Effects of Increasing Temperature and Population Growth on Rice Production in Bangladesh: Implications for Food Security

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Author
Jayanta Kumar Basak

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For orders and request please contact:

Unnayan Onneshan-The Innovators
House: 19A, Road: 16 (New), Dhanmondi, Dhaka-1209, Bangladesh
Tell: +(880-2) 815 82 74, 911 06 36; Fax: + (880-2) 815 91 35
E-mail: info@unnayan.org; Web: www.unnayan.org

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Executive Summary

Potential increase in global temperature due to climate change and population growth and those impacts on rice productivity, above all food security, is of major concern in recent years. Every year a huge amount of rice production is being damaged for changing climate, and eventually threatening food security in Bangladesh. The purpose of this paper is to build the interfaces among Boro rice production, increasing temperature and population growth and those effects on total rice production in Bangladesh.

Population growth rate in Bangladesh is two million in each year and it will become 233.2 million within 2050, if the current trend continues. Bangladesh will require more than 55.0 million tons rice to feed her total population by the year 2050. In 2007-2008, Boro rice production contributed 58% of the total rice production, whereas T.Aman 34% and Aus rise was only 7%. Therefore, the rice production depends on a considerable part on Boro rice production.

The effects of temperature on yield of Boro rice has been assessed using the DSSAT (Decision Support System for Agrotechnology Transfer, version 4) model for the years 2020, 2030, 2040 and 2050, respectively. The study has been conducted on the basis of IPCC Fourth assessment report and found a considerable yield reduction (1.5%, 2.5%, 4.4% and 5.4%) on the specified years which will directly affect to the total rice production of this country. Rice shortage may have occurred more than 35% for population growth (two million people per year) whereas it may be 50% for growing population and increasing temperature in 2050 compared to the total rice production in 2006-07. Rice demand for a single people was 580 gm per day or 211.73 kg per year in 2006-07. More than 6.5 crore people may fully deprive from their rice requirement within 2050 which is above 45% compared to the total population in 2006-07 for the combined effects of increasing temperature and population (35% for population growth). Consequently, 1.06 thousand crore Taka may diminish which has counted more than 2% of the Agricultural and Forestry GDP in the fiscal year 2007-08 (Tk. 0.80 thousand crore for increasing population in 2050). Bangladesh will face a remarkable food shortage in the next few years and it will turn into a vital issue around 2050, if the current trend continues. Improving Boro and T.Aman production and protecting the declining rate of Aus rice production and developing more heat tolerant rice varieties and management practices would be a major concern for increasing rice production in Bangladesh.

Section 01

1.1 Introduction

Agricultural crop of Bangladesh is highly influenced by different seasonal climatic variables such as high fluctuations of day and night temperature, changing rainfall pattern, high carbon dioxide concentration, humidity, day-length etc. It is also constrained by different climatic disasters such as floods, droughts, cyclone, storm surges, sea level rise etc. For example two rounds of floods and devastating cyclone, Sidr in 2007 and cyclone Aila in 2009, caused severe damages in agriculture production, especially the rice production and caused severe food crisis.

Food security refers to the availability of food and one's access to it. A household is considered food secure when its occupants do not live in hunger or fear of starvation. According to the Food and Agricultural Organization (FAO, 2002), food security exists when all people at all times have physical, social, and economic accesses to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. To achieve food security four components such as availability, accessibility, stability and utilization must be sufficient. These components are often dependent on some natural events, such as flood, cyclone, water conservation, degradation due to erosion, drought etc.

In the coming decades, agriculture of Bangladesh will face a great challenge to feed its growing population; and consequently the food demand will increase by many folds. Bangladesh as a whole still has a very low level of nutrition. Many households and individuals do not eat a balanced diet, even in good production years. According to the World Bank, approximately 33 million of the 150 million people in Bangladesh cannot afford an average daily intake of more than 1800 kilocalories (the minimum standard for nutrition as set by the World Food Program). For people in most developing countries, the daily calorie average is 2,828. On the contrary, in Bangladesh, that average is only 2,190 (Foshol, 2009).

Therefore it is imperative to increase rice production in order to meet the growing demand for food emanating from population growth. However, there have been ups and downs in the domestic production of food grain. The diverse climatic phenomena like cyclone, drought, changing rainfall patterns and temperature; there has been a significant lost in food grain production in every year. So the challenges are faced by the agricultural sectors from the climatic conditions and population growth; require systematic integration of environmental and economic development measures for a sustainable agriculture growth.

1.2 Objectives of the Study

- Assessment of Population and Rice production (Boro, Aus and T.Aman) Trend in the year of 1971-2006.
- Projection of Possible Population and Rice production in the year of 2020, 2030, 2040 and 2050.
- To identify the state of food security in the realm of changing climatic conditions, mainly focusing on temperature rise and population growth on rice production in Bangladesh.
- Assessing the effect of food security on human rice demand and economic conditions in Bangladesh in the year of 2020, 2030, 2040 and 2050.
- The study proposes policy recommendations for yield improvement to attain food security needed to feed the country's huge population.

Section 02

2.1 Present Status of Population and Rice Production in Bangladesh

Rice production systems make a vital contribution to the reduction of hunger and poverty in Bangladesh. Total rice production in Bangladesh was 10.32 million tons in the year 1975-76 when the country's population was only 79.90 millions and cultivated rice area was 10.32 million ha. However, the country is now producing 27.32 million tons in 10.71 million ha rice area to feed more than 140 million people (BBS and DAE, 2007). This indicates that the growth of rice production was much faster than the growth of

population and the cultivable rice area change is not so significant between the years of 1975 to 2007. This rice production has been possible largely due to the adoption of modern rice varieties on around 73% of the rice land which contributes to about 85% of the country's total rice production, modern rice cultivation technology, improvement irrigation facilities and applications of fertilizer and pesticides (BBS, 2006).

T.aman had a vital role in total rice production up to 1995-96; after 1995-96, Boro rice is playing a significant role in the total rice production. Boro rice production gradually increased due to increase in cultivation area, high yield varieties, modern technology and improvement in irrigation facilities during winter season. In 2007-2008, Boro rice contributed to above 58% of the total rice production, whereas, T.aman 34% and Aus rice was only 7%. From this analysis, it is clear that the rice production of this country depends on a considerable part on Boro rice production.

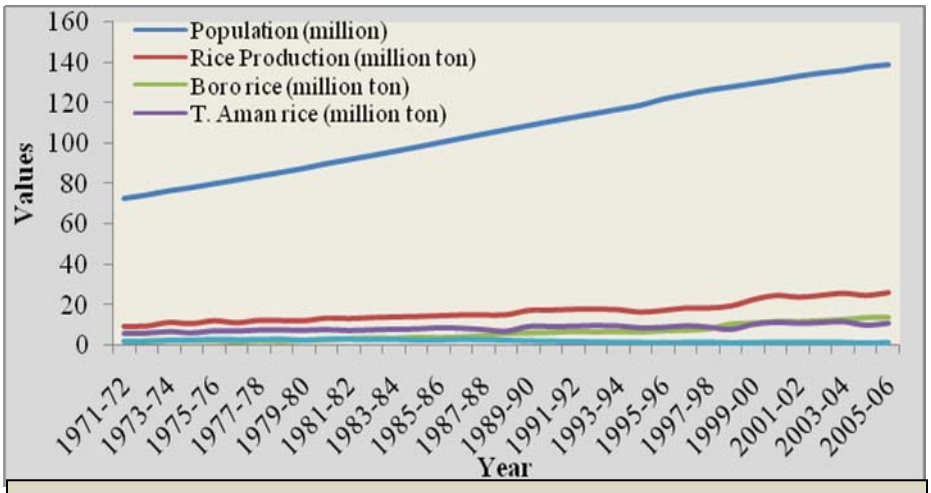

Figure 1: Population and rice production in Bangladesh (Year wise)

Rice cultivation areas are mostly unchanged in the last few decades but there is a good sign to increase Boro rice area because it makes an important contribution to increase the overall rice production and the main source of livelihood for the farming community in Bangladesh. Rice areas of T.aman and Aus have gradually decreased after the year of 1989-90 (Fig. 2).

Population of Bangladesh is increasing at a rate of two million every year and the total population will be 233.2 millions in the next 40 years, if the current trend continues. Therefore, Bangladesh will require more than 55.0 million tons of rice by the year 2050. During this time total rice area will have shrunk due to pressure from cultivating high value crops, urban and industrial development and expansion of human settlement area.

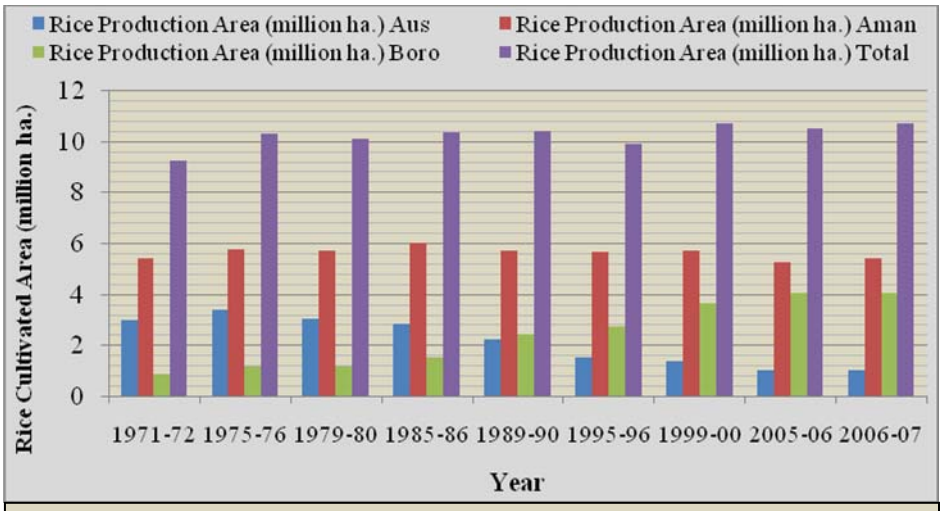

Figure 2: Area under rice production in Bangladesh

2.2 Potential Impacts of Temperature on Rice Production in Bangladesh

Temperature greatly influences not only the growth duration, but also the growth pattern and the productivity of rice crops. During the growing season, the mean temperature, and the temperature sum, range, distribution pattern, and diurnal changes, or a combination of these may be highly correlated with grain yields (Basak et al., 2009). Rice plant has nine growth stages with its three distinct growth phases and every stage has an optimum temperature range for its proper development. The critical temperatures for the development of the rice plant at different growth phases (vegetative, reproductive and ripening) are shown in Table 1. These critical temperatures differ according to variety, duration of the critical temperature, diurnal changes and physiological status of the plant (Yoshida, 1981). Extreme temperatures, whether low and high, cause injury to the rice plant. High temperatures are a constraint to rice production and cause a significant yield

reduction. When temperatures exceed the optimal for biological processes, crop often respond negatively with a steep decline in net growth and yield (Rosenzweig and Hillel, 1995).

Table 1: Critical temperature for the development of rice plant at different growth stages

Growth stages	Critical temperature (^{0}C)		
	Low	High	Optimum
Germination	16-19	45	18-40
Seedling emergence	12	35	25-30
Rooting	16	35	25-28
Leaf elongation	7-12	45	31
Tillering	9-16	33	25-31
Initiation of panicle primordia	15	-	-
Panicle differentiation	15-20	30	-
Anthesis	22	35-36	30-33
Ripening	12-18	>30	20-19

(Source: Yoshida, 1978)

A number of modeling studies (e.g., Basak et al., 2009; Mahmood et al., 2003; Mahmood, 1998; Karim et al., 1996) have been carried out to assess the impacts of climate change and variability on rice production in Bangladesh. DSSAT model has predicted significant reduction in Boro rice yield due to climate change. Yield reductions of over 20% and 50% have been predicted for the years 2050 and 2070, respectively (Basak et al., 2009). Karim et al., argued that a significant yield reduction may have occurred for rice and wheat (35% and 31%, respectively) due to changing climatic conditions in future. Therefore, there is a great possibility to hamper both rice and wheat production (main food grain in Bangladesh) which may directly affect the food security and also make a social security problem for developing countries like Bangladesh.

2.3 Future Rice Demand for Food Security

Huge population size, extreme population density and high levels of poverty impose significant challenges to sustain the food security in Bangladesh. From the analysis of

population data of the last 35 years (1971-2005), it was found that population increased at a rate of 2.042 million per year. Similarly, rice production increased at a rate of 0.4582 million tons per year (rice production data, 1971 to 2005), Boro rice production increased at a rate of 0.3654 million tons per year, T.aman production increased at a rate of 0.1388 million tons per year, whereas Aus rice production decreased at a rate of 0.0463 million tons (Fig. 1). The statistical data indicate that rice production will largely depend on Boro rice production in future. If this rate continued for a few years such as 2020, 2030, 2040 and 2050, then there will be a huge amount of rice shortage (5.08, 6.02, 7.80 and 10.50 million tons, respectively) compared to the requirement of total population on the specified years (Table 2 and Fig. 3). These projected results of rice production may be possible if there are great possibilities to develop new rice varieties, improve management practices, increase new rice areas, and above all strengthen the government policies in agricultural sectors. Projected values of population and rice production (included Boro, T.Aman and Aus rice) on the specified years (2020, 2030, 2040 and 2050) are calculated by simple trend line equation

$$\mathbf{Y=mX+C}$$

Where, **Y**-Projected value (population or rice production) for a specific year

m- Slope (rate of change per year)

X-Interval between two periods (initial to projected year) and

C-Constant

Equations used to calculate projection values are **Y=2.0418X+69.876** (population), **Y=0.4582X+8.7376** (rice production), **Y=0.3654X-0.4721** (Boro rice production), **Y=0.1388X+5.946** (T. Aman rice production) and **Y= -0.0463X+3.268** (Aus rice production).

The study used the standard formula developed by Abdullah et al., 2006 to estimate rice consumption for the targeted years, is as follow

$$\mathbf{X_{t+n}= (1+r)^nQ_t}$$

Where, $\mathbf{X_{t+n}}$-volume of targeted year,

r-Average growth rate (average growth rate 1.41% for Bangladesh, source: BBS, 2006)

$\mathbf{Q_t}$-Volume of base year (2006)

n-Total number of years ahead

The projected values represent that rice production will not be sufficient compared to its population and it will be more acute in 2050. About 10.50 million tons rice may be shortage for its total population demand in 2050 which is about 38.43% compared to the total rice production in Bangladesh in the year of 2006-07 (rice production in 2006-07 was 27.32 million tons). From the analysis, it is also clear that Boro, T.Aman and Aus rice production would be shortage in all targeted years compared to the growing population. T.Aman and Aus rice production shortage are significantly higher than Boro rice production. Therefore, food insecurity will not only occur for Boro rice production, but it may also be more vulnerable for the reduction of Aus and T.Aman production.

Table 2: Projected Total Population and Rice production in Bangladesh

Year	Population (million)	Total Rice Production (million tons)		
		Requirement	Production	Achievement/Shortage
2006-07*	140.60	29.77	27.32	-2.45
2020	171.97	36.73	31.65	-5.08
2030	192.38	42.25	36.23	-6.02
2040	212.80	48.60	40.81	-7.80
2050	233.22	55.90	45.40	-10.50

(*Source: BBS, 2006-07 and Author's own calculation)

Year	Boro Rice Production (million tons)			T. Aman Rice Production (million tons)			Aus Rice Production (million tons)		
	Req.	Prod.	Ach. /Short.	Req.	Prod.	Ach. /Short.	Req.	Prod.	Ach. /Short.
2006-07	16.31	14.96	-1.35	11.82	10.84	-0.98	1.64	1.51	-0.13
2020	20.12	17.80	-2.32	14.58	12.89	-1.70	2.02	0.95	-1.07
2030	23.15	21.45	-1.70	16.77	14.27	-2.50	2.33	0.49	-1.84
2040	26.62	25.10	-1.52	19.30	15.66	-3.64	2.68	0.03	-2.65
2050	30.63	28.76	-1.87	22.20	17.05	-5.50	-	-	-

(Source: Author's own calculation)

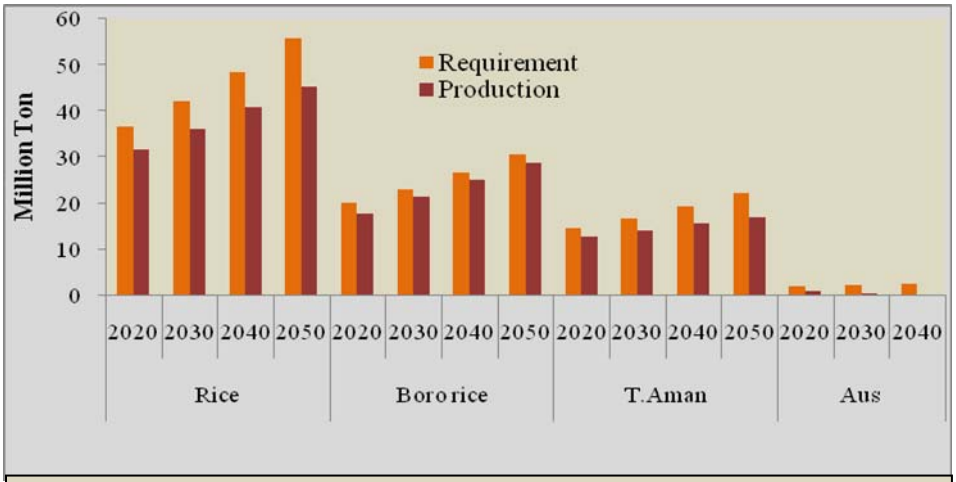

Figure 3: Rice production and requirement in Bangladesh

2.4 Impacts of Temperature on Rice Production Associated with Food Security

Already it has been mentioned that during 2007-08, Boro rice contributed above 58% of the total rice production in Bangladesh. To see the effects of temperature on Boro rice yield and consequently rice production in Bangladesh, a modeling study (Decision Support System for Agrotechnology Transfer, version 4) has been conducted for specifically Boro rice to observe the effect of temperature on the basis of IPCC Fourth assessment report (temperature is projected to rise in a range from 1.8°C to 4.0°C by 2100) for the following assumptions (Table 3). It should be also noted that the other climatic phenomenon such as changing solar radiation and rainfall pattern, cyclone, flood, drought etc are not considered for the present study.

Predicted Boro rice production may be reduced at a rate of 1.5%, 2.5%, 4.4% and 5.4% (base year 2008) in the targeted years 2020, 2030, 2040 and 2050, respectively. Therefore, a considerable amount of Boro production may decline, which will directly affect to the total rice production of this country. Rice and Boro rice production, requirement, shortage and achievement for the targeted years (2020, 2030, 2040 and 2050) are shown in Table 4.

Table 3: Year wise assumptions carbon dioxide concentrations and temperature data		
Year	IPCC	CO_2
	Average Temperature	379 ppm in 2005
2008 (Base)	**0.042 ^{0}C/year**	**1.9 ppm/year**
2020	0.67	409
2030	1.09	428
2040	1.51	447
2050	1.93	466

Table 4: Effects of Temperature on Rice Production						
Year	**Total Boro Rice Production (million tons)**			**Total Rice Production (million tons)**		
	Req.	**Prod.**	**Ach. /Short.**	**Req.**	**Prod.**	**Ach. /Short.**
2006-07	16.31	14.96	-1.35	29.77	27.32	-2.45
2020	20.12	17.53	-2.59	36.73	29.05	-7.68
2030	23.15	20.91	-2.24	42.25	34.00	-8.25
2040	26.62	24.00	-2.62	48.60	38.20	-10.40
2050	30.63	27.20	-3.43	55.90	41.97	-13.93

(Source: Author's own calculation)

Temperature influences rice production significantly. From the modeling study it is found that there will be a small amount of Boro production shortage in the years 2020, 2030, 2040 and 2050 (Table 2); but when the temperature effects are considered, there is a considerable amount (2.59, 2.24, 2.62 and 3.43 million tons, respectively) of Boro production shortage which directly affect the total rice production in Bangladesh. About 13.93 million tons rice production shortage in 2050, which account for about 50.10% of the total rice production for the year 2006-07 (Table 4). As a result, more than 11.50% (3.14 million tons) rice shortage may occur only for temperature and its effect on Boro rice production during 2050 (38.43% rice shortage may occur for increasing population and 50.10% for increasing population and temperature effect in 2050, compared to 2007) (Fig. 4).

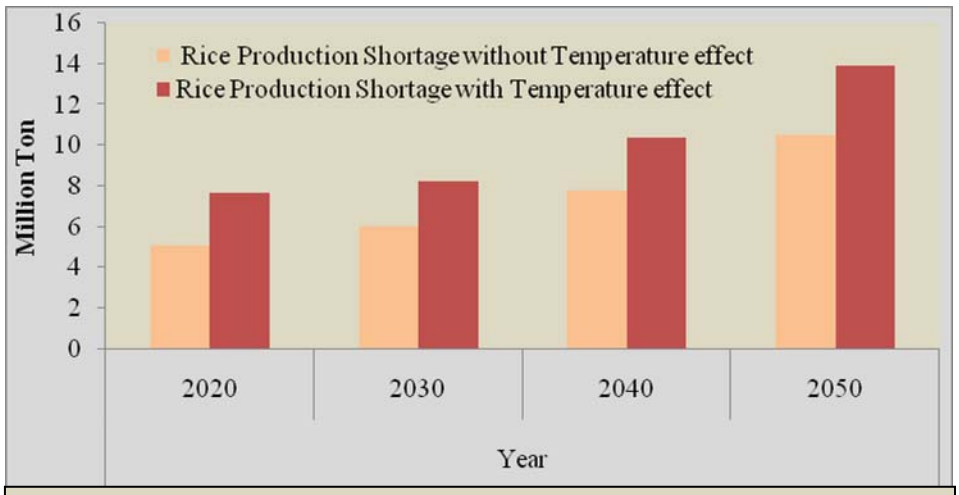

Figure 4: Impacts of Temperature on rice production in Bangladesh

2.5 Impacts on Human Rice demand

In Bangladesh rapid population growth makes it difficult for rice production to keep pace with the rising demand for food. According to the BBS 2006-07, the total rice demand in Bangladesh was 29.77 million tons, whereas production was only 27.32 million tons, corresponding to the total population 140.60 million. More than 2 million tons rice shortage occurred in 2006-07. Therefore, a huge amount of population in our country partially or fully deprived from their basic rice demand even a single day and this condition will be more vulnerable in future due to pressure from huge population growth. At the same time climate change makes this problem more acute.

Rice demand for a single people was 580 gm per day or 211.73 Kg per year in 2006-07, but the rice production was not sufficient on that corresponding years. From the previous analysis (Table 2), it was found that rice may shortages 5.08, 6.02, 7.80 and 10.50 million tons in the years of 2020, 2030, 2040 and 2050, respectively. These shortages may arise only by the huge population's rice demand on those corresponding years. About 10.50 million tons rice shortage may occur in 2050 and if it is converted to rice demand for people, more than 4.5 crore people fully deprive from rice, which is counted above 35 percent compared to the total population in 2006-07. When the temperature effects are considered with population growth (Table 4), rice shortages may occur 7.68, 8.25, 10.40 and 13.93 million tons on the specified years. Therefore, more than 6.5 crore people may

fully deprive from their rice requirement within 2050 which is higher than 45 percent compared to the total population in 2006-07 (Table 5).

Table 5: Population growth and Temperature effect on Food Security in Bangladesh

Year	Population Growth			Population Growth and Temperature		
	Rice Shortage million tons	People deprive from rice million	% of Population	Rice Shortage million tons	People deprive from rice million	% of Population
2020	5.08	24.00	17.07	7.68	36.27	25.80
2030	6.02	28.43	20.20	8.25	38.96	27.71
2040	7.80	36.84	26.20	10.40	49.12	34.94
2050	10.50	49.60	30.92	13.93	65.80	46.80

(% of population is counted by comparing to the total population in 2006-07)

2.6 Impacts on Economic Conditions in Bangladesh

Agriculture remains the most important sector of Bangladesh economy. It contributed 20.83 percent to the national GDP and providing employment for 48.1 percent of the population. In 2007-08 fiscal years, agricultural sector contributed 6.99 percentages of the total export earning. For the last nine months in 2009, it increased 651 million USD. Accounted value of the amount is 5.59 percentage of the total export earning on that time (Bangladesh Economics Review, 2009).

According to the Bangladesh Economics Review 2008, the total GDP in 2007-08 fiscal years was more than five thousand billion Taka (Tk. 5458.2 billion), whereas the contribution of Agricultural and Forestry sectors was more than fifty thousand crore Taka (Tk. 50157 crore) and the GDP growth rate on that fiscal years was 6.19 percentage. In the analysis of the last few years data, it has observed that GDP growth rates follow a increasing trend and maximum cases, it was above 5.5 percentage in 2001 to current year. In this study, GDP in the fiscal years 2000 to 2008 were used to find the possible GDP in the targeted years 2020, 2030, 2040 and 2050 by using polynomial method (Table 6). From the previous study (Table 4 and Table 5), it was found that there are considerable amount of rice shortages may occur in the specified years both for increasing temperature and growth of population. These rice shortages are calculated in terms of money (Taka in thousand crore) by using this following formula:

$$Q = q(1+r)^n$$

Where, **Q** = Rice price for those specified years

q = Rice price in base years (Assume, rice price Tk. 32 per Kg. in 2008-09)

r = Average rate of inflation in 2008-09 is 7.84 %

n = Total number of years ahead

These rice shortages may have a significant role in country's economy in future and found a reasonable amount GDP may be affected by those rice shortages and it will play a vital role in 2050. Almost 0.10% of the total GDP and 0.60% of Agricultural and Forestry GDP will diminish by the population growth within 2050. Accordingly 0.12% of the total GDP and 0.80% of the Agricultural and Forestry GDP will decrease by the increasing temperature and population. About 0.80 thousand crore Taka may loss in 2050 for increasing rice demand. Comparatively it will become 0.15% of the total GDP and 1.5% of Agricultural and Forestry GDP in the fiscal year 2007-08. On the other hand, about 1.06 thousand crore Taka may loss for increasing population and temperature which has counted more than 0.2% of the total GDP and 2% of Agricultural and Forestry GDP in the fiscal year 2007-08. It should be also noted that the value of percentages are not so significant limits, because in this study only Boro rice is considered to see the effects of increasing temperature on its production and overall it impacts on rice production; consequently human rice demand and economic conditions in this country. These figures must be high, if other crops (T.aman and Aus rice), wheat, potato, etc and other agricultural sectors such as fishers, forestry, etc are considered which directly or indirectly affected by changing climatic states.

Table 6: Population growth and Temperature effect on Food security, consequently Bangladesh Economy

Year	Total GDP (Taka in Th. Crore)	Ag. GDP (Taka in Th. Crore)	Population Growth				Population Growth and Temperature			
			Rice Shortage (million tons)	Rice Shortage (Taka in Th. Crore)	% of Total GDP	% of Ag. GDP	Rice Shortage (million tons)	Rice Shortage (Taka in Th. Crore)	% of Total GDP	% of Ag. GDP
2020	613.00	90.00	5.08	0.040	0.007	0.04	7.68	0.061	0.01	0.07
2030	696.00	102.00	6.02	0.101	0.015	0.10	8.25	0.140	0.02	0.14
2040	794.00	118.00	7.80	0.280	0.04	0.24	10.40	0.373	0.05	0.32
2050	880.00	134.00	10.50	0.800	0.10	0.60	13.93	1.061	0.12	0.80

(Th. : Thousand)

Section 03

3.1 Adaptation Strategies

Bangladesh is one of the most vulnerable countries to climate change because of its economic, social constraints and geological location. Individual dependence on agricultural, widespread poverty, inadequate technology and lack of political power are likely to exacerbate the impacts of climate change and food security of this country. Improving Boro and T.Aman production and protecting the declining rate of Aus rice production and developing more heat tolerant rice varieties and management practices would be a major concern for increasing rice production.

Adaptation involves adjustments to decrease the vulnerability of rice production to climate changes. Field level adaptations include changes in planting and harvesting dates, tillage and rotation practices, substitution of crop varieties or species more appropriate to the changing climate regime and improved irrigation and drainage systems. There are a range of technological options that are presently available, which can be properly used for enhancing the rice production systems, ability to adapt and to mitigate the effects of climate change. Crop scientists should probably place even more emphasis on development of heat and drought resistance and feasibility of manipulation through modern genetic technique.

Government of Bangladesh can also facilitate adaptation to climate change through water development projects, agricultural extension activities, incentives, subsidies, provision of insurance, emphasis the agricultural research organization, above all strengthen the government polices in agricultural sectors.

3.2 Conclusion

Impacts of climate change food production and food security are global concerns, but they represent a particular threat for Bangladesh. Agriculture is already under pressure mainly due to increase in demand of food for growing population. The prospects of global climate change make this problem a priority for Bangladesh.

Higher temperatures and water stress due to heat would result in a decline in rice production significantly. Increasing population also affect food security in future. The correlation of the two factor's effect would be more acute in 2050. Economic conditions of this country directly relate with the combination of those factors and will be hampered the total economic growth rate in future. The study shows, Boro rice production shortage is a considerable, partly due to the effect of only temperature which directly affect the total rice production. From the trend line analysis, it is observed that T.Aman production was slightly increased, whereas Aus production decreased a significant rate. This study also indicates that the rice cultivation area was not considerably changed in the last few decades. From the study, it is clear that food security in future will mainly depend on Boro rice production. If rice production will not to be adequate to meet the demand, therefore, a major part of our population will be deprived from food and pass a hungry life with their family and face malnutrition problem. Consequently, our next generation is going to face a great challenge for their daily food due to changing climatic conditions and pressure of huge population.

The sustainable increase of rice production for food security will require efforts to enhance the capacity of rice production system to adapt to global climate change as well as to mitigate the effects of rice production on global warming. Technical options for adaptation and mitigation are available, which should be properly applied in agricultural sectors. Policy support to rice research and development to develop and transfer appropriate and efficient technologies, however, will be vital for the realization of such measures for sustainable rice production. Above all public awareness of the impact of climate change on the agricultural production deserves priority consideration.

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Annex I

Selection of study area:

The simulation study was conducted for six major rice growing locations in Bangladesh. Among them, Rajshahi was selected from Rajshahi division; Mymensingh was selected from Dhaka division; Satkhira from Khulna division; Barisal from Barisal division; Comilla from Chittagong division; and Sylhet district from Sylhet division. It has been also mentioned that the weather and soil data were also collected for those selected locations.

Data Collection:

Crop management data required by the DSSAT model include planting method, transplanting date, planting distribution, plant population at seedling, plant population at emergence, row spacing, plant per hill, fertilizer application dose and irrigation application and frequency were collected from Bangladesh Rice Research Institute (BRRI, 2009). The major crop management input data used in the model for all simulations.

Soil data (percentage of clay, silt and stones, organic carbon, cation exchange capacity, pH in water, etc) were collected from Soil Resources Development Institute (SRDI), Dhaka and Bangladesh Rice Research Institute (BRRI), Gazipur.

Weather data included daily average maximum and minimum temperature, daily precipitation, carbon dioxide, etc in 2008 were collected from BMD. First, the simulation study is conducted for 2008 to predict boro rice yield for the major six rice growing locations under 2008 climatic parameters.

The model uses a detailed set of crop specific genetic coefficients, which allows the model to respond to diverse weather and management conditions. Therefore, in order to get reliable results from model simulations, it is necessary to have the appropriate genetic coefficients for the selected cultivar. The Boro rice variety BR3 has been selected in the present study because genetic coefficients for this variety are available in the DSSAT modeling system. Although this variety is not widely used at present time, the effects of climate change and variability on this variety provides insights into possible impact of climate change on boro rice yield in the future. In order to assess the effect of climate change on the rice varieties currently being grown in Bangladesh, it is necessary to determine their genetic coefficients through carefully controlled field and laboratory experiments for 1 to 2 years field experiment.