



Causes, Impacts and Adaptation Strategies to Climate Change: A Case Study of Bangladesh

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Article History

Received: 11 December 2017

Accepted: 29 January 2018

Published: April-June 2018

Citation

Mohammed Nasir Uddin, Nahid Anjuman, Abdul Muktedir Bin Moustainoor Rahman, Md Asaduzzaman Sarker. Causes, Impacts and Adaptation Strategies to Climate Change: A Case Study of Bangladesh. *Climate Change*, 2018, 4(14), 134-143

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General Note



Article is recommended to print as color version in recycled paper. *Save Trees, Save Climate.*

ABSTRACT

Climate change is very common but red-hot issue in the global arena while Bangladesh is already treated as one of the most vulnerable area to climate change and is highlighted through the last two world climate change conference at Warsaw in Poland (2013) and Paris in France (2015). A good numbers of studies have already been conducted in the same issue and still conducting as

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the problems of climate change has been emerging every day. The paper reviews the causes, impacts and adaptation to climate change while agricultural field has taken into considerations for the same. The paper is made up of general discussion of climate change first and then highlighted the case study of Bangladesh for the same issue. Natural as well as anthropogenic process are the two broad causes of climate change while various impacts of climate change such as sea level rising, reduced productions, drought severity, frequent flooding, increasing salinity etc., that largely affect agriculture and national economy as well. Different adaptation strategies to climate change such as diversified agricultural practices, additional irrigation, using different modern machineries, saline and drought tolerance varieties; integrate farming system, afforestation etc. have been practicing at field level to combat against climate change impacts. Besides, proper management system such as weeding, mulching, thinning, irrigation with fresh water, IPM, integrated farming system, agroforestry etc. are also employed by the farmers to overcome drawbacks of the climate change effects. Existing adaptations strategies can be recommended but future research is necessary to formulate sound policies, more provision for rewarding for environmental practices, strong collaboration with international agencies etc. that might be taken at macro level by the different stakeholders and nations as well.

Key words: Causes, impacts, adaptation, climate change, Bangladesh.

Abbreviations: GoB - Government of Bangladesh

1. INTRODUCTION

The climate change is a burning issue of global talk where it simply refers to any change in climate over time due to natural as well as human activities (IPCC, 2007). It is well known that both developed and developing countries have been facing numerous problems due to climate change where developed countries are more responsible for creating negative impacts of climate change compared to developing countries. The impact of climate change in developing countries (like Bangladesh) is more vulnerable as they have scarce resources (socially, technologically and financially) to battle with the climate change effects. Therefore, it was really difficult to reach the United Nations (UN) Millennium Development Goals (MDGs) by 2015 for developing countries in response to climate change effect although they already taken a good numbers of adaptation strategies for the same. Therefore, climate change is also considered (SDG 13: Take urgent action to combat climate change and its impacts) for further developmental activities under the United Nations Sustainable Development Goals (SDGs).

In developing country like Bangladesh, the livelihoods of the poor are highly dependent on agriculture and therefore they are trying to increase agricultural productivity in a way so that they can achieve food security as targets of the Millennium Development Goals (Rosegrant *et al.* 2006). But, 14 per cent of the greenhouse gases (GHG) has been generating through this agricultural activities (WRI 2010) that affect the climate change issue. Change in temperature, rainfall, that is climate variability largely affect the agriculture and its crop production which ultimately distress the food security and livelihoods of the poor. In the field of agriculture, adaptation to climate change is a crucial to assure for food security of the people and nation as well. Adaptation to climate change help to bounce back (*i.e.* resilience) to the desirable crop production from vulnerable condition which makes food security and reduce poverty as well.

GHG is essential to reduce as it is one of the most important factors which is responsible for the global warming. Reducing emission, removal of carbon from the atmosphere and using biofuel or agricultural intensification rather extensification are the major ways to alleviate the greenhouse gases (Smith *et al.* 2008). Lal, 2004 found organic matter that is source of organic carbon increases soil fertility and crop productivity and moreover reduce GHG emission specifically in the soil degradation area. But, reality is that organic matter has been depleting continuously due to unsustainable land management for crop production particularly in the developing countries where sustainable land management includes conservation tillage, cover cropping, water harvesting, agroforestry, and enhanced water and nutrient management that improve soil carbon sequestration (SCS), increase yields and enhance resilience to climate change (Niggli *et al.* 2009). On the other hand, protection of soil degradation, improve soil fertility and even getting more farm revenue can be achieved through agroforestry practicing (Verchot *et al.* 2007; FAO 2009).

The last couple of world climate change conferences (*i.e.* Warsaw 2013 and Paris, 2015) have been highlighted the Bangladesh case as one of the most vulnerable country to climate change in the world. In this connection, there are many reasons for instances recurrent floods, cyclones, tidal forces, droughts, geographical location, over population and their dependency on agriculture etc. behind of this issue. About 174 natural disasters such as floods, droughts, cyclones etc., have been affected in Bangladesh during the period of 1974 to 2003 which mainly damages livelihoods of the people and economy of the country as well. Half million (500000)

human lives had death caused by cyclone in 1970 while cyclone of 1991 killed 138,000 people of Bangladesh (ADB, 2004; BCAS, 1991). According to GoB (2008), Bangladesh has most frequently affected country compared to others in the world considering the death associated with noteworthy tropical cyclones cyclone Table 1. Therefore, it is necessary to study more about the cause, impacts and adaptations strategies to climate change particularly in the field of agriculture. Keeping in mind this broad area, this paper reviews the general concepts in this regard.

Table 1 Death associated with noteworthy tropical cyclones in the world

Year	Location	Deaths	Year	Location	Deaths	Year	Location	Deaths
1584	Bangladesh	200,000	1897	Bangladesh	175,000	1963	Bangladesh	11,520
1737	India	300,000	1900	Texas, USA	6,000	1963	Cuba-Haiti	7,196
1779	India	20,000	1906	Hong Kong	10,000	1965	Bangladesh	19,279
1780	Antilles	20,000	1912	Bangladesh	40,000	1965	Bangladesh	12,000
1822	Bangladesh	40,000	1919	Bangladesh	40,000	1970	Bangladesh	500,000
1833	India	50,000	1923	Japan	250,000	1971	India	10,000
1839	India	20,000	1937	Hong Kong	11,000	1977	India	10,000
1854	India	50,000	1941	Bangladesh	7,500	1985	Bangladesh	11,069
1864	India	50,000	1942	India	40,000	1988	Bangladesh	5,708
1876	Bangladesh	100,000	1960	Bangladesh	5,149	1989	India	20,000
1881	China	300,000	1960	Japan	5,000	1991	Bangladesh	138,000
1895	India	5,000	1961	Bangladesh	11,468			

Source: GoB, 2008

2. CAUSES OF CLIMATE CHANGE

Climate change is happening because of mainly two causes named anthropogenic cause i.e. human made and natural cause.

2.1. Anthropogenic causes

Human activities have greatly influenced to climate change through changing of earth's atmosphere where greenhouse gasses, aerosols and cloudiness are the major issues. This change has been coming from the using of fossil fuels from which carbon dioxide release to the atmosphere. The government of UK has been identified human made causes of climate change which are as follows: Majority of (86%) cause of climate change responsible for using fuel for both generates energy and transport while only 4% and 7% cause of climate change are responsible for industry and agriculture respectively⁵².

According to IPCC (2007); fossil fuel, land use and agriculture are the main three responsible issues for increasing GHG in the atmosphere that has been observed over the last more than two decades. There are many scientific papers that has been show that agricultural practices by the farmers has greatly affect the climate change because of releasing greenhouse gasses such as carbon dioxides, methane and nitrous oxide. Excessive application of fertilizers and insecticides especially urea responsible for nitrous oxides and carbon dioxides while intensive cultivation of rice under water irrigated condition causing for methane gas. Deforestations and desertification as the result of land use change by the human along with fossil fuel use increases carbon dioxides whereas rainforest help to absorb 20% of the carbon dioxides. Forest reduces the GHG emission to protect the earth cool from global warming while 22% greenhouse gas emission has been estimated due to deforestation. Mainly fossil fuel using in transportation, building heating and cooling and industries for goods production which may causes for carbon dioxides gas where agricultural activities, natural gas distribution and landfill are the main causes for methane gas.

2.2. Natural Causes of Climate Change

There are four natural issues named volcanic eruption, ocean current, earth's orbital and solar variation are responsible for climate change.

2.2.1. Volcanic eruption

Large volumes of sulphur dioxide, water vapour, dust and ash are the elements that have been generated from volcanic eruption which affect the atmosphere. The GHG carbon dioxide is also produced from volcanic eruption but carbon dioxides emission from human activity are 200 times more than emissions from volcanic activity. On the other hand, tiny particles called aerosols are also generated from volcanic eruptions. Volcanic eruption has stronger effect on atmospheric cooling⁵³.

2.2.2. Ocean current

There are two types of ocean current such as surface current and deep water current. About 10% of all the water of the ocean makes up the surface current whereas deep water current makes up by the rest of 90% of ocean. Ocean current is influenced by the primary and secondary forces where solar heating, winds, gravity and coriolis are included into the primary forces and current flow is secondary force of the ocean current⁵⁴.

2.2.3. Earth orbital changes

Change of the earth orbital around the sun may cause the change of the tilt where tilt is defined warmer summer and colder winter. Less change indicates the cooler summer and milder winters. Although the orbital change of the earth is slow but it lead to small change which is climatically important⁵⁵.

2.2.4. Solar variations

It is well known that sun is the main source of energy. It has an effect on climate change over an extended period of time. Radiation that coming from the sun is varies time to time and may affect the earth atmosphere. Due to effect greenhouse gas, the solar variation may occur in the earth which also responsible for climate changes⁵⁶.

3. GENERAL IMPACTS OF CLIMATE CHANGE

The negative impacts of the climate change in the developing countries is not equal ratio (Stern, 2007; IPCC, 2007) while these impacts are already being experienced across the world. Christensen *et al.* (2007) and Cruz *et al.* (2007) have found in the central Asia, average temperature is warmer than global average but cold in East Asia and south Asia. Precipitation of the Asia is increasing trend whereas it decreases only in summer. Intensity of the precipitation is shown in the south Asia while snow and ice in Himalayan and Tibetan Plateau glaciers has been reducing at increasing trend. Longer summer duration and less winter duration are also impacts of climate change in this area. On the other hand, higher temperature that is also higher than global average temperature with decreasing trend of precipitation that leads to severe drought in the Africa (Boko *et al.*, 2007; Christensen *et al.*, 2007). Meanwhile; climate change is not always bad impact as Thornton *et al.* (2006) shown that agricultural growing season has been expanded in Ethiopian highlands or Mozambique due to increase of temperature and rainfall.

According to IPCC (2001), Weather variability and sea level rising are the most important consequences of climate change where 0.6°C temperature of the globe and 2 to 3% precipitation of the tropical latitude has been increased by 20th century but 3% precipitation has decreased only in subtropical area. Global temperature would be increased from 1.4 to 5.8°C by the 21th century. On the other hand, about 10cm to 20cm of the sea level has been raised over the last decade and would be expected to rise from 1-cm to 90cm by the next decade (21th century). Most frequent and intensity of the drought in the Asia and Africa have been found in recent decade. However, intensity of the warming the globe depends on the rate of increases emission of greenhouse gases.

FAO (2007) identified two types of groups of impact of climate change where physiological effects on crops, pasture, forests and livestock changes in land, soil and water resources; increased weed and pest challenges; shifts in spatial and temporal distribution of impacts; sea level rise, ocean salinity increases; increase sea temperature causing fish to inhabit different ranges are considered as biophysical impacts. Besides, lower yield of production; reduced marginal GDP from agriculture; fluctuations in world market prices; changes in geographical distribution of trade regimes; increase risk of hunger and food insecurity; migration (may be domestic or international) and civil unrest are the socio-economic impacts of climate change. The climate change and global warming are proportionately relationship where global warming may affect in different ways on earth's flora and fauna.

Bangladesh is one of the best examples of flooding where frequent floods are very common. It is also projected that about 17.5% of the total land of the country would be lost if sea level rising one meter. Besides, agriculture of the coastal region such as crop, livestock, fisheries are vulnerable to flood while 1% of the people have been displaced for the same incidence (IPCC, 2007; Erickson, 1997). The Majuro Atoll in the Pacific Marshall Islands, islands in the South Pacific and Indian Oceans, including many in the Maldives and French Polynesia are the example which are at risk to go into the sea for the same. Disappearing wetlands, coastal Erosion, shortage of water resources, disappearing Ice Packs are also responsible for sea level rising (Siddiqui, 2009).

Crop yields as well as cost of production have been changed due to flood, drought, cyclones, salinity etc. which are the consequences of climate change resulting world food price was high in 2007-2008. High temperature and uneven rainfall has been changing growing seasons and affect the crop germination and photosynthesis that reduces the yield of production. On the other hand, numerous diseases and famine has been occurred in livestock sector in the world. Bird flu is the latest disease in this sector that severely affects especially the poultry. During the flood, livestock sector has been greatly affected. Fisheries sector has also been damaged due to floods as the area of fish culture has been displaced. Therefore, farmer of the agricultural sector become more vulnerable situation (FAO, 2009).

4. A CASE STUDY OF BANGLADESH

4.1. Introduction

Since independent of Bangladesh (1971), food security is the key challenge of development as large number of population (150.25 million) of the country (BBS, 2012) along with limited resources especially land. About 147, 570 square km of the total area of Bangladesh while only 8 million hectare of land are using as cultivable land. Geographically, Bangladesh is located between North-Eastern part of South Asia between 20 ° 34' and 26°38' north latitude and 88° 01' and 92 ° 41' east longitude. Bangladesh is surrounded by India in the west; north and northeast while it shares border with Myanmar (former Burma) to the South-East and the Bay of Bengal to the south. About 200 nautical miles of boundary of sea has been extended from the base lines constitutes the economic zone of the country. Bangladesh is also well known for rivers. Padma, Meghna, Jamuna, Brahmaputra, Tista, Gorai etc., are the major rivers in Bangladesh which are mainly responsible for fertile land (BBS, 2009). The economy of Bangladesh depends on agricultural development where 18.43% GDP has contributed to the nation through different agricultural sub sectors such as crop, livestock, fisheries and forestry (WB, 2012).

Bangladesh is already recognized as most vulnerable country to climate change (Faruky *et al.*, 2011). Heavy rainfall, sea level rise, floods, droughts, cyclones, salinity etc. are common natural hazards of Bangladesh which are associated with climate change. Agriculture sector is one of the most severely affected by the climate change (Selvaraju, 2006). Scarcity of the surface and groundwater resources, increasing of winter temperature affecting the wheat and pulse crop in this area though pest infestation, sterility of the spikelet which lead to reduce crop yield. According to IPCC (2007), Bangladesh has been losing a good number of cultivable land due to rise of sea level where it has been estimated about 20% of the land would be inundated because of 1 meter rising the sea level. Prolonged natural disasters like floods, droughts, cyclones etc. and salinity, landslides are responsible for risks and uncertainty to agriculture and it's production due to climate change. Therefore, generally the poor people especially who are engaged with agriculture would suffer more from climate change (Sperling, 2003).

4.2. Impacts of climate change in Bangladesh

Impacts of the climate change are common scenario in the world. However, it varies from region to region and country to country. In the context of Bangladesh, climate change impacts are briefly explained below:

Salinity of the soil is the most threaten to crop cultivation especially in the coastal region of the country where as this area covers 47000 km which is also 32% of the country landmass. During tidal flood saline water come to the plain land especially in the crop land. Therefore, this water percolated into the soil and mix with the ground water may cause the soil salinity. FAO (2007) reported that about 3 million hectares of land has been affected by mild salinity whereas it was 1.5 million hectares just after independent of Bangladesh (1973). Erickson (1997) reported that 17.5% of the total landmass of the country will go under submerge condition due to one meter sea level rising. However, World Bank (2000) identified the impacts of sea level rise on the basis of basic needs of the people of Bangladesh which is shown in the Table 2.

Table 2 Impacts of sea level rise on the basic needs of the people of Bangladesh

Basic Human Needs	Impacts of sea level rise
Food	Flooding of the agricultural low lands and deltas due to sea level rising (Miller, 2004) that decrease food production whereas only salinity decreases 0.2million metric tons of rice production (World Bank, 2000).
Cloths	Ability of buying cloths decrease as poverty increases due to shortage of food caused by sea level rising.
Housing	Huge number of housing losses will be happened as 29,846 sq. km area of land will be lost as well as 14.8 million of people will be landless by sea level rising (IPCC, 2001a).

Health	Salinity in the coastal area increase the risk of cholera and flood is the responsible for diarrhea and both are caused by sea level rise(World bank, 2000)
Education	Educational institutions destructions due to floods and cyclones and guardians of the students failed to support to continue their study as they are highly economically affected.

Source: World Bank, 2000

Soil salinity degrades the soil fertility that may inhibit crop production especially rice production and enhance the shrimp culture. So, the area of shrimp culture has enlarged whereas area of rice production decreases which lead to significant decrease the total rice production (World Bank, 2000; Ali, 2005) and wheat production which is calculated about equivalent to US\$ 586.75 million (BRAC, 1999; cited in Islam, 2004). Other hand, Elimination of the existing varieties of the crop or yield reducing which may lead to generates new and modern varieties are requires high expertise, cost, time etc. Increase insect infestation, diseases infections are also another threats to crop production.

Drought is the very common disaster in Bangladesh especially in the northern part of the country. About one third of the cultivable land has been affected by the drought in every year while 60% of the total cultivable land has been occupied by Aman rice which is grown in rainfed condition. A study has been conducted by Rashid & Islam (2007) and shown in Table 3 that indicates intensity of the drought, area and yield loss of transplant Aman rice.

Table 3 Intensity of droughts and loss of yield of T-Aman rice

Intensity of drought	Area of land (ha)	Location	Average yield (t/ha)	Yield loss due to drought (%)
Very severe	342990	Rajshahi & Nawabgonj	1.7 - 2.5	70 - 90%
Severe	737028	Barind area & Gangetic alluvium	2.0-2.5	50-70%
Moderate	3154950	Western, central and southern regions, Modhupur tracts, Kustia & Jessore	2.5 -3.5	30-50%
Slight	2867895	Teesta, Brahmaputra and gangetic alluvium; alluvium soil of Meghna & Surma-Kushiara rivers	3.0-4.0	10-30%

Source: Rashid & Islam, 2007

The loss of life, crops, animal, fisheries, lack of drinking water, disease infections, infrastructures damages, food shortages, destruction of the houses have been common scenario during cyclones that have observed during recent cyclones *sidr* (2007) and *ayla* (2008). GoB (2008) estimated the damage loss of the cyclone *sidr* of the Bangladesh and found significant damage to infrastructures, assets and loss of production value particularly in the area of agriculture valued at US\$ 438 million which is about 95% of the total losses. The following Table 4 indicates the sector wise loss and damage of agriculture.

Table 4 Estimated damage and losses of agriculture during cyclone *sidr* in Bangladesh.

Name of the Sub-sectors	Disaster effect (Million US\$)		
	Damage	Loss	Total
Crop		411.6	411.6
Livestock	19.3		19.3
Fisheries	2.0	4.7	6.7
Total	21.3	416.3	437.6

Source: GoB, 2008

Flood is another common and frequent natural disaster associated with climate change in Bangladesh. It creates various problems to livelihoods especially for the poor. After independent of Bangladesh, 1974, 1987, 1988 and 1998 have recorded major and devastating flooding event whereas 2004 and 2007 have been identified as most recent year of flooding in Bangladesh (Saifullah, K., 2009; Hussain, M., 2008). In the year of 1988, About 100,250 sq-km (68%) of the country have inundated while destroyed crops of 500,000 ha of land and damage worth about US\$2.8 billion (The World Bank, 2002). Besides, inundated 38% of the country, crop damage 1.3million ha, damage worth about US\$ 2.2 billion during the flood 2004 in Bangladesh (ADB-World Bank, 2004).

5. ADAPTATION TO CLIMATE CHANGE

Adaptation is a process by which an individual can moderate or cope with or take advantage of the consequences of climate change. The vulnerability of climate change is hard to improve because of low economic capacity, inadequate infrastructures, lack of technologies, highly dependent on natural resources etc. On the other hand, frequent natural disaster affects the individual's capacity that is another constraint to cope or adapt with climate change. Therefore, country needs to support from developed countries or international organizations like EU, USAID, UNDP, FAO etc. Based on domestic as well as international supports, Government of the Bangladesh has already taken a good numbers of programmes for the same. Coastal afforestation programmes, develop information and service system, alternative agriculture, drought and saline resistance varieties, adaptive and diversified fish culture programmes, constructions of flood and cyclones shelter etc. are the important programmes that have been taken by the GoB (GoB, 2005). These programs have been implementing with the collaborations among the different departments such as Department of Agricultural Extension (DAE), Department of Environment (DoE), Department of Forest (DoF), Department of Livestock Services (DLS), Department of Fisheries (DoF), Bangladesh Agricultural Research Council (BARC), Department of Disaster Management (DoDM) are the major.

Proper management system such as weeding, mulching, irrigation with fresh water, thinning etc employed by the farmers can help overcome drawbacks of the salinity and droughts although recently, very few numbers of salinity and drought tolerance varieties have generated but it is not widespread throughout the country. Farmers is now using modern machineries like power tillers, tractors for deep and rapid tillage operation which can help to reduce soil salinity. Besides, tractor, seed drill, combined harvester, weeder, thresher, drier, reaper etc. are also using for agricultural operations resulting farming activities have been done in timely and economically (Roy et al, 2006).

Irrigation is the vital issue for crop productions in Bangladesh. In this regards, farmers are dependent on deep water as well as rainwater. One of the study conducted by Uddin and Bokelmann (2012) and found additional irrigation is identified as top most strategy to crop production among the 14 adaptation strategies that farmers were practiced at their farming activities while digging small size of ponds for rain water harvesting for irrigation that is also very common in other developing countries like Ethiopia (Amha, R., 2006). However, Ramasmasy & Baas, (2007) have conducted a study where they enlisted about 26 adaptation practices to climate change. Out of 26, the most important are Seedbed method for T-aman rice, manures and composting, depth of transplanting for T-aman, weed control reduce water seepage, water control structures, mini-ponds, supplemental irrigation, shallow and deep tube wells, system of rice intensification, drought-resistant rice varieties, green manure – T.aman system, T. aus – ChiniAtap system, T.aman – mustard/linseed system, T.aman – chickpea system, T.aman – mungbean system, famine reserve crops, homestead gardens, mulberry intercropping in rice, mixed cropping, fodder cultivation, fish cultivation in mini ponds, cottage industries, community-based biogas production, plantation and seed storage for higher viability. Specific adaptation strategies to climate change effects include changing the timing of planting and using heat and drought resistant varieties [Swearingen and Bencherifa, 2000; Mortimore and Adams, 2001; Southworth et al. 2002; Howden et al., 2007] with new cultivars having been selected and applied for the same purposes [Rosegrant and Cline, 2003; Eckhardt et al. 2009]. Practicing soil and water conservation techniques [Asfaw and Lipper, 2011], fertilizer use, irrigation [Howden et al., 2007; Eakin, 2005] and diversification to non-farm activities [Mortimore and Adams, 2001; Morton, 2007] are also adaptation strategies that have been practiced at farm level in response to climate change in different corner of the world like Bangladesh. Although different supports and technological interventions may be available, lack of available water, shortage of cultivable land, and unpredicted weather appeared to be the major problems farmers encounter in adopting climate change adaptation strategies in Bangladesh (Uddin et al. 2014). From the above discussions, it is clear that lots of adaptations strategies have been practicing to combat against with climate change effects. But, may be, there is a gap to assessment of impact of adaptation strategies practiced by the farmers in Bangladesh and their effectiveness in response to climate change effects. Moreover, there is also necessary to develop capacity of the vulnerable people who have been struggling every moment with climate change. So, interested researcher need to be emphasized to do focus on these issues, so that they could signify contribute to the climate change issue in formulating the future sound policies. In connection to these issues, national and international collaboration might be strengthened.

6. CONCLUSION

Climate change is one of the major challenges of the development not only Bangladesh but also in the world at present. Day by days, it is increasing pressures to the policy makers, scientists, learners; producers etc. although lots of initiatives have already taken to battle with climate change. But developing countries have yet not taken enough strategies in response to climate change as compared to developed countries although developing countries are less responsible for the same. Emissions of GHGs are the main anthropogenic cause whereas volcanic eruption, solar radiation etc. are the natural causes of climate change. Sea level raising that

led to natural disasters such as floods, salinity etc. are the major impacts of climate change. Different adaptation strategies to climate change such as diversified agricultural practices, additional irrigation, using different modern machineries, saline and drought tolerance varieties, Integrate farming system, afforestation etc., have been practicing at field level to combat against climate change impacts particularly in Bangladesh. Existing adaptations strategies can be recommended but impacts of adaptation strategies; effectiveness of those adaptation strategies etc. might be future research arena to formulate sound policies. More provision for rewarding to environmental practices, strong collaboration with international agencies etc., that might be taken at macro level by the nations and other stakeholders as well.

SUMMARY OF RESEARCH

1. Causes, adaptation and impacts of climate change in agriculture is crucial particularly in Bangladesh. Thus, this paper reviews the papers, books, scientific reports etc. to critically explain the situation.
2. Both anthropogenic and natural causes are the responsible for affecting the agriculture. While emissions of GHGs are the main anthropogenic cause whereas volcanic eruption, solar radiation etc. are the natural causes of climate change.
3. FAO mentioned that the Physiological effects on crops, pasture, forests and livestock changes in land, soil and water resources; increased weed and pest challenges; shifts in spatial and temporal distribution of impacts; sea level rise, ocean salinity increases; increase sea temperature causing fish to inhabit different ranges are considered as biophysical impacts. Besides, lower yield of production; reduced marginal GDP from agriculture; fluctuations in world market prices; changes in geographical distribution of trade regimes; increase risk of hunger and food insecurity; migration (may be domestic or international) and civil unrest are the socio-economic impacts of climate change. The similar impacts found in Bangladesh situation.
4. Different adaptation strategies to climate change such as diversified agricultural practices, additional irrigation, using different modern machineries, saline and drought tolerance varieties, Integrate farming system, afforestation etc. have been practicing at field level to combat against climate change impacts particularly in Bangladesh.
5. Assessment of impact of adaptation strategies practiced by the farmers in Bangladesh and their effectiveness in response to climate change effects will be a research gap. Moreover, there is also necessary to develop capacity of the vulnerable people who have been struggling every moment with climate change. So, interested researcher need to be emphasized to do focus on these issues, so that they could signify contribute to the climate change issue in formulating the future sound policies.

FUTURE ISSUES

We believe that many scientists who have interest about the climate change particularly in agriculture have to pay attention to do research work for sound environment. The area of the research work may be adaptation strategies, coping strategies, mitigation mechanism, obstacles in climate resilience etc.

DISCLOSURE STATEMENT

There is no special financial support for this work from the funding agency.

ACKNOWLEDGMENT

As it a review article, therefore, we only acknowledged to the persons whose papers were reviewed.

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