

## ASSESSING THE IMPACTS OF RESENT CLIMATIC SITUATIONS ON AGRICULTURAL PRODUCTION IN THE SOUTH-WESTERN COASTAL BAGHERHAT DISTRICT OF BANGLADESH

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### ABSTRACT

The study was carried out in the South-western coastal Bagherhat district of Bangladesh to know the scenario of climatic pattern and its effects on crop production. Twenty ninety years (1991-2019) data of different climatic parameters such as temperature, relative humidity, rainfall, wind speed and total sunshine were analyzed for the study. The ten years crop related data were also collected in annual basis from the year of 2010 to 2019 in respect of annual *crops* production. The investigation explored that the maximum air reached above 40.50°C at 2016 and the increasing trend are very prominent. The maximum air temperature ranged as 36.40-40.50°C within 29 years of period. In case of minimum temperature the prominent fluctuations was also observed within the range of 7.20-11.50°C. Overall average 1% temperature is being increased by each 10 years. The average values lied within 25-26°C, but the upward trend for the maximum temperature and downward trend for minimum temperature make the situation more extreme in coastal Bagherhat district. Average relative humidity (RH) fluctuated in downward trends and lied within the values 79-81 except the year 2004-2006 (83%). The highest rainfall was 6816.08 mm in 2011. The line diagram proved the increasing trend of total annual rainfall, but the level is minimal. As like as RH and rainfall, the wind speed was drastically decreased during the study period. The total sunshine hour decreased up to 10% within the study period, while the highest sun shine hour (2589.80 hr) was recorded in 2002. On the other hand the lowest sun shine hour (1924.30 hr) was found in 2015. The study also stated that agriculture is under challenges due to changing climate in coastal Bagherhat district. The total production is 439578 M.ton against the demand amount of 331170 M.ton. The production of rice, jute, potato and mustard are being increased but there is vast scope for more cultivation of wheat and B. aman rice. The yearly average B. aman production is only 125 M.ton against the total rice production (21645 M.ton) in Bagherhat district.

**Key words:** Climatic situation, agricultural production, coastal Bagherhat district.

### Introduction

The coast of Bangladesh are highly resistant to climate change due to very low elevations, some terrain on the sea level, the topography of the deltaic region, the Bay of Bengal, socioeconomic profile and infrastructure renders the capacity to tackle the effects of climate related disasters (Agrawala *et al.*, 2003). This area is more affected than any other regions of Bangladesh. They experience a variety of natural and man-made disaster events (Sea Level Rise-SLR, cyclones, storm surges, floods, droughts, salinity, riverbank erosion, and landslides). The coastal areas of southwestern Bangladesh are already affected by rising temperatures, slow climatic stresses such as saltwater intrusions into agricultural soils, ground water, sudden storm surges and increased intensity such as floods, riverbank erosion impacting from cyclones, storm surges and climate change (Huq *et al.*, 2015). The effects of climate change are being felt by different parts of the world and by different communities. It is already established that climate-related risks, including extreme events such as cyclones, excessive rainfall, and consequent floods and logging, salinity and riverbank erosion, adversely impact the rural life of South Asian's coast (Dastagir, 2015). Kabir *et al.* (2016) stated that the effects of climate change have serious implications on the lifestyle patterns of affected people and their overall health. Climate factors increase the incidence of various water-borne infections such as cholera and diarrhea, as well as vector infections such as dengue fever and malaria associated with common health problems (Costello *et al.*, 2011).

Climate change now occupies the top of the environmental concerns that impede progress in socioeconomic development and threaten human security. According to 4<sup>th</sup> IPCC Report, Bangladesh is recognized worldwide as one of the country's most vulnerable to the impacts of global warming and climate change (IPCC, 2007). This is due to its unique geographic location, dominance of floodplains, and low elevation from the sea, high population density, high levels of poverty, and overwhelming dependence on nature. One critical variable that determines the vulnerability of Bangladesh to climate change impacts is the magnitude of sea level rise. Scientists of Bangladesh believe that because of sea level rise coastal Bangladesh has already experienced the worst impacts especially in terms of coastal inundation and erosion, saline intrusion, deforestation, loss of bio-diversity and agriculture, and large scale migration (DOE, 2007). Coastal areas in Bangladesh are on the 'front line' of climate change, directly affected by storm surges, drainage congestion, and sea level rise. Most of Bangladesh is less than ten meters above sea level, with almost ten per cent of the country below 1 m, making it extremely vulnerable to increasing high tides. With sea levels expected to rise by an average of two to three mm per year during the first part of this century (IPCC, 2007). Many of the anticipated adverse affects of climate change, such as sea level rise, higher temperatures, and an increase in cyclone intensity, will aggravate the existing stresses that already impede development in Bangladesh, particularly by reducing water and food security and damaging essential infrastructure (MoFE, 2012). These impacts could be extremely detrimental to the economy, the environment, national development, and the people of Bangladesh (Reid and Sims, 2007).

Extreme weather conditions such as high temperatures, heavy precipitation, floods, droughts, storms, and cyclones affect crop production. Rising temperatures and heavy rainfall can even destroy crops (Chowdhury and Faisal, 2005). Various studies indicate that a temperature rise of 1 to 20<sup>0</sup>C in combination with lower solar radiation causes sterility in rice spike lets. High temperature was found to reduce yields of HYVs of Aus, Aman and Boro rice in all study locations and in all seasons of Bangladesh. The effect was particularly evident at a rise of temperature by 40<sup>0</sup>C. Climate changes, especially in temperature, humidity and radiation, have great effects on the incidence of insect pests, diseases and microorganisms. A change of 10<sup>0</sup>C changes the virulence of some races of rust infecting wheat (DAE, 2007). Agriculture remains an important economic sector, employing almost half of Bangladeshis, mainly in rice production. As 70% of the territory's land is used for agriculture, and approximately one-quarter of the country is inundated on average each year, this sector is highly vulnerable to climate risk (MOEF, 2012). Bangladesh's economic reliance on agriculture has declined in recent decades, as more than half of its GDP is now derived from the service sector, while the industrial sector makes up around 26% of GDP (CIA, 2015). In these situations the challenges of agriculture needs to be undertaken under intensive research. The present PhD research is one the touches for exploring the impacts of extreme climates on pertaining agriculture in the South-western coastal Bagerhat district of Bangladesh.

## Materials and Methods

The study was carried out in the South-western coastal Bagerhat district of Bangladesh to know the scenario of climatic pattern and its effects on crop production. Twenty ninety years (1991-2019) data of different climatic parameters such as temperature, relative humidity, rainfall, wind speed and total sunshine were analyzed for the study. The ten years crop related data were also collected in annual basis from the year of 2010 to 2019 in respect of annual *crops* production. The data on *crop* production were critically analyzed to conclude an overall statement on crop production in relation to climatic variation in coastal Bagerhat district of Bangladesh.

## Results and Discussion

### *Climatic parameters in Bagerhat district*

**Temperature:** Thirty years climatic conditions in Bagerhat district presented in respect of air temperature covering the maximum, minimum and average values during 1991-2019. The maximum air temperature fluctuated within the years (Fig. 1) and ranged as 36.40-40.50<sup>0</sup>C within 29 years of period. The minimum

temperature ranged within of 7.20-11.50<sup>0</sup>C. Overall average 1% temperature is being increased by each 10 years. The average values lied within 25-26<sup>0</sup>C, but the upward trend for the maximum temperature and downward trend for minimum temperature make the situation more extreme in coastal Bagerhat district of Bangladesh. This magnitude of the rise in air temperature can frequent more natural disaster in hazards prone coastal areas of Bangladesh (Shaibur *et al.*, 2017).

**Relative humidity:** Average relative humidity (RH) for Bagerhat within 29 years (1991-2019) period were shown in Fig. 2, which revealed that the RH fluctuated in downward trends and lied within the values 79-81 except the year 2004-2006, when the values reached upto 83% in respect of yearly average value.

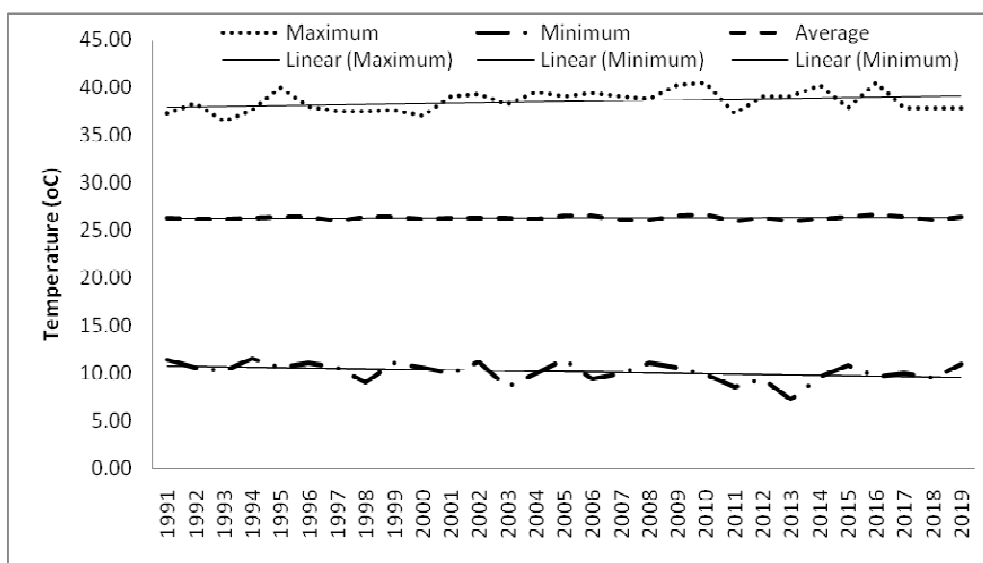


Fig. 1 Air temperatures in Bagerhat District (1991-2019)

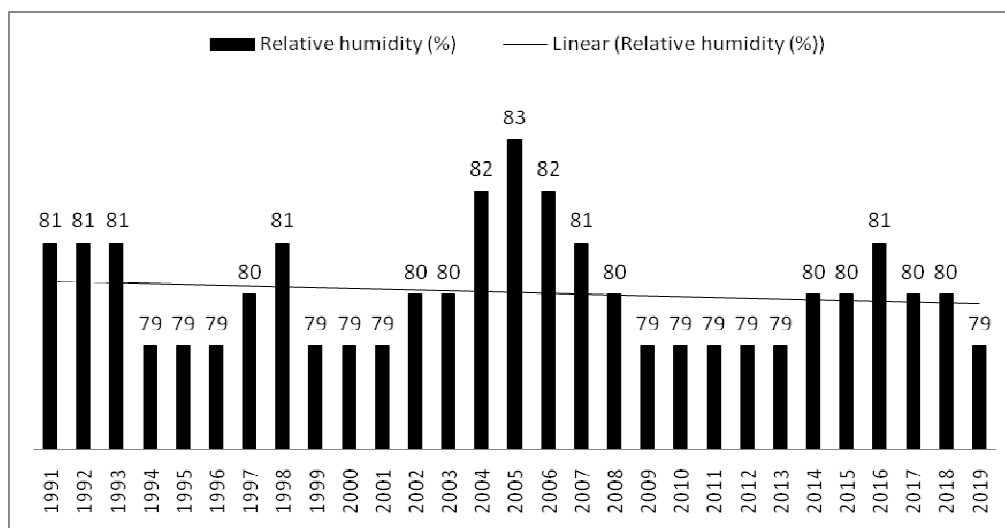


Fig. 2 Relative humidity in Bagerhat District (1991-2019)

**Rainfall:** Fig. 3 shows the variation of total annual rainfall during the year 1991-2019. The highest value of rainfall was 6816.08 mm in 2011. The line diagram proved the increasing trend of total annual rainfall, but the level is minimal. The data also found that most of the ppt. falls during the month of June-September. The average rainfall during last 60 years has a positive trend with a slight decrease in monsoon season (Habib, 2011 and Hossain *et al.*, 2018). The increase of rainfall was most probably due to the increasing temperature with time (McGregor *et al.*, 2005). Though the total rainfall is increasing but it is so irregular resulting coastal agriculture is being hindered greatly. Due to above facts, expansion of economic agriculture is being hampered mostly in whole coastal as well as overall Bangladesh.

**Monthly wind speed:** As like as RH and rainfall, the wind speed was drastically decreased during the study period (Fig. 4). This change in wind speed is one of the major components of climate changes over the world and also in the coastal belt of Bangladesh.

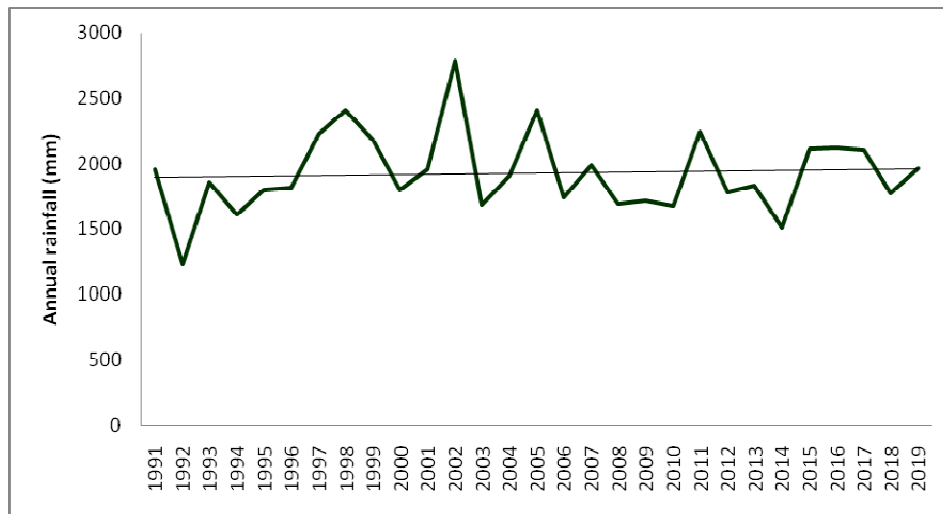


Fig. 3 Total rainfall in Bagerhat District (1991-2019)

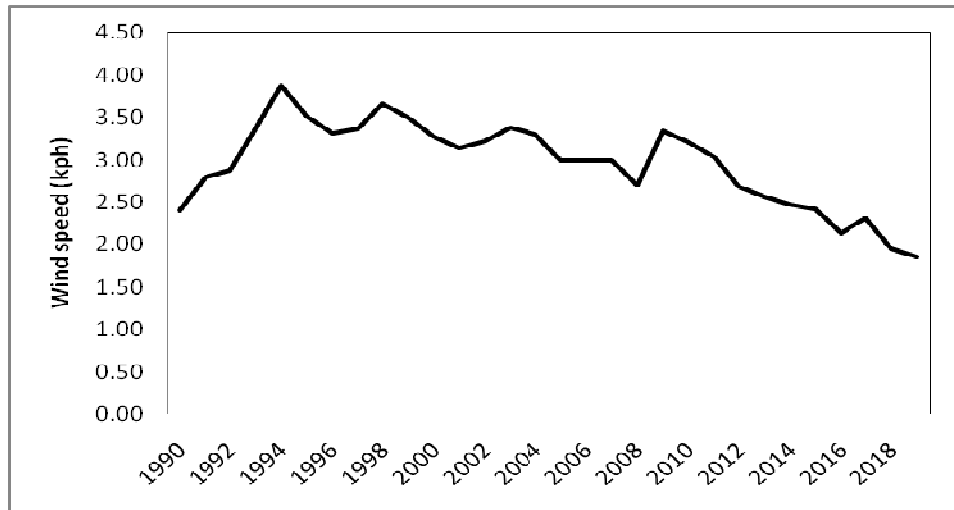


Fig. 4 Yearly average wind speed in Bagerhat District (1990-2019)

**Total sunshine hour:** The total sunshine hour decreased up to 10% within the measuring period (Fig. 5), while the highest sun shine hour (2589.80 hr) was recorded in 2002. On the other hand the lowest sun shine hour (1924.30 hr) was found in 2015. The agriculture mainly depends on nature; furthermore, those catastrophic climatic states are being impacted our agriculture mostly. This phenomenon creates the uncertainty in sustainable and economic agricultural production all over Bangladesh.

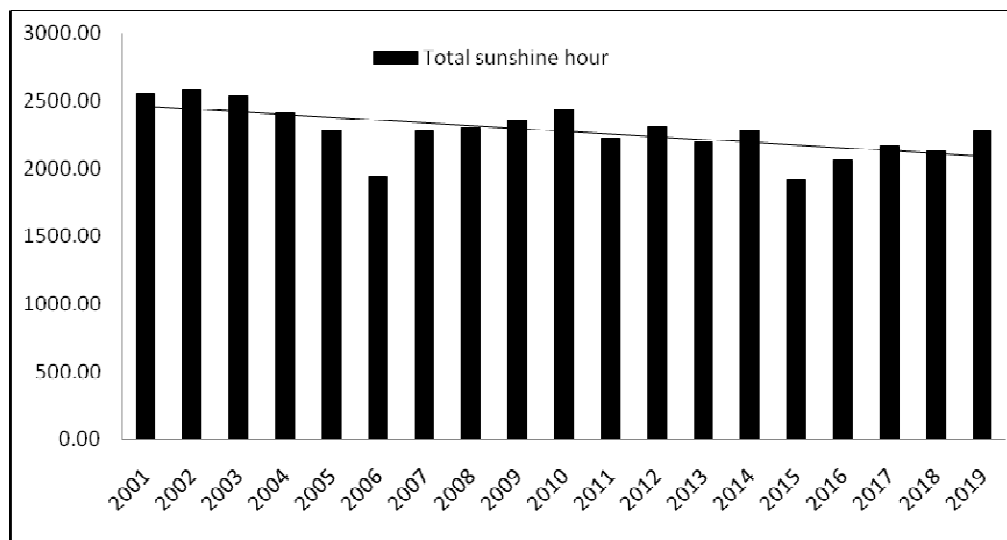


Fig. 5 Total sunshine hour in Bagerhat District (1991-2019)

**Agricultural production in changing climate at coastal Bagerhat district within the period 2010-2019:**

Agriculture is under challenges due to changing climate in coastal Bagerhat district. But due to great care from Bangladesh Govt. and specially the agriculture related Govt. organizations viz. DAE, BADC etc. the crop production is surplus. The total production is 439578 M.ton against the demand (331170 M.ton). Table 1 presented the production amount of some major crops, where it was observed that though the production of rice, jute, potato and mustard are being increased but there is vast scope for more cultivation of wheat and B. aman rice. The yearly average B. aman production is only 125 M.ton against the total rice production (21645 M.ton) in Bagerhat district. The cropping intensity is 151%, which also confirmed the more demand of crop production in this area. In rice production, Aus, B. aman, T. aman and Boro contributed as 4.06, 0.33, 39.89 and 55.73% (Fig.6), respectively to total rice production during 2010-2019 in coastal Bagerhat district of Bangladesh.

Table 1. Crop production in Bagerhat district within 2010-2019

Year	Aus (M.ton)	B. Aman (M.ton)	T. Aman (M.ton)	Boro (M.ton)	Wheat (M.ton)	Jute (bales)	Potato (M.ton)	Mustard (M.ton)
2010	22335	3713	148622	183461	616	16079	7820	733
2011	19890	3388	148370	187960	730	14424	6930	662
2012	16615	1367	143688	181440	665	11176	8490	626
2013	14245	544	146713	188565	708	10720	8352	658
2014	13505	778	156080	213822	1522	13576	9990	782
2015	12783	970	150230	213625	1472	14552	11975	940
2016	12392	970	154600	239310	1095	3128	13634	990
2017	14760	570	160360	250750	450	19766	12400	1170
2018	15490	222	172414	260165	114	16450	7860	1196
2019	15605	153	168030	245370	167	20160	7865	1085

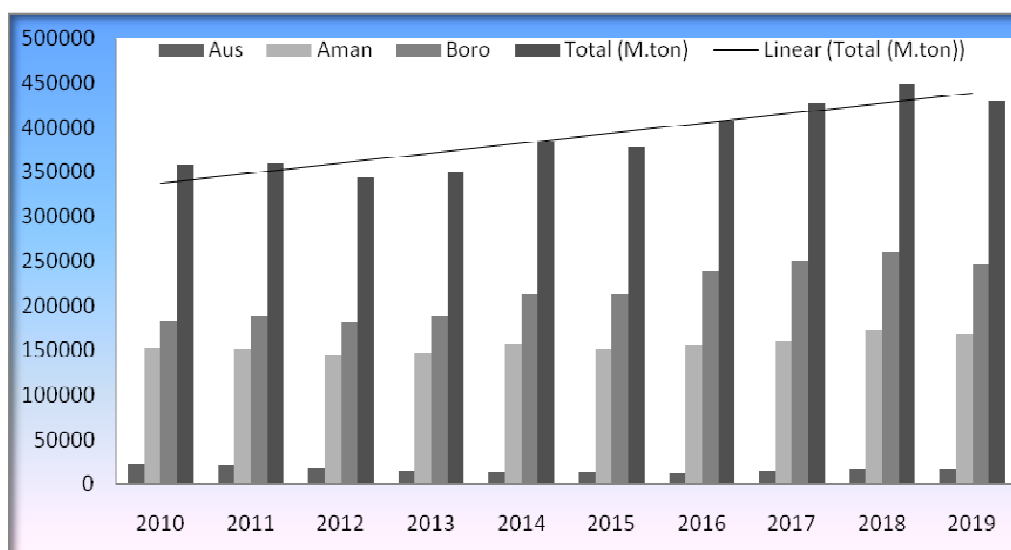


Fig.6. Rice production status in Bagerhat district within 2010-2019

Climate change and agriculture are interrelated processes, both of which take place on a global scale (IPCC, 2007). Global warming is projected to have significant impacts on conditions affecting agriculture, including temperature, carbon dioxide, glacial run-off, precipitation and the interaction of these elements (Fraser, 2008). These conditions determine the carrying capacity of the biosphere to produce enough food for the human population and domesticated animals. The overall effect of climate change on agriculture will depend on the balance of these effects. Assessment of the effects of global climate changes on agriculture might help to properly anticipate and adapt farming to maximize agricultural production (Fraser, 2008). Haque *et al.* (2012) stated that there was a statistically non significant increasing trend of average annual temperature but significant relative humidity, whereas non-significant decreasing trend in respect of average annual total rainfall and annual average sun shine from the year of 1990 to 2010. There was also a statistically significant relationship between the *Boro* rice productions with the varied climatologic due to climate sensitive of *boro* rice. The study also concluded that the effect of climate on agriculture is related to variability in climates in local climates.

### Conclusion

Climate change and agriculture are interrelated processes. The upward trend for the maximum temperature and the downward trend for the minimum temperature make the situation more extreme. So to ensure sustainability either way, we need to lower the temperature and apply climate change-oriented coastal farming technologies to the coastal areas of Bangladesh.

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