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**Sea Level Rise, Natural Disasters and Threats to
Human Security in Bangladesh**

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Introduction

1. Climate change now occupies the top of the environmental concerns that impede progress in socioeconomic development and threaten human security. Global warming resulting from various human activities causes sea level rise that affects low level coastal areas in the deltas and island nations of the world. In 1990, the Intergovernmental panel on climate change (IPCC) projected that with a business as usual scenario of green house gas emission, the world would be 3.3⁰C warmer by 2100 that will cause about one meter rise in the sea level from thermal expansion and melting of glaciers.

2. The projected sea level rise poses a significant threat to human security in Bangladesh, a densely settled country in the world that has 710 km long coast to the Bay of Bengal. A one meter rise in the sea level will affect the vast coastal area and the inland flood zones that might be subjected to increased frequency of cyclones and floods from which the country already suffer. It will pose increased threat of damage to infrastructures, destruction of fisheries, reduction of cultivated land, crop failures and the loss of biodiversity.

3. Formulation of adaptation policies and an action plan for effective implementation is urgently needed to face the crucial challenges to habitation, food, employment security faced by the people that threaten to slow down socio-economic development of the country. The global community and multi-lateral and bi-lateral development agencies must come forward to support Bangladesh in formulating and implementing appropriate adaptation policies to meet this huge environmental threat to a resource-poor country.

4. This presentation aims to highlight the natural disasters that the country has already been struggling with, the projected impact of sea level rise (SLR) on human security in Bangladesh; and possible course of action that the government and other development

organization must take to support the people develop resilience to cope with this impending man-made environmental hazard.

Ecosystems and natural disasters

5. Bangladesh now supports about 145 million people within a land area of 144 km². It ranks 11th in the league table of the world with regard to population. With a density of population of over 1000 per km² Bangladesh has the distinction of being the most densely settled country of the world except Singapore. The country has made remarkable progress in reducing population growth from three to 1.4 percent per year over the last three decades and has accelerated economic growth from four percent per year during the first two decades of independence to over six percent during this decade. But the population is still growing at 1.4 percent adding two million new mouths to be fed every year. The labor force of about 54 million has been increasing by 1.5 million annually. Feeding the growing population, improving the quality of the vast human resource, and generating productive employment for them are big challenge for the policy makers in the country.

6. Bangladesh is situated on deltas of large rivers flowing from the Himalayas: The Ganges unites with Jamuna (the main channel of the Brahmaputra) and later joins the Meghna to eventually empty in the Bay of Bengal. The country is sloping gently from the north to the south, meeting the Bay of Bengal in the southern end. The three major rivers and their numerous tributaries carry water from the catchments of the Himalayas and flood a third of the country in normal years. When they rise at the same time and the draining to the sea is impeded by high tide in the sea, the country suffers disastrous floods with inundation of over 50 percent of the land area. Over the last thirty seven years of its independence, Bangladesh suffered such devastating floods in 1974, 1987, 1988, 1998, 2004, and 2007. Floods are becoming more frequent allegedly due to climate change.

7. Bangladesh runs parallel to the Bay of Bengal forming 710 km long coastline. The coastal zone covers 19 of the 64 districts of which 12 districts meet the sea or lower

estuary directly. The number of upazillas (sub-districts) that are directly exposed to the coast is 48 and another 99 upazillas (out of 508) are located behind the exposed coast (interior coast) are subjected to tidal fluctuations and are affected by saline water intrusion. The coastal zone covers 47,000 km² area, about 32 percent of total landmass of the country. Twenty eight percent of the total population lives in the coastal zone. The average population density in the coastal zone is currently 890, about 12 percent lower than the average for the country as a whole. The population density is however only about half in the exposed zone (570 per km²) compared to the interior zone (1200 km²). A one meter rise in sea level will inundate about 17.5% of the landmass mostly in the central and western coast (9 districts in the Barisal and Khulna region).

8. The Bangladesh coast is often devastated by severe cyclonic storms and tidal surges that take heavy toll on human lives, infrastructure and livelihoods. The devastation caused by three major cyclones occurred in 1970, 1985, 1991 and 2007 are still vivid in the memory of the present generation. The November 1990 cyclone with a tidal surge of over nine meters was accountable for death of 500,000 plus people. The neglect of relief and rehabilitation in its aftermath by the central government is considered a major factor behind the breakup of Pakistan and the independence of Bangladesh in 1971. The cyclone of April 1991 in the eastern coast caused a death toll 139,000 people with an estimated economic loss of US\$ 1.78 billion. The most recent cyclone, Sidr, which struck the southwestern coast on November 15, 2007 with a wind velocity of up to 250 km per hour took a toll of 3,3363 people with another 871 missing. It affected 2.06 million households and 8.96 million people and destroyed crops in about 2.5 million ha of land.

9. The frequency and intensity of natural disasters is projected to increase with climate change and sea level rise. We have already noted that abnormal floods that inundate more than a third of the country occur with greater frequency. The recent floods takes longer time to drain, occurs at a later part of the crop with little opportunity for recovery of crop, and affects towns and cities with huge damage to infrastructure and industrial assets. Rising sea levels will impede drainage of water southwards from the Himalayas terrain by the major rivers. This feed back effect can cause penetration of heavier floods further

inland. The storm surge during cyclone may increase to over 9 meters with heavier risks loss of human and animal lives and destruction of assets.

10. It may be mentioned here that with frequent exposure to natural disasters, Bangladeshi people have developed resilience against with learning of how to cope with them. The government and the civil society have also demonstrated greater effectiveness in managing relief and rehabilitation efforts. The farmers in the severe flood-affected zones have changed land use and cropping patterns that helped minimize damage to agriculture and loss of crops. The building of cyclone shelters though inadequate in number, and an improved system of cyclone warnings have helped reduce dead tolls from severe cyclones. The natural disasters now cause more damage to infrastructures such as house, factories, roads and other transport network, industrial and business capital, and educational and health institutions. A severely affected sector is inland fisheries that have vastly expanded in recent years.

Threat to human security

11. Bangladesh is a severe land scarce country. The huge population of 145 million now has to depend for their living on only eight million ha of cultivated land. The cultivated land has been declining by almost one percent every year due to erosion of river banks and diversion of agricultural land for habitation, industrial use, and infrastructure development. A third of the rural households are landless, some of whom regularly migrate to ecologically risky areas such as unprotected coasts or newly established islands in riverbeds and estuaries for habitation and livelihoods. Some people even live on boats and make a living on fishing and river transport. The average size of land holding has declined from 1.47 ha in 1961 to only 0.6 ha in 2005, despite rapid rural urban migration of the population. The sea level rise will make the situation worse. A one meter increase in the sea level will inundate nearly 30,000 km² area. It will make an additional 15 million people landless who will become environmental refugees. The inundation will not only cause the loss of agricultural land, but also of existing homestead, roads and other communication infrastructure.

12. Sea level rise will affect food and agricultural production by increasing the intensity of salinity intrusion in the dry season and the depth of flooding in the wet season from tidal fluctuations. The climate change will increase the frequency of cyclones and occasional depressions that affect agricultural production through heavy rains and increased velocity of winds. Salinity intrusion will decrease agricultural production by degrading soils and reducing availability of fresh water. Already nearly one million ha of land in the east and the western coast suffer from soil salinity which inhibits adoption of improved varieties of rice that helped achieve a respectable growth in food production in other parts of Bangladesh. In the coastal districts farmers still grow mostly tradition low-yielding varieties and keep the land fallow in the dry season due to higher intensity of soil and water salinity. The Barisal region (the central coast) was once the food basket of the country, but it has now become a food deficit region due to continued pressure of population on fragile land resources, and the sluggish growth in agricultural production. Sea level rise will further aggravate the unfavorable growing conditions for most agricultural crops.

13. It is difficult to predict the direction of impact of sea level rise on fisheries which is an important source of livelihood of the coastal population at present. Inundated fields and expansion of estuaries may increase the fish habitat which may have a favorable impact on fisheries production. Many low lying fields in the coastal belt have now been turned into fish ponds with marginal investments. Shrimp farming has spread in the region due to availability of brackish water which is much more profitable than rice farming and is an important source of foreign exchange earning for the country. The area under shrimp farms have increased from only 1,330 ha in 1975 to 116,000 ha in 2004. But shrimp farming has allegedly caused damage to environment and contributed to growing socio-economic inequity in the region. Higher frequency of cyclones, intensity of tidal surge, and flooding would make inland fisheries a more risky venture in the region.

14. Sea level rise may also increase the risk of health hazards by spreading communicable diseases (such as diarrhea) due to lack of pure drinking water. Increased stress on the

fresh water zone by saline sea water will decrease drinking water availability in the region. Due to soil salinity use of tube wells as a source of drinking water is rare in the region. People usually use ponds as a source of drinking water. The ponds get contaminated with fallen twigs and leaves of trees during high winds. Outbreak of diarrhea and cholera is a major health risk after every cyclone because of people drinking contaminated water from ponds.

15. The Sundarbans, one of the largest mangrove forests of the world located in the south-western coast will also be inundated by the sea level rise. The site is home to many of unique species of plants and rich in biodiversity. Sea level rise will cause rise in the salinity concentration in the water and soil in the Sundarbans. Increased salinity will change the habitat pattern of the forest and may increase disease pressure for many species. Aquatic organisms might migrate inwards because of increased salinity. Some fear that the sea level rise might destroy the Sundarban entirely causing great loss to biodiversity. It will affect livelihoods of several million people dependent on forests. It will also weaken protection of coastal people from cyclones as the mangrove swamps serve as natural barriers against strong winds and tidal surges.

Adaptation options to support resilience

16. As Bangladesh is already extremely densely settled, relocation of coastal people in inland regions is not possible. Indeed many landless households from inlands now migrate to the coast and settle in new accreted char lands which are heavily exposed to devastation during cyclones. India, the giant neighbor of Bangladesh is already concerned about past and present illegal migrants from Bangladesh. So, local level management of the adverse impact of the sea level rise is of utmost priority.

17. As the sea level will rise gradually, it is expected that the people themselves might adjust their habitation and livelihood strategies to develop resilience against SLR. They might adopt the following strategies;

- Raise homesteads with land fillings so that houses remain above the water level during high tides;
- Take up fisheries and boat transport as sources of livelihoods and reduce dependence on agriculture;
- Move from coastal capture fisheries to marine fisheries;
- Practice fresh water prawn culture during the monsoon season when salinity level remains low followed by brackish water shrimp culture during the dry season;
- Adopt salt-tolerant crops and species of trees, and salt-tolerant tall rice varieties, if available;
- Use of boats as a means of transport reducing dependence on road transport, and so on.

The government and the development organizations must come forward to help people in their efforts to develop resilience against SLR.

18. Even today houses in the flood-affected areas are built on raised beds with earth fillings to ensure protection against floods. But the raised embankments and earth walls are threatened by erosion. Houses could be constructed on top of high concrete pillars. But most low-income households cannot afford such quality housing. The government should reserve patches of high lands in the coastal zone and promote cluster compact housing on such land instead of the present scattered housing settlement. The government may also promote public works programs in the dry season to further raise the height of such land for housing purposes, and provide long-term soft loans for housing.

19. With support from donor agencies the government constructed polders in the coastal zones in the 1960s and 1970s to protect areas from storm surges and to save rice farming from salinity water intrusion. Many of the polders have been weakened because of poor maintenance and a substantial portion of the coast has remained unprotected. The government should develop a long-term plan to maintain the polders, build new dykes in unprotected areas, raise the height of the dykes gradually along with the rise of the sea level, and take appropriate dyke enforcement measures.

20. Multipurpose cyclone shelters that were built after the 1991 cyclone have been found useful as temporary shelters during floods and cyclones. The number of deaths during the 2007 cyclone was substantially less because of such shelters and an effective early warning system. But there are only 1733 such shelters and most of them are located in the eastern part of the coast. It is estimated that the existing shelters are adequate to cover only 15 percent of the population. Substantial donor assistance is needed to build adequate number of such shelters for comprehensive coverage in the entire coast. The newly built shelters could be used as schools and community buildings during normal times.

21. Feasible options for fresh water availability within reasonable distance of housing settlements should be explored and supported. Water treatment facilities should be introduced in the area.

22. R&D institutions should be supported to develop and disseminate salt-tolerant species of rice, fisheries and coastal forestry. Farmer-participatory experiments should be conducted to validate such technologies. Agricultural credit should be extended to support extension of improved varieties and coastal fisheries. An action research on indigenous knowledge of coping mechanism, alternative livelihood options, context specific needs and alternative agricultural systems should be initiated with public-private sector partnerships.

23. The NGOs of Bangladesh have been playing an important role in disaster management. The big NGOs in Bangladesh have numerous offices in the coastal areas and a large number of educated field workers employed to provide micro-credit and education and health services. This huge infrastructure could be effectively used to support public efforts at disaster preparedness and management. The NGOs can be mobilized to raise awareness of the people about climate change and adaptation strategies, and to build capacity at the community level to activate the early warning system in times of need, and to undertake relief and rehabilitation measures in the aftermath of natural disasters.

Conclusions

24. The government of Bangladesh has recently produced a document titled “Climate Change Strategy and Action Plan”. The document has identified six major areas of concern and outlined some remedial measures, i) food security and health, ii) comprehensive disaster management, iii) infrastructure, iv) research and knowledge management, v) mitigation and carbon development, and vi) capacity building and institutional strengthening. The development partners and the international community must extend help to the government to develop a SMART action plan and provide financial support to implement such a plan to address the impending threat to human security in Bangladesh caused by sea level rise.