Proceedings of 2022 Asian Conference on Crisisonomy
(20 ~ 23 July, 2022; Jeju National University; Asian Association for Crisisonomy)

Climate Change Driven Disaster and its Consequence in Agriculture and Food Production in Bangladesh

Muhammad Shahidul Haque*

Department of Biotechnology, Bangladesh Agricultural University, Mymensingh 2202, Bangladesh
*Correspondence: haquems@bau.edu.bd Tel.: +8801716066503

A B S T R A C T

Bangladesh is prone to regular natural catastrophes, which result in the deaths of people, animals, and plants, as well as the destruction of homes, highways, and public and private property. Bangladesh is ranked eighth on the list of countries most vulnerable to climate change, while emitting only 0.56 percent of global emissions that affect global climate. Many calamities, such as cyclones, flooding, thunderstorms, temperature rises, unpredictable rainfall, increased soil salinity, drought, water logging, and submergence, are caused by climate change. All of these factors work against Bangladesh's agricultural and food security. Bangladesh is particularly vulnerable to increasing sea levels as a result of global warming since low-lying areas would be flooded first. According to climate experts, increasing sea levels will drown 17 percent of the country's land by 2050, displacing roughly 20 million people. Moreover, due to flash floods, water levels rise quickly, submerging plants for 1–2 weeks. In Bangladesh, flash flood submergence is becoming a growing problem, resulting in a food crisis. Bangladesh was struck by 60 strong cyclones between 1797 and 1991. This document presents a brief description of the disasters, focusing on the loss of life and damage to crops and property, among other things.

Key words: Agriculture; Crop production; crisis, disaster management; food security; biodiversity

1. Introduction

Bangladesh is and agrarian country in Asia. It is a country with a high population density. It has been 50 years since the country gained independence in 1971. It has a fast-growing population. Bangladesh's agriculture sector employs the most people. Agriculture employs roughly 42.7 percent of the workforce and accounts for about 80 percent of rural people's income [1]. Agriculture accounts for 14.2 percent of Bangladesh's GDP and employs about 80 percent of the rural population. Bangladesh experienced a food problem when it was founded in 1971, and food production could not even support a population of 65 million people. Fortunately, throughout the last 50 years, the government has boosted food production to keep up with population growth. Bangladesh's agricultural performance is a key factor in the country's food production. With an unregulated population growth and gradually decreasing arable land, the country's current level of food production is a tremendous achievement. However, rising natural disasters and climate change pose a danger to food security.

Bangladesh is located at the crossroads of two distinct environments, with the Bay of Bengal (BoB) to the south and the Himalayas to the north [2], providing Bangladesh with both life-giving monsoon and catastrophic disasters such as tropical cyclones (TC), storm surge, flood, drought, and erosion on the one hand [3]. Bangladesh has over 300 rivers and alluvial soil, making the country extremely productive. Bangladesh's terrain, in-cluding low-lying ones, is ideal for crop cultivation. As a result, Bangladesh is frequently hit by destructive floods, tropical cyclones and storm surges, tornadoes, riverbank erosion, drought, and other natural disasters [4,5]. Floods, droughts, storms, cyclones, and tidal waves all have an impact on food production. Bangladesh has proven to be one of the world's most disaster-prone areas, with its recurring cycle of floods, cyclones, and storm surges. Bangladesh was affected by 60 strong cyclones between 1797 and 1991, majority of which were accompanied by storm surges. During the 1960s and 1970s, a massive system of

embankments was built to protect Bangladesh's coastal areas from cyclonic storm surges and floods, but it is now in need of repair. The World Bank approved the Cyclone Pro-tection Project in 1989, which included the rehabilitation of existing embankments, the construction of new embankments, and the construction of roadways.

2. Materials and Methods

This study utilized the secondary data from various sources like journal articles, national and international organizations, newspapers and internet website. Many web-sites of Bangladesh Government have published official information while international organizations are also working on the natural disasters, agriculture and its problems with probable solutions. Many of the information has been collected and reproduced to prepare tables and figures with useful information in this study. The information on cyclones, floods and loss incurred have been reproduced.

3. Results and Discussion

3.1. Flood and its Effects

Bangladesh is facing increased natural disasters such as cyclone, salinity, drought, heavy rainfall and thunderstorm, coastal erosion, flood and flash flood. It is brutally affected by nationwide or local flood throughout the country in most of the year due to untimely rainfall or water coming from the neighboring northern country India.

Table 1: Major floods in Bangladesh over the last 75 years

Year	Flood affected Area	Affected Area
1955	50,700	34.2
1974	52,720	36.6
1987	57,491	39.9
1988	89,970	63.0
1998	100,250	68.0
2004	55,000	38.0
2007	62,289	42.2

The agriculture of the South Asian country, especially Bangladesh is largely dependent on seasonal weather patterns and climatic conditions. The recent global climate change has imposed a negative impact on the farming pattern in the country. The prevalence of heavy rainfall, floods, extreme temperature patterns and droughts has slowly changed the cropping patterns. These phenomena will continually adversely affect the country's agricultural system. Crop quality and quantity will reduce, water use (irrigation) will be changed, and land use pattern will change with migration of people. The increased frequency and intensity of floods, water logging, soil erosion and salinity have made the farming communities highly vulnerable and resilient. The data in Table 1 shows that flood affected area increased gradually form 34.2 % in 1955 to 68 % in 1998. The next years had a slight improvement. However, loss could not be prevented.

3.2. Cyclone and its Effects

Fifteen severe cyclones with a speed above 100 km/h have been recorded during 1960 to 2017 (Table 2). May is the most critical time for cyclone. The cyclone affected area include mostly Chittagong and its Northern Part, Cox’s Bazar, Teknaf and Khulna.

The 1991 cyclone hit Bangladesh late 29 April night. The maximum wind speed in Sandwip reached 225 km/h. At other places, the maximum wind speed varied from 160 km/h to 185 km/h, and Bhola 178 km/h. The storm had the maximum storm surge height of about 5 to 8 m. The casualties were: 150,000 people, 70,000 cattle and loss of property were estimated at about Tk 60 billion. In May 1997 another cyclone hit the coastal islands and chars near Chittagong, Cox's Bazar, Noakhali and Bhola districts. The maximum wind speed was 225 km/hour, and the storm surge reached 3.05 metres. Casualty: 126 people. On 25–27 September 1997, A severe cyclonic storm hit coastal islands near Chittagong, Cox's Bazar, Noakhali and Bhola. It had wind speeds of up to 150 km/hour, and a storm surge of 1.83 to 3.05 metres.

Table 2: Fifteen severe cyclonic storms with hurricane speed were identified during 1960 to 2017.

Year	Date	Area Crossed	Wind speed (km/h)
1960	30–31 October	North Part of Chittagong	193
1961	5-9 May	Meghna Estuary	161
1963	28 May	North Part of Chittagong	202
1965	7-15 December	Cox's Bazar	184
1970	13 November	North Part of Chittagong	193
1974	24-28 November	Chittagong	161
1985	22-25 May	Chittagong	154
1988	24-30 November	Khulna	193
1991	25-30 April	North Part of Chittagong	225
1994	24 April-2 May	Teknaf	200
1997	15-19 May	Teknaf	230
2007	11-15 November	Khulna Barishal	193
2009	27–29 May	south-western 15 districts	120
2016	21 May	Chittagong	100
2017	29–31 May	Chittagong, Cox's Bazar	110

Figure 1 shows the death due to cyclone in Bangladesh during last 50 years. It appears that the frequency of cyclone has increased recently but the number of death reduced, probably due to awareness of the people and the appropriate measures taken by the government. Many national and international NGOs are working the cyclone prone areas to mitigate the crisis.

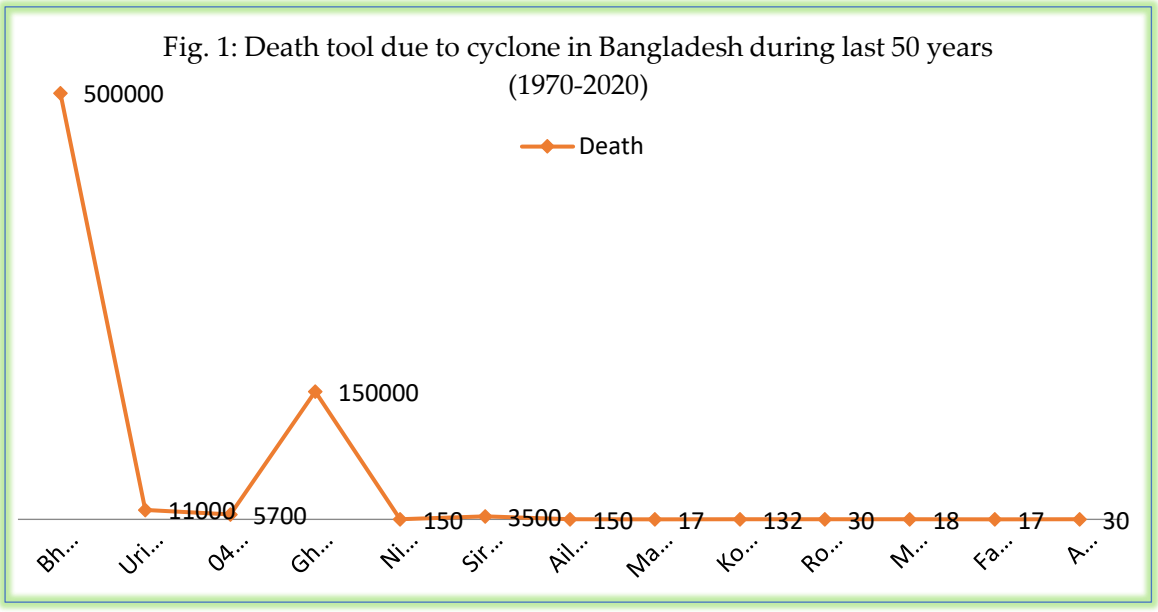

Fig. 1: Death tool due to cyclone in Bangladesh during last 50 years (1970-2020)

3.3. Challenges of drought

Northwestern parts of Bangladesh are particularly exposed to droughts. A strong drought can cause above 40% damage to broadcast aus rice. During the kharif season, it causes significant destruction to the T. aman rice in approx. 2.32 million ha every year. In the rabi season, about 1.2 million ha of agricultural land face droughts of different magnitudes. Apart from the agricultural loss, droughts have important effect on livestock population, land degradation, health and employment. Past droughts have typically affected about

47% area of the country and 53% of the population [6]. Every five to ten years, Bangladesh is affected by the major country-wide droughts. It causes huge loss to the agricultural crops, livelihood, health and fisheries etc. which are directly related to food security of the country

3.3. Challenges of Submergence

Bangladesh is very vulnerable to rising sea levels due to global warming as low-lying lands will get submerged first. About 10,000 square kilometers of the total area of Bangladesh is covered with water which makes it very prone to the effects of deforestation, soil degradation, and erosion. As predicted by climate experts, rising sea levels will submerge some 17 % of the nation's land and displace about 20 million people by 2050. Flash flood submergence is becoming a growing challenge in Bangladesh Agriculture. Due to flash flood water levels rises rapidly and plants remain submerged for 1–2 weeks.

3.4. Challenges of Soil Salinity

Climate change impacts would lead to the increased river and groundwater salinity in Bangladesh's Southwestern coastal regions by 2050 [7]. (Brammer 2014). The coastal regions of Bangladesh cover 2.85 Mha, of which 0.83 Mha are arable. This represents around 30% of the cultivable lands of Bangladesh. There are some 2.5 Mha of low-lying coastal lands and around 1.51 Mha (53%) of these areas are affected by salinity. The monsoon wet season (June-October), keeps both soil and river salinity low and thus enabling rice production. However, soil salinity increases each year in the dry season (November-May), limiting agricultural production. The total area of land affected by salinity in Bangladesh in 1973 was 0.833 million hectares; by 2000, it had risen to 1.02 million hectares, and by 2009, it reached 1.056 million hectares [7]. (Brammer 2014). During a period of 36 years, saline prone area increased by 26.7 %. The rise in salinity will further aggravate due to climate change in future days and will have negative impact on food production and food and nutrition security in Bangladesh.

3.4. Challenges of waterlogging

In Bangladesh, waterlogging is a common occurrence. Dhaka residents are bracing for the same old problem of waterlogging as the monsoon approaches. Dhaka gets submerged multiple times a month during Bangladesh's relentless monsoon season. A single hour of rain plunges Dhaka into a quagmire of waterlogged streets created by poor drainage and unplanned urbanization. The main causes of the capital's current waterlogging problems are unplanned urbanization and a weak drainage infrastructure. Dhaka's water-drainage system can barely handle 20mm of rainfall, despite the fact that rainfall in most regions often exceeds 40mm. Furthermore, most drains are still clogged with dirt and debris. As a result, a large portion of our capital city falls in just a few hours of rain. The situation has also been exacerbated by poor upkeep of the current drainage infrastructure. However, the local government's efforts to address and resolve the issues have been ineffective. Dhaka has not yet reached the point when it must embrace the fact that flooding is unavoidable. Dhaka's waterlogging problem, we feel, can be resolved. Now is the time for a coordinated and well-executed strategy backed by adequate resource allocation.

Bangladesh is considered as one of the most vulnerable in the world regarding extreme climatic events. In Bangladesh, more than 165 million people live on the low-lying land of the Ganges Brahmaputra-Meghna (GBM) delta and face inter alia to catastrophic storm surge floods caused by cyclone [4,8-10]. According to the Bangladesh Delta Plan 2100 [11], by 2050, tropical cyclone intensity may increase (a 10-year return period cyclone will be more violent and cover 17% more land), as well as tidal storm surges and coastal floods with inundation depths 14–69% higher than current levels.

Dasgupta et al. [12] found the places at danger of flooding while investigating Bangladesh's vulnerability to cyclones in a changing climate, as well as the potential damage and costs of response. The exposed zone would increase by 69 percent with a 27 mm rise in sea level and a 10% increase in wind speed. Another 5,500 cyclone shelters would be required in the country. Extreme rainfall of more than 200 mm in five days is the main cause of landslides, which are becoming more often as a result of climate change [13].

Bangladesh has improved its economic and social development during the previous 50 years, as well as its resilience to natural risks and calamities. Climate-related calamities claim the lives of far fewer people in the country today than they did before the country's independence in 1971. It is a remarkable achievement for a country like Bangladesh, where population growth and increased physical exposure to disaster hazards are regarded as potential constraints.

4. Conclusions

The geographical location, multiplicity of rivers, and the monsoon climate made Bangladesh a highly disaster prune country in Asia. The natural hazards like cyclone, storm surge, flood, drought, tornado, riverbank erosion etc. are very common in Bangladesh as they frequently visit the country. A total of 7 floods and 14 cyclones were most

devastating and catastrophic because of their strength and area they affected.

To overcome devastation and continue sustainable food production for our people, farmers must adapt to climate change. The effects of climate change affect farmers' ability to grow the food we all require to feed the future population projected to be 202 million in 2050. The increasingly unpredictable weather and more extreme conditions – like floods, cyclone, thunder storm, hails and droughts will change crop growing seasons, limit the availability of water for drinking as well as irrigation, allow weeds to grow, pests and pathogens to thrive, which all together can reduce crop productivity. Soil salinity and erosion, industrialization, making roads and houses are reducing the amount of land available for agriculture, and declining biodiversity, affects the pollination of crops. Moreover, farmers are under pressure to conserve water and use fewer agricultural inputs. As they adapt to the above changes, farmers also need to mitigate the greenhouse gas emissions contributed by agriculture through adopting climate-smart practices.

In conclusion, the government should provide active support and take appropriate measures to protect the vulnerable climate, promote policies, and improve crisis management communication to ensure a safe community. Climate change is a development concern; hence it must be incorporated into the country's national development strategy. Disaster management plans must be updated on a regular basis to determine how best to respond in a disaster. Furthermore, political commitment is required to address the issues of flooding, sea level rise, and saline intrusion of agricultural land, to name a few. Mitigation methods, rather than adaptation practices, might be a preferable way to solve the situation.

References

"CIA – The World Factbook". *Central Intelligence Agency*. *Retrieved* 19 June, *2022*.

Wahiduzzaman, M. Major Floods and Tropical Cyclones over Bangladesh: Clustering from ENSO Timescales. Atmosphere 2021, 12, 692. https://doi.org/10.3390/atmos12060692

Ali, A. Vulnerability of Bangladesh to climate change and sea level rise through tropical cyclones and storm surges. *Water Air Soil Pollut.* **1996**, *92*, 171–179.

Ali, A. Climate change impacts and adaptation assessment in Bangladesh. Clim. Res. 1999, 12, 109–116.

Ali, A. Cyclone; Bangla Academy: Dhaka, Bangladesh, 1999; p. 147

Selvaraju,R., A.R. Subbiah, S. Baas and I. Juergens. 2006. Livelihood adaptation to climate variability and change in drought-prone areas of Bangladesh. Case Study Project Under Institution For Rural Development, Pp. 1-76.

Brammer H (2014). Bangladesh's dynamic coastal regions and sea level rise. Cli. Risk Manage. 1: 51–62102, 47–57, 2019.

Becker, M., Karpytchev, M. and Papa, F.: Chapter 7 - Hotspots of Relative Sea Level Rise in the Tropics, in Troopical Extremes, edited by V. Venugopal, J. Sukhatme, R. Murtugudde, and R. Roca, pp. 203–262, Elsevier

Nicholls, R. J., Hutton, C. W., Adger, W. N., Hanson, S. E., Rahman, M. M. and Salehin, M.: Ecosystem Services for Well-Being in Deltas, Springer International Publishing., 2018.

Uddin, M. N., Islam, A. S., Bala, S. K., Islam, G. T., Adhikary, S., Saha, D., Haque, S., Fahad, M. G. R. and Akter, R.: Mapping of climate vulnerability of the coastal region of Bangladesh using principal component analysis, Applied geography,

GED (2018), Bangladesh Delta Plan 2100: Bangladesh in the 21st Century (Abridged Version) (Dhaka, General Economics Division (GED), Bangladesh Planning Commission).

Dasgupta, S., Huq, M., Khan, Z.H., Ahmed, M.M.Z., Mukherjee, N., Khan, M.F. & Pandey, K. (2010) 'Vulnerability of Bangladesh to Cyclones in a Changing Climate: Potential Damages and Adaptation Cost', The World Bank Development Research Group Environment and Energy Team, April 2010

Kirschbaum, D., Kapnick, S.B., Stanley, T. & Pascale, S. (2020). 'Changes in extreme precipitation and landslides over High Mountain Asia', Geophysical Research Letters 47, e2019GL085347. https://doi.org/10.1029/2019GL085347