

CLIMATE CHANGE AND AGRICULTURE IN BANGLADESH

INFORMATION BRIEF

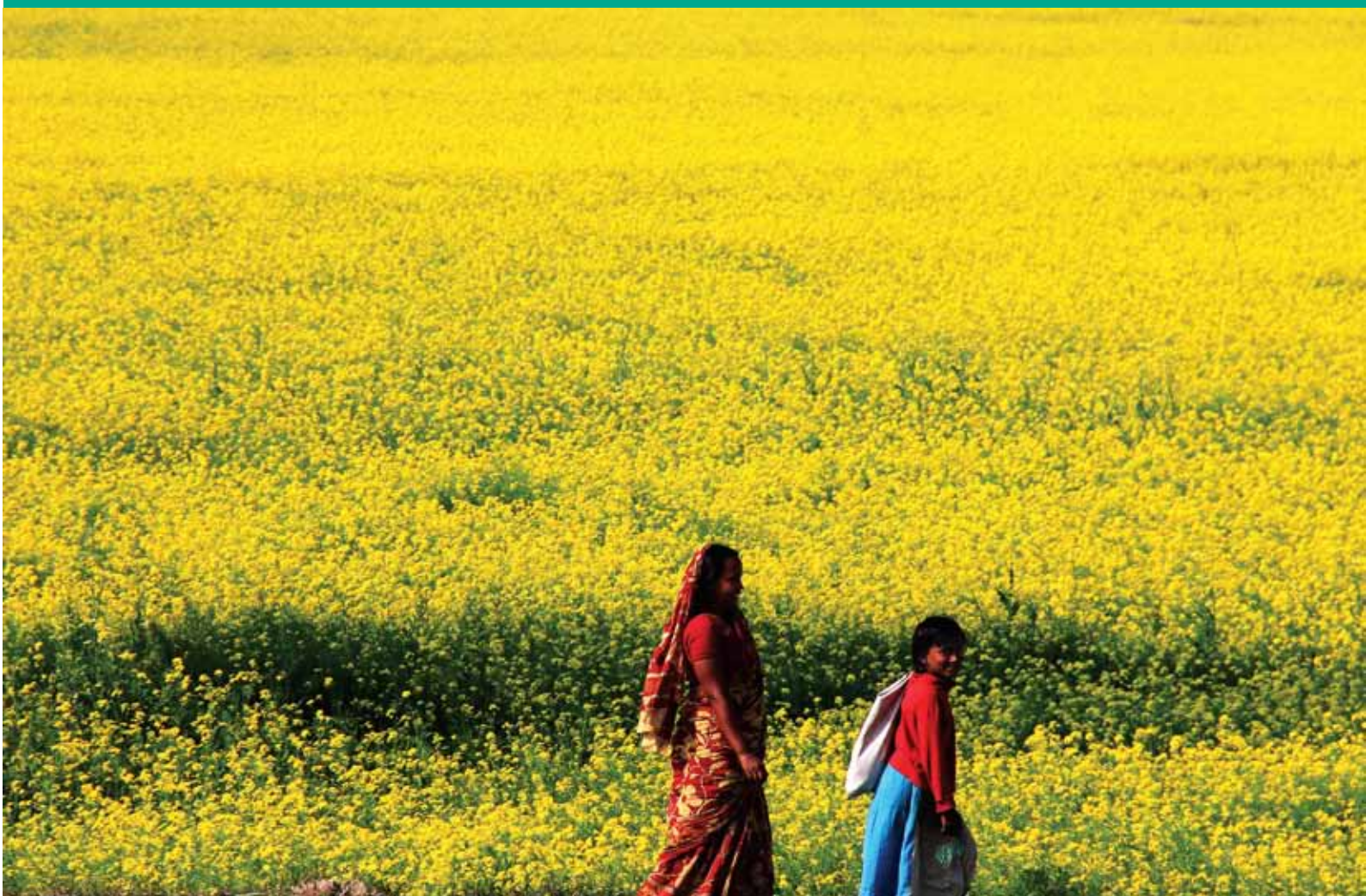


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KEY POINTS

- Crop production is adversely influenced by erratic rainfall, temperature extremes, increased salinity, drought, floods, river erosion, and tropical storms. All of which are likely to increase as a result of climate change.
- Increased extreme weather events and sea level rise has the potential to increase

the demand on the agricultural sector whilst limiting the amount of cultivatable land.

- Bangladesh has a number of potential adaptation and mitigation mechanisms and this paper suggests relevant policy to this affect.

INTRODUCTION

Agriculture is the backbone of the country and is synonymous to the food security of the country. Attaining food self sufficiency by 2013 along with ensuring food to all is adopted in the 'Vision 2021' of the Government of Bangladesh.¹ Pressure for increased crop production is triggered by the rapid population growth and it is the most important challenge. Apart from food security, the sector alone contributes about 12% of the GDP and employ 44% workforce of the country. For these reasons, the government has put topmost priority to the agriculture sector. Agriculture sector is directly related to the rural poverty as the sector benefits livelihood of the rural poor people who account for majority of the population. Agriculture sector is the contributor of income and employment generation in Bangladesh.² Most of the farmers are marginally occupying subsistence farming. Crop production raises rural income and creates jobs for poor people.³

Bangladesh is one of the most climate vulnerable countries in the world. Located between the Himalayas and the Bay of Bengal, the country is very prone to natural disasters.⁴ Climate change accelerated the intensity and frequency of occurrences of salinity, storms, drought, irregular rainfall, high temperature, flash floods, etc. that resulted from global warming. Global warming is harmful for crops of the tropical countries.⁵

IMPACTS OF CLIMATE CHANGE ON AGRICULTURE

Agriculture is the most vulnerable sector as its productivity totally depends on climatic factors like temperature, rainfall, light intensity, radiation and sunshine duration, which are predicted to be erratic.

Incidences of floods, droughts, high temperature, flash floods and floods, etc., are predicted to be more frequent and intense. Salinity intrusion could be more acute problem in future due to sea level rise.

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 then crop production faces constraints. A study⁶ found that 1°C increase in maximum temperature at vegetative, reproductive and ripening stages there was a decrease in *Aman* rice production by 2.94, 53.06 and 17.28 tons respectively. With the change in temperature (by 2°C and 4°C), the prospect of growing wheat and potato would be severely impaired. Production loss may exceed 60% of the achievable yields.⁷ Higher temperature has negative effect on soil organic matter also.

Impact of Rainfall on Crop Production of Bangladesh



¹ Planning Commission. (2010). *Outline Perspective Plan of Bangladesh 2010-2021- Making Vision 2021 A Reality, Final Draft*. General Economics Division, Planning Commission, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.

² Planning Commission. (2009). *Millennium Development Goals – Need Assessment and Costing 2009-2015 Bangladesh*. General Economics Division, Planning Commission, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.

³ Ministry of Environment and Forest (MoEF). (2009). *Bangladesh Climate change Strategy Action Plan, 2009*, Government of the People Republic of Bangladesh.

⁴ World Bank. (2010). *Bangladesh – Country Assessment Strategy FY 2011 – 2014*. Bangladesh Country Management Unit, South Asia Region, The World Bank Office, Dhaka.

⁵ UNEP. (2009). *IEA Training Manual, Volume Two, Vulnerability and Impact Assessments for Adaptation to Climate Change (VIA Module)*.

⁶ Islam, M. N., Baten, M. A., Hossain, M. S. and Islam, M. T. (2008). 'Impact of few important Climatic Parameters on Aman Rice Production in Mymensingh District'. *J. Environ. Sci. & Natural Resources*. 1(2): 49-54.

⁷ Karim Z. 1993. Preliminary Agricultural Vulnerability Assessment: Drought Impacts due to Climate Change in Bangladesh. IPCC Eastern Hemisphere Workshop on Vulnerability Assessment to Sea-Level Rise and Coastal Zone Management, 3-6 August 1993, Tsukuba, Japan

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 found⁸ that 1mm increase in rainfall at vegetative, reproductive and ripening stages decreased *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% as delivered by the Bangladesh Agriculture Development Corporation (BADC).

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.



Photo: IUCN / Shehzad Chowdhury

Salinity also decreases the terminative energy and germination rate of some plants.^{9,10} The loss of rice production in a village of Satkhira district was investigated¹¹ and it was found that rice production in 2003 was 1,151 metric tons less than the year 1985, corresponding to a loss of 69%. Out of the total decreased production, 77% was due to conversion of rice field into shrimp pond and 23% was because of yield loss.

Sea level rise cause inundation of more area which is already reported by scientist. Therefore damage of agricultural crops will be more in future. About 1/3 of Bangladesh or 49,000 sq. km. area are influenced by tides in the Bay of Bengal. Through study it is clear that the inundation coastal inundation area will be increased in future with an adverse effect on crop production. In a study¹² 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. In Bangladesh, about 15-17 million people will be displaced from the land inundation by sea level rise that will cost 12-16% of total land area.¹³

Impact of Flood on Crop Production

Flood has most deleterious affect on crop production of Bangladesh. The 1988 flood caused reduction of agricultural production by 45%.¹⁴ 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* rice crop from flash floods has become a regular phenomenon in the *haor* areas over the recent years. Considering all the direct and induced adverse effects of climate change on agriculture, one may conclude that crop agriculture would be even

⁸ Ibid

⁹ Rashid, M.M., Hoque, A.K.F. and Iftekhar, M.S. (2004). 'Salt Tolerances of Some Multipurpose Tree Species as Determined by Seed Germination'. *Journal of Biological Sciences*, 4 (3): 288-292

¹⁰ Ashraf, M.Y., Sarwar, G., Ashraf, M., Afaf, R. and Sattar, A. (2002). Salinity induced changes in α -amylase activity during germination and early cotton seedling growth, *Biologia Plantarum* pp.589-91.

¹¹ Ali, A.M.S. (2005). *Rice to shrimp: Land use/ land cover changes and soil degradation in Southwestern Bangladesh*, Land Use Policy [Inpress]

¹² Butzengeiger, S. and Horstmann, B. (2004). Sea level Rise in Bangladesh and the Netherlands- One Phenomenon, Many Consequences, Bonn: Germanwatch; available at: <http://www.germanwatch.org/download/klak/fb-ms-e.pdf>.

¹³ World Bank. (2000). *Bangladesh: Climate Change & Sustainable Development*. Report No. 21104 Bangladesh, Dhaka

¹⁴ Karim, Z., Hussain, S.G. and Ahmed, M. (1996). 'Assessing impacts of climate variations on foodgrain production in Bangladesh.' *Water, Air, and Soil Pollution*, 92:53-62.

more vulnerable in Bangladesh in warmer world.¹⁵

Impact of Cyclone on Crop Production

Cyclone cause huge damage to production of crop. FAO/GIEWS Global Watch (2007)¹⁶ reported at the time of the passage of cyclone SIDR, the main 2007 “*aman*” rice crop, accounting for about 70% of the annual production in the most affected area, was nearing harvest. According to the estimate by Department of Agricultural Extension of Bangladesh, the loss in rice equivalent is at some 1.23 million tonnes, with 535,707 tonnes in the four severely affected districts, 555,997 tonnes in badly affected 9 districts and 203,600 tonnes in moderately affected 17 districts in Bangladesh.

Impact of Drought on Crop Production Due to Climate Change

Drought mostly affects Bangladesh in pre-monsoon and post-monsoon periods. During the last 50 years, Bangladesh suffered about 20 drought conditions. During 1981 and 1982 droughts affected the production of the monsoon crops only. The drought condition in north-western Bangladesh in recent decades had led to a shortfall of rice production of 3.5 million tons in the 1990s. If other losses, such as, to 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.¹⁷

RESULTANT IMPACT AND ECONOMIC LOSSES

Natural calamities intensified by climate change, damage field crops in every year. In 1990's, drought in the north western Bangladesh caused a shortfall of rice production by 3.5 million tones. Unprecedented flash flood in the *haor* areas had accounted for a loss of about 150,000 metric tonnes of rice at the beginning of 2010. According to the World Bank and OECD, climate change may risk 40% of the overseas development assistance (ODA) to Bangladesh. Increase in country's GDP requires an increased growth in agricultural sector.

It has been reported¹⁸ that salinity affected areas in coastal Bangladesh have increased from 0.83 million hectares in 1990 to 3.05 hectares in 2001. Another study estimated that in eastern Bangladesh alone 14,000 tons of grain production would be lost to sea level rise in 2030 and 252,000 tons would be lost by 2075 (current agricultural production for the country is 30 million tons). OECD referred to a study that estimated a GDP decrease in the range of 28% to 57% from 1m sea level rise.¹⁹

EXISTING ADAPTION MECHANISMS AND CONSTRAINTS

Adaptations to climate change for agricultural sectors includes the resilient variety, cropping pattern, irrigation techniques, sustainable land management, early warning, research, subsidies, supply of inputs etc. The country is trying to develop coping mechanism against natural hazards like floods, droughts, tidal-surges etc. through support of the Government.

Research

Researchers of institutions under National Agricultural Research Systems (NARS) are engaged to innovate technologies that will be resilient to climate change and ensure expected crop production. Research and developments of stress (salt, submergence, drought, high temperature) tolerant rice and wheat varieties can ensure food security by an increase in yield of up to 20%. Bangladesh Rice Research Institute (BRRI) has released salt-tolerant rice varieties like BR-11, BR-23, BRRI rice -28, BRRI rice -41, BRRI rice -47, BRRI rice -53 and BRRI rice -54 using gene-marker technology. Seeds of BRRI rice -47 variety are multiplied by the Bangladesh Agricultural Development Corporation (BADC) and disseminated by the Department of Agriculture Extension (DAE) to the farmers for cultivation in the salinity prone southern districts. Innovation of short duration varieties like BR -33 by BRRI and BINA -7 by the Bangladesh Institute of Nuclear Agriculture (BINA) is successfully cultivated to avert so called *monga* situation in the northern Bangladesh. BRRI rice -32 and BRRI rice -52 can stand submergence during flash flood.

¹⁵ World Bank. (2000). *Bangladesh: Climate Change & Sustainable Development*. Report No. 21104 Bangladesh, Dhaka.

¹⁶ FAO/GIEWS Global Watch (last updated 21 December 2007). Livelihood of over 8.9 million people adversely affected by Cyclone Sidr in Bangladesh. Retrieved from: <http://www.fao.org/giews/english/shortnews/bangladesh071221.htm>

¹⁷ Drought. Updated in Banglapedia. Retrieved 5 June 2010, from, <http://www.banglapedia.org/httpdocs/HT/D0284.htm>

¹⁸ Karim, Z and Iqbal, A. (eds.). (2000). *Impact of land degradation in Bangladesh: Changing Scenario in Agriculture Land*. Bangladesh Agricultural research Council, Dhaka, 106p.

¹⁹ OECD. (2003). *Development and Climate Change In Bangladesh: Focus on Coastal Flooding and the Sundarbans*. Environment Directorate, Development Co-Operation Directorate. Organization for Economic Co-operation and Development (OECD), COM/ENV/EPOC/DCD/DAC(2003)3/FINAL.

Moreover, BADC is testing adaptability of an African rice variety namely NERICA-1 which is drought tolerant. Bangladesh Agriculture Research Institute (BARI) is working with heat tolerant wheat and tomato varieties.

Irrigation

Irrigation will be crucial in the context of climate change. Introduction of 'Alternate Wetting and Drying (AWD)' irrigation technique by the DAE has been found to be promising in increasing water use efficiency for crop production. In the comparatively dry Rajshahi and Rangpur division (Barind region), Barind Multipurpose Development Authority (BMDA) ensures irrigation for rice where 100 hour free electricity bill for irrigation of last year's *aman* season were provided to the farmers from the Ministry of Agriculture (MoA) in 2009. A 20% rebate in the electricity bills for irrigation throughout the country to encourage irrigated cropping has also been provided by the government. Both the BADC and BMDA are in pursuit of increasing irrigation coverage by taking newer projects and programmes in every year. To achieve food production, it has been suggested that the target of 150,000 ha of land to be brought under irrigation by 2012.²⁰

Financial Adaptation

For the first time the government, apart from subsidies and rehabilitation, has given various incentives to farmers for crop production. Recently, financial assistance of around BDT 750 crore for diesel fuel used to irrigate *boro* rice was distributed among the farmers through their bank accounts. Farmers affected by the flash flood will be given free seeds and fertilizers that will cost BDT 48 crore for the *boro* season in 2011. To compensate the loss of *boro* rice by flash floods in *haor* areas, fertilizers worth BDT 26 crore were distributed free among 346,100 farmers for enhanced *Aus* production and this programme is ongoing in 2011. The Bangabandhu National Agriculture Award, 1415 is awarded to 32 farmers and entrepreneurs to encourage more food production. Increased allocation for fertilizer subsidy, irrigation and other inputs and research activities are some notable financial contributions of the public sector. Such augmentation of support for enhanced production is a crucial adaptive measure for

sustained production.

Farmers need profit for their products that will encourage them to grow more crops subsequently. Interventions for smallholder farmers like storage facility to reduce post harvest losses, increasing agro-processing facilities as well as promoting community mobilizations are important. In order to ensure fair market price of crop products, the MoA is going to establish 'Agri-business Cell' in the ministry. The Directorate of Agricultural Marketing (DAM) has started 15 retailers and 60 growers markets throughout the country to ensure fair price and to eliminate middleman ship in agricultural marketing.

Sustainable Land Management Practices

Land is the base for crop production. Soil resources of the country are experiencing pressure for increased food production. Increasing cropping intensity and mineralization of soil organic matter exhausts the soils capacity to support crops. Soil Resources Development Institution (SRDI) of the MoA is working to improve soil health and preserve it for future generation.²¹ The institute prepared Upazilla Land and Soil Resources Utilization Guide for 459 upazillas throughout the country that will help farmers to apply fertilizers according to the need based on fertility status of the soil. Moreover, MoA is working with the Ministry of Land to enact proposed Agricultural Land Conservation and Land Use Act, 2011 to safeguard agricultural lands from encroachments for developments.

Fertile soil is the prerequisite for better production. Organic manures can increase soil fertility and productivity. The MoA is encouraging farmers to use organic fertilizers like compost, farmyard manure to safeguard soil health. The farmers are advised to use green manure and biofertilizers instead of chemical fertilizers to sustain soil health. Agronomic practices like intercropping with leguminous crops, reduced tillage, alternate cropping, soil mulching, etc. are applied by the farmers to maintain soil fertility. These actions will reduce the use of chemical fertilizers, thereby mitigate emissions from them.

FINANCING ADAPTATION IN AGRICULTURE

²⁰ Planning Commission. (2009). *Millennium Development Goals – Need Assessment and Costing 2009-2015 Bangladesh*. General Economics Division, Planning Commission, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.

²¹ Soil Resources Development Institute (SRDI). (2010): www.srdi.gov.bd

Finance and technology are the means to achieve adaptation and mitigation. After investment by the Bangladesh government in disaster preparedness and adopting other strategies for climate change, financing and implementing the strategies is the challenge for the moment.²² National Adaptation Program of Action (NAPA) addresses immediate and urgent needs to deal with climate change. Climate change has propelled an initiative to develop a multi-donor trust fund contributed by the GoB and the development partners. Commitment was made in the Copenhagen Accord at COP-15 to establish 'Copenhagen Green Climate Fund' to aid projects design to mitigate green house gases. The BCCSAP urged to allocate funds from international communities on grant basis. This will help to access to the technologies required for efficient mitigation. Bangladesh government established 'Climate Change Trust Fund' amounting to 100 million USD. This funding is already in use for the implementation of plans spelled out in the BCCSAP.²³ Climate change is in the agenda of the NARS institutions that are implementing various research projects funded by the development partners along with GoB.

Constraints in Assessing Financial Flows in the Agriculture Sector

The Climate Change Strategy and Action Plan (2009) confirmed that additional amount of allocation will be required for sustained adaptive measures. The Government of Bangladesh invested over 10 billion USD and adopts policies to combat climate change impacts.²² About 500 million USD is estimated to be needed to

implement action plans of BCCSAP for first two years.²³ A credible assessment is vital that must incorporate other sectors in a logical way.

Costing for managing climatic disturbances in agriculture sector is calculated in terms of the amount of crop loss. However, more integrated approach considering issues for example - loss of agricultural land, damages lands, reduce employment, risk health, harms livestock, etc. to ascertain the total loss in figures. This is important in negotiations for funding in both home and abroad.

National and International Sources of Finance and Investments

The Green Climate Fund, established as a financial mechanism of the Copenhagen Accord predicts annual financing for developing countries rising to around \$100 billion per year by 2020, in support of developing countries to mitigate and adapt to climate change. In fact, in November 2010, Bangladesh became one of the first three countries to tap into a pilot climate change fund to help developing and highly vulnerable nations adapt to climate change. Part of this grant will help shore up the country's coastal embankment to withstand cyclones and storm surges, and also pay for water supply projects and promote farming of more resilient crops. However, these types of funds need to be administered properly with sound disbursement modalities, an appropriate governance structure and careful resource management.



Photo: IUCN / Tanguar Haor Project

²² World Bank. (2010). *Bangladesh – Country Assessment Strategy FY 2011 – 2014*, Bangladesh Country Management Unit, South Asia Region, The World Bank Office, Dhaka.

²³ Ministry of Environment and Forest (MoEF). (2009). *Bangladesh Climate change Strategy Action Plan, 2009*, Government of the People Republic of Bangladesh



Photo: IUCN / Tanguar Haor Project

POLICY AND INSTITUTIONAL ARRANGEMENTS

Climate change impacts are not unknown to the policy makers. The National Adaptation Program of Actions (NAPA) provides guidance for adaptation measures taken up to combat climate change impacts. The revised version of National Agriculture Policy of 2011, has included climate change as one of its three priority areas. Some issues related to the impact from temperature rise and variation in precipitation on agriculture needs further attention. The Agriculture Extension Policy of 1996 puts emphasis on sustainable agricultural however and explicit consideration extension of climate resilient variety or cropping pattern need incorporation. Similarly, the Integrated Pest Management Policy of 2002 need to provide guidance on climate change and disaster risk reduction issues. There is an implicit mentioning that the policy should increase self reliance of farmers by promoting locally developed and crop management practices which eventually address adaptation to climate change. National Seed Policy need to put priority on seed production likely to be affected by climate change through technologies.

CONCLUSION AND RECOMENDATIONS

Climate change impacts on Bangladesh are not a future issue. The country is affected by salinity, flood and flash floods, droughts, temperature variations, erratic rainfall etc. which result in crop losses. Despite the country has shown resilience to climate change. The target of rice production was increased and being subsequently achieved in the recent years. Price subsidy for fertilizer and other agricultural inputs has contributed to make them affordable to the farmers. Research on stress tolerant technologies (seed, fertilizer, irrigation, agronomic practices) and their expansion acts as positive adaptive action against climate change.

Comprehensive and coordinated study on the real time impacts of climate change on crop production and assessment of the needs to avert the crisis must be carried out for making correct policy decision.

Financial assistances for production and to compensate crop losses were channelled to the farmers in a comparatively transparent way through their bank accounts. Use of e-Agriculture through internet and village based AICCs allowed farmers to get instant expert opinion on problems of their crop fields. These

'farmers-friendly' actions encouraged farmers, who work hard to ensure better production in recent years. The MoA is committed to harness efforts ensure food security by taking all necessary steps. Allocation for subsidy of fertilizers and other assistances for desirable crop production share majority of the ministry's financial budget. Funding is continued for research and development of stress resilient technologies by the fifteen affiliated departments of the MoA. Still the challenge of producing more food crops for increasing population from decreasing cultivable lands prevails for food security of the country.

Elevated pressure for food production may undermine or overlook the deleterious effects of using genetically modified (GM) materials and hybrid seeds that affects human health. Concepts of food safety and the use of GM technologies also deserve due attention as far as the health of the consumers are concerned.

Crop production in recent years was able to accomplish the target. However, domestic crop production still supplemented with the import of rice, wheat and other

crops to meet national food demand. Imports are augmented due to crop loss from uncertain climatic affects. Increasing price of foodstuffs and agricultural inputs like seeds, fertilizers, agrochemicals along with their unavailability in the international markets make the economy of Bangladesh more vulnerable.

Bangladesh is the forerunner in formulating and adopting NAPA and BCCSAP in compliance to the Bali Action Plan. The country has been participating in the COP of the UNFCC and has been raising concerns of the country to the international forum. Climate Change Trust Fund is established locally with domestic funding. Major policy documents of the government included climate change and thorough considerations may be required for policies supporting agriculture and other natural resources to combat the detrimental effects. However, sectoral cooperation and coordination is required for the success. A balance is to be maintained among the quality & quantity of food produced, maintaining sustainability of the environment and natural resources.



Ministry of Environment and Forests
Government of the People's Republic of Bangladesh

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