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Managing Climate Change: Bangladesh Perspective

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Abstract

More recently the issue of climate change assumed special importance because of the accumulation of evidence of global warming. Climate change is a global challenge. All nations are affected, some more than others. It is a threat to social and economic stability and sustainable human existence. Bangladesh is one of the most proactive developing countries on the global scene to address the challenges of climate change. Our sustainable future depends, to great extent on our ability to build a world where people have sustainable livelihood, food security, pro people health care services and green environment for them. Climate change and its adverse impact has become a block against all our efforts to mitigate the effects of our poverty situation and to achieve the millennium goal of Bangladesh. Climate change has come to the forefront of discussion and attention amongst the governments, business leaders, non-government quarters and people in general. It covers all sectors and human endeavors. Its management therefore will be a complex and highly interactive responsibility for all. Coordination along with keeping track of development imperatives will be the key for a successful implementation of future strategies.

Keywords: Climate change, Ozone layer, global warming, adaptation, mitigation, environmental issues, policy implication.

1. Introduction

A low-lying country with more than 230 waterways, Bangladesh is one of the most disaster-prone nations in the world. The country is well within the tropics and is the largest delta in the world formed by the mighty rivers namely the Ganges, the Brahamaputra and the Meghna. Bangladesh has special geographical feature. It has the Himalayan range to the north, the Bay of Bengal to the south with its funneling towards Meghna estuary and the vast stretch of Indian land to the west. The combined effects of the role played by these special geographical features have significant bearing on climate system of Bangladesh. Bangladesh is especially vulnerable to climate change because of geographic exposures, low income, and greater reliance on climate sensitive sectors such as agriculture. Impacts of climate change in Bangladesh include excessive flooding, increased salinity and drought, lack of drinking water and water logging due to the rise of sea level.

Climate change is now a reality in many countries and an extremely difficult and complex development challenge as well. It is not the only problem of environmental degradation, the

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problem runs far deep and its reach in destabilizing many of the natural systems is potentially immense.

Objectives of the Study

This study focuses on the possible impact of climate change faced by Bangladesh. The specific objectives of the study are as follows:

i. To examine the global and regional perspective and action plan on climate change.
ii. To assess Bangladesh's stance related to Bali Action Plan and subsequent activities such as the formulation of Bangladesh Climate Change Strategy and Action Plan (BCCSAP).
iii. To examine possible impact and implications of climate change in Bangladesh.
iv. To make some policy recommendations.

Methodology of the Study

The study is mainly based on secondary data. Data have been collected from different published materials like the publication of IPCC, the World Bank, Bangladesh Bureau of Statistics, Ministry of Environment and Forest, and Directorate of Environment. Relevant writings of some scholars have also been consulted. The collected data have been processed manually and analysis has been made in order to make the study more analytical, informative and useful to the users.

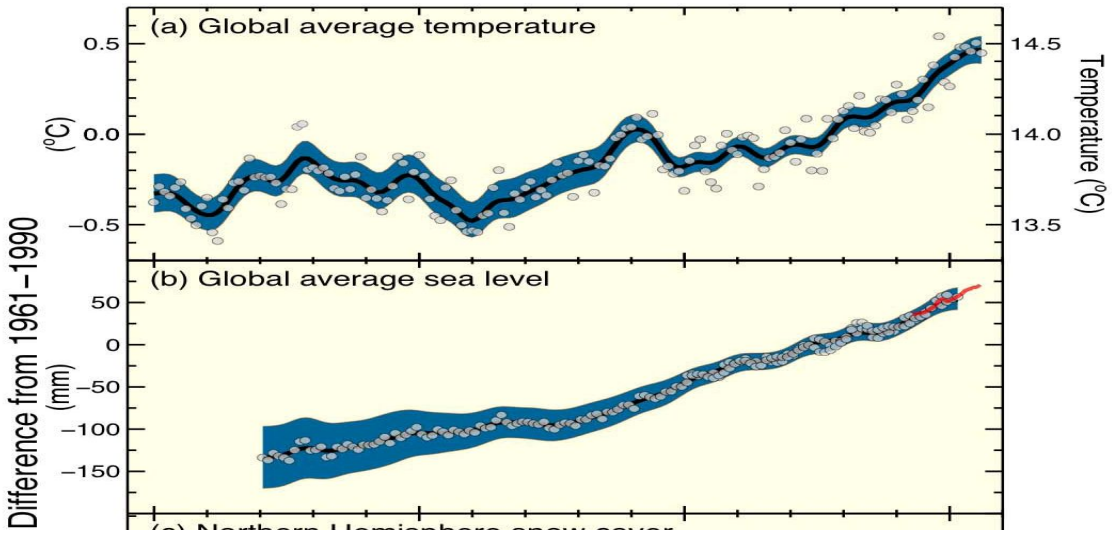
2. Literature Review

Scientific records suggest that it has become significantly drier in the Sahel, the Mediterranean, southern Africa and parts of southern Asia and significantly wetter in eastern parts of North and South America, northern Europe and northern and central Asia (Klein Tank and Konnen, 2003). There are evidences which suggest that large-scale global circulation such as ENSO interact with more localized precipitation events. Scientists infer that changes in large scale atmospheric circulations have indeed happened (Quadrelli and Wallace, 2004). The rate of warming is found to be the highest so far during the last 5 years (over 2001-2005) . Figure 1 shows the trend in global warming as well as the trend in sea level rise over the period since 1900.

While assessing global-scale impacts of anthropogenic climate change scientists concluded in the AR4 that it is likely that anthropogenic warming over the last three decades has had a discernible influence on many physical and biological systems (Root and Schneider, 2002; Permesan and Yohe, 2003; Root *et al.*, 2003). Scientists have also concluded that urban heat island effects are real but localized, and have not biased the large-scale trends. At the same time, there is a consensus to conclude that the land regions have warmed at a faster rate than the oceans, while for the latter case both sea surface temperatures (SST) and nighttime marine air temperatures have attributed the warming trend. It has been observed that the recent warming is strongly evident at all latitudes in SSTs spreading over each of the oceans, though there is an inter-Hemispheric difference in warming rates. Arctic region showed much faster warming than elsewhere, which is almost twice the global average rate for the past 100 years.

In the Fourth Assessment Report of IPCC (AR4), scientists across the world have gathered and presented many evidences that clearly suggest that accelerated climate change has indeed been occurring since the industrial revolution and more specifically in recent decades (Trenberth *et al.*, 2007). It is also evident from records that changes in extreme temperature indices are consistent with warming of the climate.

Fig 1: Simulated and actual changes in global temperature



Source: *IPCC (2007 a), Climate Change 2007: The Physical Science Basis; Summary for Policy Maker*

IPCC Report (2007) reveals scientific records to infer that intense tropical cyclone activity has increased since about 1970. Trends are apparent in SSTs and other critical variables that influence tropical thunderstorm and tropical storm development. Globally, estimates of the potential destructiveness of hurricanes show a significant upward trend since the mid-1970s, with a trend towards longer lifetimes and greater storm intensity, and such trends are strongly correlated with tropical sea surface temperatures (SST).

Impacts on physical systems

While assessing global-scale impacts of anthropogenic climate change scientists concluded in the AR4 it is likely that anthropogenic warming over the last three decades has had a discernible influence on many physical and biological systems. There are evidences that physical and biological systems on all continents and in most oceans are already being affected by recent climate changes, particularly regional temperature increases. Scientists also concluded (with medium confidence) that despite continuous adaptation efforts and other non-climatic drivers, climatic effects on human systems are emerging

The direction of possible changes in the physical and human systems due to climate change and their likelihood are shown in Table 1 below.

Table 1: Possible Impacts of CC on Physical and Human Systems

Phenomenon and direction of trend	Likelihood of future trends based on projections for 21st century using SRES scenarios	Examples of major projected impacts by sector			
		Agriculture, forestry and ecosystems	Water resources	Human health	Industry, settlement and society
Over most land areas, warmer and few cold days and nights, warmer and more frequent hot days and nights	Virtually certain	Increased yields in colder environment; decreased yields in warmer environment; increased insect outbreaks	Effects on water resources relying on snow melt; effects on some water supply	Reduced human mortality from decreased cold exposure	Reduced energy demand for heating; increased demand for cooling; declining air quality in cities; reduced disruption to transport due to snow, ice; effects on winter tourism
Warm spells/heat waves. Frequency increases over most land areas	Very likely	Reduced yields in warmer regions due to heat stress; wild fire danger increase	Increased water demand; water quality problems, e.g., algal blooms	Increased risk of heat-related mortality, especially elderly, chronically sick, very young and socially isolated	Reduction in quality of life for people in warm areas without appropriate housing; impacts on elderly, very young and poor
Heavy precipitation events. Frequency increases over most areas	Very likely	Damage to crops; soil erosion, inability to cultivate land due to water logging of soils	Adverse effects on quality of surface and ground water; contamination of water supply; water scarcity may be relieved	Increased risk of deaths, injuries, infectious respiratory and skin diseases	Disruption of settlements, commerce, transport and societies due to flooding; pressures on urban and rural infrastructures; loss of property

Area affected by drought increases	Likely	Land degradation, lower yields/crop damage and failure; increased livestock deaths; increased risk of wildfire	More widespread water stress	Increased risk of flood and water shortage; increased risk of malnutrition; increased risk of water and flood-borne diseases	Water shortages for settlements, industry and societies; reduced hydropower generation potentials; potential for population migration
Intense tropical cyclone activity increases	Likely	Damage to crops; wind throw (uprooting) of trees; damage to coral reefs	Power outages cause disruption of public water supply	Increased risk of deaths; injuries; water and flood-borne diseases; post-traumatic stress disorders	Disruption by flood and high winds; withdrawal of risk coverage in vulnerable areas by private insurers, potential for population migrations, loss of property
Increased incidence of extreme high sea level 9excludes tsunamis)	Likely	Over salinity of irrigation water, estuaries and freshwater system	Decreased fresh water availability due to salt water intrusion	Increased risk of deaths and injuries by drowning in floods; migration-related health effects	Cost of coastal protection versus cost of land use relocation; potential for movement of population and infrastructure

Source: IPCC (2007), Climate Change, 2007: The Physical Science Basis; Summary for Policy Makers.

There are growing number of evidences that climate change is strongly affecting many aspects of systems concerning snow, ice and frozen grounds. There are emerging evidences that climate change can be attributed to changes in hydrological systems, water resources, coastal zones and oceans. Ground instability of permafrost regions provides a major example where glaciers are rapidly melting and creating lakes in mountain regions and limitation on mountain sports in lower elevation alpine areas.

Scientists provide evidences that the spring peak discharge is occurring earlier in rivers affected by snow melt, attributable to enhanced glacial melt. Lakes and rivers around the world are warming, with effects on thermal structure and water quality. The effects of sea-level rise, enhanced wave heights, and intensification of storms are found in some coastal regions. Coastal erosions are also reported. Losses of coastal wetlands and mangroves are caused by sea level rise.

3. Global Action on Climate Change

Global response- UNFCCC and Kyoto Protocol

As the evidence and impacts of climate change became increasingly clear through studies and research and deliberations at the global and national levels became clear, demand arose for doing something about it. The first definitive action came in 1992 at the UN Conference on Environment and Development held in Rio de Janeiro. The Conference established the United Nations Framework Convention on Climate Change (UNFCCC, or, Convention) which came into force in 1994. Countries which have signed the Convention and ratified are called Parties (192 in number). A Conference of Parties (COP) takes place every year. The upcoming Copenhagen COP is COP 15.

Linked to the Convention, a protocol has been signed in 1997 in Kyoto (hence called Kyoto Protocol, or, KP) which came into effect much later in 2005. The KP is a legally binding instrument under which industrialized countries committed themselves to a lowering of emission on an average of 5% below the 1990 level. The first commitment period ends in 2012. The KP has several market-based instruments to lower emission. Its main drawbacks are the low level of commitment and the exclusion of the USA, the largest emitter country. In fact, the KP targets have been hardly achieved. Many countries actually have overshot the 1990 level emission.

It is against such a background that the COP 13 had been held in Bali. It stands out as a landmark and the present negotiations have much to do with the decisions taken in Bali. The post-Bali submission of Bangladesh remains the watershed against which later activities including the integration of CC issues in planning for development have to be judged.

The Bali Action Plan and Subsequent Developments

The COP 13 in Bali saw some path-breaking changes in the negotiations for mitigation (i.e., emission reduction). The decision 1/CP 13 or the Bali Action Plan (BAP) calls for a global shared vision and enhanced actions on 4 areas, mitigation (i.e., emission reduction), adaptation, finance and technology transfer and development as well as capacity development. The most interesting were the decisions which dealt respectively with mandatory mitigation commitment by developed country parties and voluntary mitigation actions by developing country parties. All country parties are expected to reduce emission. Much of the debate that is going on since then revolves around these two provisions, the conditions under which these should be operational, the relationships of these with the commitments under KP beyond 2012 and of course the level of reduction pledge given the scientific evidence that there has to be drastic cuts in emission and its peaking within a few years (2015 to be exact).

At the same time, however, there has been some substantial progress in adaptation talks, how these can be facilitated and the resources that might be necessary, how to generate those and how to allocate the available resources among the adversely affected countries equitably. There has also been progress in technology transfer and development issues. While nothing is final yet, it is almost certain that substantial resources will flow under different circumstances, bilaterally and multilaterally, for adaptation and also for mitigation. Bangladesh will have to prepare itself for utilizing such funds in the most effective way to quicken her process of development. And this has to be within the Bali Action Plan and Bangladesh's own ideas regarding the operationalization of the Bali Action Plan.

Operationalising Bali Action Plan in Bangladesh context

The BAP makes it clear that the developing countries responsibilities and actions have to be looked at within the framework of sustainable development. Bangladesh in subsequent submission regarding how to operationalise the BAP has put it in terms of ensuring four types of security. These are food security, water security, energy security and livelihood security (including health). Given that agriculture is expected to be heavily adversely affected, food security becomes the most important issue for Bangladesh. On the other hand, much of what happens to various sectors due to climate change relates to water, too much or too little of it or its spatial distribution between and within years. Furthermore, water is also a shared natural resource for Bangladesh with some of the country's neighbors which calls for regional actions for ensuring availability. Water security is thus absolutely essential. Livelihood security relates to the ultimate well-being of the people without which development is meaningless. As health becomes a major issue under climate change, this is also included as part of well-being under climate change.

The issue of energy security is interesting in Bangladesh context. Given that Bangladesh is low energy consumer while she needs energy increasingly for development, the country must be allowed to consume as much energy as necessary for development. While this may seem obvious, a potential conflict may arise with the decision 1b(ii) under BAP which calls upon all developing countries to contribute as their situations permit to lower emission which means in many cases lowering energy consumption. But this may conflict with the right to development. Bangladesh has made it clear that while she will use energy in the most efficient way, she will not compromise with her need for energy for development. Indeed, the four securities are inviolate principles of development which has been later incorporated in the Bangladesh Climate Change Strategy and Action Plan to which we now turn as the precursor of planning under climate change.

4. Regional Perspective of Climate Change

Climate change in the region is also a pertinent issue for the countries of the region. These countries share a common geo-physical conditions and common river basin. The geographical location and natural environment demand for a common platform to address the impact of climate change in the region. Underscoring the importance of this our Honorable Prime Minister Sheikh Hasina raised a proposal at the 16th SAARC summit held in Thimpu, Bhutan from 28 to 29 April, 2010 regarding formation of "The Himalayan Council" in line with "The Arctic Council". Her proposal was well received by other Heads of Government of SAARC. A declaration on climate change in the region was made at the said SAARC summit. It is expected that follow-up actions are to be taken in this regard.

5. Impact of Climate Change: Bangladesh scenario

Climate change and its adverse impact has become a block against all our efforts to mitigate the effects of our poverty situation and to achieve the Millennium development Goals in Bangladesh. Climate change and its consequences have been decreasing and will further decrease our vitality to invest more in our health sector.

Evidence of Climate Change in Bangladesh: It is reported that the surface average temperature has been rising in Bangladesh, though there is no agreement among studies on the rate of change. Available literature suggests that a general warming is expected in future, where the rate of warming will be higher for the winter months (i.e., DJF) than the monsoon months (i.e., JJA).

There is a great deal of local-level perception-based evidence that the rainfall pattern has become erratic in recent years, if not in recent decades. However, the official agency has ruled out any possibility of drastic change in rainfall patterns beyond climate variability. Intriguingly, a bi-modal shift in rainfall behavior has already been reported, which may further be attributed to recent shifts in hydrological peaks in various rivers inside Bangladesh. Local level experience and anecdotal evidence clearly show that in both Gaibandha and Jamalpur, people now observe two to three flood peaks instead of one, as the latter had been regularly observed decades ago.

Increased susceptibility to natural disasters: All the above phenomena clearly highlight the increased hazard susceptibility in terms of flood, drought and salinity ingress in Bangladesh. As it has been reported in many articles, floods will be more intense, will inundate more areas and occasionally will perhaps prolong to devastate people's livelihoods, national economy and infrastructure. Similarly, literature suggest that the central western region will be hit hard due to exacerbated drought and marginal farmers would not be able to maintain livelihood thrusts by switching technologies to offset moisture stress. Simultaneously, increased salinity would tend to reduce crop suitability throughout the southwestern region and perhaps appear to be a deterring factor for industrial activities in the affected areas.

Coastal impacts - water logging: A northward shift in isohaline lines under climate change would compound the already alarming effect of water logging in the southwestern region. It has been reported that the sea surface temperatures (SST) along the northern Indian Ocean (i.e., Bay of Bengal) has gradually been rising steadily. Though there is no evidence that the frequency of occurrence of cyclone along the Bay of Bengal has actually changed over the past five decades due to rising sea surface temperatures (SST), that cyclone intensity might be increased by as high as 10% due to increased warming.

Coastal impacts-rough seas and cyclones: There is a strong correlation between increasing sea surface temperatures (SST) and the occurrence of too many rough sea events in the recent years. Coastal fisher folks are not only facing extreme challenges to maintain livelihoods due either to incomplete fishing trips or to too many days lost for not being able to fish in the open sea, many have been tried to out migrate and faced extreme conditions in foreign jails. High wind actions have been causing economic damage to fisher folks by quickly damaging the traditional boats.

High wind actions have been eroding sea-facing coastal islands; even embankments located far inland than the open sea. Sudden breaches in embankments have been destroying standing crops, inundating crop lands with saline water, thereby diminishing economic potential of the coastal lands, and forcing poor people to out-migrate from the affected areas by destroying their livelihoods. The cases of Gabura and Padmapukur Union of Satkhira District have been providing evidences of increased wave actions due to increased sea surface temperatures (SST).

It is rather premature to infer whether there is any increase in frequency of high intensity

cyclones along the Bay of Bengal. There are many decadal-scale return periods of occurrence of high intensity cyclones, without the effect of higher SST. However, the contribution of higher sea surface temperatures (SST) cannot be completely taken out of the influence of it causing the occurrence of recent major cyclones such as Sidr.

6. Actions taken by the Government toward Confronting the Issue of Climate Change

Bangladesh has been among the countries signatory to UNFCCC and the Kyoto Protocol. As per provisions of UNFCCC, Bangladesh had prepared the Initial National Communication (INC) with GEF-UNDP funding and had sent it to the UNFCCC secretariat in 2002. The Second National Communication has now been in process under which a GHG Inventory will be prepared and, simultaneously, programmes on Adaptation and Mitigation will be undertaken. A' Climate Change Cell' has been created in the Department of Environment with a view to preparing and adopting a coordinated strategy in respect of issues related to the phenomena of climate change at local and national levels under the auspices of the Comprehensive Disaster Management Programme (CDMP) of the Ministry of Food and Disaster Management. As a signatory to UNFCCC, Bangladesh needs to fulfill certain commitments made by her to the world community. To this end, a National Adaptation Programme of Action (NAPA) has been prepared in 2005. NAPA has been prepared by the Ministry of Environment and Forest (MOEF), Government of the People’s Republic of Bangladesh as a response to the decision of the Seventh Session of Conference of the parties (COP7) of the United Nations Framework Convention of the Climate Change (UNFCCC). The NAPA is the beginning of a long journey to address adverse impacts of climate stimuli including variability and extreme events and to promote sustainable development of the country. The action plan has identified 15 areas where necessary programmes will be undertaken. The BCCSAP 2009 adds several new areas of action in line with the priorities of the government. These include among others, developing and harnessing the water resources through better river course management and river training which also helps in minimizing the destructive potentials of future floods that are expected to be more severe due to climate change, and managing locational and involuntary displacement of people and their livelihood.

UNFCCC has created 'Least Developed Countries Fund (LDCF)' and 'Special Climate Change Fund (SCCF)' to facilitate the least developed countries to address the losses and adversities due to climate change. Currently LDCF and SCCF, respectively, have US $ 115m and US $ 61,5m.

7. Bangladesh Climate Change Strategy and Action Plan (BCCSAP)

Bangladesh prepared the Bangladesh Climate Change Strategy and Action Plan (BCCSAP) in 2008 and revised it in 2009. This is now an approved document of the Government. This is expected to be the blue print for subsequent integration of climate change issues such as mitigation, adaptation, technology transfer and development, and capacity building into the mainstream planning process.

The BCCSAP takes the Bangladesh submission on Bali Road Map, particularly the 4 securities, as the starting point and develops a strategy of sustainable development centered around the issue

of climate change. Note that the strategy and action plan does not say anything about the non-CC related development strategy for planning. In fact, as has become apparent, all our development thinking and practice from now on has to centre around climate change even when it is not affected by climate change because the resource envelop for climate change-centered planning will have obvious implications for allocations to non-climate change projects and programmes.

On the basis of the 4 securities, the strategy is to safeguard the development prospects of Bangladesh in a way that the country becomes a middle-income one by 2021 and achieves the targets under MDGs as fast as possible. Under the action plan, there are six major themes and 44 programmes (Table 3). The very first relates to ensuring food and livelihood security. The programmes mainly fall under development of crop varieties and development of technology suitable for agricultural production under various adverse climatic conditions that are likely to obtain in future. Three of the themes including food and livelihood security fall under adaptation which is the prime need of the country. The other two adaptation programmes relate to construction and maintenance of necessary infrastructure, particularly those related to water management. The third important area is disaster management as disaster risk reduction and post-disaster rehabilitation are going to engage a lot of energy and resources of the country due to climate change.

Two of the themes fall under cross-cutting issues of capacity development and research and knowledge management. The last one is extremely important because, a lot of the possible impacts of climate change are still unknown and uncertain. Continuous research will be necessary for understanding the unfolding situations as well as development of country specific solutions to the emerging problems or adapting technology imported from elsewhere. It must be noted that many of these activities already exist in some form. What is needed is their consolidation and reorientation to the purpose at hand.

The serious consequences of climate change, including especially the consequences for Bangladesh, lead naturally to the question of what should be our response. Two types of response need to be considered. The first relates to adaptation, i.e., measures that have to be taken given the very high likelihood that climate change will occur and will have adverse effects. The second relates to mitigation, i.e. steps to be taken that might reduce the extent of climate change.

Table 2: BCCSAP 2009 Themes and Programme Areas

Theme	**T1: Food Security, Social Protection and Health**
Programme	P1. Institutional capacity for research towards climate resilient cultivars and their dissemination P2. Development of climate resilient cropping systems P3. Adaptation against drought P4. Adaptation in fisheries sector P5. Adaptation in livestock sector P6. Adaptation in health sector P7. Water and sanitation programme in climate vulnerable areas P8. Livelihood protection in ecologically fragile areas P9. Livelihood protection of vulnerable socio-economic groups (including women)
Theme	**T2: Comprehensive Disaster Management**
Programme	P1. Improvement of flood forecasting and early warning P2. Improvement of cyclone and storm surge warning P3. Awareness raising and public education towards climate resilience P4 Risk management against loss on income and property
Theme	**T3 : Infrastructure**
Programme	P1. Repair and maintenance of existing flood embankments P2. Repair and maintenance of cyclone shelters P3. Repair and maintenance of existing coastal polders P4. Improvement of urban drainage P5. Adaptation against Floods P6. Adaptation against tropical cyclones and storm surges P7. Planning and design of river training works P8. Planning, design and implementation of resuscitation of river and khals through dredging and de-siltation work
Theme	**T4: Research and Knowledge Management**
Programme	P1. Establishment of a centre for knowledge management and training on climate change P2. Climate change modelling at national and sub-national levels P3. Preparatory studies for adaptation against sea level rise P4. Monitoring of ecosystem and biodiversity changes and their impacts P5. Macroeconomic and sectoral economic impacts of climate change P6. Monitoring of internal and external migration of adversely impacted population and providing support to them through capacity building for their rehabilitation in new environment P7. Monitoring of impact on various issues related to management of tourism in Bangladesh and implementation in priority action plan
Theme	**T5: Mitigation and Low Carbon Development**
Programme	P1. Improved energy efficiency in production and consumption of energy P2. Gas exploration and reservoir management P3. Development of coal mines and coal fired power stations P4. Renewable energy development P5. Lower emission from agricultural land P6. Management of urban waste P7. Afforestation and reforestation programme P8. Rapid expansion of energy saving devices eg. Compact Florescent Lamps (CFL) P9. Energy and Water Efficiency in Built Environment P10. Improvement in energy consumption pattern in transport sector and options for mitigation
Theme	**T6: Capacity Building and Institutional Strengthening**
Programme	P1. Revision of sectoral policies for climate resilience P2. Main-streaming climate change in national, sectoral and spatial development programmes P3. Strengthening human resource capacity P4. Strengthening gender consideration in climate change management P5. Strengthening institutional capacity for climate change management P6. Main-streaming climate change in the Media

Source: Bangladesh Climate Change Strategy and Action Plan (BCCSAP), 2009.

8. Policy Recommendation

Efforts should be directed towards enhanced national and international action on mitigation, enhanced action on adaptation, enhanced action on technology development and transfer to support action on mitigation and adaptation, enhanced action on the provision of financial resources and investment to support action on mitigation and adaptation and technology cooperation.

Bangladesh would need to prepare for long term adaptation, which could be a drastic as changed sowing dates due to seasonal variations, introducing different varieties and species, to practicing novel water supply and irrigation systems. In essence, we have to identify all present vulnerabilities and future opportunities, adjusting priorities, at times even changing commodity and trade policies in the agricultural sector while promoting training and education throughout the masses in all possible spheres. In the UN Conference on Climate Change held from 28 November to 9 December 2011 in Durban, South Africa, Bangladesh emphasized the urgency of establishing the adaptation fund body as a means of getting easy and direct access to the fund from 2012.

BCCSAP 2009 has been approved and our strategy would be to follow that and examine which are the urgent tasks that need to be taken up and may be completed by and large within the next few years. The policy recommendation may be categorized under the following sub-heads. Actions to be taken under each sub-heads have been recommended.

Research and Knowledge Management: Actions under this sub-head may include a) National centre for research, knowledge management, and training, b) climate change modeling and their impacts, c) preparatory studies for adaption against sea level rise (SLR).

Low Carbon Development: The following actions and programs are recommended in this category: a) Renewable energy development, b) Management of urban waste, c) Afforestation and reforestation, d) Rapid expansion of energy saving devices, e) Improving energy efficiency in transport sector.

Capacity Building: Under this framework, the recommendations are as follows: a) Revision of sectoral policies for climate resilience, b) Mainstreaming climate change in national, sectoral and spatial development programmes, c) Strengthening human resource capacity, d) Gender considerations in climate change, e) Strengthening institutional capacity, f) Mainstreaming climate change in media.

Comprehensive Disaster Management: This sub-head may cover actions and programs as mentioned here: a) Improving of cyclone and storm surge warning, b) Awareness raising and public dissemination, c) Risk management against loss of income and property.

9. Conclusion

Climate change issues encompass all the sectors of the economy. A multi-dimensional approach is needed for the formulation of policies and implementation of programs related to climate change. Poverty, environmental degradation and sustainable livelihood, all interact in a complex

way. A comprehensive approach is also needed for implementation of policy measures in respect of climate change issues in Bangladesh. Public–private sector cooperation in the management of environment and climate change is to be encouraged and concerted efforts are to be undertaken.

References

Ali, A., 1999, Climate change Impacts and Adaption Assessment in Bangladesh, Climate Research, Vol. 12, pp. 109-116

Asian Development Bank (ADB) (1994) "Climate Change in Asia: Bangladesh Country Report", Manila, The Philippines: Asian Development Bank, *Regional Study on Global Environmental Issues Series.*

Government of the People's Republic of Bangladesh, Ministry of Environment and Forest (2009) *Bangladesh Climate Change Strategy and Action Plan (BCCSAP), 2009.*

Government of the People's Republic of Bangladesh, Ministry of Environment and Forest, (2005), National Adaptation Programme of Action (NAPA), 2005.

Huq, Saleemul and Jessica Ayers (2008) "Climate Change Impacts and Responses in Bangladesh - Note", Brussels, Belgium: European Parliament, DG Internal Policies, Policy Department Economy and Science (January).

Intergovernmental Panel on Climate Change (IPCC), IPCC forth Assessment Report: Climate Change 2007, B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds.), Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Klein Tank, A.M.G., and G.P. Können, 2003: Trends in indices of daily temperature and precipitation extremes in Europe, 1946–1999. *J. Clim.*, 16, 3665–3680.

Parmesan, C. and G.Yohe, 2003: A globally coherent fingerprint of climate change impacts across natural systems. *Nature*, 421, 37-42.

Quadrelli, R., and J.M. Wallace, 2004: A simplified linear framework for interpreting patterns of Northern Hemisphere wintertime climate variability. *J. Clim.*, 17, 3728–3744.

Rahman, A. Atiq (2008) "Climate Change and its implication: Responsive strategic options for Bangladesh", Dhaka, Bangladesh: UNDP Bangladesh, *Policy Dialogue*, No. 8 (March 13).

Root, T.L. and S.H. Schneider, 2002. Climate change: overview and implications for wildlife. *Wildlife Responses to Climate Change: North American Case Studies*, T.L. Root and S.H.Schneider, Eds., Island Press, Washington, District of Columbia, 1-56.

Root, T.L., J.T. Price, K.R. Hall, S.H. Schneider, C. Rosenzweig and J.A. Pounds, 2003: Fingerprints of global warming on wild animals and plants. *Nature*, 421, 57-60.

Trenberth, K.E., P.D. Jones, P. Ambenje, R. Bojariu, D. Easterling, A. Klein Tank, D. Parker, F. Rahimzadeh, J.A. Renwick, M. Rusticucci, B. Soden and P. Zhai, 2007: Observations: Surface and Atmospheric Climate Change. In: *Climate Change 2007: The Physical Science Basis*. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

World Bank (2000) *Bangladesh: Climate Change and Sustainable Development*, Washington, DC: World Bank.

World Bank (2010), *World Development Report 2010: Development and Climate Change*, Washington, DC, World Bank.