	591	785
Nadia	101	74	57	36	44	50	44	27	432	673	774	760
<b>Average (RBD)</b>	<b>84</b>	<b>66</b>	<b>50</b>	<b>55</b>	<b>23</b>	<b>19</b>	<b>22</b>	<b>12</b>	<b>502</b>	<b>636</b>	<b>1061</b>	<b>842</b>
<b>Non-River Bank Districts</b>												
Bankura	8	3	1	0	4	1	1	0	468	516	705	787
Birbhum	29	9	20	16	14	5	17	15	498	626	832	937
Cooch Bihar	295	332	328	336	5	6	7	4	580	607	663	618
Darjeeling	1	1	2	1			2	1			598	577
Dinajpur***	40	23	13	6	21	12	6	4	1133	1035	1152	1280
Jalpaiguri	8	5	7	4	5	3	4	2	570	603	672	527
Puruliya	17	21	19	16	7	14	7	7	415	66	660	388
<b>Average (NRBD)</b>	<b>57</b>	<b>56</b>	<b>56</b>	<b>54</b>	<b>8</b>	<b>6</b>	<b>6</b>	<b>5</b>	<b>523</b>	<b>493</b>	<b>755</b>	<b>731</b>
<b>Average West Bengal</b>	<b>71</b>	<b>62</b>	<b>53</b>	<b>55</b>	<b>16</b>	<b>13</b>	<b>15</b>	<b>9</b>	<b>512</b>	<b>569</b>	<b>918</b>	<b>790</b>

Source: Directorate of Agriculture, Evaluation Wing, Government of West Bengal. Note: 24-Parganas\* includes North & South 24 Parganas; Midnapore\*\* includes East & West Midnapore; Dinajpur\*\*\* includes Uttar and Dakshin Dinajpur

**Table A.28: Area, Production and Yield rate of Rice in West Bengal Across Various Districts**

Rice												
District	Area in thousand ha				Production in thousand tons				Yield rate in kgs. per ha			
	1980-81	1990-91	2000-01	2008-09	1980-81	1990-91	2000-01	2008-09	1980-81	1990-91	2000-01	2008-09
<b>River Basin Districts</b>												
24-Parganas*	640	714	700	667	923	1157	1508	1657	2954	3470	4376	4896
Burdwan	549	560	583	636	1003	1420	1571	1876	1825	2534	2697	2815
Hoogly	253	275	119	302	509	611	504	876	2011	2218	2527	2866
Howrah	90	133	113	118	1514	233	224	207	1677	1747	1979	1795
Malda	203	264	222	147	287	492	523	657	1416	1866	2360	2962
Midnapore**	903	1025	1108	1046	1256	1529	2584	2737	1390	1492	4665	4746
Murshidabad	303	354	224	398	422	785	548	1124	87	92	136	258
Nadia	208	285	229	241	281	695	650	800	1347	2439	2836	2884
<b>Average (RBD)</b>	<b>394</b>	<b>451</b>	<b>412</b>	<b>444</b>	<b>774</b>	<b>865</b>	<b>1014</b>	<b>1242</b>	<b>1588</b>	<b>1982</b>	<b>2697</b>	<b>2903</b>

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Rice												
District	Area in thousand ha				Production in thousand tons				Yield rate in kgs. per ha			
	1980-81	1990-91	2000-01	2008-09	1980-81	1990-91	2000-01	2008-09	1980-81	1990-91	2000-01	2008-09
<b>Non-River Bank Districts</b>												
Bankura	381	435	396	417	593	844	993	1026	1556	1941	2511	2764
Birbhum	357	377	318	394	586	813	797	1212	1643	2158	2503	3078
Cooch Bihar	273	306	292	294	278	402	517	500	1018	1315	1772	1615
Darjeeling	43	55	34	32			467	502			2218	2412
Dinajpur***	0	0	494	479	539	833	682	729	2289	2776	3769	4435
Jalpaiguri	265	275	261	236	295	250	384	391	1113	907	1473	1662
Puruliya	251	285	262	314	343	373	475	744	1368	1307	1812	2472
<b>Average (NRBD)</b>	<b>224</b>	<b>248</b>	<b>294</b>	<b>309</b>	<b>376</b>	<b>502</b>	<b>616</b>	<b>729</b>	<b>1284</b>	<b>1486</b>	<b>2294</b>	<b>2634</b>
<b>Average West Bengal</b>	<b>315</b>	<b>356</b>	<b>357</b>	<b>381</b>	<b>589</b>	<b>696</b>	<b>828</b>	<b>1003</b>	<b>1446</b>	<b>1751</b>	<b>2509</b>	<b>2777</b>

Source: Directorate of Agriculture, Evaluation Wing, Government of West Bengal. Note: 24-Parganas\* includes North & South 24 Parganas; Midnapore\*\* includes East & West Midnapore; Dinajpur\*\*\* includes Uttar and Dakshin Dinajpur

**Table A.29: Total Number of Livestock and Poultry in West Bengal Across Various Districts**

District	Total Livestock				Total Poultry			
	1972	1982	2003	2007	1972	1982	2003	2007
<b>River Bank Districts</b>								
24-Pgs*	2599209	4706037	3897836	4492983	3083379	5755087	9146957	12961961
Burdwan	1705819	2673286	3329912	3701702	1481503	2073583	5004744	6429429
Hooghly	675709	1438240	1842076	1865685	376790	1663017	2516338	3116070
Howrah	463730	718565	581734	596230	720409	1245768	1063795	1392115
Malda	936300	1583622	1547269	1933732	701594	1303043	2412470	3282042
Midnapore**	2717180	4410886	5491896	6159861	1651222	3433780	6064881	9638942
Murshidabad	1253943	2019267	3024300	3658709	1411196	2222829	5471013	5167809
Nadia	893380	1713203	1612653	2002652	743097	1882813	2807473	2844168
<b>Total</b>	<b>11245270</b>	<b>19263106</b>	<b>21327676</b>	<b>24411554</b>	<b>10169190</b>	<b>19579920</b>	<b>34487671</b>	<b>44832536</b>
<b>Non-River Bank Districts</b>								
Bankura	1623240	2237600	2548281	2779169	915888	1429777	2964836	3880710
Birbhum	1285956	1641428	2125056	2502876	1005849	1844844	3580657	4223131
CoochBehar	946797	1285343	1614689	1830308	438370	783720	1667453	1655786
Darjeeling	306404	4331709	599168	695064	303883	559270	673026	953032
Dinajpur***	1287641	1868491	2579421	2738961	997000	2035746	3604328	3574542
Jalpaiguri	1037154	1230318	1726436	1892418	704639	1136091	1996697	2143252
Purulia	1316184	1736790	1949082	2250647	900447	1268566	2074056	2601303
<b>Total</b>	<b>7803376</b>	<b>14331679</b>	<b>13142133</b>	<b>14689443</b>	<b>5266076</b>	<b>9058014</b>	<b>16561053</b>	<b>19031756</b>
<b>West Bengal</b>	<b>19048646</b>	<b>33594785</b>	<b>34469809</b>	<b>39100997</b>	<b>15435266</b>	<b>28637934</b>	<b>51048724</b>	<b>63864292</b>

Source: Directorate of Agriculture, Evaluation Wing, Government of West Bengal. Note: 24-Parganas\* includes North & South 24 Parganas; Midnapore\*\* includes East & West Midnapore; Dinajpur\*\*\* includes Uttar and Dakshin Dinajpur

**Table A.30: Revenue and Expenditure of Forest of West Bengal (in Lakh)**

Year	Revenue	Expenditure	Profit	Growth
1980-81	1576.05	1805.02	-228.97	-
1990-91	3394.09	7252.00	-3857.91	-1.5849
2000-01 <sup>®</sup>	6577.36	17915.42	-11338.1	-0.19389
2007-08	15215.35	26612.24	-11396.9	-0.00052

Sources: (1) The Principal Chief Conservator of Forest, Government of West Bengal; (2) Forest Development Corporation Ltd., Govt. of West Bengal

**Table A.31: Out-turn of Forest Produce in West Bengal Across Various Districts ('000 cubic meters)**

State/District	Item	1980-81	1990-91	2000-01	2003-04	2004-05	2005-06	2006-07	2007-08
<b>River Bank Districts</b>									
24-Pgs*	Timber	2.2	11.5	0.1	-	0.1	0.2	-	0.87
	Firewood	11.2	7.5	0.3	0.4	0.1	0.1	-	0.02
Burdwan	Timber	4.3	4	2.9	2.8	1.3	1.6	1.1	12.15
	Firewood	16.3	5.5	6.3	18.4	10.9	10.6	9.7	9.5
Hooghly	Timber	(a)	(a)	(a)	0.1	-	-	-	-
	Firewood	(a)	(a)	(a)	-	-	-	-	-
Howrah	Timber			2.3	-	0.1	-	-	0.04
	Firewood	(a)		0.2	-	-	-	-	-
Malda	Timber	0.2	0.8	0.5	-	0.5	-	0.4	0.85
	Firewood	0.2	0.1	-	0.1	-	-	0.1	0.11
Midnapur**	Timber	41.7	0.2	17.8	13.6	28	3.1	4.3	156.51
	Firewood	149	2.4	97.1	116.4	165.4	67.2	47.8	85.99
Murshidabad	Timber	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
	Firewood	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
Nadia	Timber	1.6	0.5	0.1	-	0.5	0.7	0.3	0.97
	Firewood	1.4	1	-	0.1	0.1	0.6	0.6	0.47
Total	Timber	50.00	17.00	23.70	16.50	30.50	5.60	6.10	171.39
	Firewood	178.10	16.50	103.90	135.40	176.50	78.50	58.20	96.09
<b>Non-River Bank Districts</b>									
Bankura	Timber	13.5	1	22.1	29.3	21.9	6	5.7	17.85
	Firewood	40.4	3	68.9	112.9	135.5	53.5	16	143.52
Birbhum	Timber	1	0.3	2.1	1.3	8.6	0.2	1.3	0.81
	Firewood	2.5	-	6	5	3.7	1.4	2.2	0.01
Cooch Behar	Timber		11.7	3.4	5.8	0.2	2.9	0.6	0.24
	Firewood		15.1	31.7	1.2	-	0.9	-	-
Darjeeling	Timber	10.5	21.1	12.3	12.7	14.3	10.7	8.3	6.72
	Firewood	14.7	33.6	8.4	22.1	17.4	7.5	4.3	4.27
Dinajpur***	Timber	(c)	(c)	2.3	0.6	0.9	0.3	0.4	-
	Firewood	(c)	(c)	-	0.1	-	-	-	-
Jalpaiguri	Timber	112.8	37.2	19.3	59.6	22.3	27.8	38.1	10.96
	Firewood	165.8	130.7	14.6	14.6	20.6	14.8	23.7	4.37
Purulia	Timber	1.2	-	3	4.8	15.2	0.9	0.5	23.61
	Firewood	3.8	11.7	16.9	15.4	12.9	10.7	19.1	13.76
Total	Timber	139.00	71.30	64.50	114.10	83.40	48.80	54.90	60.19
	Firewood	227.20	194.10	146.50	171.30	190.10	88.80	65.30	165.93
West Bengal	Timber	189.00	189.00	88.30	88.20	130.60	113.90	54.40	61
	Firewood	405.30	210.60	250.40	306.70	366.60	167.30	123.50	262.02

Source: Principal Chief Conservator of Forests, Government of West Bengal. Notes: 24-Parganas\* includes North & South 24 Parganas ; Midnapore\*\* includes East & West Midnapore; Dinajpur\*\*\* includes Uttar and Dakshin Dinajpur; (a) The forest area of Hooghly, Murshidabad, and Uttar & Dakshin Dinajpur district are included in Burdwan, Nadia, and Malda districts respectively; (1) "Timber" includes plywood, match wood, other timber and poles, upto 2004-05. (2) "Firewood" includes quantity of firewood required for production of charcoals, other firewood and pulp wood upto 2004-05. (3) For 2005-06 and 2006-07 Timber does not include any other wood. Firewood does not include pulpwood.