CLIMATE CHANGE AND FOOD SECURITY

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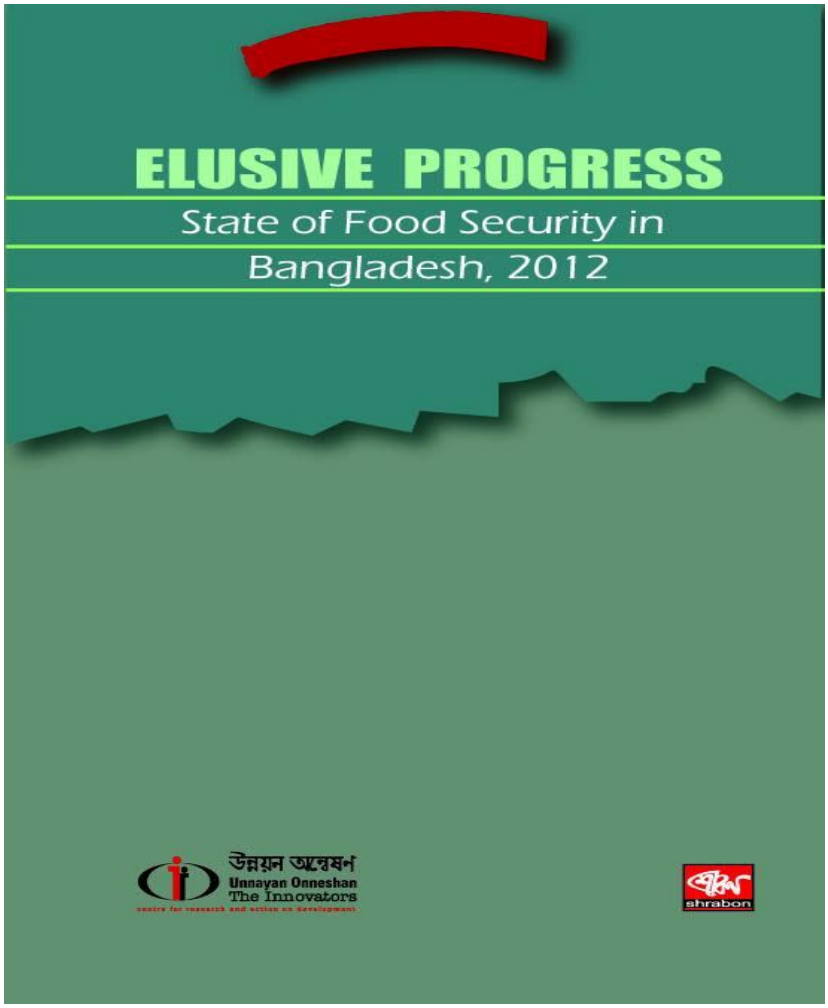

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1 INTRODUCTION

Scientists throughout the world are paying much effort to explore the relationship between irreversible climate change and its impact on food production and therefore, food security. However, with improvement of calculation models they have found tacit relationship between climate change and food security. The unprecedented impacts of climate change along with other environmental and geomorphologic changes make more concerns over food security especially, for the poor and marginal population (Gregory & Ingram 2000; Parry et al. 2001; Rosegran & Cline 2003).

Considering global temperature into account, climate science says that mean global temperature has been increasing since about 1850 due to accumulation of greenhouse in the atmosphere. The greenhouse gases are the resultant of burning fossil fuels whose abatement is difficult and gradual increase of these gases has long term effect on weather of the earth (FAO, 2008). Intensive agriculture to supplement for increasing food demand causes massive deforestation as well as significant effects on temperature, humidity, rainfall pattern, and water availability. These changes has long term impact on food system which encompasses dynamic components of food availability, food access and food utilization.

Though, most accepted opinion of food production within a food system is that production must grow steadily in order to meet twin challenges of economic growth and development. Food system must be simple in case of subsistence farmers who produces food on his farm covering the components of food availability, food access and food utilization. It is widely accepted that climate change is unequivocal and impacts the food systems that underpin food security (IPPC, 2007).

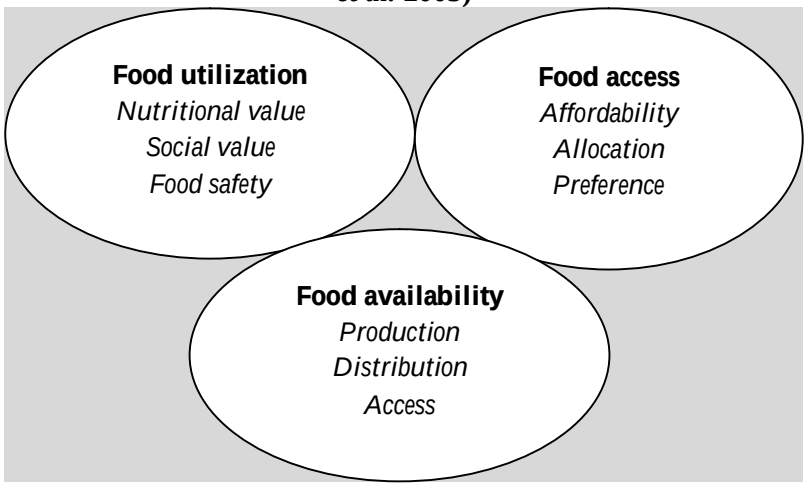
Ensuring food security has been one of the major goals of Bangladesh since its independence in 1971 when most of the people were living under the poverty line (IFAD, 2012). With rapid economic growth in the recent years, Bangladesh significantly improves its cropping practices with a view to fulfill the food requirements for its vast population. Even without climate change the agricultural system of Bangladesh is in crisis point due to over population, market instability and inequitable economic growth. Feeding such a huge population is taking huge toll on croplands, pastures, fisheries resources and forests. Moreover, freshwater remain scarce day to day due for over-utilization and trans-boundary phenomena.

With intensification of agricultural system to meet the increasing demand of food there has been profound changes in the organisation in the food system in Bangladesh. In many areas food system has changed radically due to natural hazards and adverse impacts of climate change.

2 FOOD SYSTEM, FOOD SECURITY AND CLIMATE CHANGE

Generally, the term food system is used to describe all the activities involved in producing, processing, transporting, selling, storing and eating food. More specifically, food system comprises certain activities, resources and infrastructure that collectively determine the food security of a given locality or a group of people. Otherwise, food systems are defined as a set of dynamic interactions between and within the bio-geophysical and human environment which result in the production, processing, distribution, preparation and consumption of food. The components of food systems are distinct which includes food availability (production, distribution and access), food access (affordability, allocation and preference), and food utilization (nutritional value, social value and food safety) (USAID, 1992; Ingram et al. 2005). Food system broadly involves the productivity and production which underpins food security.

Figure 1: The three components of food system with their major elements (Source: Ingram *et al.* 2005)



Climate change is regarded as one of the several interacting factors that affect food system in many ways. Firstly, agriculture, forestry and fisheries all are sensitive to climate change as their production system are likely to be affected by climate change. Other food system processes, such as food processing, distribution, acquisition, preparation and consumption, are as important for food security as food and agricultural production are. However, as the frequency and intensity of severe weather increase, there is a growing risk of storm damage to transport and distribution infrastructure, with consequent disruption of food supply chains. The rising cost of energy and the need to reduce usage of fossil fuel along with the food chain have led to a new calculus – "food miles", which should be kept as low as possible to reduce emissions. These factors could result in more local responsibility for food security, which needs to be considered in the formulation of adaptation strategies for people who are currently vulnerable or who could become so within the foreseeable future (FAO, 2008).

3 CLIMATE CHANGE IMPACT ON FOOD SECURITY IN BANGLADESH

3.1 Impact of Temperature on Crop Production

Every crop has a temperature range for their vegetative and reproductive growth. When temperature falls below the range or exceeded the upper limit, crop production faces constraints. With the climatic conditions of Bangladesh these are very much conducive. A study (Islam et al., 2008) found that 1^0C increase in maximum temperature at vegetative, reproductive and ripening stages there was a decrease in *Aman*[1] rice production by 2.94, 53.06 and 17.28 tons respectively. With the change in temperature (by 2^0C and 4^0C), the prospect of growing wheat and potato would be severely impaired. Production loss may exceed 60 percent of the achievable yields (Karim, 1993). Higher temperature has negative effect on soil organic matter also. As a result, food insecurity will occur.

3.2 Impact of rainfall on crop production

Rainfall is one of the major climatic factors for crop production. All crops have critical stages when it needs water for their growth and development. Moreover, excessive rainfall may occur flooding and water logging condition that also lead to crop loss. It was found that for 1mm increase in rainfall at vegetative, reproductive and ripening stages decreased the *Aman* rice production by 0.036, 0.230 and 0.292 ton respectively. Scarcity of water limits crop production while irrigation coverage is only 56 percent as delivered by the Bangladesh Agriculture Development Corporation (BADC). As a result, it has a great negative impact on the food system of the country.

3.3 Impact of Sea Level Rise on Crop Production

Sea level rise affects agriculture in three ways, i.e., by salinity intrusion, by flooding and by increasing cyclone frequency and its depth of damage. Combined effects of these three factors decrease agriculture production in the coastal zone. Salinity intrusion due to sea level rise will decrease agricultural production by unavailability of fresh water and soil degradation (MoEF, 2011).

Salinity also decreases the terminative energy and germination rate of some plants (Rashid, 2004; Ashraf, 2002). For example, the loss of rice production in a village of Satkhira district was investigated and it found that rice production in 2003 was 1,151 metric tons less than the year 1985,corresponding to a loss of 69 percent. Out of the total decreased production, 77 percent was found due to conversion of rice field into shrimp pond and 23 percent was because of yield loss (Ali, 2005).

In addition to this, sea level rise cause inundation of more area which is already reported by scientist. Therefore, damage of agricultural crops will be more acute in future. About one third of Bangladesh or 49,000 sq. km. area is influenced by tides in the Bay of

[1] Aman is a rice variety which is generally cultivated in December-January,

Bengal. Through the study it is clear that the inundation coastal inundation area will be increased in future with an adverse effect on crop production. In a study (Butzengeiger and Horstmann, 2004) found that if sea level rise up to 1 meter, normal flood waves can be expected to increase from presently 7.4 meters to 9.1 meters.

6.3.4 Impact of Flood on Crop Production

Flood has most deleterious effect on crop production of Bangladesh. The 1988 flood caused reduction of agricultural production by 45 percent (Karim et al., 1996). Higher discharge and low drainage capacity, in combination with increased backwater effects, would increase the frequency of such devastating floods under climate change scenarios. Prolonged floods would tend to delay *Aman* plantation, resulting in significant loss of potential *Aman* production, as observed during the floods of 1998. Loss of *Boro*[2] rice crop from flash floods has become a regular phenomenon in the *Haor* areas over the recent years.

A recent evidence (Unnayan Onneshan, 2012) shows that the food consumption pattern in flood prone areas of Bangladesh is very poor than the national rural level (Table 2). Considering all the direct and induced adverse effects of climate change on agriculture, one may conclude that crop agriculture would be even more vulnerable in Bangladesh in the warmer world (World Bank, 2000).

Table 1: Food consumption pattern (per capita in gram per day) in flood affected area of Bangladesh

Average	Carbohydrates (per capita in gram per day)		Protein (Fish, Pulse, Meat, egg)		Fat (Edible Oil)		Vitamins (Fruits and Vegetables)	
	G	S	G	S	G	S	G	S
Yearly Average	412	419	33	28	9	10	200	133
Average	408	411	31	20	8	8	192	122
National Rural average	426.55		62.66		14.20		241.39	

Source: RESOLVE Project, Unnayan Onneshan
Note: National data are adopted from Household Income Expenditure Survey, 2010
G: Gaibandha, S: Sirajgonj

Table 2: Comparison of losses resulting from recent large floods

Item	1988	1998	2004	2007
Inundated area of Bangladesh (percent)	60	68	38	42
People affected (million)	45	31	36	14
Livestock killed (Nos.)	172,000	26,564	8,318	40,700
Crops fully/partly damaged (million ha)	2.12	1.7	1.3	2.1
Rice production losses (million tons)	1.65	2.06	1.00	1.2
Total losses (in USD billion)	1.4	2.0	2.3	1.1

Source: World Bank, 2007

[2] Boro is a rice variety which is generally cultivated in in March-May

3.5 Impact of Cyclone on Crop Production

Cyclone causes huge damage to production of crop. FAO/GIEWS Global Watch (2007) reported that at the time of the passage of cyclone, SIDR, the main 2007 "*Aman*" rice crop, accounting for about 70 percent of the annual production in the most affected area, was nearly to harvest. According to the estimate by Department of Agricultural Extension of Bangladesh, the loss in rice equivalent is found at 1.23 million tons, with 535,707 tons in the four severely affected districts, 555,997 tons in badly affected 9 districts and 203,600 tons in moderately affected 17 districts in Bangladesh.

Table 3: Comparison of losses resulting from recent cyclone

Tropical cyclone	Damaged entities	Damages occurred
12 November, 1970	Crop lost	Tk. 4.41 billions
	Loss of cattle	280000
	Loss of poultry	500000
26 May 1985	Damage to crops	90381 ha
	Livestock lost	135033
	Trees destroyed	1200
29 April 1991	Damage to crops in acreage	133272 (fully), 791621 (partly)
	No. of domestic animal killed	1061028
	Total loss in terms of money	Tk. 145 billions
15 November 2007 (Sidr)	Livestock killed	1778507
	Crops damaged (fully)	505660 ha
	Crops damaged (partly)	1177086 ha
25 May, 2009 (Aila)	Crops damaged	77,486 acres (fully), 245, 968 acres (partly)
	Livestock deaths	150,131

Source: Bangladesh Meteorological Department (2007), Bangladesh Water Development Board, Ministry of Food and Disaster Management, (2009)

Cyclone has a devastating effect on the rice production of the coastal area of Bangladesh also. For example, in 2007, due to cyclone of *SIDR* the cultivated area of rice and consequent rice production declined at a great scale (Figure 2 and Figure 3).

Figure 2: Cultivated area of rice in South-Western coastal area of Bangladesh from 2001-2002 to 2008-2009.

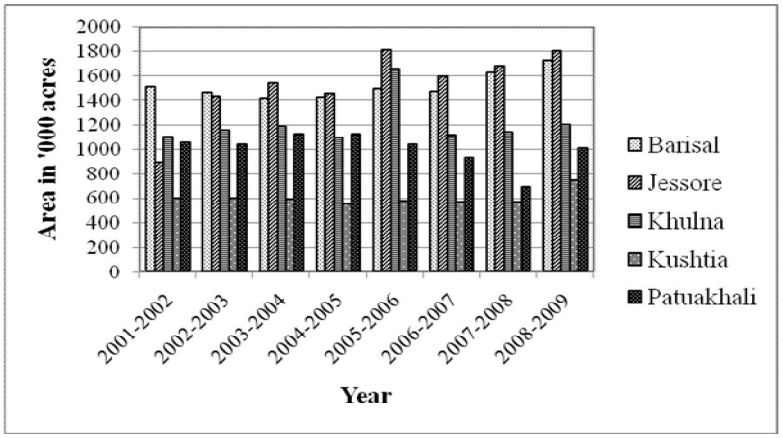
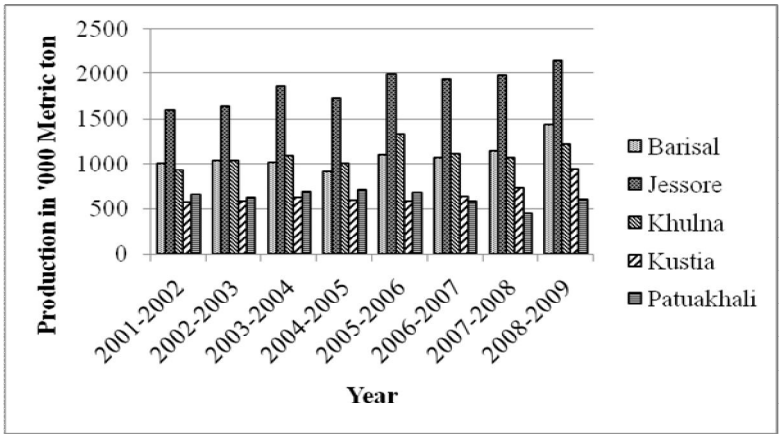


Figure 3: Production of rice in South-Western coastal area of Bangladesh from 2001-2002 to 2008-2009



3.6 Impact of Drought on Crop Production Due to Climate Change

Drought mostly affects Bangladesh in the pre-monsoon and post-monsoon periods. For the last 50 years, Bangladesh has suffered about 20 drought conditions. During the drought of 1981 and 1982, the production of the monsoon crops was affected only. The drought condition in North-Western Bangladesh in the recent decades had led to a shortfall of rice production of 3.5million tons in the 1990s. If other losses, such as other crops (all *rabi* crops, Sugarcane, Tobacco, Wheat etc.) as well as to perennial agricultural resources, such as, bamboo, betel nut, fruits like litchi, mango, jackfruit, banana etc are considered, the loss will be substantially much higher (Banglapedia, 2010).

Bangladesh is affected by major country-wide droughts in every five years. However, local droughts occur frequently and affect the crop life cycles. The agricultural drought, related to soil moisture deficiency, occurs at various stages of the crop growth. Monsoon failure often brings yield reduction and famine to the affected regions. A better understanding of the monsoon cycle is clearly found from major scientific and social value.

Northwestern regions are particularly vulnerable to droughts. A severe drought can cause more than 40 percent damage to broadcast *Aus*. Each year, during the *Kharif* season, drought causes significant damage to the *T.Aman* crop in about 2.32 million ha. In the *Rabi* season, 1.2 million ha of cropland are facing droughts of various magnitudes. Apart from loss to agriculture, droughts have significant effect on land degradation, livestock population, employment and health. Between 1960 and 1991, droughts occurred in Bangladesh 19 times. Very severe droughts hit the country in 1951, 1961, 1975, 1979, 1981, 1982, 1984, 1989, 1994, 1995 and 2000. Past droughts have typically affected about 47 percent of the country and 53 percent of the population (FAO, 2007).

Table 4: Chronology of major drought events and its impact in Bangladesh

Year	Details
1791	Drought affected Jessore district, prices doubled or tripled.
1865	Drought preceded Dhaka famine
1866	Severe drought in Bogra, rice production of the district was hit hard and prices tripled.
1872	Drought in Sundarbans, crops suffered greatly from deficient rainfall.
1874	Extremely low rainfall affected Bogra, great crop failure.
1951	Severe drought in Northwest Bangladesh substantially reduced rice production.
1973	Drought responsible for the 1974 famine in northern Bangladesh, one of the most severe of the century.
1975	Drought affected 47 percent of the country and more than half of the total population.
1978-79	One of the most severe droughts in recent times with widespread damage to crops reducing rice production by about 2 million tons, directly affecting about 42 percent of the cultivated land and 44 percent of the population.
1981	Severe drought adversely affected crop production.
1982	Drought caused a loss of rice production of about 53 000 tons while, in the same year, flood damaged about 36 000 tons.
1989	Drought dried up most of the rivers in Northwest Bangladesh with dust storms in several districts, including Naogaon, Nawabganj, Nilpahamari and Thakurgaon.
1994-95	The most persistent drought in recent times, it caused immense crop damage, especially to and rice and jute, the main crops of Northwest Bangladesh and to bamboo clumps, a main cash
1995-96	Crop in the region.

Source: Food and Agricultural Organization, 2007

The associated decline in crop production, losses of assets and lower employment opportunities contributed to the increased household food insecurity. Food consumption fell along with household ability to meet food needs on a sustainable basis. Vegetables and many other pulses are in short supply during drought.

4 RESOURCES CONSTRAINTS IN THE FACE OF CHANGING CLIMATE

In Bangladesh, ensuring food security has been one of the major national priorities in last few decades but the target has always been interrupted by its resource constraints. Moreover, adverse climate change impact accelerated this constraints affecting on natural resources and human livelihood. Although food security challenges in Bangladesh are huge and have been discussing with emphasize, but most of them are associated with resource constrains. Present section of this chapter will highlights the major national resources constraints which are facing to climate change way forwarding to the food security. However, major constraints in terms of food security in Bangladesh attributed to cultivable land scarcity, irrigation water scarcity in summer, lack of technological knowledge, lack of climate adaptive crop variety, lack of institutions and professionals as well as social and cultural constraints are prominent.

4.1 Land Scarcity

Land resource is the fundamental natural resource that provides habitat and sustenance for living organisms, as well as being a major focus of economic activities. Total cultivable land in Bangladesh is very less compared to the population. Per capita cultivable land in the country is about 0.2 acres (SEHD, 2012), which is one of the lowest in the world. This landlessness has acute impact on national food production and

ultimately threatens to go forward to food security. Degradation of cultivable land added new dimension because it loses potential production capability by decreasing soil quality as well as effective use. Climate change impacts result such as cyclones, floods, salinity intrusion, sea level rising enhance the threat in an alarming rate. Population of Bangladesh is already too big by any standard compared to its total land. Increasing sea level rise and river bank erosion are two most important reasons to lead the land shortage of the country. According to Ministry of Agriculture, area of total cultivable land is 8.44 million hectare (Table 6).

Table 5: Bangladesh agriculture at a glance

Category	Amount
Total area	14.845million hectare
Forest	2.599 million hectare
Cultivable land	8.44 million hectare
Current fellow	0.469 million hectare
Single cropped area	2.851 million hectare
Double cropped area	3.984 million hectare
Triple cropped area	0.974 million hectare
Net cropped area	7.809 million hectare
Total cropped area	13.742 million hectare
Total food crop demand	23.029 million metric ton
Total food crop production	27.787 million metric ton
Net production	24.569 million metric ton

Source: Ministry of Agriculture (MoA), 2012

4.2 Irrigation Water Scarcity

Water experts have sounded an alarm that within the next 25 years, half of the population of the world could have trouble in finding enough fresh water for drinking and irrigation (Khan, 2009). Currently, as reports reveal, at least 80 countries, representing 40 percent of the population of the world are subject to severe water shortages. Conditions may get worse as population growth and global warming disrupts rainfall patterns.

Bangladesh is highly dependent on irrigation for agriculture especially for summer and winter. This scenario is much more delicate in Northern Western and Southern part of the country. In the North Western part of the country which experience droughts annually, are mainly results of adverse climate change impact such as decreasing inadequate rainfall, huge temperature increase and other so on. The situation is very critical both water for domestic use and for agriculture which comes mostly from ground water via deep tube well and shallow tube wells. Climate change impact resulting drought and decreasing ground water level has become a main concern to present agricultural activities in this region. In Southern part, saline water intrusion is the main concern for agricultural production as well food security. Saline water intrusion in fresh agricultural land made the crisis more acute by decreasing soil fertility. Study found that increase of temperature and sea level rise has both adverse impacts on environment as well the agricultural production. In sensitivity analysis found that the average production at

Barisal, Comilla and Sylhet district was above 5000 kg/ha, whereas in Rajshahi and Satkhira it was below 4000 kg/ha (Basak, 2009).

The reason of this production disparity is due to massive climate change impact on Southern and North Western region. Availability of both surface water and ground water is therefore very critical for the habitation of these areas.

4.3 Lack of Technological Knowledge

Technological adaptations can serve as a potent means of adapting to climate variability and change (Adger et al. 2007). Innovative technologies can be developed to adapt to climate change impact, and the transfer of appropriate technologies to the developing countries forms an important component of the UNFCCC (Mace, 2006). Bangladesh like other developing countries needs modern technology combating with adverse climate change impact. Thus, technology transfer from the developed country to developing country have become more vulnerable, indispensable and the most discussing issue in any climatic conference.

Bangladesh as a developing country has limitations to modern technology as an adaptation response to climate change. Farmers in the rural area mostly practice traditional agricultural system although the scenario has been changing rapidly for the last two decades. However, present changing face of climate demands new agricultural pattern as well as advanced technologies to support agriculture, develop innovative varieties of high yielding crop which can adapt the changing impact of climate.

4.4 Inadequate Institutions and Professionals

Institutions and professionals are important for food security in the all regimes. Institutions comprises both rules and organisations which play significant role for delivering rural services, supporting implementing project and programme as well as strengthening marginal people rights and access to the asset. When institutions are weak, they can hinder effective implementation of policies, but reform often goes beyond single policies and requires an understanding of institutional structures as well as the way of change. In Bangladesh, institutional set up perspective on account of the developing country is not satisfactory here. On the other hand, Bangladesh has huge professional lacking as well as skilled professionals to lead the policies and project regarding fulfilling the national demand of agricultural production and food status.

In Bangladesh, although a lot of government and non-government project regarding food security have been implementing by the means of rules and organisations, many cases have failed to achieve the goal. Another significant challenge is lack of interest among the young professionals in agricultural sector. Although present government has taken a lot of step to accelerate agricultural sector focusing production increase and ensure food security but different barriers are there to interrupt the activities.

5 ACHIEVING FOOD SECURITY IN THE FACE OF CLIMATE CHANGE

In order to mitigate the adverse impacts of climate change on food sector, we need to analyze the possible options that could assist in increasing food security. Therefore, adaptation in the agriculture sector must be well integrated with both the broad national development goals and livelihood priorities at the local level. Rural agrarian people have long been adapted to a variety of climate risks with their traditional knowledge. These coping strategies are varied depending on regions and prevailing socio-economic conditions. As the climate change is a reality now, more and different adaptation intervention is required to ensure food security within a given time.

Formal and informal sources of support can play critical role in minimising climate risks on food security. The supports may be investments in agriculture and water resources, or may be on infrastructures (e.g. embankments in floodplain and coastal areas to protect against floods and storm surges) or irrigation.
Groundwater irrigation plays an important role in crop agriculture in the drought prone areas. Irrigation provides a mean to adapt soil moisture condition with diversifying crop agriculture, promoting high yielding variety crops, increased cropping intensity. Flood prone areas of the Southern Bangladesh coastal embankment provide protection to crop agriculture and livelihood assets playing a great role in food security. In recent years government of Bangladesh has invested over USD 10 billion (at constant 2007 prices) for flood management in embankments, coastal polder and cyclone shelters (BCAS, personal communication). With this protection, substantial increases in production have been made possible.

Case Story

Mrs. Manzura Khatun, 37 years old woman is the resident of Pirgacha Village under Kazipur upazila, Sirajganj. The village is bar island of the mighty river Jamuna. Mrs. Khatun Family consists of five members her husband, two daughters and a son. Her husband, day laborer, lives outside of home in most of the time around the year. She has two bighas cultivable lands where she cultivates paddy. According to Mrs. Khatun, flood is common phenomena in this area which affects almost every year. In last year, she lost all of her crops due to over flooding. It make huge food shortage in her family demand and ultimately on national demand. Regarding this, however farmers of this area thinking about alternative crops like wheat, maize, Sesame in kharip seasons. Different development organization are also focusing their concern in this front issue and starting working how local level how food production can be augmented in house hold level. Gono Kalyan Sangstha (GKS) is one of them, working how climate change adaptive agriculture model can practice in the area. They also Introduced an innovative model "Sand Bar cropping" aiming to cultivate crops in sandy char land areas under a project named RESOLVE.

Agriculture research and technologies plays a vital role in adapting agricultural sector. Bangladesh made significant progress in agricultural research through improving and innovating newer varieties of crops. Some of government agencies made remarkable progress in innovating high yielding varieties including the Bangladesh Agriculture Research Institute (BARI), Bangladesh Rice Research Institute (BRRI), Bangladesh Institute of Nuclear Agriculture (BINA) and the Bangladesh Agriculture University (BAU). Department of Agricultural Extension (DAE) plays an important role in disseminating the newer varieties which are fit with changing climate through trial and critical evaluation in the demonstration plots.

Bangladesh Rice Research Institute (BRRI) has developed drought and flood tolerant as well as rice varieties. Drought tolerant short durational rice include BR 25, BRRI dhan 33 and BRRI dhan 39 whereas flood tolerant varieties include BR 11, BR 20, BR 21, BR 22, BR 23 and BR 24; and BRRI dhan 31, 32, 33 and 34. Bangladesh
Agricultural Research Institute (BARI) has also promoted some drought tolerant and flood tolerant vegetable and cash crops like chili, tomato, okra, cucumber,

bringal/eggplant, potato, cowpea, barley, maize, linseed and sesame (Winston, et al; 2010). These new varieties will continue to play major role in helping farmers to cope up with unpleasant weather conditions as well as to achieve minimum food requirement.

1. Moreover various adaptation measures shows fruitful towards achieving food security in the face of climate change. The adaptation options are given below:
2. Zero or minimum tillage to cultivate potato, aroid and groundnut with water hyacinth and straw mulch
3. Zero-tillage cultivation of mashkalai, khesari, lentil and mustard
4. Modified sorjan system (*zuzubi* garden) with vegetable cultivation in char land
5. Floating bed vegetable cultivation
6. Cultivating foxtail millet (kaon) in char land
7. Parenga practice of *T. AMAN* cultivation system
8. Relay cropping of sprouted seeds of aman rice in jute fields
9. Raising vegetables seedlings in polythene bags homestead trellises
10. Zero-tillage maize cultivation
11. Chickpea cultivation using a priming technique
12. Supplementary irrigation of *T. AMAN* from mini ponds
13. Year-round homestead vegetable cultivation
14. Pond-water harvesting for irrigation to cultivate *Rabi* vegetables
15. Sorjan system for cultivating seasonal vegetables, fruits and fish
16. Vertical agriculture

Recommendations

1. Community seed bank and food bank should be ensured by the local communities with the help of agricultural officers and concerned authorities.
2. Strengthening the capacity building of the local communities with the help of the local NGOs in association with governmental and international cooperation.
3. Habituating the adjustment of agricultural practices with the changing climate and consequently the recurrent floods, droughts and cyclones.
4. Food security and sustainable agriculture must be integrated with national and international policies considering the changing climate.
5. Agricultural production based budget and investment should be enhanced and properly distributed among the climate induced impacts affected communities.
6. Sustainably intensify agricultural production by changing the conventional systems for reducing greenhouse gas emissions and other negative environmental impacts of agriculture.
7. Developing of specific programmes and policies to assist populations and sectors that are most vulnerable to climate changes and food insecurity should be ensured by the concerned authorities as practical as possible.
8. Reducing loss and waste in food systems, targeting infrastructure, farming practices, processing, distribution and household habits
9. Reshaping the food access and consumption patterns to ensure basic nutritional needs are met and to foster healthy and sustainable eating patterns in the climate

vulnerable areas should be emphasized by the local NGOs, and local government authorities with the involvement of the local communities.

10. Creating the comprehensive, shared, integrate information systems that encompass human and ecological security regarding to the food system which should be ensured by the government.

6 CONCLUSION

It is clear that a number of pathways through which climate change will impact on food availability, accessibility and utilization. Climate induced changes both natural and man-made in agricultural productivity will likely affect the incomes earned by the poor as well as food prices faced by poor households along with the net effect on food security with a function of each household's particular set of livelihood strategies. This chapter not only demonstrates climate change impacts on food security in Bangladesh but also tries to give a figure of several changes caused by disaster in different regions. However, different agricultural interventions for a food secure economy are also pointed out as adaptation measures in the face of climate change. Finally, it is can be said that although food production in Bangladesh is increasing with its high population demand, the scenario may change with a view to the adverse impact of climate change collision like flood, sea level rising, drought, saline intrusion, cyclones etc. Government and different development agencies should concentrate their focus on the integrated way and to develop innovative variety so that on growing national food demand can meet through increasing production and adaptability against the adverse impact of climate change.

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Annex

Potential impacts of climate change on food systems and food security

	Impact on food system assets	**Impact on food system activities**	**Impact on food security outcomes**	**Impact on other human well-being outcomes**
A. CO2 fertilization effects	•Production assets	•Producing food	•Food availability (production, distribution, exchange) •Food accessibility (allocation, affordability, preference)	• Livelihoods
B. Increase in global mean temperatures	•Production assets •Storage, transport and marketing infrastructure	•Producing food •Storing and processing of food •Consuming food	• Food availability (production, distribution, exchange) • Food accessibility (allocation, affordability, preference) • Food utilization (nutritional value, social value, food safety) • Food system stability	• Livelihoods • Social values and behaviors • National and global economies

C.1. Gradual changes in precipitation (increase in the frequency, duration and intensity of dry spells and droughts)	•Production assets •Food preparation assets	• Producing food •Storing and processing of food •Distributing food • Consuming food	•Food availability (production, distribution, exchange) • Food accessibility (allocation, affordability, preference) • Food utilization • Food system stability	• Livelihoods •Social values and behaviours •National and global economies
C.2. Gradual changes in precipitation (changes in timing, location and amounts of rain and snowfall)	•Production assets	• Producing food Consuming food	• Food availability (production, distribution, exchange) • Food accessibility (allocation, affordability, preference) • Food system stability	• Livelihoods •Social values and behaviours •National and global economies
D. Impacts of increase in the frequency and intensity of extreme weather events (increase in annual occurrence of high winds, heavy rains, storm surges, flash floods and rising water levels associated with tornados, tropical storms, and prolonged heavy rains)	•Production assets •Storage, transport and marketing infrastructure •Non-farm livelihood assets •Food preparation assets	•Producing food • Processing food • Distributing food • Consuming food	•Food availability (production, distribution, exchange) •Food accessibility (allocation, affordability, preference) •Food utilization (nutritional value, social value, food safety)	• Livelihoods •Social values and behaviours •National and global economies

E. Impacts of greater weather variability	•Production assets	•Producing food	• Food availability • Food accessibility • Food system stability	• Livelihoods • Social values and behaviours • National and global economies

Source: Food Agriculture Organisation and IDWG on Climate Change. Table produced for Climate Change and Food Security: A Framework Document (2008)

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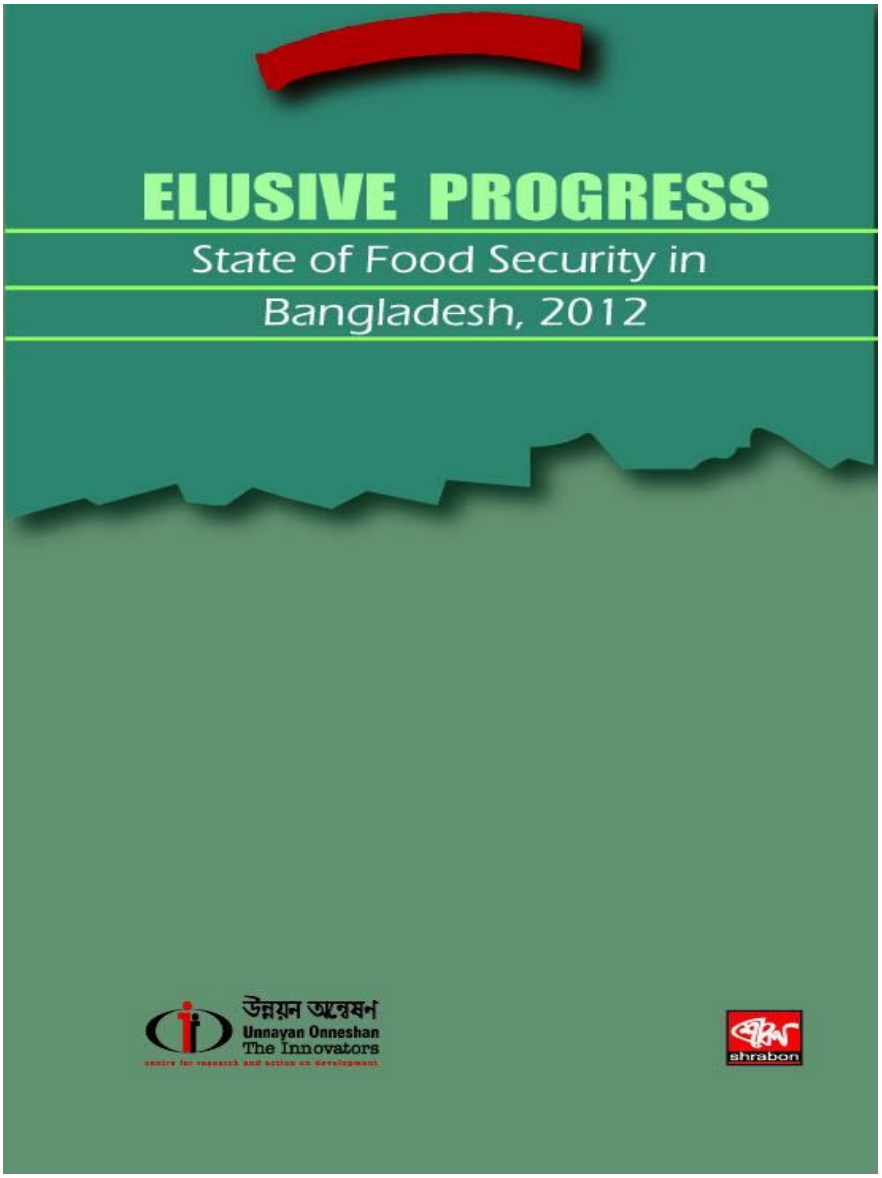

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