# Agriculture and Food Security in Bangladesh: How Climate Change Affects the Extreme Poor?

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***Abstract***

*This paper looks at the possible consequences of climate change on the extreme poor in Bangladesh in the context of agricultural and food security. A special reference to the climate change impacts on forests and biodiversity has also been provided in this paper for Chittagong, Chittagong Hill Tracts (CHT) and Cox's Bazar districts. Secondary sources suggest that climate change has already affected the vulnerable population, especially the extreme poor, the poorest 10% of the population. The hardest hit areas are haors, CHT, the coastal zone and riverine chars where most of the disadvantaged and deprived population and tribal areas are situated. The severity of the adverse affects of climate change on these people warrant strong foundations for constructive, responsive and adaptive agricultural technologies, policies, rules and regulations. In order to alleviate poverty of this downtrodden people in both rural and urban areas, several projects and programmes are being implemented in Bangladesh in recent years, and of these the Economic Empowerment of the Poorest Challenge Fund (EEP), or Stimulating Household Improvements Resulting in Economic Empowerment 'shiree' (a DFID funded project) has implemented in 2008 to lift out one million of the very poorest out of poverty by 2015.*

***Keywords:*** *Climate Change; Agriculture and Food Security; Haor; CHT; Coastal Zone; Riverine Chars; Extreme Poor; Bio-Diversity.*

## 1. Background and Introduction

This paper looks at the possible consequences of climate change for the extreme poor in Bangladesh in the context of agricultural and food security. A special

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reference to the climate change impacts on forests and biodiversity has also been provided in this paper for Chittagong, Chittagong Hill Tracts (CHT) and Cox's Bazar districts. It has been reported by a Global Climate Change report that, about 63 percent of the developing world's total population lives in rural areas, according to World Bank estimates, and they include nearly 75 percent of the approximately 1.2 billion people who are trapped in extreme poverty. In Bangladesh, and indeed globally, agriculture, food security and climate change are very much co-related and associated with the alleviation of poverty. The recent price hikes resulting in an acute food crisis are a manifestation of the adverse affects of climate change on the general population. This crisis has hit the poorest more than any other income group due to their dependence on agriculture and the primary sector of the economy. The good news is that recent studies have cited an increase in crop production as a way to alleviate the suffering of the extreme poor. This paper will explore how agriculture and food security can alleviate the extreme poverty situations in Bangladesh, something that is happening mainly due to abrupt behaviours of climates in recent times. Quoting from the Bangladesh Chief Advisor's speech at the UN High-level event on Climate Change in New York on 24th September 2007, *"deforestation, inadequate carbon sequestration, soil erosion, global warming - all of these are part of the growing menace that is climate change"*. Climate change is the most serious and biggest challenge for the extreme poor people of Bangladesh and other South-Asian nations. This is not a new phenomenon, as the climate has always been changing. What is new is the cumulative impact of human activities on the climate and the accelerating rate of change.

The reasons behind the current crisis have not been well communicated and understood at all levels, especially by the extreme poor segment of society. The recent landslides disasters in Chittagong show how many extreme poor people, living in hill-side slums have become victims of climate events. Similar challenges exist in other ecologically fragile parts of the country, such as river-island and mainland chars, cyclone and flood-prone coastal belts, wet lands, monga-prone areas and hill-side areas. Bangladesh, like most other South Asian countries, is being threatened in two main ways. One is the sea level rises in the Bay of Bengal, and the other is the affect of the *melting of ice in the Himalayan glaciers*, often called the water tower of Asia, resulting in more flooding in the Ganges delta region. New Age reported on 31 August 2008, that the visiting president of Iceland, Olafur Ragnar Grimson, in a speech addressed to a symposium on climate change and food security, proposed the formation of a Himalayan council with nations across the Himalayan region to address the

regional concerns over climate changes. Such a council could initially serve as a forum for promotion of the necessary research and play a role in developing a constructive dialogue on how to address the challenges. Grimson's proposal replicated the principles of the Arctic Council formed after the end of the cold war era in early 1990s by eight countries, including the United States and Russia, to address climate issues. The economic and food security of more than a billion people around the Himalayas will be affected with the melting of the Himalayan glaciers, he pointed out, urging politicians, scientists, businessmen and civic organisations to face the future challenges together.

## 2. Understanding the concept of climate and climate change

### 2.1 Climate

In simple terms, climate is the prevailing weather conditions of an area, and is sometimes quantified in terms of the average of weather indicators over a period of at least 30 years[1]. For Bangladesh, the monsoon season, and pre-monsoon and post-monsoon rotations, is critical factors. Monsoon is the most vulnerable time due to its uncertainty and variability. We have been the victims of climate change, but we are not in a severe and critical condition. But in recent times, it has become a serious concern for all concerned, including the government and our development partners due to the abrupt changing behaviour of the nature.

### 2.2 Climate change

Climate change is a natural phenomenon and incidence, but it is mostly man-made and widely influenced by our behaviour and putting heavy pressure on the nature in many ways and means. With the development of modern technology and its wider uses, the nature can't absorb the negative effects of these and as a consequence the rate of change in temperature is increasing abruptly and it is called *global warming*. Over the last several years, global warming has become a very big concern for the people, mainly in the developing countries and they are suffering seriously with the loss of lives and other physical and economic resources. The unusual global warming is also changing the weather conditions very badly and seasons' normal behaviour has been changing gradually in many ways. Gradually, the scenario has been changed dramatically and it has become the most serious concern for South-Asian countries, mainly Bangladesh due to her deltaic landmass, high population density and low level of development. Bangladesh has already been coping with a lot of physical and man-made problems. These includes natural calamities, such as, high rainfalls, floods,

cyclones, tornados, tidal storms, sidr, droughts, and socio-economic problems, such as, low levels of literacy, poor health delivery systems, famines, high unemployment and extreme poverty.

### 3. How Extreme Weather Events Affects in Bangladesh?

Bangladesh has been suffering from extreme weather events from time immemorial. "It has been reported that from 1991 to 2000, Bangladesh lost the human lives of 200,000 in 1993 big disasters and financial loss stood at US $ 5.9 billion, which is equivalent to Tk. 41,300 crores. During the period of 1973-1987, we lost about 21.8 lakh tones of paddy due to droughts and the amount of loss due to floods, it has been calculated as 23.8 lakh tones. In recent times, the number of incidence also increased due to storm in monsoons and storm surges in Bangladesh and the last havoc of the cyclone sidr of November 15, 2008, Bangladesh we lost the human lives of about 4,000 and other physical and economic losses" (Climate Change Cell 2008).

The recent cyclone SIDR is an example of the havoc and devastation that an extreme weather event can do to a vulnerable country like Bangladesh. Apart from Sidr, there have been 45 devastating cyclones from 1793 to 1997. Droughts, floods, water-logging, cyclones, storm surges, landslides cause regular havoc in the country. Referring to an acute fodder crisis in the flood-hit Lalmonirhat district, the New Age of 4th September 2008 reported that "About 35 char areas are hit hard due to the crisis, according to farmers and people concerned".

### 4. Climate Change Scenarios in Bangladesh

Currently in Bangladesh, the issues of climate change are a serious concern for the government and people, with multi-dimensional and multi-sectoral dimensions. No sector of the economy is un-affected. The Government of Bangladesh and its development partners are committed to take urgent action to reduce the vulnerability of poor people in general and poorest in particular. Due to its geographical locations lack of development Bangladesh is likely to suffer more than most other parts of the world. Extreme weather events such as droughts, floods, water-logging, cyclones, storm surges, landslides are now happening almost every year and sometimes twice in a year (e.g. floods occurred two times in 2007) due to climate change. The *sea level* rise and consequent *saline intrusion* hugely affects us as a low-lying deltaic country. It has been reported that during the period from 1961 to 1990 the annual mean temperature increased at the rate of $0.0037^0$ C but during 1961 to 2000 the rate was 0.0072 (Coast, 2007). This

means that in the last decade alone, the annual mean temperature rise was almost double than the previous years.

A direct consequence of *sea level rise* caused the intrusion of salinity with high tide through the rivers and estuaries. This is more acute in the dry season when fresh water flows from rivers reduce. Over the last decade these changes have become evident. The major cause of *global warming* is the increasingly regular emission of the green house gases (GHG), like carbon dioxide, carbon-mono-oxide, methane, chloro-fluro carbon, nitrous oxide, etc. Table-1 below illustrates the changes in sea level rise over the years.

***Table 1 : Storm surge heights (m) under different sea surface temperature and sea level rise scenarios (wind speed of 225 km h-1 corresponds to that of the April 1991 cyclone). (Taken from Ali 1996)***

| | Current temp. (27.C) | increase 2.C | increase 4.C |
|---|---|---|---|
| Wind speed (km h-1) | 225 | 248 | 275 |
| Surge height in m (% change) | | | |
| Sea level rise- 0.0m | 7.6 (0) | 9.2 (21) | 11.3(49) |
| Sea level rise - 0.3 m | 7.4 (-3) | 9.1 (20) | 11.1(46) |
| Sea level rise- 1.0 m | 7.1(-7) | 8.6(13) | 10.6(40 |

*Source: Global Warming and its Aftermath in South Asia (2007), edited by Dr. Asgar Ali.*

Bangladesh is a pioneer for adaptation to climate change, and can be a beacon for others (BCAS, 2008). Climate change presents the most immediate and unprecedented threat to global agriculture and natural resources (ANR) and to the lives and of livelihoods of the hundreds of millions of people who depend on small-scale farming and other livelihood activities. We must thus develop a new approach that integrates and applies the best and most promising tools and technologies, and find practical solutions to address the problems and vulnerabilities. The next decade is most critical as strong foundations are needed for constructive, responsive and adaptive agricultural technologies, and policies and rules that help people, especially the poor, reduce their vulnerability to climate change.

## 5. Bangladesh's Position on Global Climate Index

Bangladesh is rated as being of greatest risk from global climate change (The Daily Star, 5 December 2008, see table below). The Daily Star report mentions

that "Bangladesh is on top of the global climate risk index as the country was most affected by extreme weather events cyclone Sidr and floods in 2007. International NGO Germanwatch has prepared the index of 170 countries styled Global Climate Risk Index 2009 and released it yesterday at the conference centre of UN climate change summit in Poznan, Poland. Bangladesh is on top with climate risk index (CRI) score 3.00, while North Korea got the second position with 10.33 and Nicaragua third with 12.25. Bangladesh tops the position with a death toll of 4,729 last year due to natural calamities with an additional absolute loss of property worth more than $10 billion. Pakistan is another country from South Asia that is also among the top 10 countries with the fifth score of 13.17". Table-2 below shows the ranking of the risky ten countries of the world.

*Table 2: Ranking of the Risky Ten Countries in Climate Change Vulnerabilities*

| The Risky 10: Ranking | Country |
|---|---|
| 1 | Bangladesh |
| 2 | DPRK Korea |
| 3 | Nicaragua |
| 4 | Oman |
| 5 | Pakistan |
| 6 | Bolivia |
| 7 | Papua New Guinea |
| 8 | Vietnam |
| 9 | Greece |
| 10 | Tajikistan |

*Source: The Daily Star, December 05, 2008*

## 6. Global impacts of climate change

The global impacts of climate change are hard to determine as in many ways it is happening through emissions of carbon dioxide and other greenhouse gases from burning fossil fuels and other industrial activities. Its impact is so huge and wide that it is not possible to calculate exactly. The task of forecasting the impact of global warming is made more difficult due to political factors and the lack of technology and resources. For example, due to poor governance in some of the least developed countries, statistics on climate-related losses are not released to the press or, in some cases, even if released and published, the data is deliberately misleading for the purpose of attracting the donors. On the other hand, due to lack of technology, modern forecasting can't be done by many developing countries.

However, the reports produced by IPCC contain much useful information on the status of climate change. The fourth IPCC of 2007 said that, in the last century, the increase of carbon dioxide, nitrous oxide and methane was 25%, 19% and 100%, respectively. Different reports made it clear that global warming is the principal environmental problem for the world and it has now become a serious concern for all. It is true that in the past, it has been very difficult to assess the Earth's atmospheric characteristics due to lack of strong weather forecasts. But now it is highly modernised and categorically can be forecasted globally, regionally and nationally and as a result, we can reduce the losses by early forecasts. The major cause of global warming is the increasingly regular emission of the green house gases (GHGs), like carbon dioxide, carbon-mono-oxide, methane, chloro-fluro carbon, nitrous oxide, etc., all of which heat trapping gases. Among the GHGs, the heat trapping efficiency of chloro-fluro carbon is 10000 times more than that of carbon dioxide and the emission of chloro-fluro carbon in the atmosphere is growing at a rate of 5 percent annually[2].

## 7. Key reasons of climate change in Bangladesh

The main reasons[3] for the disaster situations of climate change in Bangladesh are as follows:

- Bangladesh is located in South-Asia
- Bangladesh is low-lying, plain and deltaic
- More seasonal diversity and controlled by the floods
- High density of population and widespread poverty
- Most people are farmers

## 8. Influence of climate change on agriculture

Compared to other countries of the South-Asian region, Bangladesh is in a serious situation and needs to take immediate steps to come out of this trap.

- The IPPC fourth assessment report made the following observations about the effect of climate change in Bangladesh:
- Average temperatures have increased over the last 14 years (1985-1998) by $1^0$ C in May and by $0.5^0$ C in November.
- Soil salinity in Bangladesh increased and as a result, 830,000 hectares of cultivable lands have been affected
- The average rainfall in Bangladesh is increased
- Heavy floods have been repeated in 2002, 2003, 2004 and 2007
- The number of cyclones in the Bay of Bengal has been increased

- In summer, salt water from the sea comes inland by up to 100 kilometers
- In 2050, the productions of rice and wheat will be decreased by about 8% and 32%, respectively

These observations are very serious and precautionary measures need to be taken immediately with the coordinated support of the development partners. Just recently, Bangladesh was fortunate to be escaped from the cyclone 'Nargis' which caused a big disaster in neighbouring Mayanmar. It has been reported that about 125,000 people[4] lost their lives and a huge losses occurred in other sectors, which are yet to be reported by the Myanmar military regime. Table-3 below is a further example of how cyclones have been affecting Bangladesh.

## 9. Status of Agriculture and Food Productions in Bangladesh

Agriculture is still the backbone of the economy. There is a saying that, "Agriculture in Bangladesh is a gamble in the monsoons" i.e. agriculture mostly depends on monsoons behaviour due to climatic conditions. As a result, crop production varies considerably. In 2006-07 the contribution of agriculture to

*Table 3: Storm surge scenarios for cyclones affecting Banladesh since 1960, each of which caused at least 1000 human deaths, Business as usual: no climate change: 2 and 4 c: lower and upper bounds of the rise in temperature by 2010, as given by the IPCC*

| | | | | |
|---|---|---|---|---|
| Oct 9 1900 | 3000 | 3.05 | 3.09 | 4.55 |
| Oct 30 1960 | 5.149 | 4.37.6.10 | 5.53-7.38 | 6.80-1100 |
| May 9 1961 | 11.498 | 244.306 | 295-309 | 3.64-4.55 |
| May 28 193 | 11.529 | 427-5.18 | 5.17-627 | 6.36-772 |
| May 11 1965 | 19279 | 3.66 | 4.43 | 5.45 |
| May 31 1965 | 12000 | 6.10-762 | 5.53-922 | 1100-11.35 |
| May 12 1970 | 500.000 | 6.19-914 | 5.53-1106 | 11.00-1362 |
| May 25 1985 | 11069 | 305-4.57 | 369-353 | 4.680 |
| Nov 29 1988 | 5.708 | 1.52-3.05 | 184-369 | 2.27-4.55 |
| Apr 29 1991 | 138000 | 610-702 | 353-9.22 | 1100-11.35 |

*Source: Website: http://www.meteo.slt.lk/cccs.html*

overall GDP was 21%, respectively. Within the agriculture sector, the contribution of crops and forest was 16.38% and for fisheries it was 4.73%. In 2006-07 production of cereal grains (paddy), wheat and maize) was 284 lakh metric tons, of which rice (or paddy) was 269 lakh metric tons (source - page-24, A Book on Agriculture, Food Security and Poverty Alleviation by Zafar Ahmed Chowdhury, August 2008).

## 10. Impact of Climate Change on Agriculture

The impact of climate change on agriculture is very vital to assess as rice is the staple food and the principal crop in Bangladesh. As reported in the Bangladesh Climate Change Impacts and Vulnerability, A Synthesis by Ahsan Uddin Ahmed, Climate Change Cell, July, 2006, Page-39, that "Rice is by far the most important crop in Bangladesh. Together with the possible reduction in Aman rice area (as a result of greater spread of flood waters, and longer duration of flooding) and a reduction in the Boro rice area (which will be limited due to constraints in irrigation), the total area suitable for rice production may in the future stagnate or possibly decrease (WB, 2000). CEIGS (2006) has shown that due to sea level rise along the southwestern region of Bangladesh Aman suitable areas decrease significantly. Floods affect agricultural production considerably. Karim *et al.* (1996) reported that the 1988 flood caused reduction of agricultural production by some 45 percent. In the case of the most devastating flood of recorded history, in 1998, Aman production potential of some 2 to 2.3 Mha could not be realized. The prolonged flood of 1998 did not allow the farmers to transplant seedlings in appropriate time rendering a loss of about 3.5 Mmt. With the possibility of increasing frequency of such high intensity floods, it may be argued that Aman production is likely to suffer heavy damages under climate change". In addition to Aman, Aus rice and Wheat productions also can be affected by climate change in different years in Bangladesh. According to A General Circulation Models (GCM)-coupled crop modeling exercise carried out by Karim *et al.* (1998), Aus production would suffer by 27 percent while wheat production would decline by 61 percent under a moderate climate change scenario. Under a severe climate change scenario which is associated with 60 percent moisture stress, yield of Boro might reduce by 55 to 62 percent. Table-4 below summarizes the output of modeling study (Ahsan Uddin, 2006).

## 11. How are Extreme Poor People Are Affected by the Agriculture and Food Productions?

Bangladesh has always suffered from uncertain weather conditions but over the past few decades, due to climate change, extreme weather events have been becoming more frequent, while rising sea levels are damaging agricultural productivity. As the extreme poor are predominantly rural and many lives on vulnerable location, climate change seems to them more severely than other groups.

| Simulation | HYV *Aus* | | HYV *Aman* | | HYV *Boro* | | Wheat | |
|---|---|---|---|---|---|---|---|---|
| | ('000' tonnes) | Percent change | ('000' tonnes) | Percent change | ('000' tonnes) | Percent change | ('000' tonnes) | Percent change |
| Baseline (1994-95) | 702 | 0 | 4,484 | 0 | 6,200 | 0 | 890 | 0 |
| CCCM | 512 | -27 | 4,170 | -7 | 6,014 | -3 | 712 | -20 |
| GFDL | 512 | -27 | 3,901 | -13 | 5,766 | -7 | 347 | -61 |
| 330 ppmv $CO_2$ +2°C | 569 | -19 | 3,901 | -13 | 5,952 | -4 | 561 | -37 |
| 330 ppmv $CO_2$ +4°C | 435 | -38 | 3,363 | -25 | 5,766 | -7 | 285 | -68 |
| 580 ppmv $CO_2$ +0°C | 920 | 31 | 5,605 | 25 | 7,626 | 23 | 1,228 | 38 |
| 580 ppmv $CO_2$ +2°C | 793 | 13 | 4,977 | 11 | 7,440 | 20 | 881 | -1 |
| 580 ppmv $CO_2$ +4°C | 660 | -6 | 4,529 | 1 | 7,192 | 16 | 534 | -40 |
| 660 ppmv $CO_2$ +0°C | 983 | 40 | 5,964 | 33 | 8,060 | 30 | 1,317 | 48 |
| 660 ppmv $CO_2$ +2°C | 856 | 22 | 5,336 | 19 | 7,874 | 27 | 970 | 9 |
| 660 ppmv $CO_2$ +4°C | 730 | 4 | 4,888 | 9 | 7,626 | 23 | 614 | -31 |

*Source: Karim et al., 1998*

The extreme poor people who are the poorest to the poor segment of the Bangladesh rural society is mainly affected by the low productions of agricultural crops. They are affected in many ways and some of the key areas are discussed in the proceeding sections.

### 11.1 Employment and Income in Agriculture

The agriculture sector alone generates two-thirds of the total country's employment, contributes one-fourth of total exports, and provides food security for the expanding population. The main source of income in rural areas is agriculture. According to HIES, 2000, agriculture provides 40% of the average rural household income. Agriculture plays a vital role in ensuring income and livelihoods of the poor people (Zafar Ahmed Chowdhury, 2008). Extreme poor people mostly depend on casual daily wages, primarily in agriculture.

Agriculture sector comprises of crops, livestock, forests and fisheries. With faster growth this sector and could bring a substantial portion of extreme poor people into mainstream development activities. Unfortunately the agriculture sector has been growing more slowly than the economy as a whole, and is, in particular, lagging behind the industry and service sectors.

### 11.2 Share-cropping

Very few extreme poor people own any agricultural land, however some are able to gain access to land through share cropping. Mostly, the extreme poor people use the worst quality land (often the most at risk from climate change) and lack

the capital to investment in agricultural inputs (quality seed, fertiliser, pesticides, etc.). In addition, there is a general trend away from share-cropping towards fixed cash tenancies, which may require an up-front payment of land rent or lease costs.

### 11.3 Increase in Food Prices

Poor people without sufficient land to grow their own food, have been hit by the increase of prices of basic foods. This has meant that many of them have had to reduce the amount of food consumed or switch to lower quality and cheaper items. In 2008 the price of rice increased from Tk.15-20 to Tk.35-40 per kilogram, although it falls back to Tk. 28-30 by the end of the year.

### 11.4 Difficulties in for Finding Alternative Job

Due to low agricultural productions the extreme poor people need to look for alternative job outside their surrounding areas. As they are in poor economic conditions/hardships, the extreme poor people can't afford to avail better transport facilities for moving to the appropriate places for finding better employment or alternative job. In Bangladesh, they are considered as special class for availing any transport facilities to go to city areas or any other locations and for which they are provided poor seating arrangements or even on the roof of the vehicle and on the truck or lorry. In this way, several accidents occurred for this sort of poor transport arrangements.

### 11.5 Housing and Shelter

Extreme poor people lack adequate housing and shelter, and often are forced to live in more vulnerable locations which are exposed to risks from climate change – such as outside of coastal protection embankments, or unstable char islands and it areas subject to flooding.

### 11.6 Grazing Field for the Livestock

The extreme poor people own a few livestock animal (either a cow or a goat or a lamb). Due to lack of adequate agricultural crops cultivations practices, they find it difficult for managing grazing field and food for their livestock animals. With droughts mainly, the grazing field is unavailable and fodder is scarce.

### 11.7 Nutrition and Protein

The nutrition and protein intake is another area which the extreme poor people are seriously affected due to low agricultural productions by drought which is climate

change vulnerability. In such situations, the nutrition and protein intakes in standard calories are beyond the capacity of the extreme poor people.

### 11.8 Health and Hygiene

Without adequate agricultural production, health and hygiene are affected for the extreme poor people. In the absence of low income and unemployment situations, the extreme poor people can't afford to avail the health and hygiene facilities for their children and families.

### 11.9 Water and Sanitation

Water and sanitation is essential for the extreme poor people in the rural society, which is affected due to poor agricultural productions. Due to climate change vulnerabilities, drinking water is a serious shortage in the coastal belt, mainly. Irrigation water is another scarce, which affects the agricultural crops production seriously.

## 12. Current Projects and Programmes for the Extreme Poor

In Bangladesh, 63 million people still live in poverty and 30 million of them live in extreme poverty. The number of people living in extreme poverty is increasing and is likely to continue. The UK Department for International Development (DFID) has allocated approximately £265 million under four different projects as an indicative programme for DFIDB on extreme poverty. These are: Char Livelihoods Programme (CLP), BRAC Challenging the Frontiers of Poverty Reduction (CFPR), Urban Partnerships for Poverty Reduction (GoB/UN), EEP challenge Fund and PROSPER (Component on Financial Services for the Extreme Poor). Of these, an allocation of £65 million over 8 years (2008-2015) is made by DFIDB to establish and operate a Challenge Fund for the Economic Empowerment of the Poorest (EEP) or Stimulating Household Improvements Resulting in Economic Empowerment (shiree) in partnership with the Government of Bangladesh. The programme will focus particularly on the poorest 10% of households that other initiatives have not been able to reach. It is a major component of DFID's portfolio of activities designed to reduce extreme poverty and vulnerability to climate change and disasters. Harewelle International Ltd. in consortium with PMTC Bangladesh Ltd., The British Council, Unnayan Shamannay and the Centre for Development Studies (CDS), University of Bath has been contracted by DFID to manage this challenge fund. Under this project, there will be a number of NGO partners to implement this challenge fund project

and they will be working at the vulnerable areas, where this extreme poor people resides and there might have an integrated approach for protecting poor and remote households from environmental degradations and also there would be a strategy for adopting mitigation and protection measures by the partner NGOs to address the vulnerabilities. In this context, the partner NGOs, who will be selected and finalised to work in this project will need to develop asset accumulation approaches and other interventions approaches for poverty alleviations, so that the assets and means of the project participants will be protected from the increasing frequencies of river erosion, flooding, cyclones and other devastating environmental consequences.

If we see the scenario of extreme poverty situations in Bangladesh, then it is evident that the proportion of our people living below the poverty line is huge, one source suggests it about 20% of the total population i.e. 30 million people and the World Bank and Chronic Poverty Research Centre suggests that it is closer to 30% of the total population i.e. 45 million people. However, whatever the number of extreme poverty stricken peoples are, but we have to address this serious problem in a constructive and effective manner. These caused mainly due to the recent environmental degradations for the climate change affects.

As mentioned above, the Economic Empowerment of the Poorest-EEP and it is now commonly referred to as shiree: the Bangla word for steps or ladder. The acronym resonate DFID's approach: *stimulating household improvements resulting in economic empowerment.* 'shiree' is committed to working with those international and national NGOs who are active and able to demonstrate their ability to target the economic bottom 10% of Bangladeshi households and show their experience in graduating these numbers of people from poverty by 2015.

'shiree' will provide funding to NGOs to address the vulnerabilities of one million extreme poor people over eight years via two major funds:

*The scale fund*: large-scale projects designed to bring rapid benefits to large numbers of poor people; and

*The innovation fund*: smaller projects designed to develop innovative approaches to reduce extreme poverty.

## 13. Adaptations to Climate Change Vulnerabilities

Adaptation to climate change refers to adjustment in natural and human systems in response to actual or expected climate stimuli or their effects, which moderates or harm or exploits beneficial opportunities. Various types of adaptation can be

distinguished including anticipatory and reactive adaptation, and autonomous and planned adaptation (IPCC, 2001).

### 13.1 Agriculture and Food Security in Bangladesh

With the recent increases in food prices, food security has become an important issue. If climate change reduced the capacity of Bangladesh to grow food, then food security will become a bigger problem. A number of measures have been proposed below to increase resilience of agriculture to climate change.

- Use of saline-resistant rice varieties;
- Development of crop varieties resistant to drought and pest attacks;
- Changing the crop calendar through adjusting the timing of crops and introducing types of crops and varieties that are resilient particular features of climate change;
- Introduction of crop insurance system with minimum premiums for vulnerable areas. However this is not a good idea as it would require massive government subsidies, would distort the economic rationale of the farming system, and would be open to abuse and corruption;
- Establishment of passbooks for farmers to give them access to subsidised inputs and loans;
- Establishment of seed banks for rice, wheat and potato;
- Develop high temperature tolerant varieties for the climate critical zones;
- Application of shorter duration of rice crops e.g. chandina variety of rice;
- Develop rice cultivars having high photosynthetic efficiency;
- Develop flood tolerant modern rice cultivars;
- Research efforts should be geared up for varietal break-through in genetic engineering;
- Vegetable cultivation on the floating method using water hyacinth accumulation in the south-west region of Bangladesh;
- Management packages should be made available to the farmers with adequate extension services;
- Promoting fodder, poultry & milk marketing enterprises; and
- Improved cropping patterns in the climate sensitive haor areas in Bangladesh with promotion of alternative Rabi crops which can be harvested before flooding.

## 14. Resilience to Climate Change by the Extreme Poor

In Bangladesh, due to the vulnerabilities of the extreme poor in all disaster situations, such as, flooding, cyclone, river bank erosion, storm, drought, cold spell, water-logging and desertification, the affected people have developed some sort of resilience with the impact of climate change. Hence, it is highly essential to increase the resilience of these extreme poor communities to cope-up with the impact of climate change. This is adaptation to climate change, which means adjusting to risks from the observed situations of the past or expected changes in the future. Under this, several activities might be considered, like, disaster management, adaptations to climate risks in the sectors of agriculture, water, health, physical infrastructure, education, energy, etc. In any pro-poor growth projects, all these can be considered for adjustment by the CBOs/NGOS, based on the local and geographical conditions, so that the extreme poor can harness benefits out of the sectoral supports, provided by the government and other relevant agencies.

## 15. Climate Change Impact and its Resilience by the Extreme Poor in the Context of Chittagong, Chittagong Hill Tracts (CHT) and Cox's Bazar Districts of Bangladesh

There is no denial of the fact that Bangladesh is one of the badly affected countries from the impacts of climate change. The impact of climate change in Bangladesh is now a reality and no more a projection, hence concerted efforts need to be taken for all regions of the country, including Chittagong, CHT and Cox's Bazar districts of Bangladesh. The major impacts of climate change in this region and all over the country are manifold and some of these are highlighted below:

*Increasingly frequent and severe tropical cyclones* with higher wind speeds and storm surges leading to more damage in the coastal region,

*Heavier and more erratic rainfall* in the Ganges-Brahmaputra-Meghna river basin system, including Bangladesh, during the monsoon season, resulting in higher river flows, causing over-topping and breaching of embankments and widespread flooding in rural and urban areas, river bank erosion, resulting in loss of homes and agricultural land to the rivers, and increased sedimentation in riverbeds leading to drainage congestion and water-logging.

*Melting of the Himalayan glaciers,* leading to higher river flows in the hot months of the year, followed by lower river flows and increased saline intrusion after the glaciers have shrunk or disappeared.

*Lower and more erratic rainfall*, resulting in increasing draughts, especially in drier northern and western regions of the country.

*Sea level rises* leading to submergence of low-lying coastal areas and saline water intrusion up coastal rivers and into groundwater aquifers, reducing freshwater availability; damage to the Sundarbans mangrove forest, a World Heritage site with rich biodiversity; and drainage congestion inside coastal polders, which will adversely affect agriculture.

*Warmer and more humid weather* leading to increased prevalence of disease and disease vectors. (Climate Change Strategy and Action Plan, 2008).

If we consider the above points, then it is evident that Chittagong and its surrounding hill districts are severely affected by climate change impacts from many angles. The devastating cyclones, storm surges, earthquakes, land-slides, flooding, etc. have been the general picture for the hill districts of Chittagong. Several damages have been reported, but still constructive research areas in respect of climate risks and vulnerabilities have not yet been identified and facilitated substantially and as far as information gathered no major plans are underway in this respect. The Daily Star in her 2nd August 2008 publication on environment, entitled, "Climate Change: Impacts on Forests", reported that,

*"Because of the increased rainfall in monsoon, water runoff rate on the forest floor has increased from the previous one. As a result, rapid soil erosion causes nutrient leaching and destroys micro-organism and dense hill forests in Chittagong, Chittagong Hill Tracts (CHT), Sylhet, and Cox's Bazar. Most of the forests are also likely to be affected from the absence of ecological memory that is the network of species for interaction between each other and environment, and building the capacity for reorganisation within or outside the forest patch after different perturbations. Researchers show that regeneration rate of Garjan (Dipterocarpus Spp) in the Chittagong and CHT has declined considerably in the last decades. The monoculture plantation of teak in CHT also exacerbates soil erosion because of poor undergrowth during heavy rainfall. Forestry experts find monoculture seldom leaves the land very productive for further recolonisation. Moreover, the increasing frequency of flood, as a consequence of climate change, and its prolongation also triggers the mortality of some home garden species such as jackfruit, papaya and bamboo mainly found in the plain land village forests"*

Under the Climate change resilient development for the extreme poor in the context of Chittagong, CHT and Cox'S Bazar districts, several measures can be undertaken for implementation based on the practical conditions. Some of the key measures are highlighted below:

### 15.1 Sustainable technologies for natural resources management, forest, water and bio-diversity conservation and agricultural activities implementation

Broadly speaking, this is natural resources management intervention, which is very much important to appropriately using the sustainable and proven technologies available and applicable for managing natural resources, water, bio-diversity and agricultural activities of the area, based on the geographical characteristics. Climate change coping strategies in the context of natural resources management will be considered here for building the capacity. Capacity building efforts on Climate change coping strategies, like, specific skills trainings on agriculture, fisheries, forest, bio-diversity, wetlands, floodplains, conservations, environmental degradations, poultry, livestock, etc. will be required to consider. Apart from these, demonstrating technologies for ensuring livelihoods of the extreme poor people will also be important to consider. However, specific subject areas will need to be determined based on assessing the local needs. It may be worthwhile to mention here that, "recent studies show that massive afforestation with exotic species wouldn't be a pragmatic solution for the adaptation to the climate change. Rather, it is suggested that as implications of response, diversity and functional diversity-biodiversity should be conserved in their natural habitat by protecting existing natural forests, minimising soil disturbances, reducing carbon loss from soil, preventing potential loss of mycorrhizae and increasing freshwater inflow in the saline affected mangrove regions" (The Daily Star, 2008-08-02).

### 15.2 Mainstreaming climate change risks and mitigation strategies into natural resources management and local development planning

Under this, climate change risks and mitigation strategies will need to be mainstreaming into natural resources management and local level planning. It needs to engage in a systematic and comprehensive effort would be required to reduce the negative impacts of climate change through integration into the overall development and planning process in each geographical region of 'shiree' project areas. The pre-requisites for mainstreaming these are awareness raising, orientation, capacity building, advocacy and lobbying at different levels and spheres of operations at meso and micro levels. Based on the local conditions of the project areas, the mainstreaming process will be determined through integration, cooperation, coordination and partnerships among all stakeholders. Very recently, DFID took an initiative to integrate all the development partners of the country to facilitate the donor resources on climate change efforts through

mainstreaming the same into the Bangladesh development plans and process. In this respect, Bangladesh has been chosen to act as a leader in climate change actions due to her past experiences on this.

### 15.3 Mainstreaming household livelihood security-oriented approaches to climate change

Under this, the mainstreaming of HLS-oriented approaches to climate change of the 'shiree' project areas will be made with the local level planning process developed for the 'shiree' project Clients. This will help the project clients to ensure their benefits from the available climate change adaptation plans of the government and donor agencies.

### 15.4 Support to climate change adaptation and environmental protection measures and financing

Here we are considering the financing of climate change adaptation measures in the 'shiree' project areas. Based on the geographical locations and specific activities of the project in respect of climate change adaptations, a financing strategy and operational plans will be developed in course of time to implement the proposed and projected activities. However, 'there are over 35 climate change related activities under implementation by the donor community. This number is likely to rapidly increase over the next few years. Today, there is a golden opportunity to create a multi-donor trust fund (MDTF) that will channel all climate change grants, loans and technical assistance to provide a more harmonized approach. This 'one stop shop' for climate change related donor funding in Bangladesh will significantly reduce transaction costs for global and bilateral funds. It will pave the way for large fund flows in the future, while ensuring proper institutional structures, governance, management and targeting at a national level[5]'.

### 15.5 Development of a community based disaster preparedness plan

Under this, based on the geographical conditions, emergency disaster preparedness plan will need to be developed with the support of 'shiree' project team. In each geographical area, workshop will be organised with the facilitation of resource persons' team and project clients will be engaged in developing the plan in each year using the participatory approach. Necessary equipment for rescue and disaster protections will be provided to the project clients.

## 16. Conclusions and Recommendations

In conclusion, it can be said that understanding the vulnerabilities to climate change and developing strategies for adaptations, especially in fighting extreme poverty is not an easy task and not a straightforward one. However, if concerted efforts and initiatives are taken collectively by the development partners, policy makers, concerned partners and other stakeholders, then it would be possible to address the current issues and challenges, which the extreme poor people are mainly facing. The Dhaka declaration of the five-day International Symposium on Climate Change and Food Security in South Asia, which was ended on August 31, 2008 concluded that, "Climate change and Food Security in South Asia Network and South Asia Climate Outlook Forum both to be maintained by the WMO will share information on management of climate change and related science, data, tools and methodologies South Asia" (source: The Daily star, 31st August, 2008). It is evident from the above discussions that climate change has been affecting our extreme poor people the most, who live near flood prone areas, embankments, polders and are completely dependent on agriculture. From the several predictions, it has been clear that in near future, the climate change situation would be worsening and mainly the extreme poor people who live in both urban and rural society will have hard hit. Hence, we have to address the serious issues which, this segment of the rural and urban society are facing and we need strong international support to adapt and manage the impacts due to climate change through mainstreaming of all development activities with the climate change. It is noted that some pro-poor growth initiatives of the DFID are trying to address the problems of extreme poor people for lifting out them from their extreme situations. It is a major component of DFID's portfolio of activities designed to reduce extreme poverty and vulnerability to climate change and disasters.

The following recommendations are made in respect of climate change adaptations for Bangladesh, with a special reference to Chittagong, CHT and Cox's Bazar districts:

First, given the seemingly lower literacy rates of the tribal population in the CHT and Cox's Bazar area, efforts should be intensified to increase enrolments to primary education and to improve the quality of primary education in the CHT. Moreover, in addition to basic literacy, it is important to provide market-relevant skills training to be less vulnerable to climate-induced impacts that are likely most severe in the agricultural sector.

Second, even though the average tribal household is estimated to be less landless than the average Bengali household, it is clear that the quality of land has been

deteriorating rapidly in the CHT, largely due to short rotations slash and burn agriculture. This practice needs to be seriously discouraged.

Third, there is some indication that the tribal population remains more dependent on agriculturally- and forest-based income than the average Bengali population, even though there are significant differences across the three CHT districts and non-traditional employment is rising. Hence, policymakers need to be reminded that the adverse effects of climate change fall primarily on the tribal population and not the Bengali one.

Fourth, while Bangladesh has made significant progress with building cyclone shelters and setting up national warning systems, due to a combination of physical, economic and social factors, the most vulnerable people are the least forewarned and prepared. Similarly, there are some indigenous knowledge like (a) indigenous floating cultivation, and (b) the protection of forest commons that will allow coping better with climate change-induced hazards.

Finally, given that climate change impacts will inadvertently put stress on the peaceful coexistence of tribal and non-tribal people in the CHT, it would be useful to undertake further measures to defuse the remaining social tension between the two ethnic groups.