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Spatial – Temporal Variation of Population Growth and Sustainability of Food Grain Production in West Bengal, India

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ABSTRACT

This paper examines the dynamics in population growth and sustainability of food grain production in West Bengal. Linkage between population growth and food production is an issue of debate since late eighteenth century when Malthus predicted that population growth will outstrip the food supply. Though fertility level in West Bengal reached to below replacement (TFR is <2.1) but population will increase till next few decades due to the mechanism of population momentum. Average annual growth rate has declined over the last two decades but absolute growth in the population increases the demand for food. There has been remarkable increase in the food grain production in West Bengal after 1980s but till the current level of food production is not sufficient enough to meet the domestic food requirement, though this gap decreased over the time. Besides, slow growth in the agricultural in the last few years is another concern of sustainable food production. Population growth in the West Bengal has significant association with food grain production and agriculture. Cultivable land and net sown area has reduced significantly due to the rapid growth of population. Cropping intensity increased drastically because of the reduction of net sown area and increase in population. Hence, it is very essential to increase the current level of food production more than proportional of population growth to ensure the food security in the near future in West Bengal.

1. INTRODUCTION

Population increases in a geometrical ratio whereas food production increases only in arithmetic ratio. This fact of unbalanced growth pattern between population and food production became a priority discussion point in late eighteenth century when Malthus predicted that population growth would outstrip food supply, causing great human suffering. When population continues rapidly within the limited resources, it has several adverse implications on earth, agriculture, bio-diversity, environment and population itself [1, 2]. Hence the most focused aim of government population policy is population stabilization, either by expanding family planning services or improving socio economic status of women [3]. Bucharest conference in 1974 emphasized to reduce the population growth by

focusing both on fertility limitation and on related development aims. Immediate reduction in fertility do not guarantee the population stabilization, it is mostly depend on the age composition of the population. Population will be stabilized in a condition when numbers of women leaving the reproductive age group will equal to the numbers of women entering in the reproductive age group. Until this condition is achieved, population have tendency to increase which is called as '*population momentum*'. Population dynamic simply means the short-terms and long-terms changes in the size and age structure of the population. It deals with the way population is affected by birth and death rates and by immigration and emigration. The linkage between population dynamic, food production and nutrition security is complex to generalize [4, 5]. There is no steady relationship between population growth

and food production [6]. There have been large fluctuations in agricultural production. Though after mid 1980s, India achieved self-sufficiency in food grain production but there is no surety that grains in productivity would be sustained (Parikh, 2007). One concern is that Indian agriculture is mostly affected by climatic or natural barriers like drought, flood etc. And another concern is the environmental effects of High Yield Variety (HYV) technology. Use of chemical pesticides and fertilizers in agriculture may increase the yield capacity in short-term but it has adverse affect on soil fertile which may reduce the yield per capita in the future. Indian agriculture always remains as a subsistence type in nature but not as a commercial. Roy and Pal (2002) [8] showed that public investment in agriculture has declined considerably which might affect adversely in agriculture. The concern might be true. Many of the authors urged that agricultural growth rates in India are slowing down [9, 10, 11]. When growth rate of food grain production turns down, but population is hardly declining, then sustainability of food grain availability is a big question mark to us.

Though West Bengal is performing well in the food grain production but major concern is in the future sustainability of the food grain production. Because of the site advantage, being located on fertile Gangetic plain, West Bengal remains most densely populated state in India. According to 2011 population census of India, West Bengal population reached to 91.3 million with an additional increase of 11 million population since last census. With this large numbers of population it is very essential for the state to increase the current level of food grain production to ensure the quality and adequate diet for most humans. In West Bengal many people are malnourished today, especially children (38% under age five) and women. Though fertility of West Bengal reached to the replacement level (below 2.1) but the population momentum will guarantee a

continued population growth for next few decades in the state. As population expands, the food problem will become increasingly severe, conceivably with numbers of malnourished. Considering of these facts, the paper will examine the temporal and spatial variation of population growth and food production in West Bengal.

2. DATA AND METHODOLOGY

The data for the present study has been gleaned from multiple sources in view of the array of different parameters to assess population dynamics, food production and nutrition security in West Bengal. The different sources are: Census of India; Statistical Abstract of West Bengal, 2008; and others published reports. Census data have been used to understand spatial and temporal pattern of population growth where annual exponential growth rate and decadal growth rate have been computed. Information regarding food grain production and land use pattern has been gathered from Statistical Abstract of West Bengal.

Percentage of cultivable land and percentage of net sown area were defined as the proportion of cultivable land and proportion of net sown area, respectively, to the total geographical area of particular administrative unit.

3. RESULTS AND DISCUSSION

3.1. Population dynamics in West Bengal

In the last century, population of West Bengal has increased more than 5 times than that of population in 1901. In 1901, the total population was 16.9 million which increased to 91.3 million in 2011, adding a total 74.4 million population in the last one hundred and ten years (table 1).

Table 1. Population dynamics and growth pattern in West Bengal, 1901–2011.

Year	Total population in India (million)	Population dynamics in West Bengal			
		Total population (million)	% share of national	Average annual exponential growth rate (percent)	Progressive growth rate over 1901
1901	238.4	16.9	7.1	-	-
1911	252.1	18.0	7.1	0.6	6.5
1921	251.3	17.5	6.9	-0.3	3.6
1931	279.0	18.9	6.8	0.8	11.8
1941	318.7	23.2	7.3	2.0	37.3
1951	361.1	26.3	7.3	1.3	55.6
1961	439.2	34.9	7.9	2.8	106.5
1971	548.2	44.3	8.1	2.4	162.1
1981	683.3	54.6	8.0	2.1	223.1
1991	846.4	68.0	8.0	2.2	302.4
2001	1028.7	80.2	7.8	1.7	374.6
2011*	1210.2	91.3	7.5	1.3	440.2

Source: Census of India, * provisional 2011

There was a fluctuating trend in the population growth in West Bengal. Till 1931, the annual exponential growth rates were negligible. It shows a

negative growth rate during 1911 to 1921. During this time population declined marginally due to great influenza epidemic and two successive bad harvests.

The late eighteen and nineteen centuries saw the worst famines and these were bad enough to have a remarkable impact on the long term population growth of the country, especially in the half century between 1871–1921. As a part of the nation, West Bengal was also influenced by these famines. The Bengal famine of 1770 is estimated to have taken the live of nearly one-third of the population of the region. After 1921, there was continues growth trend in the population. West Bengal's population increased to 26.3 million in 1951 from 17.5 million in 1921. During this period the growth rates were low (average annual exponential growth rate was 1.3 percent) because of the high fertility and high mortality. Hence, natural increase in population was quite low, added only nine million population in these thirty years. During 1951-1981, the growth rate was very high, exceeding 2.4 percent average annual exponential growth rate. In this period the population increased to 54.6 million in 1981 from 26.3 million in 1951, adding a total of 28.3 million population. After independence mortality has declined very faster rate than fertility which broaden the gap between births and deaths and ultimately it contributes on the natural increase of the population. Besides the natural increase, effect of net migration was significant in the rapid growth of population in West Bengal.

During 1981-2011, the growth rate showed a declined trend (average annual exponential growth rate 1.7 percent) over the previous period. Though there was a slight fluctuation between 1981 and 1991 but afterwards it showed a steady decline trend. In the last decade (2001-2011) the average annual exponential growth rate reached to 1.3 percent.

Figure 1 shows that along with the mortality, fertility also started to decline over the time and hence natural growth rate turned down remarkably. During 1981-83 natural growth rate was 21.9 per thousand of live births and it came down to 12.1 per thousand of live birth during 2005-2007.

Figure 2 shows that decadal growth rate of West Bengal declined since form 1971-1981. During 2001-2011, decadal growth rate declined to 13.9 percent which is much lower than the national growth rate (17.6 percent). Though the growth rate of population in West Bengal is lower than the national average but it is significantly higher than some of the South Indian states.

The growth rate of West Bengal started to decline since 1981-1991 whereas growth rate of Kerala began to decline nearly 30 years before than West Bengal since 1961-1971.

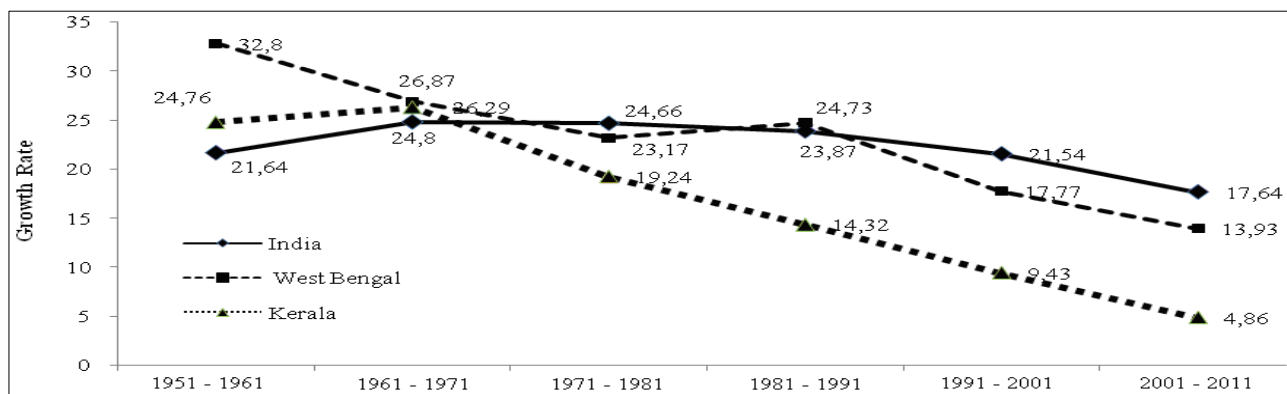


Fig. 1. Trends in Natural Increase in West Bengal 1981-2009.

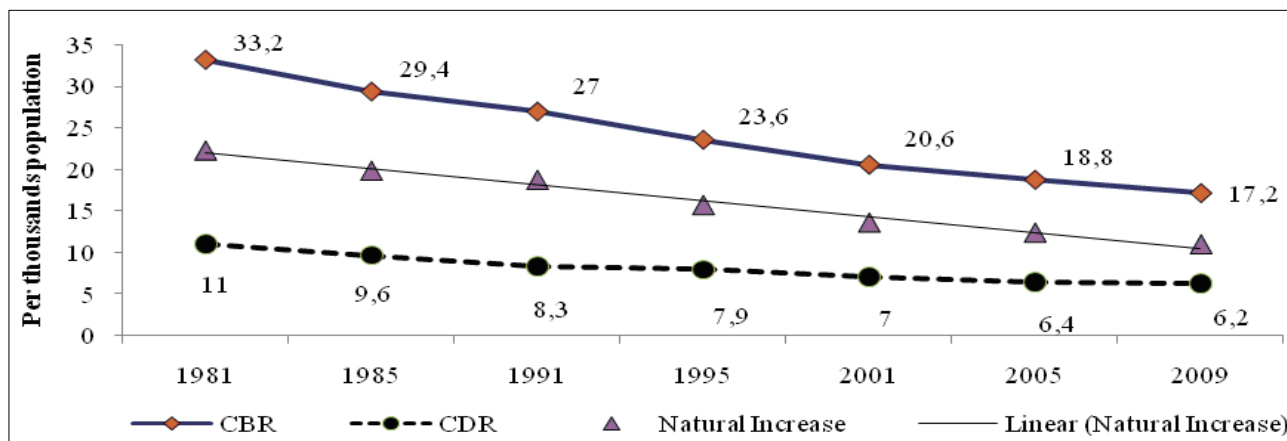


Fig. 2. Trends of decadal growth rate in West Bengal, Kerala and India.

Now the major concern of population dynamics is that though fertility reached to the replacement level of fertility in West Bengal (TFR below 2.1) but it will not guarantee the population stabilization in the near future because of the impact of population momentum. This momentum in population will continue for some more years because high TFR in the past have resulted in a large proportion of population being currently in their reproductive age group.

3.2. Spatial growth of population in West Bengal

Spatial pattern of decadal absolute growth of population during 1981-2011 has been presented in table 2. During 1981-91, decadal absolute growth of West Bengal was recorded by 13.5 million population. Highest decadal growth rate was found for Midnapur district where nearly 1.6 million population increased in this decade and followed by Burdhaman (1.2 million), Kolkata (1.1 million) and Murshidabad (1.0 million) districts. These four districts collectively contribute

almost 36 percent in the decadal absolute growth of the state during 1981-1991. In the next decade (1991-2001) the decadal absolute growth of population was 12.1 million which showed a reduction of 1.4 million population since previous decade. During this time the highest decadal absolute growth was found for North-24 Pargonas (1.6 million population) followed by Midnapur (1.3 million), South 24 Pargonas (1.2 million) and Murshidabad (1.1 million) districts. These four districts together contribute 43 percent in the absolute decadal growth of the state during 1991-01. Most amazingly, Kolkata's population showed a stagnant absolute growth during 1991-2001, showing an additional increase of only 1.8 lack population. During 2001-11, West Bengal was recorded with the absolute growth of 11.1 million population which showed a farther reduction of one million population over the last decade. In this period, highest absolute growth found for Midnapur district (1.4 million population), followed by South 24 Pargonas (1.2 million), Murshidabad (1.2 million) and North 24 Pargonas (1.1 million). These four districts together contribute 45 percent in the decadal absolute growth of the state.

Table 2. Temporal and district wise growth pattern of population in West Bengal 1981-2011.

District Name	Decadal absolute growth of population ('00000)			Change in absolute growth during 1981 -2011		Percent contribution to growth		
	1981 - 1991	1991 - 2001	2001 - 2011	Absolute Change ('00000)	% Change	1981 - 1991	1991 - 2001	2001 - 2011
West Bengal	135.0	121.4	111.3	-23.7	-17.6	100	100	100
Burdwan	12.2	8.7	8.0	-4.1	-33.8	9.0	7.2	7.2
Birbhum	4.6	4.6	4.9	0.3	6.5	3.4	3.8	4.4
Bankura	4.3	3.9	4.0	-0.3	-6.0	3.2	3.2	3.6
Midnapur	15.9	13.1	14.0	-1.9	-12.0	11.8	10.8	12.6
Howrah	7.6	5.4	5.7	-2.0	-25.6	5.7	4.5	5.1
Hooghly	8.0	6.8	4.8	-3.2	-39.8	5.9	5.6	4.3
24-Pargonas (N)	-	16.5	11.5	-	-	-	13.6	10.4
24-Pargonas (S)	-	11.9	12.4	-	-	-	9.8	11.2
Kolkata	10.9	1.8	-0.9	-11.9	-108.6	8.1	1.5	-0.8
Nadia	8.9	7.5	5.6	-3.2	-36.4	6.6	6.2	5.1
Murshidabad	10.4	11.2	12.4	2.0	18.8	7.7	9.3	11.1
Dinazpur (N)	-	5.4	5.6	-	-	-	4.5	5.0
Dinazpur (S)	-	2.7	1.7	-	-	-	2.2	1.5
Malda	6.1	6.5	7.1	1.0	17.0	4.5	5.4	6.4
Jalpaiguri	5.9	6.0	4.7	-1.2	-20.4	4.3	5.0	4.2
Darjeeling	2.8	3.1	2.4	-0.4	-14.3	2.0	2.5	2.1
Coochbehar	4.0	3.1	3.4	-0.6	-13.8	3.0	2.5	3.1
Purulia	3.7	3.1	3.9	0.2	5.9	2.7	2.6	3.5

Source: Census of India; Note: 2011 data is the provisional census data.

Figure 3 shows the districts wise variation of decadal growth rates during 1991-01 and 2001-11 respectively. Three types of area may be demarcated: Districts with high growth rate (more than 20 percent); Districts with moderate growth rate (10-20 percent); District with slow growth rate (less than 10 percent). During 1991-2001, total eight district out of nineteen showed higher decadal growth rates, among them Uttar Dinazpur (28.7 percent), Maldha (24.8 percent) and Murshidabad (23.7 percent) are significant. These districts are mainly located on the border of Bangladesh, Nepal and Bihar. Hence, regular in-migration from these surrounding

states and countries contributed a lot to reach the higher population growth rate of these districts. Nine districts showed a moderate growth rates, whereas Kolkata showed a slow decadal growth rate with only four percent growth rate. The growth rate of population declined significantly during 2001-11 over the last decade. Decadal growth rate of the state reached to 13.9 percent from 17.8 percent, a decline of four percent, during last two decadal periods. In this period (2001-11) most of the districts show moderate decadal growth rate (10-20 percent), whereas Kolkata experiences a negative (-2 percent) decadal growth pattern.

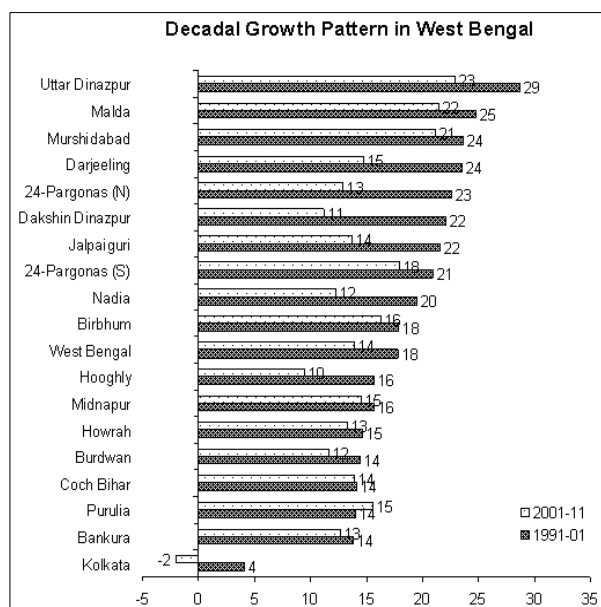


Fig. 3. District wise decadal growth rate in West Bengal, 1991-01 & 2001-11.

The significant reduction in the population growth rate in recent decade is mainly due to the significant decline in the natural increase of population and strict control over the immigrations. Illegal migration from neighbouring country has been a major problem for Bengal since independence. After 1971 large numbers of Bangladeshi nationals have crossed over to Bengal in search of livelihood. Bangladeshi migrants have significant influence in the population growth of

West Bengal. The rate of population growth in the nine Bengal districts that share their borders with Bangladesh has come down in the last decade.

The reduced growth rate of population in the districts such as Jalpaiguri, North and South Dinazpur, Nadia and North 24 Pargonas is the high light of this recent census. This clearly indicates that illegal migration has been checked substantially by fencing more border area and stepping up vigil on illegal migration. Besides the administrative cheek, demographic change and socio economic development of Bangladesh are also significant to reduce the influx form Bangladesh. Demographers said that reduction of natural increase of population in Bangladesh was also a reason for the reduction of in-migration.

3.3. Food grain production in West Bengal

West Bengal is situated in the most fertile land of lower Gangetic Plain and hence agriculture plays a pivotal role in the state's economy and nearly three out of every four persons is directly or indirectly involved in agriculture.

In spite of an agriculture-dependent state, West Bengal was still dependent on the central government for meeting the domestic food demands till 1980s. However, there has been a significant spurt in the food grain production and now the state has a surplus of food grain.

The total food production in the State in 2007-2008 was 16,060 thousand tonnes (table 3).

Table 3. Temporal and district level variation in food grain production in West Bengal, 1990-2008.

Districts	Total food grain (in thousand tonnes)			Temporal change (in thousand tonnes)			Percent contribution to food grain production		
	1990-01	2000-01	2007-08	1990-01 2000-01	2000-01 2007-08	1990-01 2007-08	1990-01	2000-01	2007-08
Burdwan	1,427.5	1,592.9	1,866.3	165.4	273.4	438.8	12.7	11.5	11.6
Birbhum	844.1	892.1	1,334.4	48	442.3	490.3	7.5	6.5	8.3
Bankura	866.6	1,016.7	1,182.8	150.1	166.1	316.2	7.7	7.4	7.4
Midnapur	1,558.7	2,638.7	2,652.5	1080	13.8	1093.8	13.8	19.1	16.5
Howrah	234.9	226.7	260.8	-8.2	34.1	25.9	2.1	1.6	1.6
Hooghly	612.7	508.4	846.8	-104.3	338.4	234.1	5.4	3.7	5.3
24-Pargonas (N)	674.2	685.2	769.2	11	84	95	6.0	5.0	4.8
24-Pargonas (S)	513.9	879.5	812.8	365.6	-66.7	298.9	4.6	6.4	5.1
Nadia	830.1	843.5	829.8	13.4	-13.7	-0.3	7.4	6.1	5.2
Murshidabad	995	979.8	1,518.2	-15.2	538.4	523.2	8.8	7.1	9.5
Dinazpur (N)	846.8*	721.1	846	369.3*	124.9	522.9*	7.5*	5.2	5.3
Dinazpur (S)		495	523.7	-	28.7	-	-	3.6	3.3
Malda	633.2	688.7	667.3	55.5	-21.4	34.1	5.6	5.0	4.2
Jalpaiguri	275.2	441.5	439.4	166.3	-2.1	164.2	2.4	3.2	2.7
Darjeeling	121.1	114.6	116.5	-6.5	1.9	-4.6	1.1	0.8	0.7
Coochbehar	432.4	574.6	610	142.2	35.4	177.6	3.8	4.2	3.8
Purulia	403.7	516.2	784	112.5	267.8	380.3	3.6	3.7	4.9
West Bengal	11,270	13,815	16,060.5	2,545.1	2,245.3	4,790.4	100	100.0	100.0

Source: Statistical Abstract of West Bengal, 2008; Note: * = Combined Dinazpur

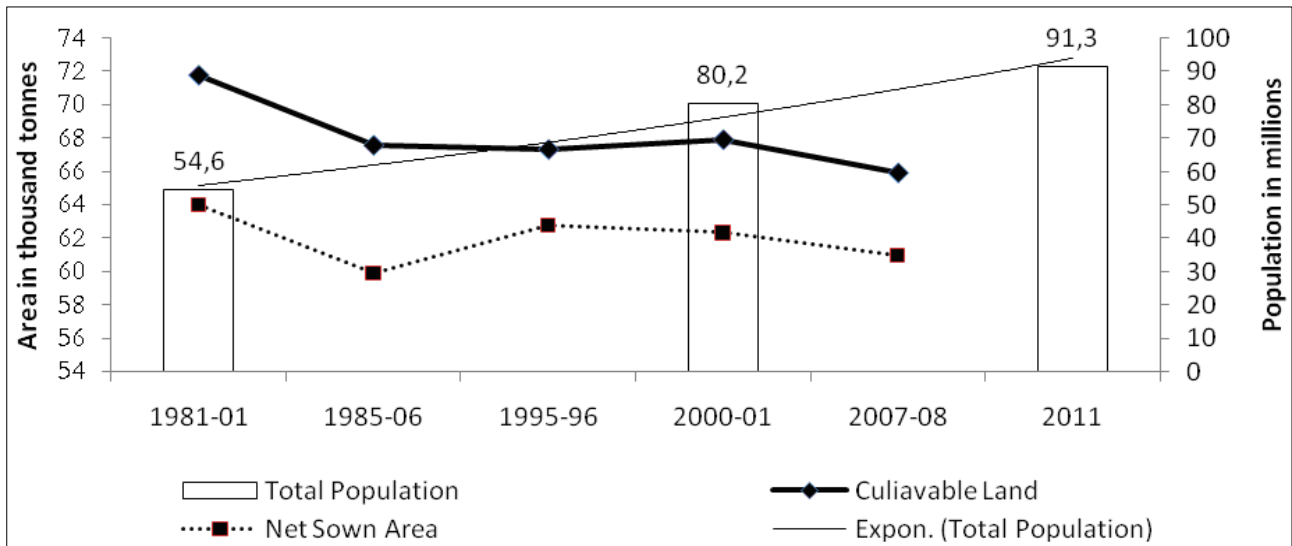


Fig. 4. Trend of Food production and Food Requirement Gap in West Bengal.

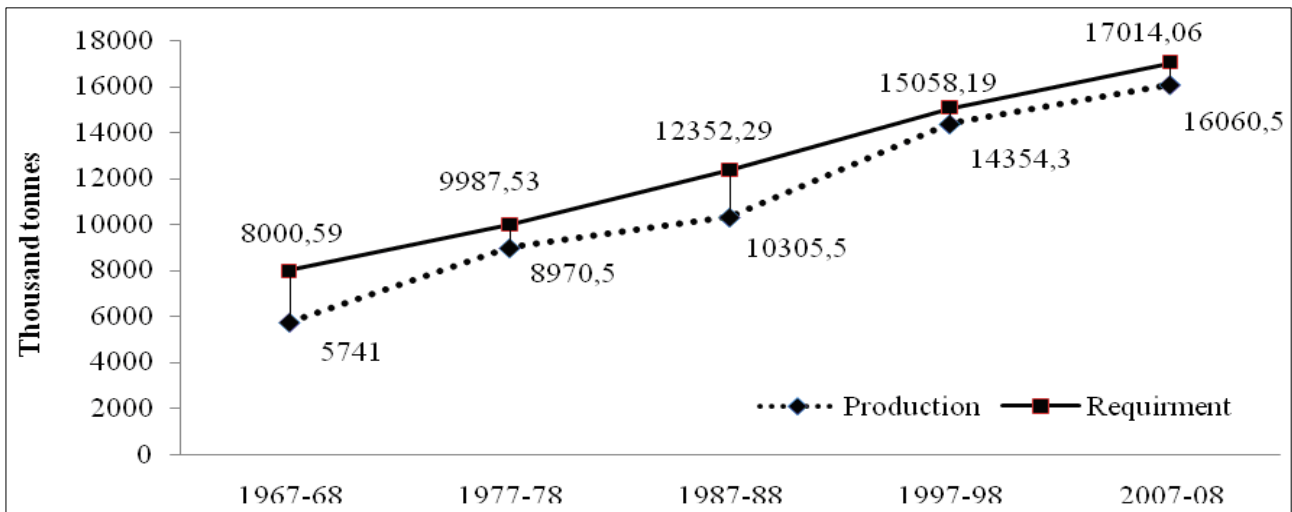


Fig. 5. Relationship between population growth pattern and availability of agricultural land in West Bengal.

During 2007-08, the production of rice was 14719.2 thousand tonnes, of wheat 917.3 thousand tonnes and of pulses 158.0 thousand tonnes respectively.

There was substantial increase in the food grain production in West Bengal in the last two decades. Table 3 shows a spatial-temporal variation of food grain production in West Bengal.

In 1990-91 the state's food grain production was 11270 thousand tonnes which reached to 16060 thousand tonnes in 2007-08. During 1990-91 to 2007-08 the additional increment in food grain production was 4790 thousand tonnes.

Temporal change in food grain production varies significantly over the districts. Among all the districts, Midnapur shows the highest increase in the food grain production during 1990-91 to 2007-08, adding a total 1093 thousand tonnes of food grain during the period and followed by Murshidabad (523 thousand tonnes), Dinazpur (522 thousand tonnes) and Bankura

district (490 thousand tonnes). There is spatial inequality in the food grain production in West Bengal. More than fifty percent of the state production is confined only in the five districts out of nineteen. During 1990-91 the top five food grain producing districts were Midnapur (13.8 percent), Burdwan (12.7 percent), Murshidabad (8.8 percent), Bankura (7.7 percent) and Birbhum (7.5 percent). These five districts together contributed 50 percent of the state production during 1990-91 whereas during 2007-08 the contribution increased to 53 percent. Food grain production in West Bengal increased significantly over the time.

The gap between food grain production and requirement decreased significantly in the recent decades (fig 4) but the current level of food grain production is not sufficient enough to meet the domestic food requirement. Fig 4 shows that during 2007-2008, total food grain production was 16060 thousand tonnes against its requirement of 17014 thousand tonnes.

3.4. Population growth and availability of land for agriculture

Rapid growth of Population in a geographical area affect adversely on the land, especially on the cultivable land. It creates pressure on the cultivable land by reducing its area. Production can decline marginally when the land crosses its caring capacity due to over population.

Availability of cultivable land and net sown area has declined remarkably in West Bengal due to increase in population (fig. 5).

Table 4 shows that proportion of cultivable land has declined from 67.4 percent to 66 percent during 1995-96 to 2007-08 in West Bengal. Proportion of net sown area also declined from 63 percent to 61 percent during the same period. Highest decline in

cultivable land was recorded in Howrah district (8.9 percent points) during 1995-96 to 2007-08, followed by Malda (6.6 percent points) and Nadia (4.4 percent points). A significant decline in the net sown area was recorded in Malda district from 76 percent to 57 percent, accounting a sharp decline of 19 percent points during 1995-96 to 2007-08. There are substantial difference between availability of cultivable land and land used for cultivation. Nearly 66 percent of total geographical area is available for cultivation but only 61 percent land is used for cultivation purpose. The gap is highest in Purulia district where 71 percent of total geographical area is cultivable land but only 50 percent is used for cultivation.

Land utilization of cultivation is very poor in South 24 Pargonas (39 percent), Darjeeling (43 percent), Purulia and Bankura (50 percent).

Table 4. District wise variation of percentage of cultivable land and net sown area in West Bengal, 1995-96 to 2007-08.

State & District	1995-96		2007-08		Percent points change during 1995-96 to 2007-08	
	% cultivable land	% net sown area	% cultivable land	% net sown area	% cultivable land	% net sown area
	West Bengal	67.4	62.8	65.9	61.0	-1.4
Burdwan	69.7	66.7	67.3	64.7	-2.4	-2.0
Birbhum	75.0	68.9	75.0	70.6	0.0	1.7
Bankura	59.6	53.1	56.6	50.2	-3.0	-2.9
Midnapur	66.5	63.8	67.5	64.3	1.0	0.4
Howrah	72.0	62.9	63.1	58.2	-8.9	-4.7
Hooghly	74.9	73.0	71.3	70.2	-3.5	-2.8
24-Pargonas (N)	71.4	67.7	68.5	67.1	-2.9	-0.7
24-Pargonas (S)	42.3	41.2	40.4	39.2	-1.8	-2.0
Nadia	81.4	76.2	77.0	74.0	-4.4	-2.2
Murshidabad	79.6	76.5	75.5	74.9	-4.1	-1.6
Dinazpur*	88.1	85.3	87.8	86.4	-0.4	1.1
Malda	82.4	76.4	75.8	56.7	-6.6	-19.7
Jalpaiguri	53.8	51.6	57.1	53.7	3.3	2.1
Darjeeling	50.6	44.8	49.6	43.2	-1.0	-1.6
Coochbehar	79.7	75.8	77.9	74.8	-1.8	-1.0
Purulia	71.0	54.2	71.3	50.0	0.3	-4.2

Note: Cultivable land includes the following categories: Permanent pastures and grazing land; Misc. tree crops and groves; Culturable waste; Fallow land; Current fallow; Net sown area.

4. CONCLUSION

It may conclude from the foregoing discussion that absolute numbers of population in West Bengal increased over the last two decades but growth rate has declined significantly. Average annual growth rate was 2.2 percent in 1981-91 which reduced to 1.3 percent during 2001-11. A significant reduction in the growth rate is also recorded in some of the districts in West Bengal. During 1991-01, total six districts showed a higher annual exponential growth rate (more than 2.0 percent) but during 2001-11 only one district showed higher annual exponential growth rate. Surprisingly, Kolkata showed a negative growth rate during 2001-11. Sudden decline in the population of Kolkata may be a result of low natural increase of population or of huge out migration from the city or may be a result of both. Though growth rate of population is decreasing but

absolute growth in the population is one of the major concerns of population dynamics in West Bengal. It increases the population density, reduces the availability of cultivable land and increases the domestic demand for food. The population growth in West Bengal has significant association with food grain production and agriculture. The cropping intensity has gone up remarkably due to the population growth and shrinking in the cultivable land. The food grain production has increased significantly in West Bengal but it is not sufficient enough to meet the domestic food requirement. So, there is urgent need to improve the current level of food grain production. On the other hand, food grain production in West Bengal is showing a slow growth pattern since last few years. Hence, food security and sustainability of food grain production will be a major concern in the very near future in West Bengal.

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