

FIRST DRAFT

Climate change and Population Movement: the Bangladesh case

Dr. Tasneem Siddiqui
RMMRU, University of Dhaka

Introduction

Bangladesh has been identified as one of the vulnerable countries which may be affected adversely due to heavy rain fall, sea level rise, drought and salinity associated with climate change. The aim of the paper is to examine the impact of climate change on population movement from and within Bangladesh. It attempts to gauge the extent of loss of livelihood in the affected areas due to climate change. It assesses, whether securitization of the issue of climate change will produce better outcome in bringing about policy changes of countries that are contributing to climate change. Finally, it attempts to find ways to make those countries bear some of the costs that are needed to ensure the livelihood rights of those who are suffering, at the same time building capacity of the Bangladesh to innovatively develop sustainable and alternative livelihood options. The paper is based on secondary information.

The paper is divided into four sections. Section one makes a conceptual discussion on human Security and climate change. It also introduces climate change issue as a non traditional security threat. Section two makes an overview of causes of global climate change and draws our attention towards its effects. Section three makes a detail scrutiny of state of Bangladesh vis -a -vis climate change. Among other effects of climate change; it particularly highlights the issue of loss of homestead and livelihood of a large number of people due to sea level rise. Migration has been identified as a natural outcome of those who will be displaced due to climate change Section four proposes to securitise the issue of climate change for ensuring greater resource allocation and transfer of technology to build the capacity of the affected people to adapt with climate change.

Section I

Human Security and Climate Change

1.1 Conceptualizing Climate Change

Climate change deals with variations in climate that is, any long term change in the statistics of weather over periods of time that range from decades to millions of years. It encompasses all forms of climatic inconstancy (that is, any difference between long term statistics of the meteorological elements calculated for different periods but relating to the same area) regardless of their statistical nature or physical causes (Enzler 1998). The term is often used in a more restricted sense to denote significant change in the mean values of a meteorological element (in particular temperature or amount of precipitation) in the course of a certain period of time, where the means are taken over periods of the order of a decade or longer. Climate change may occur in a specific region or across the whole earth.

1.2 Concept of Human Security

Although the definition of human security remains an open question, there is consensus among its advocates that there should be a shift of attention from a state centered to a people-centered approach to security that concern with the security of state borders should give way to concern with the security of the people who live within those borders. Human security therefore deals with the capacity to identify threats, to avoid them when possible, and to mitigate their effects when they do occur. It means helping victims cope with the consequences of then widespread insecurity resulting from armed conflict, human rights violations, environmental hazards and massive underdevelopment. This broadened use of the word “security” encompasses two ideas: one is the notion of “safety” that goes beyond the concept of mere physical security in the traditional sense, and the other the idea that people’s livelihoods should be guaranteed through “social security” against sudden disruptions (Siddiqui 2006). UNDP the proponent of Human Security identified seven elements in its Human development report 1994 that are considered as potentially threatening for the survival of Individuals, these are: economic, food, health, environmental, personal, community and political security. Under this formulation economic security refers to an assured basic income, food security to physical and economic access to food, health security to relative freedom from disease and infection, while environmental security denotes access to sanitary water supply, clean air, and a non degraded land system.

1.3 Impact of Climate change on Human Security

Sea level rise, by reducing fresh water availability, reducing fisheries and agricultural production, eroding coastal land, losing biodiversity and by causing health hazards creates a danger situation for the survival of people in the affected countries and regions. Tens of thousands of people will loose their land, home and livelihood that will ultimately forced

them to migrate both internally and internationally. The situation will be worst in the poverty stricken countries and regions where people's capacity to adapt with the changing climate is relatively much lower than the technologically advanced countries which are by and large responsible for the global green house gas emission and climate change.

1.4 Securitization of Climate Change

According to Buzan, Securitization is a deliberate action of purposeful actors who frame new or previously ignored challenges as existential threats to the survival and well being of people, state and international community.(Siddiqui 2006). The process of securitization results in greater resource allocation and emergency measures and state actions for the issue outside the normal bound of political procedure. In this sense, the issue of climate change should be securitized immediately in order to make it a global issue that affects almost all of the countries of the world. The coordinated efforts of different actors ranging from national to global level will have some positive outcomes regarding capacity building to deal with climate change. In this regard, the greater allocation of resources is needed to facilitate various studies in order to scrutinize the climatic problems from different perspectives based on different climatic locations with a view to finding alternative and sustainable livelihood options of the people of affected areas. The objective of securitisation is to make climate change issue as a critical agenda in various national, international and regional forums through speech act that will facilitate the participation of a diverse range of actors. Therefore, it will lead to form a global forum that will be better able to push government to pursue environment friendly policies compatible with the concept of sustainable development. The securitisation movement of climate change will ensure a greater resource allocation and transfer of technology to the affected countries and regions from those countries that are by and large responsible for global green house gas emission.

Section II

CLIMATE CHANGE, ITS CAUSES AND EFFECTS

2.1 Causes of Climate Change

There are several causes, which are the combination of both natural and man made, associated with Climate change. The natural factors include: Motion of Tectonic Plates and continental drift, Solar Variations, Orbital Variations, Volcanic eruptions etc.

Along with all these natural causes, over the last couple of hundreds of years human being aggravated the pace of climate change immensely.

Human causes :The Industrial Revolution in the 19th century saw the large-scale use of fossil fuels for industrial activities. These industries created jobs and over the years, people moved from rural areas to the cities. This trend is continuing even today. More and more land that was covered with vegetation has been cleared to make way for houses. Natural resources are being used extensively for construction, industries, transport, and consumption. Consumerism (our increasing want for material things) has increased by leaps and bounds, creating huge amount of waste. Also, our population has increased to an incredible extent. All this has contributed to a rise in greenhouse gases in the atmosphere.

Greenhouse gases and their sources: Carbon dioxide is undoubtedly, the most important greenhouse gas in the atmosphere. Changes in land use pattern, deforestation, land clearing, agriculture, and other activities have all led to a rise in the emission of carbon dioxide. Many natural and human-made gases contribute to the greenhouse effect that warms the Earth's surface. Water vapor (H₂O) is the most important, followed by carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and the chlorofluorocarbons (CFCs) used in air conditioners and many industrial processes(Koshland 2009). The increasing atmospheric CO₂ concentration is likely the most significant cause of the current warming.

Human Activity And Greenhouse Gases: The world's economy runs on carbon: the "fuel" in fossil fuels. Coal, oil, and natural gas contribute energy to nearly every human endeavor in industrialized nations, and carbon dioxide (CO₂) is a by-product of burning these fuels.. Fossil fuels such as oil, coal and natural gas supply most of the energy needed to run vehicles, generate electricity for industries, households, etc. The energy sector is responsible for about ¾ of the carbon dioxide emissions, 1/5 of the methane emissions and a large quantity of nitrous oxide. It also produces nitrogen oxides (NO_x) and carbon monoxide (CO) which are not greenhouse gases but do have an influence on the chemical cycles in the atmosphere that produce or destroy greenhouse gases. Moreover, the changing pattern of land use such as deforestation, for some development oriented projects can significantly increase the amount of atmospheric CO₂ which warms the planet.

2.2 Impact of Climate Change

Global Impact: Global warming affects many different facets of life on Earth. There will be winners and losers, even within a single region. But globally the losses are expected to far outweigh the benefits. The regions that will be most severely affected are often the regions that emit the least greenhouse gases. The followings are some of the possible impacts of global climate change, including an in-depth look at sea level rise:

Sea Level Rise: The oceans, which cover 71% of the Earth's surface, warm slowly in response to greenhouse warming because it takes a long time to heat their great mass. Sea level is currently rising at a rate of 1/10 inch per year (Koshland 2009). Due to the CO₂ already in the atmosphere, sea level is projected to continue rising for several centuries. Projections for the year 2100 show great uncertainty, ranging from several inches to nearly three feet. The impacts of rising sea level include loss of coastal ecosystems, flooding of cities, displacement of coastal inhabitants, and increased vulnerability to storm surges. And the effects would be magnified if the frequency of severe storms increases, as some climate models project. Wealthy countries, such as the United States, will be much better equipped to adapt to sea level rise than developing nations that lack the resources to build new coastal protections and infrastructure.

Impacts of Sea Level Rise On Humans: The impacts of global warming will be felt across the globe. These are a few of the many examples of the impacts of sea level rise on humans.

Flooding Bangladesh: One of the poorest nations in the world is projected to lose 17.5% of its land if sea level rises about 40 inches (1 m). Tens of thousands of people are likely to be displaced, and the country's agricultural system will be adversely affected. Coastal flooding will threaten animals, plants, and fresh water supplies. The current danger posed by storm surges when cyclones hit Bangladesh is likely to increase.

Disappearing Islands: The Majuro Atoll in the Pacific Marshall Islands is projected to lose 80% of its land with a 20-inch (0.5m) rise in sea level. Many of the islands will simply disappear under the rising seas. A similar fate awaits other islands throughout the South Pacific and Indian Oceans, including many in the Maldives and French Polynesia. Coral reefs, which protect many of these islands, will be submerged, subjecting the local peoples to heightened storm surges and disrupted coastal ecosystems. Tourism and local agriculture will be severely challenged.

Urban Flooding: Thirteen of the world's fifteen largest cities are on coastal plains. Many smaller cities, such as Alexandria, Egypt's ancient center of learning, also face a severe risk of inundation with a 39-inch (1m) rise in sea level. Parts of San Jose and Long Beach, California, are about three feet below sea level and New Orleans is about eight feet below sea level today..

Disappearing Wetlands: Coastal wetlands are especially vulnerable because they are within a few feet of sea level. In the United States, a sea level rise of one foot (0.3m) could eliminate 17–43% of today's wetlands, with more than half the loss in Louisiana.

Coastal Erosion: Over the past century, approximately 70% of the world's shorelines have been retreating due to sea level rise and increased erosion. Over the next century, increased erosion is likely as sea level rises.

Shortage of Water resources: The river, which is fed by the mountain snows, is overtaxed during dryer periods. Decreasing snow pack in the high mountains threatens to create severe water shortages and reduce the ability to generate hydroelectric power during the warmer summers.

Disappearing Ice Packs: Wildlife in the arctic regions will be seriously affected as warmer temperatures affect the ocean ice cover. The native peoples also rely on the ice to hunt these species and walrus. Observations of walrus in 1996-99 showed them to be thin and in poor condition, partly due to receding sea ice.

Reduced Livestock Farming: Over the past several thousand years, traditional livestock farmers in Africa have developed a variety of ways to cope with large climate variations. Coping with climate changes over the next century will be increasingly difficult as human populations increase and available grazing land decreases. However, when climate changes occur rapidly, populations with limited resources can be the first to suffer from famine and disease..

Health and Disease: Climate change puts a negative impact on health and spread many life threatening infectious diseases. In Central Europe alone, 21,000 deaths are tied to air pollution each year. The concentration of photochemical pollutants, such as ozone damage lung tissue and cause asthma and other lung conditions.

Agriculture: Crops production will be seriously disrupted in the inundated areas that will cause the loss of livelihood of tens of thousands of people. Resultantly it will ultimately lead to hunger and poverty and will increase the aid dependency of affected countries.

Impact on Ecosystems: Global warming puts the global ecosystem at risk. Drastic change of climate lead to the loss of many flora and fauna thus causing havoc to biodiversity. It is estimated that only about 3,000 – 4,500 Bengal tigers remain in the wild. The number in Bangladesh is projected to decrease as a result of rising sea levels. For tigers and the many other species that inhabit the forested wetlands of Bangladesh, migration to higher ground probably would be blocked by human habitation of adjacent lands.

Section III

CLIMATE CHANGE AND BANGALDESH

3.1 Climatic Characteristics of Bangladesh

Bangladesh is one of the most densely populated and disaster prone countries having about 140.5 million people (but population was 123.9 million as per Census Report of 2001) and with an area of only 147,570 sq. km. Of the total population, 76.6 percent lives in the rural area and rest is in the urban area. According to 2001 population census, the whole coastal area of the country has about 46 million people (but population was 35.1 million as per Census Report of 2001). Bangladesh has a subtropical monsoon climate characterized by wide seasonal variations in rainfall, moderately warm temperatures, and high humidity. Regional climatic differences in this flat country are minor. Three seasons are generally recognized: a hot, humid summer from March to June; a cool, rainy monsoon season from June to October; and a cool, dry winter from October to March. In general, maximum summer temperatures range between 32°C and 38°C. April is the warmest month in most parts of the country. January is the coldest month, when the average temperature for most of the country is 10°C. (**About.com: 2009**)

Winds are mostly from the north and northwest in the winter, blowing gently at one to three kilometers per hour in northern and central areas and three to six kilometers per hour near the coast. From March to May, violent thunderstorms, called northwesterners by local English speakers, produce winds of up to sixty kilometers per hour. During the intense storms of the early summer and late monsoon season, southerly winds of more than 160 kilometers per hour cause waves to crest as high as 6 meters in the Bay of Bengal, which brings disastrous flooding to coastal areas.

Heavy rainfall is characteristic of Bangladesh. With the exception of the relatively dry western region of Rajshahi, where the annual rainfall is about 160 centimeters, most parts of the country receive at least 200 centimeters of rainfall per year (see fig. 1). Because of its location just south of the foothills of the Himalayas, where monsoon winds turn west and northwest, the region of Sylhet in northeastern Bangladesh receives the greatest average precipitation. From 1977 to 1986, annual rainfall in that region ranged between 328 and 478 centimeters per year. Average daily humidity ranged from March lows of between 45 and 71 percent to July highs of between 84 and 92 percent, based on readings taken at selected stations nationwide in 1986.

3.2 The probable environmental effects

Scientists tell us that the most profoundly damaging impact of climate change in Bangladesh will take form in floods, salinity intrusion and droughts, all of which will drastically affect crop productivity and food security. It will also face riverbank erosion, sea water level rise and lack of fresh water in the coastal zones. The prognosis is more extreme floods in a country already devastated by floods; less food for a country in which half our children

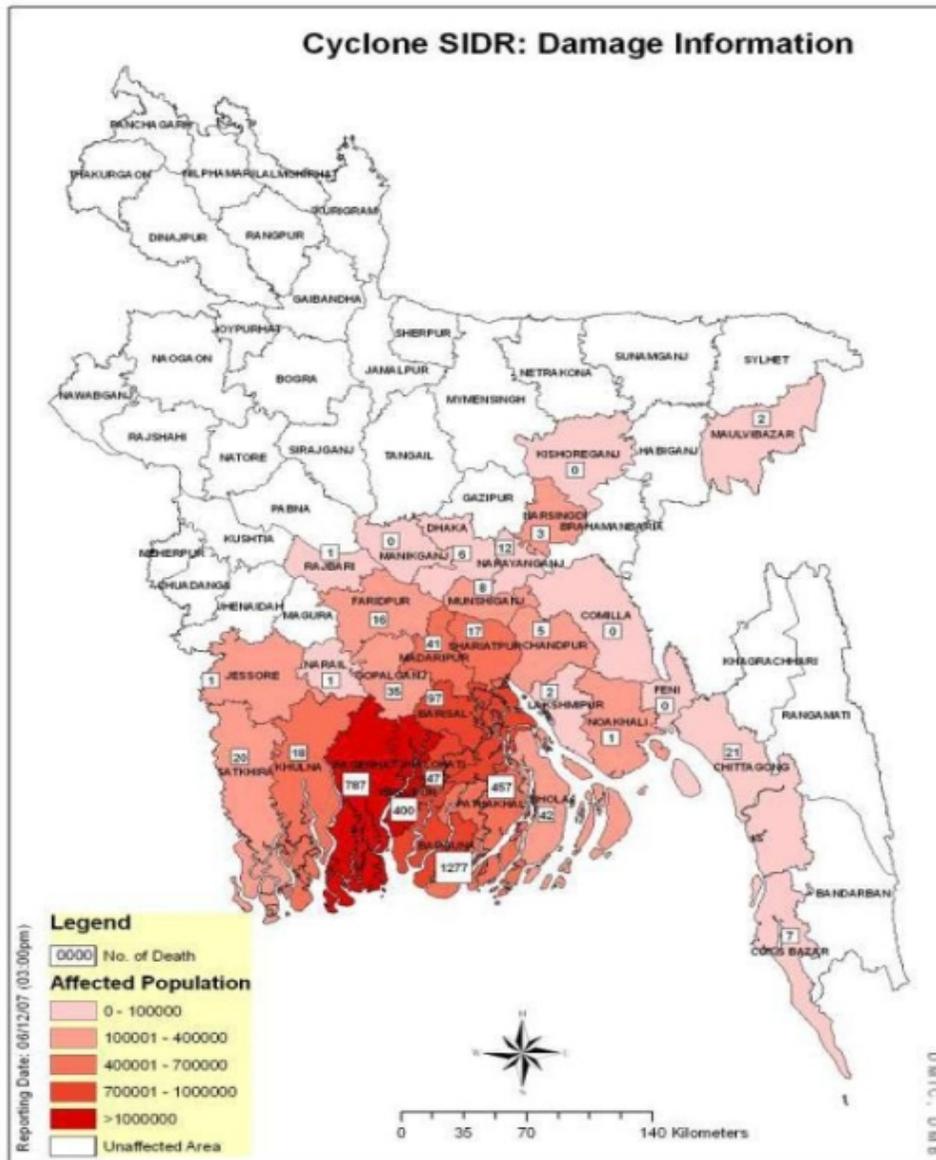
already don't have enough to eat; and less clean water for a country where waterborne diseases are already responsible for 24% of all deaths. It is also one of the poorest countries in the world: 50% of our population lives in poverty, 51% of our children are malnourished. A low economic capacity, inadequate infrastructure and a higher dependence on a natural-resource base exacerbate our vulnerability. The drastic climate change is contributing to the frequent natural disasters that are diminishing people's capacity to cope or adapt with the changing climate.

Flood: Bangladesh is situated on deltas of large rivers, formed by a dense network of 230 unstable 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. **(Hussain, 2008)** 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 erratic rainfall which is the outcome of climate change. In 2004, Bangladesh got 352mm (14in) of rainfall in a day.

Droughts: Droughts are common in Bangladesh and affects water supplies and plant growth leading to loss of production, food shortage and for many people starvation. Droughts are relatively slow to manifest and are more pervasive. Typically uncertainty of rainfall during pre-kharif and prevalence of dry days and lack of soil moisture during the dry season reduce potential yields of aus, aman, and robi crops. Depending on the intensity of drought, estimated yield reduction of different crops varies from 10 to 70 percent.

Cyclone: 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, 2009 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 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. **(Karim, 2005)** 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. In 2006, four warnings were issued in the space of two months. Every warning meant the fishermen lost valuable days at sea. When the last warning came, they could not afford to stay ashore and went to sea anyway. Officially 1,700 drowned, but many it is assumed that the real number may be closer to 10,000. **(The Independent, 2007)**

SIDR Damage



Most affected areas by Sidr

The most affected areas of the Sidr in terms of deaths are Borguna, Bagerhat, Patuakhali and Pirozpur. Other most affected districts are Barisal, Khulna, Satkhira, Jhalokathi, Bhola, Madaripur, Gopalganj, Shariatpur etc.

Figure 1: Damaged areas by cyclone sidr

Source: http://www.horizonmapping.net/projects/farmers_voice/fv_gallery/cyclone_maps.html

Sea level rise and Salinity of water: 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 km 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)(**Erickson et al, 1997**).

3.3 Impact of Sea level rise :

Though each and every natural calamity create havoc but today the rise of sea level due to drastic climate change is an alarming news for the existence of almost 17.5% land of Bangladesh. It not only may lead to disappear land but also may coin several contingent problems ranging from threat to livelihood, people's movement and other socio-economic problems. After that experts say about capacity building and adaptability to deal with climate change. In the context of Bangladesh the options like adaptability and capacity building are seriously interrupted because of:

- Its biophysical resources, particularly water, is highly sensitive to climate variability and change
- People's livelihoods & the production system are at high risk
- Disadvantageous biophysical characteristics
- High population density
- High prevalence of poverty
- Poor institutional capability to deal with extreme climate events

Salinity Intrusion: The main impacts of sea level rise on water resources are fresh water availability reduction by salinity intrusion. Both water and soil salinity along the coast will be increased with the rise in sea level, destroying normal characteristics of coastal soil and water. A comparative study between Soil Salinity map of SRDI (1998b, 1998c) for the period of 1973 and 1997 shows salinity intrusion in soil is much higher than water salinity (Figure-2). The map shows that soil of Jessore, Magura, Narail, Faridpur, Gopalganj and Jhalokati was newly salinized in 24 years of time expansion. Salinity intrusion in the freshwater zone of the coastal area has opened the door to shrimp farmers to cultivate tiger shrimp in the area. Vast number of land area is converted to saline water field day by day.

Year	Shrimp farm area (hectare)
1975	1,330
1987	67,650
2004	115,990

Source: The daily Ittefaq, 2004

Table-1 shows shrimp farm areas in three coastal districts during theyear 1975, 1987 and 2004 that indicate salinity intrusion. The increasing culture of shrimp cultivation in the crops land lead to the decreasing production of crops that not only undermine food security but also pose a threat to the livelihood of landless farmers who used to work in others land.

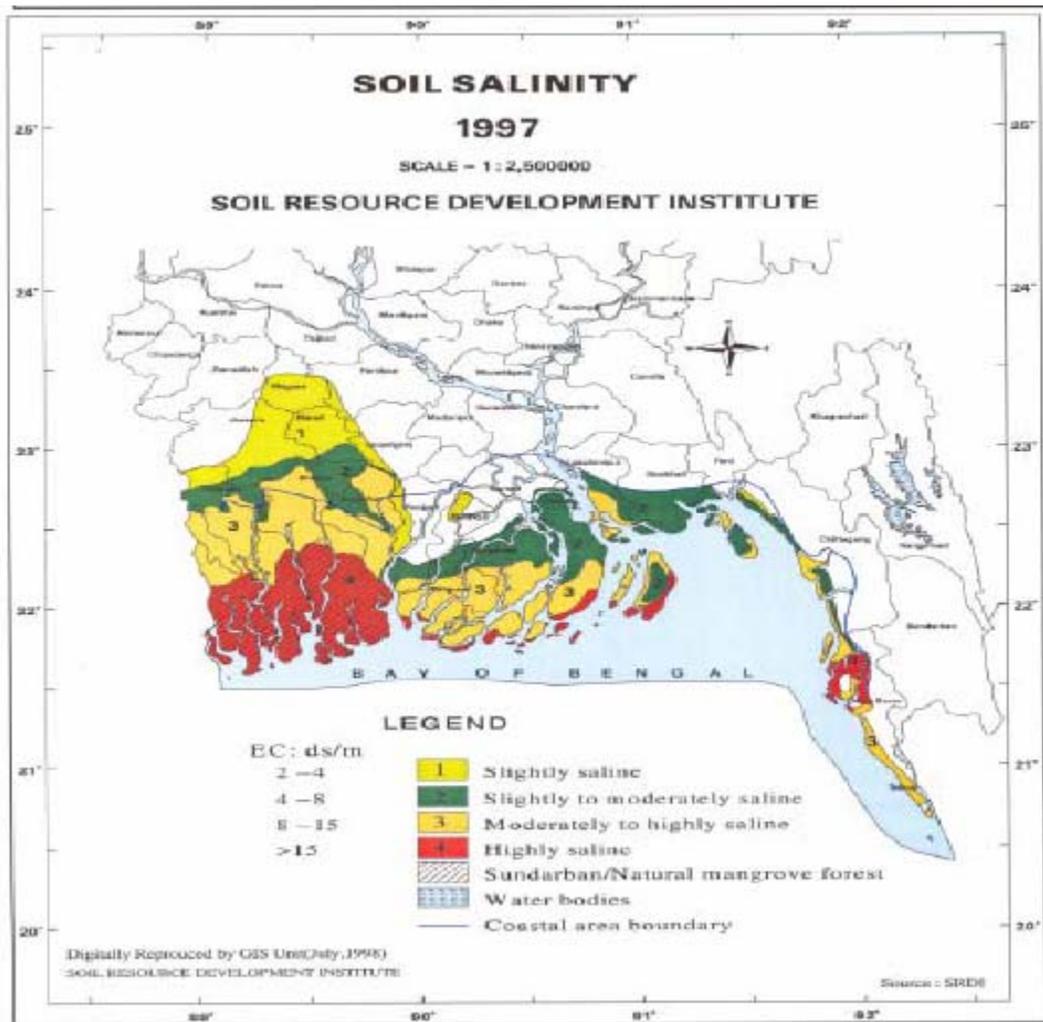


Figure-2: Soil salinity map of Bangladesh of the year 1997 (Source: SRDI, 1998c)

Impacts on fisheries and aquaculture: Sea level rise would change the location of the river estuary, causing a great change in fish habitat and breeding ground. Penaid prawns breed and develop in brackish water, where salt water and fresh water mix. Sea level rise would turn this interface backward, changing habitat of prawn. There are 60 shrimp hatcheries and 124 shrimp processing plants in the coastal zone (**Haque, 2003**). The hatcheries are located at Teknaf, Ukhia and Sadar thana of Cox's Bazar district. As the zone is vulnerable to sea level rise, shrimp hatcheries and shrimp fields are also vulnerable to the phenomena. However, sea level rise is helping shrimp farming by introducing salinity in the coastal area, but it is also harmful. A flood, which ravaged the southwestern part of Bangladesh in 2000 caused

damage or losses of at least US\$500 million to crops, fish farms, property and infrastructure. The shrimp sector was the most affected sector, losing shrimp fields of equivalent US\$230 million (CNN, 2000).

Impacts on agriculture: Salinity intrusion due to sea level rise will decrease agricultural production by unavailability of fresh water and soil degradation. Salinity also decreases the terminative energy and germination rate of some plants . Ali (2005) investigated the loss of rice production in a village of Satkhira district and found that rice production in 2003 was 1,151 metric tons less than the year 1985, corresponding to a loss of 69 per cent. Out of the total decreased production, 77 per cent was due to conversion of rice field into shrimp pond and 23 per cent was because of yield loss (Table-2).

Table-2: Declining rice production because of soil degradation

Year		1985	1990	1995	2003
Area & months under rice and shrimp farming in ha (% crop land)	HYV Aman July - Nov.	345.5 (100)	344.6 (100)	332.4 (97.0)	314 (91.9)
	HYV Boro Dec. - May	200.4 (58)	269.6 (78.2)	122.4 (32.8)	58.2 (17)
	One shrimp cycle Dec. - Jan.	36.5 (10.6)	75.0 (21.8)	210.0 (67.2)	255.8 (91.0)
	Two shrimp cycle Dec. - Nov.	0	0	20.6 (3.0)	55.0 (8.0)
Expected total rice production		1373	1689	1679	1673
Observed total rice production		1265	1260	745	522
Decline in rice production due to loss of	Area	108	221	670	890
	Yield	-	208	264	261
Total loss of rice production		108	429	934	1151

(Adapted from Ali, 2005)

Practicing shrimp cultivation in saline water has a drawback, and that is a decrease in rice production due to degraded soil quality. The decrease rate is very high and the scene is common for almost all rice fields in Khulna, Satkhira and Bagerhat districts.

A World Bank (2000) study suggests that increased salinity alone from a 0.3 metre sea level rise will cause a net reduction of 0.5 million metric tons of rice production. Sea level rise affects coastal agriculture, especially rice production in two ways. Salinity intrusion degrades soil quality that decrease or inhibit rice production. When the rice fields are converted into shrimp ponds, total rice production decreases because of decreased rice field areas.

Sea level rise will increase flood frequency and flooding duration, affecting Aman production. Due to sea level rise, salinity of water and soil will increase, and this will damage Aman cultivable land. Because of the shortage of fresh water, Boro rice production will be decreased. IRRI and wheat production will also be affected by salinity increase. A study by BARC (1999; cited in Islam, 2004) concluded that salinization will cause a reduction of wheat production equivalent to US\$ 586.75 million. Miller (2004) stated that high projected rise in sea level of about 88 cm (35 inches) would flood agricultural lowlands and deltas in parts of Bangladesh. Agricultural lands in the coastal area will be affected by salinity; soil quality will be degraded and flooding event will loss the agricultural production of the

coastal land of Bangladesh. Thus sea level rise will have an impact on agricultural production, especially on food production, leading Bangladesh to fail, obtaining food security. As Bangladesh is a dense populated country, there is no specific grazing field for cattle. Farmers get grass from their rice field. Hey is another source of fodder. Decreased rise production is decreasing fodder production resulting in fodder shortage. Ali (2005) noticed that fodder shortage is the cause for a declining livestock population from 630 in 1985 to 168 in 2003 in a small village in Satkhira district. If we try to find out the big picture of sea level rise impacts on agriculture of Bangladesh, it shows almost similar behaviour as in the case of coastal fisheries. 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. Decreased agriculture will cause decreased GDP. If agricultural production is decreased, food and cash crop production will be decreased too. Decreased food production will cause food shortage leading to health hazards or even famine. The ultimate result of reduced agricultural production is high poverty that will force Bangladesh to seek aid from other countries.

Impacts on landmass and settlement: The SLR will inflict its impacts on Bangladesh in the coastal area and through the coastal area, on the whole of Bangladesh. The coastal areas of Bangladesh is facing the Bay of Bengal with an area of 47,201 sq.km., covering 19 districts: Bagerhat, Barguna, Barishal, Bhola, Chandpur, Chittagong, Cox’s Bazar, Feni, Gopalganj, Jessore, Jhalokati, Khulna, Lakshimpur, Narail, Noakhali, Potuakhali, Pirojpur, Satkhira and Shariatpur. These coastal districts in particular are the cyclone prone area. About 2,500, 8,000 and 14,000 km² of land (with a corresponding percentage of 2%, 5% and 10% with respect to the total land area of the country) will be lost due tom SLR of 0.1m, 0.3m and 1.0m respectively. (**Hussain 2008**) The potential land loss estimated by IPCC (2001) is even worse. It reports 29,846 sq. km area of land will be lost and 14.8 million people will be landless by 1-m SLR. Land loss leads to loss of agricultural land, loss of 20 homestead, loss of road and other communication infrastructure and above of loss of wide range of biodiversity. One of the major causes of land loss is erosion.

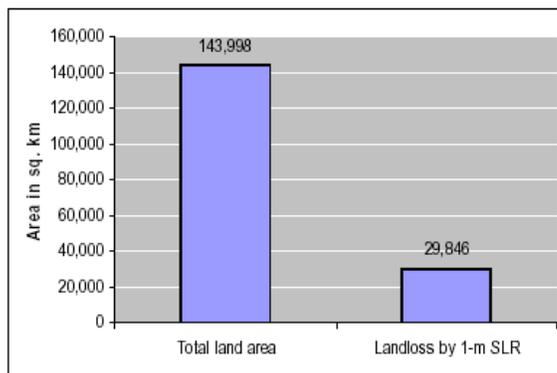


Figure-3: Total area and potential land loss by 1-m population and SLR (IPC,2001)
(Data source: IPCC, 2001)

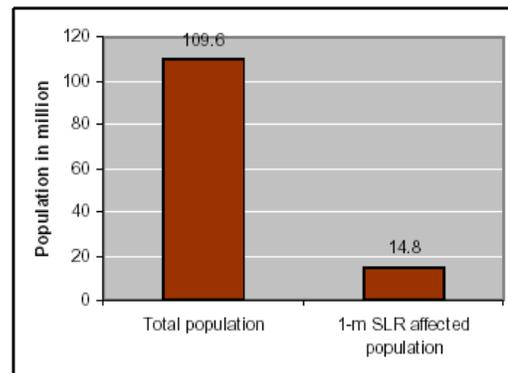


Figure 4: Total 1-m SLR affected population.

Sea level rise initiates erosion by raising water level. Raised water level wash out the loose top soil of the coast, making the coastal region steeper. Back water effect is accelerated by sea level rise that also cause erosion. Silt or other particles eroded from the surrounding areas are deposited when the lowlands of the coastal areas are filled with water. Sea level rise will play important role in erosion processes in the coastal zone. Most vulnerable shore types to sea level rise are shoaly, sandy and silty shore.(Fischer et al, 2002) Coastal areas of Bangladesh are formed of silty and sandy soils which make them vulnerable to sea level rise. Sandy and silty shores are easily eroded by sea level rise. It is supported by Vellinga (1988; cited in SDNP, 2004) stating that sea level rise of 1.0 metre will cause an erosion of a sandy shore in the order of 100-500 metre. Erosion rate due to sea level rise along the Bangladesh coast is high. The forecasted land erosion will cause displacement of coastal population. Most of the poor people do not own land. In some cases they only have a small piece of land to build a cottage to live in. Once the home is eroded, they become homeless, something like refugees in their own country. When they build a new house, it is eroded after a couple of years. Then they move to a nearby area and set up another house which is also eroded after some years. A study by Hutton and Haque (2003) observed that people even displaced ten times during the period of 1981-1993, because of river bank erosion of the Jamuna river. Thus, erosion will cause financial loss for the displaced people to build their new houses. Sea level rise will increase morphological activities in the river, inducing increased river flow. Accelerated river flow will increase river bank erosion too. Bank erosion is severe in char areas and sometimes it may wipe out chars from the map of Bangladesh. About 196 square kilometers of char area was eroded and a total of 11 chars were disappeared from Meghna river estuary area during the period of 1972-1987 (Pramanik, 1988; Cited in SDNP, 2004). Char area protects inland areas from tidal surge. It also helps accretion process along the main land. If 21 char areas are eroded, mainland will be affected seriously by tidal surge. When all chars disappear, the mainland will be eroded rapidly reducing land area of Bangladesh year after years. Net-like spread root system of mangrove acts as coastal stabilizer and binder (Hossain, 2001) that protects soil erosion in the coastal area. Salinity intrusion will harm mangrove forest of the area. Decreased mangrove will result in breaking soil composition. Thus sea level rise will accelerate soil erosion in the coastal area by reducing mangrove forest.

Impact on Salt Industry: Bangladesh is one of the salt producing countries of the world. Cox's Bazar coast of Bangladesh coastline is suitable for salt production. About 19,670 ha area has been used for salt production along the Cox's Bazar coast of the country. There are 216 salt pans, having an area of 8,153 ha only in Chakaria and Cox's Bazar Sadar thana of the district, producing 175,030 metric tons of salt annually. This coastal industry is fully influenced by sea water and its level. All the activities of salt production that are handled by salt farmers (i.e. activities in reservoir, condenser and crystallizers) are performed in the close area of the coastline.(IUCN 2003). Moreover, salt mills are also located very close to the coastline. A one metre sea level rise will inundate all the salt fields and will ruin the sectors. Salt farmers can't move upwards land for the purpose because, physical properties of the soil of the present salt field will not move backwards with sea level rise. About 20 million people are directly or indirectly related in salt production and/ or trading in Bangladesh. Sea level rise, by inundating salt fields will force this huge number of people to be unemployed.

This large population will try to find alternative profession, which is very hard or even impossible, in the case of present situation of Bangladesh.

Impact on Health: Increased stress on the fresh water zone by saline sea water will decrease fresh water availability in the coastal zone (IPCC, 2001a). Increased unavailability of fresh water will force people to drink contaminated water leading to cholera, diarrhea and other water born diseases. Again, increased salinity in the coastal zone will decrease food production in the area, causing malnutrition for the coastal people. So, sea level rise will accelerate water born diseases and malnutrition in the coastal area.

Impact on ecosystem: The Sundarbans will be completely lost with 1 metre sea level rise (World Bank, 2000, p.63). Loss of the Sundarbans means great loss of heritage, loss of biodiversity, loss of fisheries resources, loss of life and livelihood and after all loss of very high productive ecosystem. Area of the Sundarbans, inundated by different scale of sea level rise is shown in the Table-3.

Table-3: Fate of the Sundarbans with different sea level rise (SLR)

Climate change event	Potential impacts
Sea level rise	<ul style="list-style-type: none"> • 10 cm SLR will inundate 15% of the Sundarbans • 25 cm SLR will inundate 40% of the Sundarbans • 45 cm SLR will inundate 75% of the Sundarbans • 60 cm SLR will inundate the whole Sundarbans • 1 metre SLR will destroy the whole Sundarbans • Species like Sundari, main economic species in the Sundarbans, would be replaced by less valuable Goran and Gewa. • Human habitation possible prevents inland migration. • Loss of the Sundarbans and other coastal wetlands would reduce breeding ground for many estuarine fish, which could reduce their population. <p>Sea level rise would result in saline water moving further into the delta. This would reduce the habitat for fresh water fish, although it could increase the habitat for estuarine fish.</p>

(Adapted from World Bank, 2000)

The Sundarbans mangrove forest is the world's biggest unique chunk of mangrove forest, located at the south of the tropic of cancer, the southwest part of Bangladesh, covering part of Khulna, Satkhira and Bagerhat district .The area of the Sundarbans varies each year because of soil erosion or land accretion. Sea level rise will cause rise in the salinity concentration in the water and soil of the Sundarbans. Increased salinity will change the habitat pattern of the forest.

Impacts on human security: Needless to say that Sea level rise associated with climate change has strong dire of the affected areas. Sea level rise, by reducing fresh water availability, reducing fisheries and agricultural production, eroding coastal land, losing biodiversity and by causing health hazards creates a danger situation for the people of

Bangladesh. Again, ‘most important to survival and well-being’ is the basic needs of human being.

Table-4: Impacts of sea level rise on the basic needs of the people of Bangladesh

Basic needs	How sea level rise affects it
Food	Rise in sea level would flood agricultural lowlands and deltas in parts of Bangladesh (Miller, 2004; Bennett et al., 1991) that will decrease food production, causing shortage of food. Only salinity intrusion due to sea level rise will reduce 0.2 million metric ton of rice production (WB, 2000).
Cloths	Sea level rise will increase poverty. Increased poverty will decrease cloths buying capacity of the people of Bangladesh
Housing	In Bangladesh, 29,846 sq. km. area of land will be lost and 14.8 million people will be landless by sea level rise (IPCC, 2001a), losing their house.
Health	Sea level rise by extending coastal area and by increasing salinity in the area will increase the risk of cholera. It will accelerate flood intensity facilitating transmission of diarrheal disease (World Bank, 2000).
Education	Sea level rise will cause destruction of infrastructure including educational institutes. Besides, students of flood, or other sea level rise affected family will leave school/ college, in search of work to support their family.

Source: World Bank 2000

Environmental Refugee: Dalby (2002) explains that ‘ecosystem people’ are locally based populations who use their own labour to survive by cultivating and harvesting food and other resources from specific localities. Many of these people have been displaced from their homes in recent decades becoming ‘ecological refugees’. Sea level rise will create such ecological or environmental refugees in the country, forming ‘ecological marginalization’ (Homer-Dixon, 1998). Barnett (2003) states, 5.5 million people living on the Ganges delta in Bangladesh who will be forced to relocate with a 45 cm rise in sea level may seek to move inland within Bangladesh, but a significant number may seek to move 26 to neighbouring India and Pakistan-and previous migration of this kind has been a factor in violence in the region.

A study of Earth Policy Institute (2004) shows the problem more seriously, that about 40 million people of Bangladesh out of 144 million will become environmental refugees due to 1-m sea level rise (Figure-13).

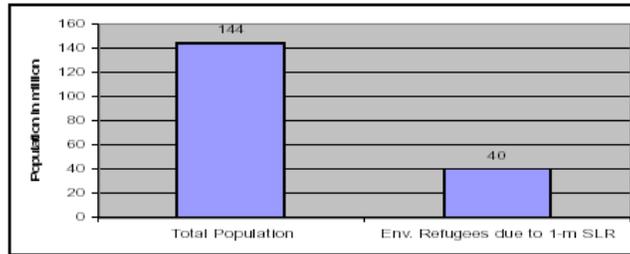


Figure-3: Environmental refugees by 1-m SLR
(Source: Earth Policy Institute, 2004)

Robert Kaplan (1994; Cited in Elliott, 2004, p.203) highlighted that different environmental problem including sea level rise will prompt mass migration, and in turn, incite group conflicts. There is a long term conflict between Bangladesh and India, regarding the distribution of water of the Ganges river, refugees and other issues. Sea level rise induced environmental refugees may trigger the conflict. Nowadays 'Push back' is common news in Bangladeshi newspapers that means pushing Bengali speaker from India to Bangladesh by Indian Border Security Force (BSF). Environmental refugees created by sea level rise will cause even worse situation that may trigger conflict between the two countries. Thus, sea level rise might be a threat to national security of Bangladesh.

3.4 Internal Factors of Climate Change within Bangladesh

Bangladesh is highly dependent on its agro based economy. Around 60% labours is involved with this profession. But over the last two decades the economy turns into rapid industrialization. The transformation of ownership of state owned industries to private and increasing growth of garment industries and manufacturing goods industries replace the agriculture sector in terms of national income. It is noteworthy that despite this rapid industrialization the country has yet to reach to sustainable economic growth due to poor environmental management. Most of the industries lack a sound waste management system. In most of the cases, wastes are externalized into the air, and river that pollute water, air and land. Moreover, unplanned urbanization and the growth of unhygienic settlement (slum) near adjacent industries pose a serious challenge to the ecosystem. On the other hand, changing livelihood pattern (consumerism) also lead to increasing emission of CO₂ and other harmful gases. In the coastal areas, hills are frequently cut down by scrupulous businessmen and forests are in the process of extinction due to the initiation of some unplanned development projects. The combined effect of these acts is treacherous as Bangladesh has already lost its one third of protective shield (Sunderban) in sidr.

3.5 The major polluters

Though Bangladesh is partly responsible for environmental degradation but the forthcoming disaster like sea level rise is surely the contribution of developed and other developing countries' policies that are by and large the major contributors to global green house gas emission and climate change. The following chart shows the asymmetric actions of OECD countries and South Asian countries in per capita global green house gas emission.

Per capita greenhouse gas emissions of OECD countries in 2000

Rank in 2000 with land-use change	Rank in 2000 without land-use change	Rank in 2005 without land-use change	Country	Year 2000 Tonnes of CO₂e with land-use change	Year 2000 Tonnes of CO₂e without land-use change	Year 2005 Tonnes of CO₂e without land-use change
9	5	5	Australia	25.9	25.6	26.9
56	39	30	Austria	10.0	10.1	11.5
27	16	19	Belgium	14.3	14.3	13.2
12	9	8	Canada	24.3	22.2	22.6
30	19	17	Czech Republic	13.9	13.9	13.7
39	25	27	Denmark	12.5	12.5	11.5
35	21	20	Finland	13.1	13.3	13.0
68	48	47	France	8.8	8.7	9.0
40	26	25	Germany	12.3	12.3	11.9
49	31	29	Greece	10.8	11.0	11.5
81	59	51	Hungary	7.4	7.4	8.3
57	40	34	Iceland	10.0	10.0	11.1
21	13	12	Ireland	16.8	17.3	16.7
66	47	45	Italy	9.2	9.2	9.7
50	35	37	Japan	10.7	10.7	10.5
16	11	4	Luxemburg	21.2	21.2	27.5
90	80	65	Mexico	6.4	5.4	6.1
32	20	16	Netherlands	13.5	13.5	13.8
18	12	11	New Zealand	19.3	18.5	18.8
44	27	33	Norway	11.4	12.1	11.2
61	44	44	Poland	9.6	9.6	9.8
84	54	55	portugal	7.2	7.8	7.9
64	49	46	Slovakia	9.3	8.7	9.3
65	46	41	Spain	9.2	9.4	10.1
78	58	56	Sweden	7.5	7.5	7.4
85	63	57	Switzerland	7.1	7.2	7.3
106	82	73	Turkey	5.6	5.3	5.5
47	34	36	UK	11.0	11.0	10.6
14	7	7	USA	22.9	24.3	23.5
Total			31	363	361.5	371

Per capita greenhouse gas emissions of South Asian countries in 2000

Rank in 2000 with land-use change ▾	Rank in 2000 without land-use change ▾	Rank in 2005 without land-use change ▾	Country	Year 2000 Tonnes of CO ₂ e with land-use change ▾	Year 2000 Tonnes of CO ₂ e without land-use change ▾	Year 2005 Tonnes of CO ₂ e without land-use change ▾
180	183	185	Afghanistan	0.9	0.6	0.0
182	177	140	Bangladesh	0.9	0.9	0.9
164	150	150	Bhutan	1.7	1.7	0.6
162	146	120	India	1.8	1.9	1.7
149	135	138	Pakistan	2.3	2.1	1.5
136	165	149	Srilanka	2.8	1.3	0.7
93	164	130	Nepal	6.3	1.3	1.5
159	141	104	Maldives	1.9	1.9	2.4
Total				18.6	11.7	9.3

The table shows that in 2000 whereas Australia’s per capita CO₂e emission is 25.9 ton there Bangladesh’s per capita emission is only 0.9 ton.

3.6 People who will lose livelihood

People who are solely dependent on agriculture farming particularly crops production will be hit hard due to the sea level rise as it will cause to disappear 29,846 sq km that will affect almost 40 million people. On the other hand, the decreasing crops production is already evident in the coastal areas due to frequent flood and cyclone storms that lead to salinity intrusion. people who are dependent on agriculture particularly crops production are vulnerable in two ways: 1. Saline water intrusion and increasing soil salinity of land that degrades the soil quality and there by undermine food production. 2. the increasing culture of shrimp cultivation in the rice fields also affects the livelihood of poor landless farmers who work as borga farmer. On the other hand, the 1 meter sea level rise will also affect our salt industries which are mostly located in the coastal areas. About 20 million people are directly or indirectly related in salt production (Hossain and Lin, 2001, p.20) and/ or trading in Bangladesh. Sea level rise, by inundating salt fields will force this huge number of people to be unemployed.

3.7 Alternative livelihood for affected people

Since the people of coastal areas will be affected adversely due to the sea level rise and about 40 million people will lose their settlements and livelihood, so, a steady process of out migration from the coastal areas to the urban centers within the region and further inland to the north is inevitable. It must be underscored that sea level rise is not an instant disaster like a tornado or a tropical cyclone; rather it is a slow, almost imperceptible process- the cumulative effects of which are enormous. (Rasid 2003) Hence, threats which are associated with climate change (cyclone, storm, surge, land erosion, flood drainage congestion, salinity intrusion, drought, tectonic process and deteriorating coastal ecosystems) affect every aspect of life and limit livelihood choices of the people. These vulnerabilities create a context of insecurity, which in turn, discourages investments, limit economic activities and squeeze employment opportunities.

3.8 Migration, a natural outcome

It is obvious that the people of Bangladesh in general are very adaptable and resilient to changing environmental conditions. This resilience will play a crucial role in determining the nature and direction of out migration from the coastal zone as a consequence of sea level rise. However, the resilience may be high but it is not infinite. There are threshold of adaptable environmental change within which people in the coastal zone do and can live. When this threshold will be exceeded with the rise of sea level, adaptive options will diminish and people will be forced to migrate. (Rasid 2003)

Pattern of Migration: The pattern of migration will include both internal and International. The poor people having poor income will be forced to migrate to the adjacent districts/ Upozilas or in Dhaka. On the other hand, the lower, lower middle and middle class will migrate to neighboring countries, gulf and even in Europe depending on their social network and ability to bear migration cost. (need to insert BD map)

Migration to bordering countries: the bordering districts of Bangladesh (Khulna, Satkhira, Bagerhat) which are also the coastal areas, susceptible to inundation due to sea level rise. The people from these districts have already a very strong social network in India. A large number of people from these districts is working in many provinces. Moreover people of bordering districts of both countries share more or less a common culture that facilitates a regular communication between them both through formal and informal channels. So it can be easily predicted that the inundation of land would increase the flow of migration both in regular and irregular channels in India from khulna, Satkhira, and Bagerhat.

Migration to Middle East, India: The earlier studies related to labor migration show that currently 7 million Bangladeshi is working abroad. and nearly 3 million in the Gulf countries. among these 3 million a greater portion of people is from Barisal and Patuakhali. It is assumed that depending on their existing social network they will be intended to migrate to middle eastern countries.

Irregular migration to the developed countries of the west: In the contemporary times a large number of people is migrating from Sharaitipur and Madaripur districts (which are also

affected by river bank erosion and soil salinity) in Italy and Spain. The concentration is so high that some of the areas are renamed. For instance: Italy Nagar in Shariatpur, Italir more in Madaripur etc. People are intended to sell their existing assets in order to go to these developed countries often taking risk through irregular channels.

Internal migration- low land to high land :. A study related to internal migration reveals that people from islands like Sandip, Vhola, and Hatia. kutubdia are gradually migrating to the high land of Chittagong like Sitakunda, Miresarai etc. As these lands are most vulnerable to cyclone, storms and sea level rise so people often maintains a second home in relatively high land areas. Moreover, it is observed that a large number of people from vholo district is currently staying in USA and other developed countries of the west.

Internal Migration- rural to urban: It is assumed that the poor people hit hard by sea level rise will be forced to migrate to the adjacent districts which are relatively high land and other urban centers where they may find their livelihood as rikshaw puller, street worker etc.

Monga and Internal Migration: The northern regions of Bangladesh, like Rangpur, Gaibandha, Kurigram, Nilphamari, drought (monga) visits every year. Topography and climate make the Northern Region of Bangladesh ecologically vulnerable to destabilizing variations including floods, river erosion, drought spells, and cold waves, all of which occur more frequently and intensely than in other regions. Amidst these compelling conditions, the local economy shows little diversification and is heavily dependent on agriculture – which yields only one or sometimes two annual harvests, in contrast with three crops per year in more fertile and benign parts of the country. In this setting, local employment is limited from September through December –in average years. As the landless and poorest survive on agricultural wage labor, their opportunities and ensuing incomes drop in this period, and they become trapped in what is called Monga - a cyclical phenomenon of poverty and hunger. During these period Every year, substantial numbers of boys and men migrate during the Monga season to cities and more benign rural regions, in search of work. This coping mechanism does not end the suffering of their families, however. Women and children whose able-bodied male household members have migrated, are vulnerable and often cannot cover their basic needs.

3.9 Proposed Tipaimukh Dam and its Impact

Along with natural calamities the geographical location of Bangladesh also makes it vulnerable. The development oriented policies of neighboring countries most notably India also affects its ecosystem. The farakka barrage lead to dry the padma in the dry season that not only affects the ecosystem but also the livelihood of people of these regions. Similarly the proposed river linking project and tipaimukh dam will surely lead to a dire environmental degradation that will cause people's displacement from those areas and loss of livelihood due to the onset of desertification.

Section IV

CLIMATE CHANGE AS A NON TRADITIONAL SECURITY THREAT

The concept of non traditional security is merely a qualitative shift from the existing security discourse that incorporates a diverse range of threats originating both outside and inside of a state. According to state centered security approach the growing climate change is the worst threat to the existence of a state which can not be deterred by no means. States like Bangladesh is in vulnerable situation due to its geographical realities that may be inundated by a 1 meter sea level rise. On the other hand, in terms of Human Security perspective, People of the coastal areas always face dire consequences due to tidal wave of ocean and cyclone, storms. The situation will be aggravated by the inundation of the coastal areas completely that will cause tens of thousands of people displaced, loss of livelihood and growing social insecurity. People will by and large lack basic needs to ensure their survival that will prompt them to migrate both internally and internationally

4.1 Securitization of Climate Change

In the context of Bangladesh, It is high time to securitise the issue of Climate Change. The securitisation movement will facilitate the participation of different actors in the process both inside and outside of country. Since the issue is very global in nature so a strong leadership consisting of different actors ranging from national to global is needed to draw the attention of major polluters and developed world about *our common future*. The securitization will ensure a greater resource allocation and transfer of technology from the developed world to the affected areas in order to make them better able to adapt with the changing climate. For instance Bangladesh now badly needs saline and drought tolerant seeds and filter to adapt with the climatic variations. The construction of high durable dam and embankment need to be immediately constructed in the coastal areas. On the other hand generating and creating more employment opportunities with alternative and sustainable livelihood like water based livelihood along with promotion of safe documented migration internationally may contribute to minimize the loss.

The Actors in Securitisation: Since climatic problems are not confined within a boundary and the extensity of hazards is global, so there is essentially need a participatory approach consisting of a consolidated and coordinated efforts of different actors from different levels. The actors can be state parties, NGOs, regional bodies, INGOs and International Organization like UN. These actors together will form forum at national, regional and Global level to understand the dynamics of climate change, their impacts and will work together to coin new ways to build up capacities of the affected areas.

Medium to be used in the securitization of Climate change: Seminar, conference, symposium, workshop at national, regional and global level, research based policy advocacy, information dissemination through website, awareness rising program like in BD: using the instrument of folkculture gonosangeet, patho natok, Jatra, Kobi gaan, drama serial, film, documentary etc. In this regard media campaign can play a significant role in identification of vulnerable areas and making regular feature on it. Before going to uphold the issue at global level there is essentially needed an effective coordination among national and regional stakeholders about the issues to be presented.

The target audience for securitization: In the process of securitisation the forum at different level will try to attract the attention of development partners, donor agencies, major polluters, Global forum like GFMD and migrants destination countries to share some of the burden of the affected people through providing logistical support, technical and technological assistance, modest resource allocation so that people can build up their capacity to adapt with changing climate. In this regard, development partners, GFMD, different forum major contributing countries to global green house gas emission, Destination countries of migrants).

Concluding Remarks

Sea level rise impacts are really high for Bangladesh, though the country plays very little role in green house gas emissions, leading to climate change and sea level rise. By affecting different livelihood activities and important ecosystem of the country, sea level rise imposes a grave threat to the existence of Bangladesh. Therefore, along with Bangladesh government the other actors particularly civil society need to pay keen attention to the issue and should develop strategy to combat sea level rise impacts and thus safe its citizen. If Bangladesh stops its total CO₂ emissions at once, the problem will remain at the same extent, because it is an outcome of excess GHG emitting countries. Helps of the international communities are necessary for technical and financial supports to combat the impacts of sea level rise on the country. Helps of technical experts and international development organizations are also essential. Bangladesh is not self-sufficient to face such a large scale problem, either. So, global initiative should be taken to save the country, as it is a global problem, to a greater extent.

References

Ali, M.S., *inundated. Exotic fish, Banglapedia*, Asiatic Society of Bangladesh, retrieved from http://banglapedia.search.com.bd/HT/E_0081.htm on 3 August 2009

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

Chanratchakool, P., 2003. *Problems in Penaeus monodon culture in low salinity areas*, Aquaculture Asia, VIII (1), pp.54-56.

Dalby, S., 2002. *Environmental Change and Human Security*, ISUMA, pp.71-79.

Earth policy Institute, 2004. *Increased flows of environmental refugees*, EDC News, (Retrieved from <http://www.edcnews.se/cases/EnvRefugeesBrown.html>), on August 5, 2009

Enzler. S.M, 1998, *The Climate Change Glossary*, <http://www.lenntech.com/greenhouse-effect/climate-change-glossary.htm>. Retrived on August 2, 2009

Ericksen, N.J et al, *Socio economic Implication of Climate Change for Bangladesh*, Briefing Document No.4, Published by BUP, Dhaka 1205

Fischer, Gunther, et al 2002, *Climate Change and Agricultural Vulnerability*, A special report prepared by the International institute for Applied System Analysis as a contribution to the World Summit on Sustainable

Homer-Dixon, T.F., 1998. *Environmental Scarcities and Violent Conflict: Evidence from Cases*. In: Konca, K., Dabelko, G.D. (ed.), Green Planet Blues, Westview Press, USA.

Hutton, D., Haque, C.E., 2003. *Patterns of Coping and Adaptation among Erosion-Induced Displacees in Bangladesh: Implications for Hazard Analysis and Mitigation*, Natural Hazards 29, pp.405-421.

Hussain, Mahbub 2008, Sea level rise, *Natural Disasters and threats to Human Security in Bangladesh*, paper presented in a conference on South Asia: Environment and Human Securities Conference, 2-3 October 2008, held in National Museum of Australia, Canberra

IPCC, 2001a. *Climate Change 2001: Mitigation*, Contribution of Working Group III to the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), Cambridge University Press, UK.

Islam, M.R. (ed.), 2004. *Where Land Meets the Sea: A Profile of the Coastal Zone of Bangladesh*, The University Press Limited, Dhaka.

Karim, Nehal, *Cyclone Storms in the Coastal areas of Bangladesh: Socio Economic Impact*, Paper presented in an International Symposium on Disaster Reduction on Costs, 14-16 November 2005, held in Monash University, Melbourne, Australia

Koshland, Marian 2009, *Causes of Climate change*, Marian Koshland Science Museum, www.koshland-science-museum.org/exhibitgcc/causes02.jsp retrieved on August 2, 2009

Koshland, Marian 2009, *Causes of Climate change*, Marian Koshland Science Museum, www.koshland-science-museum.org/exhibitgcc/impacts01.jsp retrieved on August 2, 2009

About. com <http://ancienthistory.about.com/od/atlas/qt/climateBangla.htm>

Miller, G.T., 2004. *Living in the Environment*. Brooks/ Cole-Thomson Learning, USA.

Livelihood and Climate Change, A Conceptual Framework Paper prepared by the task force on Climate Change, Vulnerable Communities, and Adaptation, IUCN, 2003

Rashid, Sajjadur, 2003, *Climate Change and Sea level Rise: Implication for Population Displacement from the Coastal Regions of Bangladesh* in Abrar, CR et al (ed), *Displaced within Homelands, the IDPs of Bangladesh and the Region*, RMMRU, University of Dhaka, 2003

Siddiqui, Tasneem (2006) , *Securitisation of Irregular Migration: The South Asian Case*, in Emmers Ralf et al (ed), *Studying Non Traditional Security in Asia*, Times centre, Singapore.

The Independent, Bangladesh: At the mercy of climate change, Monday, 19 February, 2007

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