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Impacts of Some Climatic Variables on Productivity of Boro rice in South-Western Coastal Regions of Bangladesh

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Abstract

Climate change is the top most important issue in the modern world. Various aspects of Bangladesh are verily affected by climate change. An agro-climatic study was conducted in Khulna, Satkhira and Bagerhat district in Khulna division as well as the Southwestern coastal part of Bangladesh with last 30 (1981-2011) years of some climatic data of average temperature, maximum temperature, seasonal total rainfall, average humidity and sea level pressure to address the climatic variability and its impacts on *Boro* rice production in Southwestern coastal part of Bangladesh. The average temperature increased by 0.51°C in *Boro* season in this area. The sea level pressure was about stable here. The *Boro* rice production increased by 0.04 and 0.3 tha^{-1} in Khulna and Bagerhat district. However most of the time the production showed increasing trends except in 2007 and 2009 affected by two devastating natural calamities as "SIDR" and "AILA" occurred in these two year respectively.

Key words: Climatic variables, Coastal region, Crop productivity

Introduction

Climate change is a reality and a great future concern for all over the world. Many adverse effects of climate change including extreme variability are already visible. The average global surface temperature has increased by 0.74°C during last 100 years (IPCC, 2007). Bangladesh is a country of about 143,999 Km^2. including inland and estuarine water surfaces and is located between 20°34′ and 26°33′ N latitude and between 88°01′ and 92°41′ E longitude which is basically a flat land washed regularly by water whether it is rain or flood. The coastal area covers about 20% of the country and over 30% of the net cultivated area. It extends inside up to 150 km from the coast. Bangladesh has been facing higher temperatures over the last three decades (Sarker et al., 2012). Moreover, it is forecasted to experience a rise in annual mean temperatures of 1.0 °C by 2030, 1.4 °C by 2050 and 2.4 °C by 2100 (Agrawala et al., 2003). The prediction for the winter season (December, January and February) average temperature showed a similar increasing pattern, 1.1 °C by 2030, 1.6 °C by 2050 and 2.7 °C by 2100. The projected value is 0.8 °C by 2030, 1.1 °C by 2050 and 1.9 °C by 2100 for the monsoon months (Agrawala et al., 2003). Agriculture is the largest sector of Bangladesh's economy, which accounts for about 35% of the GDP and about 70% of the labor force (Bangladesh Economics Review, 2009). Agriculture in Bangladesh is already under pressure, both from huge and increasing demands for food as well as from obstacles related to the degradation of agricultural land and water endowments (Ahmed et al., 2000).

Khulna division is one of the eight divisions of Bangladesh and is in the south-west of the country. The climate of Khulna division is generally marked with monsoons, high temperature, considerable humidity and moderate rainfall. The hot season commence early in March and continues till the middle of July. The maximum mean temperature observed is about 32°C to 38°C during the month of April, May, June and the minimum temperature recorded in January is about 7 to 16°C. The highest rainfall is observed during the month of monsoon. The annual average rainfall in the division is about 1249.90 mm (BBS, 2011). A major part of Khulna division is covered by coastal zone which is directly vulnerable and sensitive to climate change. In this peach of research it is tried to find the find the changing trend of major climatic variables and their interference on agricultural production in Khulna division.

Materials and Methods

Study area

For this research it is considered the three major South Western coastal districts as Khulna, Satkhira, Bagerhat for the study area.Khulna district (Figure 1) lies in the southern part of the country between 22°12′ and 23°01′ North latitudes and 89°14′ and 89°45′ East longitudes. Satkhira district (Figure 1) lies in the south west corner of the country between 21° 38′ and 22°57′ North latitudes and 88°54′ and 88°58′ East longitudes. Bagerhat district (Figure 1) lies in the southern part of the country between 22°13′ and 22°59′ North latitudes and 89°32′ and 89°58′ East longitudes

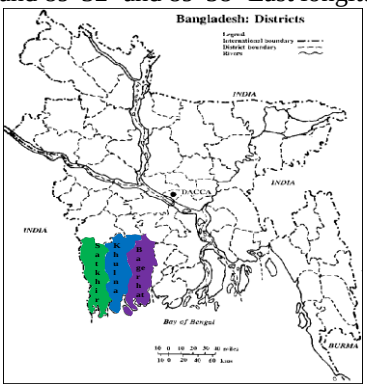

Fig.1. Map of Bangladesh with marked study area

Data collection and analysis

Daily average data of different climatic variables were collected from Bangladesh Meteorological Department (BMD) and the yearly crop production data of *Boro* rice has been obtained from Yearbook of Agricultural Statistics of Bangladesh from 1980 to 2012. After completion of collecting data, they were compiled, tabulated and analyzed according to the objective of the study. Data were put in MS excel and SPSS for statistical analyze. Annual average and total measurement of the variables (temperature, relative humidity, rainfall and sea level pressure) of the selected stations of Bangladesh were calculated to analyze the trend and their correlation with production (tha^{-1}) of each crop from 1981 to 2011. The regression equations and the coefficient of determination (R^2) have been obtained through scatter diagrams by taking two indices at a time.

Results and Discussion

Seasonal rice productivity and climatic variables

In Khulna

It was found from the Figure.2 that the *Boro* rice production (tha^{-1}) showed increasing trend at Khulna district during 1981-2011. And until the production area affecting by great Cyclone "SIDR" occurred 15, November 2007 it was also increased. During "SIDR" major part of the Khulna district was covered by saline water (BBS, 2008). The average temperature of last ten years increased by 0.51°C from previous twenty years, and the average maximum temperature of last ten years increased by 0.25°C from previous twenty years during *Boro* rice production in Khulna district. The average value of seasonal total rainfall of last decade from 2001 to 2011 was 292.45 mm and from 1981 to 2000 was 394.9 mm indicates the 102.45 mm rainfall decreasing of last ten years from previous twenty years during *Boro* rice production in Khulna.

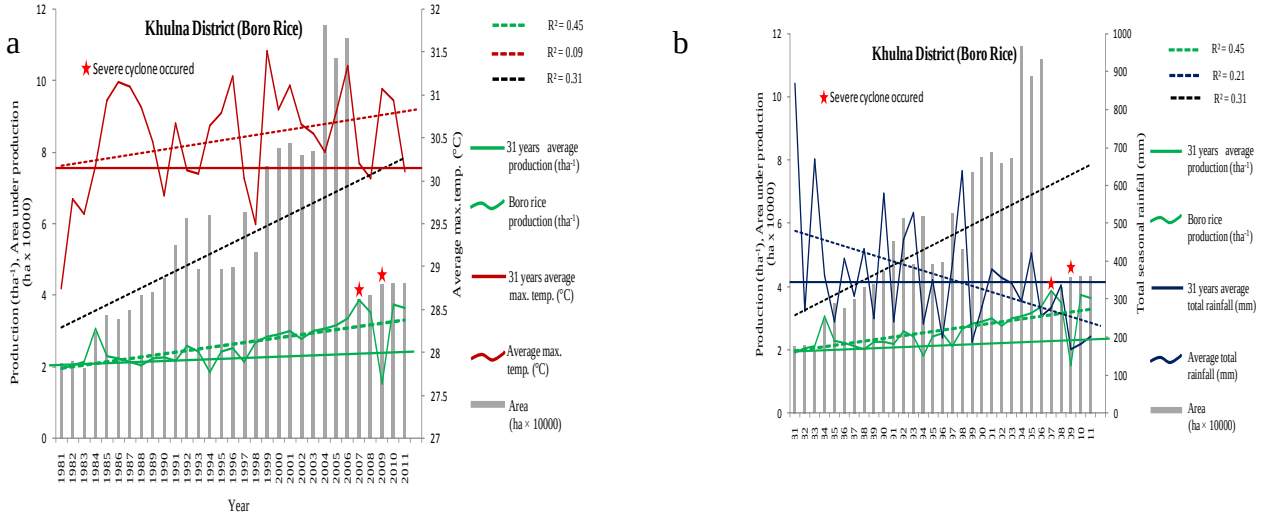

Fig. 2. Inter seasonal variability of *Boro* rice production (tha^{-1}) with area influenced by (a) average maximum temperature (°C) (b) total average rainfall (mm) at Khulna district during 1981-2011

In Satkhira

It was found from the Figure.3 that the *Boro* production (tha^{-1}) showed linearly fit trend at Satkhira district during 1981-2011. And the production area (ha) was straightly increased from 1981-2006 and in 2007 and 2008 it was decreased remarkably for the adverse effect of historical tropical cyclone "SIDR" held in 2007 in south western coastal area (BBS, 2010). The annual monsoon daily average and maximum temperature showed the increasing trend at Satkhira district during 1981-2011.The annual monsoon daily percentage of average humidity showed the moderate decreasing trend with some fluctuations at Satkhira district during 1981-2011.

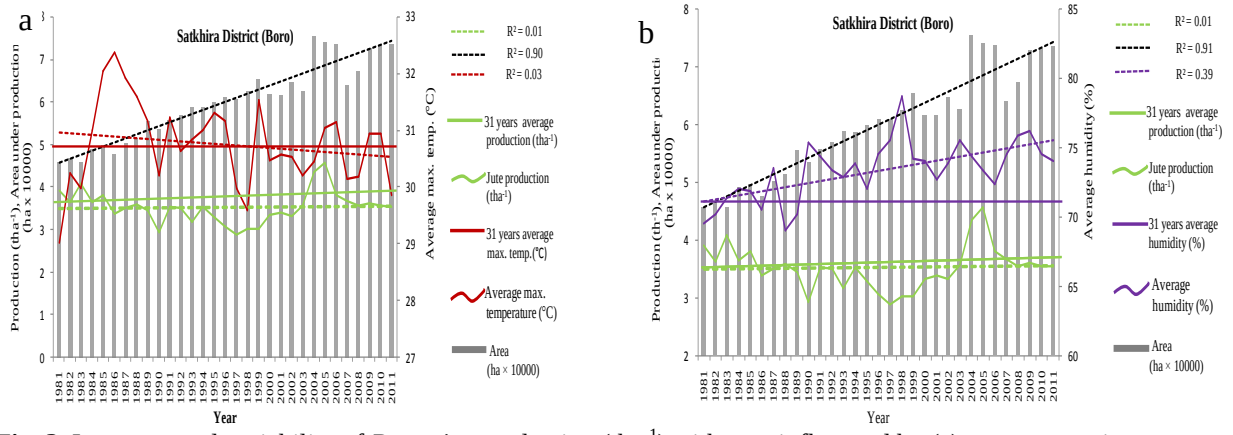

Fig. 3. Inter seasonal variability of *Boro rice* production (tha^{-1}) with area influenced by (a) average maximum temperature (°C) (b) relative humidity (%) at Satkhira district during 1981-2011

In Bagerhat

It was found from the Figure.31 that the *Boro* production (tha^{-1}) showed linearly fit trend at Bagerhat district during 1981-2011. And the production area (ha) was straightly increased from 1989-2006 and in 2007 and 2008 it was comparatively decreased for the adverse effect of historical tropical cyclone "SIDR" and in 2007 in south western coastal area (BBS, 2010). The annual monsoon daily average and maximum temperature showed the increasing trend at Bagerhat district during 1989-2011. The seasonal total rainfall showed the slightly declining trend hardly affecting production rate of *rice* from 1989-2011 in Bagerhat district.

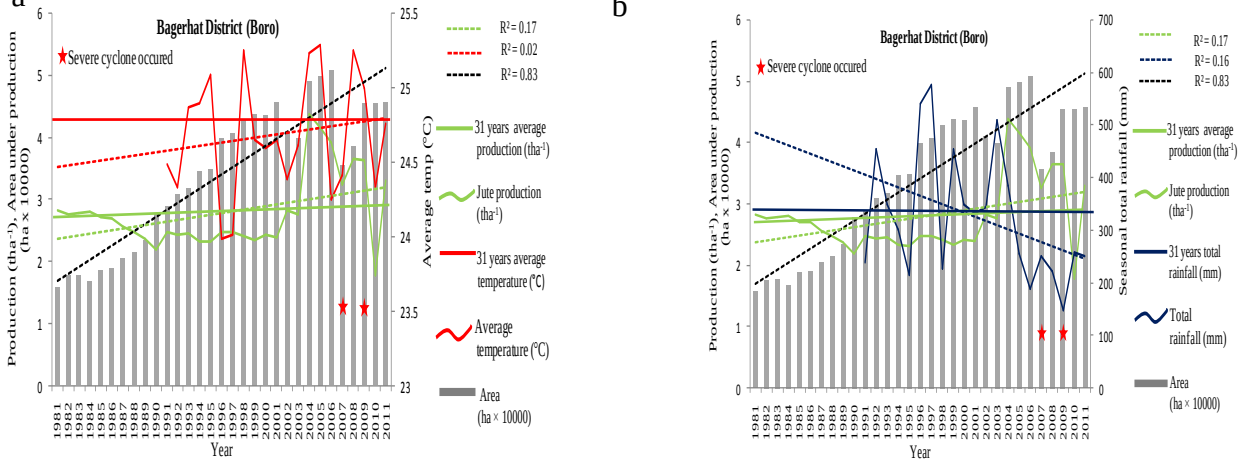

Fig. 4. Inter seasonal variability of *Boro rice* production (tha^{-1}) with area influenced by (a) average temperature (°C) (b) total average rainfall (mm) at Bagerhat district during 1981-2011

Conclusions

The climatic variables were changed by both decreasing and increasing but most of the crop productions are increased. During *Boro* season the average temperature increased by 0.51 °C from 2001 to 2011 than 1981 to 2000 and the maximum average temperature increased by 0.25°C from 2001 to 2011 than 1981 to 2000. In 2007 and 2009 the historical severe cyclone "SIDR" and "AILA" occurred respectively in the study area which damaged the production rate remarkably. The rainfall and sea level pressure was decreased by 102.45 mm and 1.39 mb. In Satkhira average temperature decreased by 1.27°C during *Boro* season. In Bagerhat district the average and maximum temperature was increased and the rainfall and sea level pressure was decreased but the production was increased gradually in *Boro* season. The rainfall increased by 152 mm during *Boro* season in Bagerhat district.

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