Poverty, Environment and Climate Mainstreaming (PECM) Project  
General Economics Division, Planning Commission

TRAINING HANDBOOK
ON POVERTY, ENVIRONMENT, CLIMATE CHANGE AND DISASTER NEXUS  
FOR THE PLANNING PROFESSIONALS

Duration: 05 days

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BACKGROUND

Poverty, Environment and Climate Mainstreaming (PECM) Project has been implementing by the General Economics Division (GED) of Planning Commission under Ministry of Planning with technical assistance form UNDP & UNEP. PECM is part of an Asia Pacific regional and global Poverty Environment Initiative (PEI). The overall goal of PECM is to provide the catalytic support to enhance the institutional capacity of targeted national stakeholders, allowing them to integrate poverty-environment-climate (PEC) linkages into national development planning and budgeting process.

The aim of this integration is to reverse environmental degradation in ways that will benefit the poor and to enable sustainable economic development. As we know that in Bangladesh, about 40 percent of the population are poor and depend on an over-exploited and degrading natural resource base. Here, poverty, growth and environmental sustainability are inextricably bound together. In one hand, industrial and urban growths to improve economic livelihoods are essential for poverty reduction in Bangladesh; while on the other, they are serious threats to environmental and human health. Moreover, the vulnerability of the poor in a hazardous environment is set to be worsened by Climate Change. Climate change has very severe and adverse economic, environmental, social, and human consequences. It is thus an extremely crucial issue for Bangladesh having significant implications on development, including achievements of MDGs. The outcomes of the PECM project are to –

- Support the integration of climate change and environmental considerations into national development planning and budgeting processes;
- Enhance UN’s country assistance to provide effective support towards climate-resilient poverty reduction efforts.

To achieve the goal and outcomes, a series of activities will be undertaken to ensure that climate change and environmental considerations are integrated into national development planning and budgeting processes. But experience shows that the planning professionals of planning commission and agencies have lack of capacity to mainstreaming PECD issues. Along with, they have capacity gap to formulate Development Project Performa (DPP) which is required for each project. Therefore, robust capacity building support is needed for the planning professional in terms of preparing DPP, basic knowledge on PECD issues and mainstreaming PECD issues in the planning and budgeting process.

Considering those above mentioned situations, PECM would arrange a basic training course for the planning professional on PECD nexus as part of capacity building activities. The whole training course would be conducted by following this module for providing a holistic idea regarding the Poverty-Environment-Climate Change-Disaster and Log-frame Analysis since it has been divided into six modules considering different aspects of PECD Nexus.

It is expected that this handbook will provide a valuable insight for the planning professionals for mainstreaming the PECD issues in the national planning process.
WHERE TO START

The handbook is developed for the planning professionals who will participate in the basic training course on Poverty, Environment, Climate change and Disaster Nexus. The course will be conducted by following the developed module and the contents of this handbook. It has been divided into five parts e.g. Module 1: Poverty, Module-2: Environment, Module- 3: Climate Change, Module-4: Disaster, Module-5: Poverty, Environment, Climate change and Disaster (PECD) Nexus and Module-6: Log-frame Analysis (LFA). Each handbook enables the participants to get an overall insight regarding specific issues. To locate your own way around the handbook, the following map will guide you. We recommend that you stared by reading quickly through the block syllabus. Then you can go back over it more slowly, concentrating on the each steps of each module.

Module-1 is on Poverty. It will cover the understanding of poverty issues and concepts, how measure poverty, setting poverty lines, poverty indices and their comparisons, inequality measures, poverty profiles, the determinants of poverty and how poverty analysis is linked to poverty reduction policies in Bangladesh.

Module-2 is on Environment. This part will cover some key concepts linked with environment e.g. definition and concepts of environment and ecosystem, environmental management, environmental migration, sustainable development and environment. Along with, some vital environmental assessment tools, natural resource management and policy, laws & regulations are the key discussion points.

Module-3 is on Climate Change. It focuses on the causes and consequences of climate change, variability and impacts on different sectors, risk, adaptation and mitigation as well as strategies, policies, plans, protocols and conventions regarding climate change.
Module-4 is on Disaster. It encompasses the understating of different aspects of disaster, preparedness and management, global and domestic perspective and related policy and strategy related to disaster.

Module-5 is on Poverty, Environment, Climate change and Disaster Nexus. This handbook will present an understanding PECD Nexus and mainstreaming issues and factors in development process as well as PECD implication in a holistic way on sustainable development.

Module-6 is on Logical Frame-work analysis. It will cover the basic concepts regarding LFA, design programme or project by using LFA and the LFA methodologies that can be used at different stages of project implementation.
AIM

The aim of the course is to provide a holistic idea to the targeted sector’s professionals regarding the Poverty-Environment-Climate Change-Disaster Nexus and incorporating all those issues into Development Project Proforma (DPP).

SPECIFIC OBJECTIVES OF THE COURSE

At the end of the training course, participants will be able to-

- explain the concepts of poverty, inequality and pro-poor growth as well as national and international aspects of poverty;
- describe and analyze environmental issues, natural resource management as well as local knowledge to conserving natural resources;
- Depict climate change variability, sectoral impacts, along with risk assessment, adaptation and mitigation in a holistic way;
- Define and examine terminologies, typologies, warning system, preparedness as well as different initiatives by global community, policy, strategy related to disaster;
- acknowledge the need of PECD issues and display a professional commitment to incorporate those issues in their work process as well as in planning outcome
- develop Logical frame work and provide feedback on DPP
# BLOCK SYLLABUS

**Time:** 09 AM-05:00PM (including 1.5 hours break)
**Effective hour per day:** 6.30 hours

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**Time:**
- **Poverty and Inequality:**
  - Understanding Poverty concepts and Issues
  - Indicators of poverty
  - Poverty, Inequality and pro-poor growth
  - Measures of Inequality
  - Poverty in Bangladesh: HIES & MDG 1

**Environment Management:**
- Definition and Concepts of environment and ecosystem
- Ecosystem services
- Sustainable Development
- Environmental characteristics of different areas of Bangladesh,
  - Human impact on natural environment i.e. floods plain
  - Natural resource management
  - Local knowledge to conserving natural resources

**Understanding Climate Change:**
- Climate & Climate Change (CC)
- Causes of CC
- Climate Change and Bangladesh: Geographical Location, Natural setting, physical infrastructure, socio-economic condition
- Projected climate change impacts and Sectoral impacts
- Managing Climate Risk Framework
- National and International Response

**Disaster Preparedness and Management:**
- Understanding disaster
- Concept of Hazard, Risk, Vulnerability and Disaster
- Types of disaster: natural and manmade

**PECD Nexus and mainstreaming:**
- Context of PECD Nexus analysis
- Factors encompasses PECD Nexus
- Relationship among Poverty, Environment, Climate and Disaster
- Mainstreaming PECD in development process

**Logical-frame Work Analysis (LFA):**
- Understanding LFA
- Key features of LFA Matrix
- Participation analysis
- Problem analysis
- Objectives analysis
- Strategy analysis
- Project elements
- Assumptions (PM)
- Indicators (PM)
- Using LFA for Identification, Feasibility study, Project design, Detailed plan Monitoring Project review and Evaluation
There is no single definition or measurement of poverty due to its multidimensional nature. However, poverty means either lack of command over commodities in general or lack of command over a specific type of consumption deemed essential to constitute a reasonable standard of living or lack of ability to function in a society or lack of enough resources or ability to meet needs.

Considering its nature and dimension, the module presents introductory issues on poverty. It covers the understanding of poverty issues and concepts, the concept of well-being, why measure poverty, how to measure poverty, setting poverty lines, poverty indices and their comparisons, inequality measures, poverty profiles, the determinants of poverty, and how poverty analysis is linked to poverty reduction policies.
SESSION-3: POVERTY AND INEQUALITY

3.1 Understanding Poverty concepts and Issues
3.2 Indicators of poverty
3.3 Poverty, Inequality and pro-poor growth
3.4 Measures of Inequality
3.5 Poverty in Bangladesh: HIES & MDG 1
3.1 UNDERSTANDING POVERTY ISSUES AND CONCEPTS

Robert Chamber said to define poverty that poverty entirely depends on who asks and who answers. Nelson Mandela says poverty is not natural rather it is man made out of sociopolitical and economic context. However, there is ambiguity in defining poverty because it has different dimensions and aspects. Poverty can be defined in several ways:

The United Nations (UN) provides a broader definition of poverty is ‘a human condition characterized by the sustained or chronic deprivation of the resources, capabilities, choices, security and power necessary for the enjoyment of an adequate standard of living and other civil, cultural, economic, political and social rights.’ (UN, 2001).

The UN definition brings together two important and related themes in contemporary understandings of poverty: the ‘capability approach’ of Nobel-prize winning economist Amartya Sen and the ‘human rights’ approach.

The ‘capability approach’ addresses poverty as ‘the deprivation of basic capabilities rather than merely as lowness of incomes.’ (Sen, 1999). In general, capability means lack of ability to function in the society. Poverty a deprivation of these capabilities thus includes situations of low income, under-nourishment, illiteracy, premature mortality, and also social stigmatization and low self-esteem.

The ‘human rights approach’ sees poverty as a violation of economic, political, social and civil rights. These include the right to health, the right to an adequate standard of living and the right to education and employment opportunities.

The World Bank defines ‘poverty is pronounced deprivation in well-being’. To define well-being, we found two approaches by the scholars. One approach is to think of one’s well-being as the command over commodities in general, so people are better off if they have a greater command over resources. In this view, the focus is on whether households or individuals have enough resources to meet their needs. A second approach to well-being (and hence poverty) is to ask whether people are able to obtain a specific type of consumption good.

1 These rights are established in numerous international documents, including the UN Charter, the Universal Declaration on Human Rights, the International Covenant on Civil and Political Rights and the International Covenant on Economic, Social and Cultural Rights.
Perhaps the broadest approach to well-being (and poverty) is articulated by Amartya Sen (1987), who argues that well-being comes from a capability to function in society. Thus, poverty arises when people lack key capabilities, and so have inadequate incomes or education, or poor health, or insecurity, or low self-confidence, or a sense of powerlessness, or the absence of rights such as freedom of speech. Viewed in this way, poverty is a multi-dimensional phenomenon, and less amenable to simple solutions. So, for instance, while higher average incomes will certainly help reduce poverty, these may need to be accompanied by measures to empower the poor, or insure them against risks, or to address specific weaknesses.

Poverty is also defined as ‘inability to meet the basic needs of life’. Basic needs of life include food, clothing, shelter, health services. Two positions ensure form it:

1. People are poor because they lack food, clothing, and/or shelter on account of inadequate income and/or high necessary monthly expenses and costs for necessary sustenance.
2. People are poor because they are not able to or have insufficient chances to (fully) use the means available such as health, education, land, credit, infrastructure, and common property.

In 2000, Deepa Narayan defined ‘Poverty is hunger. Poverty is lack of shelter. Poverty is being sick and not being able to see a doctor. Poverty is not having access to school and not knowing how to read. Poverty is not having a job, is fear for the future, living one day at a time. Poverty is losing a child to illness brought about by unclean water. Poverty is powerlessness, lack of representation and lack of freedom’.

In an attempt to define poverty operationally, the World Bank in 1990 adopted a rule-of-thumb measure of US$ 370 per year per person at 1985 prices (the “dollar a day” poverty line) for poor countries. This crude indicator may have been a convenient interim measure for practical purposes, a short-term expedient, but has not turned out to be of continuing value.

By analyzing all the above mentioned definition, we can say that there is no one single definition of poverty. However, we can say that poverty means either lack of command over commodities in general or lack of command over a specific type of consumption deemed essential to constitute a reasonable standard of living or lack of ability to function in a society or lack of enough resources or ability to meet needs. Poverty is also associated with insufficient outcomes with respect to health, nutrition and literacy, to deficient social relations, to insecurity, and to low self-confidence and powerlessness. Poverty is vulnerability defined as the probability or risk of today of being in poverty, or falling deeper in poverty, in future. Poverty is lack of opportunities, powerlessness and vulnerability as well.
Typology of poverty

On an international level, many studies were made and numerous reports and books were published. Poverty can be regarded from different angles; hence the concept is multidimensional e.g. temporary and chronic poverty, absolute and relative poverty, objective and subjective poverty, spiritual poverty, social inequality, vulnerability, social exclusion, and underdevelopment. These are all very broad concepts. Here, we will explain them in a nut shell. Some common existing typology regarding poverty is as follows-

**Primary and Secondary Poverty**

The term poverty must be considered as primary and secondary ones. *Primary poverty* has been defined as the incapability of having an income (expenditure) needed to buy the bare necessities of life. More specifically, it refers to insufficiency of income required for minimum food consumption and some other expenses. *Secondary poverty* has been defined as a situation where real incomes are adequate to meet the minimum needs but the poor do not spend the money for satisfying these needs, Primary poverty here relates to insufficiency of resources while the secondary one refers to inefficient uses of the adequate resources.

**Absolute Poverty**

Poverty may be expressed in both absolute and relative sense. Absolute poverty refers to inability of an individual to meet the minimum requirement of life. Absolute poverty is a condition characterized by severe deprivation of basic human needs, including food, safe drinking water, sanitation facilities, health, shelter, education and information. It depends not only on income but also on access to services.” In order to measure absolute poverty, it is necessary to define the threshold measures of severe deprivation of basic human needs.

The concept of absolute poverty has been widely criticized especially against its assumption of universal applicability. It assumes, for example, that there are minimum basic needs uniformly applicable to all social and economic categories in all societies. It is, however, recognized that there are variations of diets, shelter, security, leisure and recreation, depending on the diversity of cultures and modes of production, as well as the degree of socio-cultural change towards modernity and globalization.

**Relative Poverty**

Relative poverty signifies income inequality in society. It refers to the use of relative standards in both time and place in the assessment of poverty, viewed as an improvement over the concept of absolute standards. In application, relative poverty is based on judgments of members of particular societies, regarding what they see as reasonably acceptable standards of living and styles of livelihoods. The notion of relative poverty is thus elastic and receptive to conventional and rapid changes.

**Overall poverty**
It takes various forms, including "lack of income and productive resources to ensure sustainable livelihoods; hunger and malnutrition; ill health; limited or lack of access to education and other basic services; increased morbidity and mortality from illness; homelessness and inadequate housing; unsafe environments and social discrimination and exclusion. It is also characterized by lack of participation in decision-making and in civil, social and cultural life.

**Inequality**

Poverty is related to inequality and vulnerability. Inequality focuses on the distribution of attributes, such as income or consumption, across the whole population. There are two main arguments about the importance of inequality in the poverty debate. One is pragmatic, arguing that inequality can exacerbate poverty; the other is moral, arguing that inequality is a form of poverty. Inequality is not just about income. Different ethnic, racial or religious groups often have different rights or opportunities.

**Vulnerability**

Vulnerability is defined as the risk of falling into poverty in the future, even if the person is not necessarily poor now; it is often associated with the effects of “shocks” such as a drought, a drop in farm prices, or a financial crisis. Vulnerability is a key dimension of well-being since it affects individuals’ behavior (in terms of investment, production patterns, and coping strategies) and the perceptions of their own situations.

**Subjective poverty**

Closely related to relative poverty, subjective poverty has to do with whether or not individuals or groups actually feel poor. This is because those defined as poor by the standards of the day will probably have low self-esteem, hence see themselves as poor. A moderately-well-to-do person who might have done much better before, but currently experiencing cash-flow problems, may subjectively feel poor. However, he or she may be way ahead of other members of society, who may not see him as poor.
Dimensions of Poverty

The term poverty is multidimensional concept. It has many aspects and dimension. The dimensions of poverty are generally used in at least three senses.

First, there are three dimensions of wellbeing, ill-being, and poverty or deprivation. These are subjective, objective, and interactive or process. Subjective can be taken to mean what is experienced, objective to refer to conditions or causes outside a person, and interactive or process to encompass how subjective (internal and experiential) and objective (external) affect each other.

A second sense of dimension is “sets out actions to create a world free of poverty in all its dimensions”. The multiple deprivations are low income or consumption; include lack of education, health, food and shelter, fear, powerlessness and voicelessness. And there is “a powerful case for bringing vulnerability and its management to center stage”.

A third and broader usage includes the first two and extends dimension to include causes to a greater extent. Thus, for example, “Corrupt and arbitrary governance constitutes a significant factor that defines and contributes to the various other dimensions of poverty” (Parasuraman et al 2003: 33). This was also the sense which evolved out of the Voices of the Poor process, in which participatory approaches and methods were used to enable poor people in close to 300 communities in 23 countries to express and analyse their realities (Narayan et al 2000).

However, the broad consensus appears to view poverty as a multi-dimensional web of deprivation resulting in living conditions that lie below some minimum standard. In

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2 The Research Group on Wellbeing in Developing Countries at the University of Bath (White and Pettit in press) describes three dimensions of poverty.
2000, Deepa Narayan has mentioned ten “Dimensions of Powerlessness and Ill-being” were elicited and described below:

- Capabilities: lack of information, education, skills, confidence Livelihoods and assets: precarious, seasonal, inadequate
- Places: isolated, risky, subserviced, stigmatized
- The body: hungry, exhausted, sick, poor appearance
- Gender relations: troubled and unequal
- Social relations: discriminating and isolating
- Security: lack of protection and peace of mind
- Behaviors: disregard and abuse by the more powerful
- Institutions: disempowering and excluding
- Organizations of the poor: weak and disconnected

Dimensions of the bad life included not only income-poverty and material lack, but many others, some of them represented in the web of poverty’s disadvantages in the figure, for example poverty of time, living and working in bad places—“the places of the poor” and bad social, especially gender, relations. Others were the body as the main asset of many poor people, indivisible, uninsured, and vulnerable to flipping from asset to liability; many aspects of insecurity, worry and anxiety; and pervasively powerlessness. Deprivation is a continuum which ranges from no deprivation through mild, moderate and severe deprivation to extreme deprivation.

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<th>Continuum of deprivation</th>
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<tr>
<td>Mild</td>
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<td>No Deprivation</td>
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There are different sectors where deprivation takes place. This are-

- Income Deprivation
- Employment Deprivation
- Education, Skills and Training Deprivation,
- Health Deprivation and Disability
- Barriers to Housing and Services, including (e.g. homelessness, access to owner occupation) Geographical Barriers (e.g. road distance to key services)
- Living Environment Deprivation, including Indoors Environment (e.g. poor quality housing) Outdoors Environment (e.g. air quality)
- Crime
Deprivation has the cluster of disadvantages. These disadvantages are interlocked and reinforced each other to form deprivation trap—Physical weakness, Isolation, Poverty, Vulnerability and Powerlessness. Development thus can be seeing as shifting from ill-being to wellbeing with equity, with interventions to enhance wellbeing possible at any of the five points.

Robert Chambers expresses twelve dimensions of poverty each one potentially having an impact on all of the others, and vice versa, thus emphasizing the interdependence of the dimensions of poverty as we see them. Another expression of this has five dimensions to illustrate development as good change. Development thus can be seen as shifting from ill-being to wellbeing with equity, with interventions to enhance wellbeing possible at any of the five points.

But these dimensions are all abstractions, to varying degrees reductionist, based on our analysis and views. They tend to overlook and ignore the analysis and views of the objects of the definition and description—“the poor”, that is people who are in a bad condition variously described as poor, marginalized, vulnerable, excluded or deprived. There is then a fifth cluster, which is the multiplicity of their meanings.

The word poverty translated into other languages carries different connotations. This was one factor in deciding to seek better insights and comparability by inviting the local analysts to use their own words and concepts for ill-being or bad quality of life, and wellbeing or good quality of life. Even allowing for the pitfalls of analyzing and imposing outsiders’ categories on their diverse responses, values and realities, it was striking how common and strong the same dimensions were across cultures and contexts.

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3 These dimensions have been elicited in many contexts, most extensively perhaps in the World Bank’s participatory research programme Voices of the Poor, in which over 20,000 poor women and men from 23 countries were convened in small groups and facilitated to analyze and express their realities. Questions had to be confronted concerning words, translations, languages and concepts.
Many dimensions can be identified, as above. They may be physical, material, social and/or psychological, and can be experiential (subjective), external to a person (objective), related to interaction or process, or a cause, or often some combination of these. There seems no gain from restricting the meaning of dimension. Based on the above mentioned discussion, in general terms, there are four dimensions to defining and measuring poverty like the monetary, capability, social exclusion and participation.

3.2 INDICATORS OF POVERTY

There are a number of conceptual approaches to the measurement of well-being. The most common indicators are to measure economic welfare based on household consumption expenditure or household income. There are also monetary and non-monetary measures of individual welfare. A monetary indicator includes per capita measures of consumption expenditure or income of a person as well as non-monetary indicators includes infant mortality rates, life expectancy, the proportion of spending devoted to food, housing conditions, and child schooling. Traditionally a monetary measure to value household welfare is needed for measuring poverty.

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<td>Poverty incidence, depth and severity</td>
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<td>Learning achievement</td>
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<td>Measures of access to information</td>
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<td>Measures of social capital</td>
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<tr>
<td>Security</td>
<td>Measures of vulnerability to shocks and violence</td>
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Table: 1
4.1.1 Income:

It is tempting to measure household welfare by looking at household income. As we that most generally accepted definition of income is:

\[
\text{Income} = \text{Consumption} - \text{Change in net month}
\]

**Example:** Suppose I had assets of 10,000 TK at the beginning of the year. During the year I spent 3,000 TK on consumption. And at the end of the year I had 11,000 TK in assets. Then my income was 4,000 TK, of which 3,000 TK was spent, and the remaining 1,000 TK added to my assets.

The general problem with this definition is that it is not clear what time period is appropriate. Along with, the second problem is measurement. It is easy enough to measure components of income such as wages and salaries. It may be possible to get adequate (if understated) information on interest, dividends, and income from some types of self-employment. But it is likely to be hard to get an accurate measure of farm income; or of the value of housing services; or of capital gains (e.g. the increase in the value of animals on a farm, or the change in the value of a house that one owns). It is typically the case, particularly in societies with large agricultural or self employed populations that income is seriously understated because the reasons why income tends to be understood are:

- People forget, particularly when asked in single interview about items they may have purchased up to a year before.
- People may be reluctant to disclose the full extent of their income, lest the tax collector, or neighbors, get wind of the details.
- People may be reluctant to report income earned illegally – for instance from smuggling or corruption, or poppy cultivation, or prostitution.
- Some parts of income are difficult to observe – e.g. the extent to which the family buffalo has risen in value.

4.1.2 Consumption Expenditure

Consumption includes both goods and services that are purchased and those that are provided from one’s own production. In developed countries, consumption is a better indicator of lifetime welfare than is income. Because, income typically rises and then falls in the course of one’s lifetime, in addition to fluctuating somewhat from year to year, whereas consumption remains relatively stable. This smoothing of short-term fluctuations in income is predicted by the permanent income hypothesis, under which transitory income is saved while long-term (permanent) income is largely consumed.

While the available evidence does not provide strong support for this lifecycle hypothesis in the context of less-developed countries, households there do appear to smooth out the very substantial seasonal fluctuations in income that they typically face during the year. Thus, information on consumption over a relatively short period, such as one a month, as typically collected by a household survey is more likely to be representative of a household's general level of welfare than equivalent information on income, which is more volatile. A more practical case for using consumption, rather than
income, is that households may be more able, or willing, to recall what they have spent rather than what they earned.

4.1.2.1 Measuring Durable Goods

In measuring poverty it might be argued that only food, the ultimate basic need, should be included. On the other hand, even households that cannot afford adequate quantities of food devote some expenditures to other items, such as clothing, and shelter. It is reasonable to suppose that if these items are getting priority over food purchases, then they must represent very basic needs of the household, and so should be included in the poverty line. The problem is that durable goods, such as bicycles and televisions, are bought at a point in time, and then consumed over a period of several years. Consumption should only include the amount of a durable good that is eaten up during the year, which can be measured by the change in the value of the asset during the year, plus the cost of locking up one’s money in the asset.

4.1.2.2 Measure the Value of Housing Services

Ownership of house or apartment provides housing services that should be considered as part of consumption. The standard procedure is to estimate, for those households that rent their dwellings, a function that relates the rental payment to such housing characteristics as the size of the house (in square feet of floor space), the year in which it was built, the type of roof, and whether there is running water.

The estimates based on this “hedonic” regression then are used to impute the value of rent for those households that own, rather than rent, their housing. For all households that own their housing, this imputed rental, along with the costs of maintenance and minor repairs, represents the annual consumption of housing services.

4.1.2.3 Weddings and Funerals

Families spend money on weddings. Such spending is often excluded when measuring household consumption expenditure. The logic is that the money spent on weddings mainly gives utility to the guests, not the spender. Of course if one were to be strictly correct, then expenditure should include the value of the food and drink that one enjoys as a guest at other people’s weddings, although in practice this is rarely included. Alternatively, one might think of wedding expenditures as rare and exceptional events, which shed little light on the living standard of the household. Similar considerations apply to other large and irregular spending, on items such as funerals and dowries.

4.1.2.4 Accounting for Household Composition Differences

Households differ in size and composition, and so a simple comparison of aggregate household consumption can be quite misleading about the well-being of individuals in a given household. The most straightforward method is to convert from household consumption to individual consumption by dividing household expenditures by the number of people in the household. Then, total household expenditure per capita is the measure of welfare assigned to each member of the household. Although this is by far the most common procedure, it is not very satisfactory for two reasons:
First, different individuals have different needs. A young child typically needs less food than an adult, and a manual laborer requires more food than an office worker.

Second, there are economies of scale in consumption, at least for such items as housing. It costs less to house a couple than to house two individuals separately.

Solution of problem of household composition differences is application of a system of weights. For a household of a given size and demographic composition (male adult, female adult, and children) an equivalence scale measures the number of adult males (typically) which the household is deemed to be equivalent to.

### 4.1.2.6 Income or Expenditure

Now the question is which indicator is more appropriate for measuring poverty. Empirical evidence shows that most rich countries measure poverty using income, while most poor countries use expenditure. There is a logic to this; in rich countries, income is comparatively easy to measure (much of it comes from wages and salaries), while expenditure is complex and hard to quantify. On the other hand, in less-developed countries income is hard to measure (much of it comes from self employment), while expenditure is more straightforward and hence easier to estimate.

<table>
<thead>
<tr>
<th>Income (potential)</th>
<th>Pro:</th>
<th>Con:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Easy to measure, given the limited number of sources of income.</td>
<td>- Likely to be underreported.</td>
</tr>
<tr>
<td></td>
<td>- Measures degree of household 'command' over resources (which they could use if they so wish).</td>
<td>- May be affective by short-term fluctuations (for example, informal sector income, home agricultural production, self-employment income)</td>
</tr>
<tr>
<td></td>
<td>- Costs only a fifth as much to collect as expenditure data, so sample can be larger.</td>
<td>- Link between income and welfare is not always clear</td>
</tr>
<tr>
<td></td>
<td>- Reporting period might not capture the 'average' income of the household.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Consumption (achievement)</th>
<th>Pro:</th>
<th>Con:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Shows current actual material standard of living.</td>
<td>- Households may not be able to smooth consumption (for example, via borrowing, social networks)</td>
</tr>
<tr>
<td></td>
<td>- Smooths out irregularities, and so reflects long-term average well-being.</td>
<td>- Consumption choices made by households may be misleading (for example, if a rich household chooses to live simple that does not mean it is poor).</td>
</tr>
<tr>
<td></td>
<td>- Less understated than income, because expenditure is easier to recall.</td>
<td>- Some expenses are not incurred regularly, so data may be noisy.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Difficult to measure some components of consumption, including durable goods.</td>
</tr>
</tbody>
</table>

Source: Adapted from Albert (2004)
3.3 POVERTY, INEQUALITY AND PRO-POOR GROWTH

Poverty analysis refers to approaches and methodologies that can be used to understand who the poor are, causes of their poverty and identifies ways of reducing poverty. Due to the multi-dimensional nature of poverty, it requires analysis by various indicators and methods, using quantitative and qualitative approaches.

Along with, poverty analysis required to integrate issues of poverty into the project cycle and for developing results based monitoring systems which are capable to assess programme impacts on poverty. More specifically, poverty analysis:

- Helps us understand the causes and consequences of poverty
- Clarifies the interactions between various social processes and power dynamics that perpetuate poverty
- Identifies solutions in policy and practice that might break the cycle of persistent poverty
- Identifies categories of poor and vulnerable people
- Analyses the causes of poverty for specific people in a particular context
- Helps determine which dimensions of poverty are most relevant and susceptible to improvement

Poverty analysis can be used at different levels to inform different kinds of interlinking processes.
Along with, poverty analysis can be used to assess the distributional and poverty impacts of policies, strategies, programmes and projects that aim to directly as well as indirectly benefit the poor. Three steps to analyze poverty

1. Defining an indicator of welfare
2. Establishing a minimum standard of that indicator to separate the poor and the non-poor (known as poverty line)

Table-2

**Determinates of poverty**

A poverty profile describes the pattern of poverty, but is not principally concerned with explaining its causes. There is no reason to believe that the root causes of poverty are the same everywhere, region-specific analysis is essential. Among the key causes, or at least correlates, of poverty are:

- Regional-level characteristics
- Community level characteristics
- Household and Individual characteristics (*Demographic, Economic, Social*)

There are different types of indicators are being used to determine poverty. The main determinants of poverty at different level:
The poor are those whose expenditure (or income) falls below a poverty line. This section explains how poverty lines are constructed and discusses the strengths and weaknesses of defining poverty lines based on three methods: the cost of basic needs, food energy intake, and subjective evaluations. The construction of a poverty line is the most difficult step in the practical measurement of poverty.

The poverty line defines the level of consumption expenditure (if consumption expenditure is accepted as an indicator of welfare) needed for a household to escape poverty. In other words, households whose consumption expenditure falls below the poverty line will be considered poor.

The poverty line for a household may be defined as the minimum spending/consumption (or income, or other measure) needed to achieve at least the minimum utility level: In practice we cannot measure. So more pragmatic approaches are needed – there are two such approaches: One is to compute a poverty line for each household, adjusting it from household to household to take into account differences in the prices they face and their demographic composition. The other approach is to construct one per capita poverty line for all individuals, but to adjust per capita for differences in prices and household composition. The adjusted per capita is then compared with the one poverty line to determine if the individual is living below poverty line. There are two types of poverty line that is relative and absolute poverty line.

**Relative Poverty Line**

The poorest segments of the population are focused who are relatively poor. The relatively poor are always with us irrespectively of the overall level of development of the country. It is often useful to measure relative poverty to identify and target today's poor, a relative poverty line is appropriate.

**Absolute Poverty Line**

An absolute poverty line is fixed in terms of the standard of living it commands over the domain of poverty comparisons. World Bank uses two measures: (a) an estimated 1,200 million people worldwide live on less than US $1 per day, and (b) over 2 billion people worldwide live on less than US $2 per day. These are absolute poverty lines.
Caloritic Methods of setting absolute poverty lines

The methods of setting poverty lines found in practice fall under two headings: objective poverty lines and subjective poverty lines.

Objective poverty lines: The main methods found in practice are the food-energy-intake (FEI) method and the Cost-of-basic needs (CBN) method.

Food Energy Intake (FEI) method:

The method finds the consumption expenditure or income level at which food-energy intake is just sufficient to meet predetermined food-energy requirements for good health and normal activity levels. (Such caloric requirements are given in WHO, 1985, for example.) To deal with the fact that food-energy intakes naturally vary at a given income level, the FEI method typically calculates an expected value of intake at given income. This approach is parsimonious in one respect: it does not require any information about the prices of goods consumed.

The vertical axis is food-energy intake, plotted against income (or expenditure) on the horizontal axis. A line of ‘best fit’ is indicated; this is the expected value of caloric intake at given income (that is, the nonlinear regression function). By simply inverting this line, one finds the income z at which a person typically attains the stipulated food-energy requirement.

Weaknesses of the FEI:

One concern about this method is that the resulting poverty lines need not be consistent in terms of utility or capabilities more generally. Consider first how FEI poverty lines respond to differences in relative prices, which can of course differ across the subgroups being compared in the poverty profile and over time. For example, the prices of many non-food goods relative to food are likely to be lower in urban than in rural areas. This will probably mean that the demand for food and (hence) food-energy intake will be lower in urban than in rural areas, at any given real income. But this does not, of course, mean that urban households are poorer. The relationship between food energy intake and income will shift according to differences in tastes, activity levels and publicly provided goods. There is nothing in the FEI method to guarantee that these differences are ones that would normally be considered relevant to assessing welfare. Indeed, it is quite possible to find that the ‘richer’ sector tends to spend so much more on each calorie that it is deemed to be the ‘poorer’ sector.
The Cost of Basic Needs (CBN) Method:

The CBN method stipulates a consumption bundle deemed to be adequate for ‘basic consumption needs’, and then estimates its cost for each of the subgroups being compared in the poverty profile. The poverty bundle is typically anchored to food-energy requirements consistent with common diets in the specific context. However, allowances for non-food goods are also included, to assure that basic non-nutritional functioning are assured. The CBN method is utility consistent if the right bundle is used, corresponding to the relevant points on the utility-compensated demand functions. However, there is nothing to guarantee that the bundles of goods built into CBN poverty lines lie on the compensated demand functions, at the (common) reference level of utility. Thus it is important to have some way of assessing a set of CBN poverty bundles.

- Stipulate a consumption bundle that is deemed to be adequate, with both food and non-food components; and
- Estimate the cost of the bundle for each subgroup (urban/rural, each region, etc.).

Operationally, the steps to follow are these:

- Pick a nutritional requirement for good health, such as 2100 Calories per person per day.
- Estimate the cost of meeting this food energy requirement, using a diet that reflects the habits of households near the poverty line (e.g. those in the lowest, or second-lowest, quintile of the income distribution; or those consuming between 2,000 and 2,200 Calories). This may not be easy if diets vary widely across the country. Call this food component \( z^F \).
- Add a non-food component \( (z^{NF}) \). There is a lot of disagreement about how to do this.
- Then the basic needs poverty line is given by \( z^{BN} = z^F + z^{NF} \)

There is no wholly satisfactory way to measure the non-food component of the poverty line, and the procedures followed tend to be somewhat ad hoc.
Measures of Poverty

Given information on a welfare measure such as per capita consumption, and a poverty line, then the only remaining problem is deciding on an appropriate summary measure of aggregate poverty.

Headcount index

The most widely used measure is the headcount index which simply measures the proportion of the population living below the poverty line or counted as poor. The measure estimates the incidence of poverty. Formally:

\[
P_0 = \frac{N_p}{N}
\]

Where,
- \( P_0 \) is the headcount index
- \( N \) is the total population
- \( N_p \) is the total number of poor

If 60 people are poor in a survey that samples 300 people, then \( P_0 = 60/300 = 0.2 = 20\% \). The greatest virtues of the headcount index are that it is simple to construct and easy to understand. These are important qualities.

However the measure has at least three weaknesses:

i) The headcount index does not take the intensity of poverty into account. Consider the following two income distributions:

Table-3
3.4 MEASURING INEQUALITY

Inequality is a broader concept than poverty in that it is defined over the entire population, and not just for the population below a certain poverty line. Most inequality measures do not depend on the mean of the distribution, and this property of mean independence is considered to be a desirable property of an inequality measure. Of course, inequality measures are often calculated for distributions other than expenditure – for instance, for income, land, assets, tax payments, and many other continuous and cardinal variables.

The simplest way to measure inequality is by dividing the population into fifths (quintiles) from poorest to richest, and reporting the levels or proportions of income (or expenditure) that accrue to each level.

Gini coefficient of inequality

The most widely used single measure of inequality is the Gini coefficient. It is based on the Lorenz curve, a cumulative frequency curve that compares the distribution of a specific variable (e.g. income) with the uniform distribution that represents equality. To construct the Gini coefficient, graph the cumulative percentage of households (from poor to rich) on the horizontal axis and the cumulative percentage of expenditure (or income) on the vertical axis. The diagonal line represents perfect equality.

The Gini coefficient is defined as $A/(A+B)$, where $A$ and $B$ are the areas shown on the graph. If $A=0$ the Gini coefficient becomes 0 which means perfect equality, whereas if $B=0$ the Gini coefficient becomes 1 which means complete inequality. In this example the Gini coefficient is about 0.35. The Gini coefficient is not entirely satisfactory.
3.5 POVERTY IN BANGLADESH: HIES & MDG 1

Narratives of Poverty Praxis

There are different meanings of the term praxis. Here, we will use the meaning of Praxis is shared practice regarding poverty issues and useful learning insights. Here, we also focuses on assesses the global poverty agenda, and considers whether current approaches are adequate and appropriate for eradicating poverty. In addition, various policies and strategies for addressing poverty are interrogated. These include Poverty Reduction Strategy Papers (PRSPs), the role of national budgets, attempts at the pro-poor delivery of health and education services, and the role of local government and political decentralization in addressing poverty.

When the UN created the Universal Declaration of Human Rights in 1948, the signers proclaimed that all people have the right to education, work, health and well-being. Today, however, millions around the world are too crippled by poverty to fulfill these basic rights. Millions continue to go hungry. Scores of children never step inside a classroom. Families watch their loved ones die from largely preventable causes because they do not have access to adequate medical care. In essence, poverty is a denial of human rights.

Global Poverty Insights

- Nearly half the world – over three billion people – lives on less than $2.50 a day.
- According to UNICEF, 26,500-30,000 children die each day due to poverty – that’s 18 children dying every minute, a child every three seconds.
- About 1.1 billion people in developing countries have inadequate access to water, and 2.6 billion have lack of basic sanitation.
- For the 1.9 billion children from the developing world: 640 million are without adequate shelter, 400 million do not have access to safe water, 270 million do not have access to health services.
- About 2.2 million children die each year because they are not immunized.
- About 1.6 billion people – a quarter of humanity – live without electricity.
- Over nine million people, of which five million are children, die worldwide each year because of hunger and malnutrition.
- Over 11 million children die each year from preventable causes like malaria, diarrhea and pneumonia.
- About 20% of the population in the developed nations consumes 86% of the world’s goods.
- The poorest 40% of the world’s population accounts for 5% of the global income. The richest 20% accounts for 75% of world income.
- Around 27-28% of all children in developing countries are estimated to be underweight or stunted.

Source: 11-facts-about-global-poverty)
Poverty Line: The Case of Bangladesh

Until now, three approaches/methods have been employed by the Bangladesh Bureau of Statistics to estimate the poverty line for Bangladesh. These approaches are direct calorie-intake (DCI), food energy-intake (FEI) and cost-of-basic needs (CBN). According to the DCI method, a household/person is designated as poor whose actual per capita energy intake is less than the standard/minimum per capita requirement of energy. This method offers three variants of measurement to determine the standard/minimum requirement and in turn three types of poverty line. The first variant sets the minimum requirement of daily energy intake of a person at 2122 k.cal and produces a measure of the absolute poverty line. The second variant fixes the corresponding requirement at 1805 k.cal and yields a measure of the hard-core poverty line. The third variant settles that requirement at 1600 k.cal and provides a measure of the ultra poverty line.

Two types of the poverty line result from the CBN approach. The first one is called the upper poverty line and the second, the lower poverty line. The computation of these lines involves three steps. The first step formulates the food poverty line. It is obtained by monetization of the absolute poverty line (2122 kcal). The second step calculates two separate baskets for non-food consumption. While one basket represents the lower allowance for non-food consumption, the other basket represents its upper allowance. The lower allowance is applicable for the households whose total consumption expenditure equals to the food poverty line. Total food expenditure of these households is less than the food poverty line. The gap between that food expenditure and the food poverty line yields the lower allowance. The upper allowance is applicable for the households whose total food expenditure equals to the food poverty line. Total consumption expenditure of these households is greater than the food poverty line. The gap between the food poverty line and the consumption expenditure yields the upper allowance. Finally, the third step provides estimates of the upper and lower poverty lines. The estimate of the lower poverty line is derived by adding the food poverty line and the lower allowance for non-food consumption. Similarly, the estimate of the upper poverty line is arrived at by summing the food poverty line and the upper allowance for non-food consumption. In correspondence to the figures of the Household Income and Expenditure Survey (HIES), 2000, the upper and lower poverty lines for the year at national, urban and rural levels are presented below.

<table>
<thead>
<tr>
<th>Year</th>
<th>Upper Poverty Line</th>
<th>Lower Poverty Line</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>National Urban Rural</td>
<td>National Urban Rural</td>
</tr>
<tr>
<td>2000</td>
<td>686 832 648</td>
<td>564 627 548</td>
</tr>
</tbody>
</table>

Checking points: Approaches and Policies

Considering the above mentioned data towards eradicating poverty, now this is the time to consider whether current approaches are adequate and appropriate for eradicating poverty. Empirical evidence shows that Policy-makers, economists, and multilateral institutions such as the UN, IMF and World Banks have developed various frameworks for addressing poverty-yet structural poverty persists. There are many different definitions of poverty, which are vigorously debated, as are policies for its alleviation or eradication. In order to meet Goal 1 of MDG, states need to increase their capacity to address the socioeconomic needs of the poor, and need to assess whether present policies and programmes are appropriate and adequate to improve the wellbeing and
livelihoods of the poor. If we have a look to past, we will find that the international agenda for addressing poverty consists of five main elements:

Box-2

1. The MDGs;
3. Poverty Reduction Strategy Papers (PRSPs), prepared by IMF member countries, and used as a basis for lending by the IMF and World Bank as well as debt relief to Highly Indebted Poor Countries (HIPCs);
4. Technologies for delivering aid in support of PRSPs; and
5. A commitment to results-based management (RBM)

The Millennium Development Goals (MDGs), created by the international community in 2000, represent an unprecedented opportunity for the world to usher in a new era of collaboration in fighting poverty, by setting concrete targets to reduce extreme poverty by 2015. We are now only four years away from the deadline, and we have a lot of work ahead of us. The world is on track to meet the MDG target of halving the proportion of people living on less than $1 a day between 1990 and 2015. Overall poverty rates fell from 46 per cent in 1990 to 27 per cent in 2005 in developing regions, and progress in many developing countries is being sustained. This is despite setbacks caused by the 2008-09 economic downturn and the effects of the food and energy crises. However, even if these positive trends continue, in 2015, roughly 920 million people would still be living under the international poverty line of $1.25 a day, as adjusted by the World Bank in 2008.

- The number of people living under the international poverty line of $1.25 a day declined from 1.8 billion to 1.4 billion between 1990 and 2005.
- The proportion of people living in extreme poverty in developing regions dropped from 46 per cent to 27 per cent — on track to meet the target globally.
- The economic crisis is expected to push an estimated 64 million more people into extreme poverty in 2010.
- About one in four children under the age of five is underweight in the developing world, down from almost one in three in 1990.

In September 1999 the World Bank and IMF lined up behind a proposal that “country-owned” poverty reduction strategies should form the basis for all Bank and Fund concessional lending. These strategies would take the form of papers called Poverty Reduction Strategy Papers. Hence was born the PRSP process. The process was essentially a way to implement a set of principles the Bank had earlier adopted. These principles were called the Comprehensive Development Framework. The relationship between the Comprehensive Development Framework and the PRSP process is confusing, but it is probably appropriate to think of the Framework as the destination and the PRSP as the route selected. In time, the plan is that every country receiving what is called HIPC (highly indebted poor country) relief and all countries making use of the IMF’s Poverty Reduction and Growth Facility will need to author a PRSP that must then be approved by the boards of the Bank and Fund. The expectation is that eventually
about 70 low-income countries will be expected to prepare PRSPs. Clearly, the process is going to be pervasive and will not be restricted to only the most troubled or very poorest economies.

However, country experiences with PRSPs thus far reveal that there are few differences between the conditionality associated with the notorious Structural Adjustment Programmes (SAPs) and those associated with PRSPs. Another concern is that these processes are largely government-dominated, and are therefore unlikely to redistribute resources or equalize access to social power.

The process in support of PRSPs involve budget support rather than project funding, and are intended to improve the management of public expenditure and aid flows. Donors are encouraged to work together in support of Sector Wide Approaches (SWAPs), involving the direction of funding towards a single sector policy and expenditure programme (led by government), the adoption of common approaches across the sector, and adherence to government procedures for disbursing funds and exacting accountability. As part of this approach, the World Bank in particular is expected to replace structural adjustment lending with new Poverty Reduction Support Credits, which will presumably be discounted against debt. On the whole, budget support is increasingly replacing project funding.

**Results-based management** is an approach to managing organizations and programmes via effectiveness (outputs and outcomes) rather than inputs and activities, e.g. reducing poverty rather than spending money on poverty reduction programmes. The utility of results-based management goes beyond target-setting; it can also be deployed to structure rewards/disincentives for individuals, teams, organizations, local government departments, and the like.
INTRODUCTION

Environment means our surroundings, which comprises of land, water and air and other bodies. Environment is affected by the physical properties of these components. It is also affected by the changes in interrelationship prevailing between an among the components ranging from micro organism to human bodies.

Besides, ecosystem (a contraction of ecological system) is generally understood as to the entire assemblage of organisms (plant, animal and other living beings also referred to as a biotic community or bio-coenosis) living together in a certain space with their environment (or biotope), functioning as a loose unit.

The module discusses the key issues encompasses with environment like definition and Concepts, Environmental analysis, Natural resource management for safe environment as well as Environmental policy, plans, law, regulations and acts etc.
SESSION-4: ENVIRONMENT MANAGEMENT

- Definition and Concepts of Environment and Ecosystem
- Ecosystem Services
- Sustainable Development
- Environmental characteristics of different areas of Bangladesh
- Human impact on natural environment
- Natural resource management
- Local knowledge to conserving natural resources
4.0 ENVIRONMENT MANAGEMENT

4.1 ENVIRONMENT AND ECOSYSTEM

Environment

In the general term environment means our surroundings, which comprises of land, water and air and other bodies. According to US Environment Policy Act 1969, Environment is "the whole complex of physical, social, cultural and aesthetic factors which affects individuals and community and ultimately determines their form, character, relationship and survival".

Ecosystem

The term ecosystem is generally understood as to the entire assemblage of organisms (plant, animal and other living beings-also referred to as a biotic community or bio-coenosis) living together in a certain space with their environment (or biotope), functioning as a loose unit. An ecosystem is a natural system consisting of all plants, animals and microorganisms (biotic factors) in an area functioning together with all the non-living physical (abiotic) factors of the environment (Christopherson).

Together, these components and their interactions with and relationships to each other form a dynamic and complex new whole, functioning as an "ecological unit", with additional characteristics that can’t be found in the individual components. Nor could any organism live completely on its own without involving any other species of organism.

4.2 Ecosystem Services

The ecosystem provides some benefits are called ecosystem services. These include provisioning services such as food, water, timber, fiber, and genetic resources; regulating services such as the regulation of climate, floods, disease, and water quality as well as waste treatment; cultural services such as recreation, aesthetic enjoyment, and spiritual fulfillment; and supporting services such as soil formation, pollination, and nutrient cycling. The diagram below explains the services produced form ecosystems.
Provisioning Services: The quantity of provisioning ecosystem services such as food, water, and timber used by humans increased rapidly, often more rapidly than population growth although generally slower than economic growth, during the second half of the twentieth century. And it continues to grow. In a number of cases, provisioning services are being used at unsustainable rates.

The use of several provisioning services is unsustainable even in the global aggregate. From 5% to possibly 25% of global freshwater use exceeds long term accessible supplies and is maintained only through engineered water transfers or the overdraft of groundwater supplies (low to medium certainty). Between 15% and 35% of irrigation withdrawals exceed supply rates and are therefore unsustainable (low to medium certainty). Current agricultural practices are also unsustainable in some regions due to their reliance on unsustainable sources of water, harmful impacts caused by excessive nutrient or pesticide use, salinization, nutrient depletion, and rates of soil loss that exceed rates of soil formation.

Regulating Services: Humans have substantially altered regulating services such as disease and climate regulation by modifying the ecosystem providing the service and, in the case of waste processing services, by exceeding the capabilities of ecosystems to provide the service. Most changes to regulating services are inadvertent results of actions taken to enhance the supply of provisioning services.
**Cultural Services:** Although the use of cultural services has continued to grow, the capability of ecosystems to provide cultural benefits has been significantly diminished in the past century. Human cultures are strongly influenced by ecosystems, and ecosystem change can have a significant impact on cultural identity and social stability. Human cultures, knowledge systems, religions, heritage values, social interactions, and the linked amenity services (such as aesthetic enjoyment, recreation, artistic and spiritual fulfillment, and intellectual development) have always been influenced and shaped by the nature of the ecosystem and ecosystem conditions. Many of these benefits are being degraded, either through changes to ecosystems (a recent rapid decline in the numbers of sacred groves and other such protected areas, for example) or through societal changes (such as the loss of languages or of traditional knowledge) that reduce people’s recognition or appreciation of those cultural benefits. Rapid loss of culturally valued ecosystems and landscapes can contribute to social disruptions and societal marginalization. And there has been a decline in the quantity and quality of aesthetically pleasing natural landscapes.

**4.3 SUSTAINABLE DEVELOPMENT**

The world Commission on Environment and Development famously defined the term ‘Sustainable Development’ as development that ‘…..meets the needs of the present without compromising the ability of future generations’ (WCED, 1987). ‘Sustainability’ is now often use almost interchangeably with sustainable development. Sustainability is a long-term dynamic process that allows individuals, organizations and society to flourish as members of their ecological communities (ISTP, 2001).

The United Nations refers interdependent and mutually reinforcing pillars of sustainable development as economic development, social development, and environmental protection (In 2005 World Summit Outcome Document).
An "unsustainable situation" occurs when natural capital (the sum total of nature’s resources) is used up faster than it can be replenished. Sustainability requires that human activity only uses nature’s resources at a rate at which they can be replenished naturally. Inherently the concept of sustainable development is intertwined with the concept of carrying capacity. Theoretically, the long-term result of environment degradation is the inability to sustain human life. Such degradation on a global scale could imply extinction for humanity.

### 4.4 ENVIRONMENTAL CHARACTERISTICS OF DIFFERENT AREAS OF BANGLADESH

Within a relatively small geographic boundary, Bangladesh enjoys a diverse array of environmental characteristics. Being a low lying deltaic country, seasonal variation in water availability is the major factor, which generates different environmental and ecological scenarios of Bangladesh. Temperature, rainfall, physiographic variations in soil and different hydrological conditions play vital roles in the country’s diverse environment as well as ecosystems.

The environmental characteristics of Bangladesh could be categorized into two major groups, i.e. (i) land based and (ii) aquatic. The land-based environmental characteristics include forest and hill ecosystems, agro-ecosystems and homestead ecosystems; while seasonal and perennial wetlands, rivers, lakes, coastal mangroves, coastal mudflats and chars, and marine ecosystems fall into the aquatic category.

The major environmental characteristics of Bangladesh are discussed in the following section.

**Environmental Characteristics of Wetlands**

Compared with other major natural forms of landscape, a wetland is young, dynamic and physically unstable. Various called *jalah, doloni, pitoni, hola* or *gadeng*, it can change in a season or even in a single storm, as conditions range from virtually perennial aquatic lowlands to seasonally dry uplands. It changes with the vegetation, sedimentation, or geological subsidence. The key to vegetation development and community dynamics here is hydro period, affected by topography, flooding and flood type, precipitation, and water table fluctuations.

Due to continuous submergence, wetland habitat is characterized by anaerobic conditions which inhibits normal plant growth apart from a group of plants known as hydrophytes are adapted to withstand these conditions. The Haor Basin is the only region in Bangladesh where remnant patches of freshwater swamps and reed lands still exists. Once extensive forests of Hijal in the area used to provide an important source of firewood, but these forests are now almost completely destroyed. In recent times, various herbs and aquatic...
Plants are being collected for use as fuel. On top of that, aquatic plants are also being collected for use as fertilizers. Only a few patches remain of the swamp forests that once dominated the area, featuring flood tolerant trees like Hijal (Barringtonia acuatangula) and Koroch (Ponogaming pinnata).

While the haor itself is a seasonal water body formed during the monsoon, the beels are low-lying depressions of the haor system retaining water even during the dry months of the season. Thus, the haor system is a complex of both lacustrine wetlands (with open water) and palustrine wetlands (marshy – with vegetation), depending on the hydraulic behaviour in different seasons.

The ecology of the haor system is principally driven by seasonal hydraulics. During the monsoon, the entire haor system of one area becomes a single body of open water linked to the river system. When floodwater recedes, the beels become isolated and remain as standing water bodies till the next rainy season. They differ from a true lake system in that the main source of waters in tropical lakes is rainwater, while a haor system depends on both precipitation and floodwater as sources of water.

These habitats are dynamic and are susceptible to changes due to coastal processes. They lack resilience and have a low threshold to irreversible damage. The physical and ecological characteristics of these habitats make them especially vulnerable to degradation. Once degradation exceeds the limit set by the low threshold, rehabilitation becomes prohibitively expensive or impossible.

A majority of Bangladesh’s 120 million people are critically dependent on the country’s wetland systems as vital natural resources to sustain them, primarily through agriculture and fishing. While serving as the central pillar of Bangladesh’s resource base and thus providing an essential support for its goal of achieving sustainable human development, the country’s wetland ecosystems also offer critical habitats for globally significant biological diversity.

Environmental Characteristics of Land-based ecosystem

Forest ecosystem in Bangladesh

A forest ecosystem is a natural unit consisting of mostly plants, animals and microorganisms in forest area and functions together with all of non-living physical factors of the environment. Logically, trees are an important component of forest research but the wide variety of other life forms and abiotic components in most forests means that other elements, such as wildlife or soil nutrients are often the focal point. Among forest ecosystems of Bangladesh, Sundarban is major. The Sundarban, covering about one million ha in the delta of the rivers Ganga, Brahmaputra and Meghna at the point where it merges with the Bay of Bengal, is the single largest block of tidal halophytic mangrove forest in the world shared between Bangladesh (62%) and India (38%), which supports a large, biodiversity-rich unique ecosystem. With its array of trees and wildlife the forest is a showpiece of natural history. It is also a center of economic activities, such as extraction of timber, fishing and collection of honey. The area of Sundarban experiences a subtropical monsoonal climate with an annual rainfall of 1600-1800 mm and severe cyclonic storms. Enormous amount of sediments carried by the three rivers contribute to its expansion and dynamics. Salinity gradients change over a wide range of spatial
and temporal scales. The Sundarban is intersected by a complex network of tidal waterways, mudflats and small islands of salt-tolerant mangrove forests, and presents an excellent example of ongoing ecological processes. The area is known for its wide range of flora and fauna. The most famous among these are the man-eating Royal Bengal Tigers, but numerous species of birds, spotted deer, crocodiles and snakes also inhabit it. The mangroves have been extensively exploited over centuries for timber, fish and prawns, honey, fodder, or converted for paddy and aquaculture and now it faces the serious challenges for its existence. Javan rhino, wild buffalo, hog deer, and barking deer are already extinct from the area. While conservation efforts have focused on wildlife, particularly tiger, through creation of several sanctuaries and a biosphere reserve, reduced freshwater inflows are a serious threat as salinity is rising. Heritiera fomes (from which Sundarban derives its name), Nypa fruticans and Phoenix paludosa are declining rapidly.

Agro-ecological characteristics

In the context of natural and social parameters, the system of agro-ecology is wide and diverse. The agro-ecology involves the interaction between agriculturally associated organisms and their physical habitats. The productions of food-grains, livestock, energy flow and nutrient cycle, etc. are therefore the fundamental elements of the agro-ecosystem. In addition, the system comprises communities of plants and animals which are interacting with their physical and chemical environments that are modified by people to produce their food, fire, fuel, and other products for human consumption and processing.

The whole Bangladesh can be divided into 30 agro-ecological zones, and each of these zones has distinct characteristics. Eleven zones are located in the northwestern region of Bangladesh. Land types, such as low, high and other types, can be found in the northwest part of Bangladesh. Out of these, one is high piedmont plain, three terraced to level barind tract, three active, 3 low, 1 high and 2 other types of floodplains (UNDP/FAO, 1988). For the purpose of area selection, the different agro-ecological regions were grouped into three categories based on more or less similar physiographic characteristics, which include:

- High Barind
- Level Barind and Old Himalayan Piedmont Plain
- Floodplains

Among these regions, floodplains occupy a major proportion of the area.

The High Barind Region (HBR)

The High Barind Region is one of the fundamental agro-ecological zones in the northwest region. The total area occupies around 1600 km², whereby there are a wide range of ecological variations along with significant differences in physiography, soil, and slope. These diverse and complex physical conditions provide both the opportunities and limitations for land use and development. Land level of the region increasingly rises to the western side but gradually lowers to the level barind tract. Most of the land is free from flood with prevailing uniform climate all over the region and a mean annual rainfall of 1300-1400 mm. The soil is of grey, silty, puddle topsoil,
The topsoil, which has small moisture holding capacities with slow permeability, contains high acid with low organic matter. Limited surface waters are available in tanks. Groundwater is available in the eastern region. Transplanted Aman is a major crop. Meanwhile, Broad Cast Aus is cultivated before Aman through irrigation. HYV Boro is also farmed there. Rabi crops are cultivated by hand irrigation from the adjoining water tanks in field. The main constraints of agriculture include terrace soil and shortage of soil moisture during the dry season. The development strategies may exercise the ways of widespread irrigation facilities from deep tube wells to improve the crops.

**The Level Barind Region (LBR)**

Just like the HBR, the Level Barind Region (LBR) has also been developed over Madhupur clay which has ecological variations and great opportunities for development. The total area is around 5049 km², with flat landscape increasingly rises to the high barind region (HBR). In the relatively higher parts, rainwater is reserved in ponds for paddy cultivation. In lower sites, rainwater is accumulated up to about 60 cm deep in the rainy season. Flood occurs occasionally due to heavy rainfalls. In addition, the climatic condition is not uniform. The mean annual rainfall is 2000 mm in the northeast region and this is around 1300-1500 mm in the southwest region. The soil is strongly acidic with low organic matter, and there is limited surface water that can be used for irrigation during the dry season. Groundwater is available within 100 m depth from the surface but varies from one place to another. A higher proportion of the land is used for mixed Aus and Aman, deepwater Aman, capsularis jute and irrigated HYV Boro. Meanwhile, a lower proportion is devoted to transplanted Aman and cash crops, such as tobacco, cotton, potatoes, bananas, and spices.

**Low Ganges Floodplain Region (LGFR)**

The region comprises eastern half of the Ganges River with broad landscape of smooth ridges and basins (7968 km²). Moderate to deep flash floods occur respectively during rainy and dry seasons. The mean annual rainfall increases from about 1600 mm in the northwest to about 2000 mm in the southwest. Soils are olive-brown, silt loams, and silty clay loams on the upper parts of floodplain ridges and soil are dark grey, with mottled brown clay soil on the lower ridge sites. Most of the ridge soil is calcareous and non-calcareous in the upper layers. Meanwhile, non-calcareous upper layers are slightly acidic or neutral. Ample groundwater apparently exists throughout the region with limited amounts of surface water. Aus is the main crop, while early Rabi cash crops (tobacco, potato, vegetables, and spices) are cultivated by hand irrigation.

**Meandering Tista Floodplain Region (MTFR)**

This region is one of the major parts of Tista Floodplain (9468 km²) with broad almost level floodplain ridges. The ridge in the northwest region is relatively higher other than elsewhere. Flash flood occurs in the Basin of Tista River. Deep floods hit in the south and south-east regions. Most of the soil is silty. Patches of grey sandy soil occur erratically amongst the silty basin soil in several areas. Meanwhile, great climatic differences, with a mean annual rainfall of about 1500 mm in the southwest and about 2300 mm in the extreme north, are seen. Olive-brown soil with rapidly permeable and
loamy soils are seen into the upper parts of high floodplain ridges, and grey or dark grey with slowly permeable and heavy silt loam or silty clayey loam soil can be found into the lower land. Clay soil is seen in limited basin areas. Silty Tista floodplain soil possesses a very high moisture holding capacity with low organic matter. Slight to strong acid of cultivated topsoil can also be seen there. The predominant soil is grey with puddled topsoil and plough pan. During the dry season, surface water is unavailable in most of the rivers and tanks. Meanwhile, groundwater is available all over the region other than that adjacent to the HBR. During the rainy season, however, groundwater is close to the surface. T. Aman is the major crop, whereas HYV. Aus and Aman varieties are also widely cultivated. No irrigated land generally stays crop-free during the dry season.

Geo-morphological characteristics

The geographical location and geomorphological conditions of Bangladesh have made the country one of the most vulnerable ones to climate change.

Bangladesh is situated at the interface of 2 different environments, with the Bay of Bengal to the south and the Himalayas to the north. This peculiar geography of Bangladesh causes not only life-giving monsoons but also catastrophic ravages of natural disasters, to which now are added climate change. The country has a very low and flat topography, except the northeast and southeast regions. About 10% of the country is hardly 1 m above the mean sea level (MSL), and one-third is under tidal excursions. The country has 3 distinct coastal regions—namely, western, central, and eastern coastal zones.

The western part, also known as the Ganges tidal plain, comprises the semi active delta and is criss-crossed by numerous channels and creeks. The topography is very low and flat.

The Southwestern part of the region is covered by the largest mangrove forest of the world, popularly known as Sundarbans, named after the ‘Sundri’ trees. The mangrove forests act as deterrents to the furiousness of tropical cyclones and storm surges.

The central region is the most active one, and continuous processes of accretion and erosion are going on here. The very active Meghna River estuary lies in the region. The lower Meghna river estuary is highly influenced by tidal interactions and consequential backwater effect. Heavy sediment inputs from the river result in a morphologically dynamic coastal zone. The combined flow of 3 mighty rivers—the Ganges, the Brahmaputra, and the Meghna (commonly known as the GBM river system and ranking as one of the largest river systems in the world)—discharges under the name of Meghna into the northeastern corner of the Bay of Bengal. This estuarial region has seen the most disastrous effects of tropical cyclones and storm surges in the world and is very
vulnerable to such calamities. The eastern region, being covered by hilly areas, is more stable, and it has one of the longest beaches in the world.

Environmental Management

Environmental management is a mixture of science, policy, and socioeconomic applications. It focuses on the solution of the practical problems that humans encounter in cohabitation with nature, exploitation of resources, and production of waste. In a purely anthropocentric sense, the central problem is how to permit technology to evolve continuously while limiting the degree to which this process alters natural ecosystems. Environmental management is thus intimately intertwined with questions regarding limiting economic growth, ensuring an equitable distribution of consumable goods, and conserving resources for future generations.

Environmental management is a response to the increasing seriousness of the human impact on natural ecosystems. With a smaller global population base and a less pervasive use of technology, the environment might be able to recuperate on its own from human misuse, but it is now widely recognized that in many cases positive intervention is necessary if the environment is to recover.

4.5 HUMAN IMPACT ON ENVIRONMENT IN BANGLADESH

Land Resources

Bangladesh is a country of about 143,999 sq. km including inland and estuarine water surfaces and has a population estimated at about 132 million in 2000. Although the country is predominantly a plain surface, it is criss-crossed by a very high density of river systems. This gives the country a riverine nature. Being a densely populated country, there has been serious competition for access to and control over land. Over 58% people are functionally landless in Bangladesh. About 17.8 million acres are cultivated land and average household farm (those who have farm land) size is 1.5 acre. Thus, land is the most important resource in Bangladesh and it is under intense use threatening its carrying capacity.

The pressure of population on land is a crucial factor in the management of land resources in the country. Availability of land is a major constraints in Bangladesh as virtually all available land is utilized for crop production, homestead, commercial establishment, road network, urban development, forestry, fishing etc. The country lacks a comprehensive landuse policy emphasizing the most appropriate and productive use of land. Eco-systems People Poor and Livelihood Empowerment Resource
There have been many driving forces compelling people of Bangladesh to over exploit land. These are high population, poverty, improper land use, absence of land policy and ineffective implementation of laws and guidelines. Unplanned agricultural practices (use of agro-chemicals) and encroachment of forest areas for agriculture and settlement also put pressure on scarce land resources. Further, unplanned and unscientific rural infrastructure development and the growing demand for increasing urbanization are devouring productive land. Natural process such as river bank erosion, siltation also cause to degrade land.

**Water Resources**

The economic growth and development of Bangladesh has been all highly influenced by water – its regional and seasonal availability, and the quality of surface and groundwater. Spatial and seasonal availability of surface and groundwater is highly responsible to the monsoon climate and physiography of the country. Availability also depends on upstream flow and withdrawal for consumptive and non consumptive uses. In terms of quality, the surface water of the country is unprotected from untreated industrial effluents and municipal wastewater, runoff pollution from chemical fertilizers and pesticides, and oil and lube spillage in the coastal area from the operation of sea and river ports. Water quality also depends on effluent types and discharge quantity from different type of industries, types of agrochemicals used in agriculture, and seasonal water flow and dilution capability by the river system.

The contribution of local rainfall to the annual surface runoff is about 25 per cent, with significant seasonal variation. Annual rainfall and evapotranspiration of the country show that there is a substantial excess of rainfall everywhere in the monsoon season. From the annual overall averages, dependable rainfall exceeds evapotranspiration by over 10 per cent in most parts of the country, except in the Northwest (NW) and Southwest (SW) regions. In the NW region, rainfall and evapotranspiration are almost equal, but in the SW the overall deficit is about 10 per cent. From November to May, evapotranspiration exceeds rainfall all over the country, except in the Northeast (NE) region.

The largest use of water is made for irrigation. Besides agriculture, some other uses are for domestic and municipal water supply, industry, fishery, forestry and navigation. In addition, water is of fundamental importance for ecology and the wider environment. Water stress occurs when the demand for water exceeds the amount available during a certain period or when poor quality restricts its use. This frequently occurs in areas with low rainfall and high population density or in areas where agricultural land or industrial activities are intense. Even where sufficient long-term freshwater resources do exist, seasonal or annual variations in the availability of freshwater may at times cause water quality degradation.
Bangladesh has two problems with water i.e., scarcity of water for agriculture, industrial and domestic uses in the dry season and sometime, abundance of water in monsoon causes flood and natural hazards. But people treat normal flood as boon rather than bane. It is viewed that the country would face serious scarcity of fresh water for agriculture, industry, fisheries and other livelihood activities in near future. Three things happen; flow of up-stream water is decreasing and ground water level is going down particularly in the dry season and at the same time, saline water is intruding to the inland area. The water development and flood control projects have serious negative impacts on wetlands, fisheries and on the ecosystems of some parts of the country.

The increasing urbanization and industrialization of Bangladesh have negative implications for water quality. The pollution from industrial and urban waste effluents and from agrochemicals in some water bodies and rivers has reached alarming levels. The long-term effects of this water contamination by organic and inorganic substances, many of them toxic, are incalculable. The marine and aquatic ecosystems are affected, and the chemicals that enter the food chain have public health implications.

Water quality in the coastal area of Bangladesh is degraded by the intrusion of saline water that has occurred due to lean flow in the dry season. This affects agriculture significantly, as well as other consumptive uses of the water. A common phenomenon in the lower riparian countries is that of enough water in monsoon, but water scarcity during the dry season. It is also common in Bangladesh for areas that were once inundated facing water scarcity in the dry season. Dry season water availability depends on water use for irrigation, dry season rainfall and withdrawal or diversion of water upstream. It has implications for navigation, and the wetland ecosystem and its productivity.

Fisheries

The people of Bangladesh largely depend on fish to meet their protein needs, especially the poor in rural areas. Several decades ago there was an abundance of fish in this country. But recently, capture fish production has declined to about 50 per cent, with a negative trend of 1.24 per cent per year. Despite the constant depletion of the river, canal, and flood plain habitats for years, Bangladesh still holds the world’s most diverse and abundant inland fisheries. But the availability of many species that were very popular locally has been drastically decreased, and some are no longer found in the country. On the migration journey to the floodplains and the return to safe sanctuaries, populations of fish now face many obstacles and hazards, which seriously disturb reproduction in the open water and ponds (Gain, 2002).

The physical loss, shrinkage, and modification of aquatic habitats for fish, prawn, turtle and other aquatic organisms are said to be the major factors involved in depleting fish varieties. Such loss or shrinkage of aquatic habitats has been the result of thousands of physical structures, dikes, and drainage systems that have been constructed in Bangladesh in an effort to control floods, cyclones, and other natural calamities. These structures have disrupted the natural flow of waters in closed rivers, diverted rivers, and have dried up water bodies. Such physical constructions have also changed or
damaged the local ecosystems and hydrological features, resulting in irreparable damages to fisheries resources. Studies done under the Flood Action Plan (FAP) declared that all Flood Control Drainage (FCD) and Flood Control Drainage and Irrigation (FCDI) projects contributed to the decline of fish stocks and fisheries by creating obstacles in the fish migration routes. As a consequence, fish production has declined. Land reclamation required for the implementation of these projects has also reduced the permanent water bodies.

The extensive irrigation schemes for agricultural fields, and indiscriminate use of agrochemicals are changing the feeding and breeding grounds of many indigenous fish species. Discharge of pollutants into water bodies (rivers, canals, ponds, etc.) from industries, and over-fishing (especially of juvenile and brood fishes) are highly responsible for the destruction of fish species throughout the country. Short term leasing of haors and baors to individuals for commercial exploitation has led to many species becoming locally extinct. This can be attributed to the practice of almost total intake of fish stocks by dewatering the water bodies while harvesting fish. Moreover, there has been a reduction of sanctuaries for natural replenishment of fish species throughout the country, which is another factor leading to shrinkage and destruction of aquatic habitats.

**Forests**

Bangladesh is a forest poor country. The forest cover of the country has shrunk to six percent in the recent years. But still forestry contribute to economy, livelihood of many and ecological stability. Gain P (2002) reports that officially the Forest Department of Bangladesh is supposed to manage around 2.6million hectares or 18 per cent of the land surface of the country, but most part without trees and plants. This is a land mass recorded as forest land when the Forest Act of 1927 came into being. However, according to the Forest Department’s latest information it now controls 10.3 percent of land surface (Forest Department 2001). The largest category of the forests of Bangladesh are “reserved forests” which include the Sundarbans (mangroves) in the southwest (601,700 ha), the CHT region in the southeast (322,331 ha) and the Madhupur tracts in the north-central region (17,107 ha). The much smaller category of forest is the protected forests. The basic difference between the reserved and the protected forests is that the inhabitants in the reserved forest areas have no rights over the forest produces but in the protected forests they have far more rights. In many cases the protected forest is an intermediate category which eventually turns into reserved forest. The last category of forest is the unclassed state forests (USF), most in the Chittagong Hill Tracts (CHT). Village common forests managed by the indigenous people in the CHT include substantially forested portions of the USF lands.

The three main types of public forests are; (i) Tropical evergreen of semi-evergreen forest (640,000 hectares) in the eastern district of Chittagong, Cox’s Bazar, Sylhet and the Chittagong Hill Tracts region (hill forest); (ii) Moist of dry deciduous forest also known as sal (Shorea robusta) forest (122,000 hectares) located mainly in the central plains and the freshwater areas in the northeast region; and (iii) Tidal mangrove forests along the coast (520,000 hectares)–the Sundarbans in the southwest of the Khulna and other mangrove patches in the Chittagong, Cox’s Bazar and Noakhali coastal belt (Gain, 2002).
Population pressure is often cited as a primary reason for encroachment of forest areas and conversion of it to crop lands. While this can sometimes be true, there are many instances of people (especially tribals) living in harmony with forests while protecting and consuming them. Unfortunately, such traditional practices have been lost and a more commercial approach to forest exploitation has led to large-scale deforestation in Bangladesh over the last several decades. Natural forests throughout the country are increasingly being depleted. Various types of development activity, such as dikes, highway, road construction, and other infrastructure development have further intensified deforestation, and destruction of natural forests in Bangladesh. Briefly, the other causes of deforestation are listed below. The State of the Environment report of Bangladesh (2001) listed the following factors of degradation of forest resources.

- Shifting cultivation (*Jhum*), and inappropriate utilization of forest resources,
- Overgrazing, illegal felling, and fuel wood collection,
- Uncontrolled and wasteful commercial exploitation of forest resources,
- Monoculture and commercial plantation,
- High population pressure on forestlands,
- Conversion of forests and wetlands for agricultural use,
- Poverty and unemployment in the rural areas, and
- Encroachment into forestland.

**Bio-diversity**

Bangladesh possesses good terrestrial and aquatic environment that provides habitat for large number of plants, animals and birds. The country has been very rich in biodiversity. The rivers and other inland water bodies provide habitats for 266 indigenous fish species and 150 birds. In Bangladesh, 22 species of *Amphibians* have been recorded by the IUCN-B in 2000. Some of these are economically important and thus are being exploited commercially. Until the early eighties many traders in the country were exporting frog legs in large quantities. Most of the frogs were collected from the wild, and exported as a frozen food item. This practice also causes insect and predator populations to be affected.

The depletion of reptilian fauna in the country is noteworthy. *Reptiles* are environment friendly as they eat many agricultural pests, and help control their numbers. However, turtles, tortoises, snakes, lizards, and crocodiles are exploited economically because of a tradition of making useful commodities from their body parts, e.g., bones, skins, etc. Therefore, most of them are in high demand by traders in these items, and are over-exploited.

The **mammalian fauna** of Bangladesh is the most highly affected from their habitat destruction and over exploitation. Very exceptionally people in Bangladesh use some wildlife species. Most of them are used either as food (e.g. turtles, lizards, snakes, parakeets and hill Mayna, etc.). However, the country is yet to formulate appropriate policies and guidelines to manage the utilization of these biological resources in a sustainable manner. Most of them are exploited in an unsustainable way, and hence, a number of wildlife species have become threatened (State of Environment Report Bangladesh, 2001).
Bangladesh has one of the most biologically resourceful and unique mangrove forests known as the Sundarbans. The Sundarbans is the largest mangrove forest in the world. Mangrove forests have a unique combination of terrestrial and aquatic ecosystems. The mangrove forests serve as a natural fence against cyclonic storms and tidal surges, stabilize coastlines, enhance land accretion, and enrich soil near the aquatic environment. The Sundarbans Reserve Forest occupies an area of 601,700 hectares of which 406,900 ha forests, 187,400 ha water (rivers, rivulets, ponds, and canals), 30,100 ha form wildlife sanctuaries, and 4200 hectares are sand bars. It is home to several uniquely adapted flora and fauna, and provides feeding and nursery grounds for many animals. Many animals spend their entire life in the mangroves, whilst others spend some part of it.

The mangrove forest is very rich in biodiversity and supports 334 species of plants, as many as 77 insects of different orders, 7 crabs, 1 lobster, 23 shrimp/prawns, 400 fish, 8 amphibians, 35 reptiles, 270 birds, and 42 species of mammals. There are about 13 and 23 species of orchids and medicinal plants, respectively, found in the Sundarbans. It is also the largest honey-producing habitat in the country with giant honey bees (Apis dorsata). The best tree for producing honey in the Sundarbans is Khulshi (Aegiceras comiculatum).

The Sundarbans is the only remaining habitat of the famous Royal Bengal Tiger (Crocodylus porosus) occur extensively in the rivers. The forest harbors large numbers of threatened wildlife species including Python, King Cobra, Adjutant Stork, White-bellied Sea Eagle, Clawless Otter, Masked Fin-foot, Ring-lizard, and River Terrapin. The Sundarbans is also home to thousands of Spotted deer (Axis axis).

Out of 26 species of mangroves, the two dominant ones are the Sundari (Heritiera fomes) and Gewa (Excoecaria agallocha). Among the trees, Gewa and Goran (Ceriops roxburghiana) are being used in newsprint mills for paper production, as well as for fuel-wood. The Sundari and Keora (Sonneratia apetala) are used as timber woods. Leaves of gol pata (Nypa fruticans) are used for thatching. At present, there is no commercial timber felling due to a moratorium imposed by the Government of Bangladesh, with the exception of Gewa and Goran (BCAS, 2001).

Both flora and fauna are threatened by the loss of habitats resulting from unwise human interventions and resources uses. The unplanned and rapid urbanization and industrialization degrade the ecosystems and thus affect the bio-diversity. The State of Environment report of Bangladesh identified the following key factors that cause to affect flora and fauna: destruction of habitats, overexploitation of flora and fauna, indiscriminate use of agro-chemical and pesticides, industrial pollution, encroachment of wetland and forests and change in land use patterns.

Agricultural Productivity

The economy of Bangladesh is primarily dependent on agriculture. About 84 percent of the total population live in rural areas and are directly or indirectly engaged in a wide range of agricultural activities. The agriculture sector plays a very important role in the
economy of the country accounting for 31.6 percent of total GDP in 1997-98 at constant (1984-85) prices. The agriculture sector comprises crops, forests, fisheries and livestock. Of the agricultural GDP, the crop sub-sector contributes 71 per cent, forest 10 per cent, fisheries 10 percent and livestock 9 per cent. The sector generates 63.2 percent of total national employment, of which crop sectors share is nearly 55%. Agricultural exports of primary products constituted 10.4% of total exports of the country in 1997-98 (SDNP, 2002). The following table gives some basic statistics of Bangladesh agriculture.

**Table 2.1 : Basic Information about Bangladesh Agriculture**

<table>
<thead>
<tr>
<th>Issues</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Cultivated Land</td>
<td>17.8 million acre</td>
</tr>
<tr>
<td>Irrigated Area</td>
<td>8.6 million acre</td>
</tr>
<tr>
<td>Small Farmers</td>
<td>80% (9.42 million)</td>
</tr>
<tr>
<td>Medium Farmers</td>
<td>18% (2.08 million)</td>
</tr>
<tr>
<td>Large Farmer</td>
<td>2% (0.3 million)</td>
</tr>
<tr>
<td>No. of Farm Households</td>
<td>11.80 million</td>
</tr>
<tr>
<td>No. of Agri-labour Households</td>
<td>6.40 million</td>
</tr>
<tr>
<td>Cropping Intensity</td>
<td>(1996-97) 174%</td>
</tr>
<tr>
<td>Agricultural Growth Rate</td>
<td>(1998-99) 5.0%</td>
</tr>
<tr>
<td>Contribution to GDP</td>
<td>(1998-99) 31.6%</td>
</tr>
</tbody>
</table>

*Sources: Webpage (2002) of Sustainable Development Networking Programme (SDNP) of the Government of Bangladesh under SEMP*

It is to be mentioned here that all the post independence governments were committed to increase food production through encouraging modern agri-input such seeds, irrigation, fertilizer and pesticide. Farmers also were very pro-active to take the immediate benefits of the so-called "Green Revolution". All those efforts increased food production in the country substantially and the country achieved some sort of autarchy in rice production in the recent years. But on the other hand, the sustainability of agriculture is questioned, because many farmers have already experienced the bad effect of the law of diminishing return. Though the total productivity of the sector has increased but the real productivity of land has decreased. The health of soil (nutrient and fertility) is greatly affected by the increasing uses of chemical fertilizer. The biodiversity in major agro-ecological zones is under serious threat due to unplanned and excessive use of chemical and pesticides. Further, plant diversity is lost due to HVY mono-culture. If present trends continue, the quality of land is likely to fall further and, with it, the productive capacity of the sector will decline greatly.

The future directions of conserving NRs and enhancing livelihood will depend largely on how rural people interact with the resource base: both the way production is organized and how technology is applied. Both are becoming important factors in determining the nature and limits of change. It is argued that natural resources will remain a major factor in ensuring and sustaining rural livelihoods in the next decade. However, the management of the resources will need to develop, both technologically and institutionally. More efficient and effective use of natural resources can lead to substantial improvements in employment and earnings of poor and small farmers. The consequent agro-processing and marketing activities will result in further employment and earnings for rural and semi-urban people. This potential will be more profitable and
sustainable if the country can take advantages of the process of globalization and specifically some of the rules of the present trading system and the envisaged changes (Rahman and Mallick, 2001 and Asaduzzaman, 2001).

4.6 NATURAL RESOURCE MANAGEMENT

Natural Resource occurs naturally within environments that exist relatively undisturbed by mankind, in a natural form. A natural resource is often characterized by amounts of biodiversity and geo-diversity existent in various ecosystems.

Conservation of natural resources means the wise use of the earth’s resources by humanity. The term conservation came into use in the late 19th century and referred to the management, mainly for economic reasons, of such valuable natural resources as timber, fish, game, topsoil, pastureland, and minerals, and also to the preservation of forests (see forestry), wildlife (see wildlife refuge), parkland, wilderness, and watershed areas. In recent years the science of ecology has clarified the workings of the biosphere; i.e., the complex interrelationships among humans, other animals, plants, and the physical environment.

Conservation is the optimum rational use of natural resources and the environment, having regard to the various demands made upon them and the need to safeguard and maintain them for the future. It is the protection, improvement and use of natural resources according to principles that will assure their highest economic or social benefits.
In ecology, conservation includes those measures concerned with the preservation, restoration, beneficiation, maximization, reutilization, substitution, allocation and integration of natural resources. In the present time, the term conservation has become an integral part of our everyday vocabulary. The term conservation absorbs principles from multiple directions of basic and social sciences; and all the principles make up the theme.

**State of Natural resource conservation in Bangladesh**

**Forest resources:** As resource, services of forest are uniquely important. Among the range of services the most significant ones are ecotourism, watershed protection, protective and habitat functions of mangroves, carbon sequestration, and biodiversity conservation. Forest is the source of wood energy. Wood fuels are a basic need for more than 2 billion people in the Asia-Pacific region only. While wood fuels' share of total energy use is declining, in many countries wood energy is still largely considered a traditional "poor people's fuel." The forest is also the source of industrial forest products. Only in the region of Asia-Pacific about 280 million cubic metres of industrial round wood is produced annually. Beyond all the above, the forest is directly used as "forest and tree resources." They are different types of services of forests, socio-cultural roles and nature-based ecotourism, agricultural services, watershed services, carbon sequestration, conservation of wildlife habitats and biological diversity values.

**Genetic resources:** Genetic resource is the key functional point of origin of all natural and modified bio resources. Genetic resources are used in the field of variability to protect biodiversity as well as environment by utilizing biotechnological application. The subject biotechnology and its application are not new, but recent developments in the biotechnological tools and their application have opened up wide opportunities to boost agriculture, medicine, livestock production, forestry, fisheries, health and nutrition as well as management and protection of environment. This frontier technology can provide substantial benefits to the society in a wide range of sectors for improving the quality of life.

**Wildlife resources:** The concern for wildlife is, however, the concern for man himself. All forms of life -- human, animal and plant -- are so closely interlinked that disturbance in one gives rise to imbalance in the others. Producers, consumers and decomposers are linked together in food chains. Disruption of any particular link in the chain may lead to imbalance which may threaten the existence of man himself. Nature maintains this vast diversity of animals and plants in a complex organization in which various life processes of production, consumption and disposal of waste are maintained in well balanced cycles.

**Aquatic (riverine, marine and estuarine) resources:** Water is essential for life on Earth. The ocean fuels the water cycle. It supplies oil, minerals, energy, much of oxygen, and 15% of our dietary protein. Minerals are scarce in much of the open ocean, so most of the phytoplankton, and the world's major fisheries, lie on continental shelves that receive minerals washed down the rivers. Other fisheries lie in parts of the open ocean where upwelling currents carry minerals up from the bottom. Coral reefs are among the most productive of all ecosystems, and they have a diversity of life forms rivaled only by the tropical rain forest. Many prized commercial fishes are inhabitants not of the open ocean but of reefs. Rocky shore supports much more life than a sandy one.
Coastal wetlands include mangrove swamp, found in tropical and subtropical regions, and salt marsh. These wetlands are hatcheries and nurseries of many important species of marine life. Most experts believe that the oceans could sustain an annual harvest of 100 million tons, but this would require better management than we have so far achieved.

The coastal area of Bangladesh is estimated as 710km long. The country's Exclusive Economic Zone (EEZ) is 14,0915sq km and the estimated total marine water area is 1,66,066sq km. and it is uniquely endowed with a wide variety of economically important coastal resources. Bangladesh has a vast network of rivers numbering about 230, about 24,000 km in length and covering an area of 9,380 sq km (6.5% of the total area of the country). Most of the major rivers have linkage with the estuary and finally meet the Bay of Bengal. Fish is the most important fauna of these rivers and considerable number of fisher men depends on river fishing for their livelihood. Bangladesh has one of the largest mangrove eco-systems in the world which also provides a valuable physical habitat for a variety of important coastal species. Fish in the estuaries and the sea constitute a major coastal resource. Unfortunately, reliable data and information on standing stock, potential yield etc. are lacking.

Bangladesh is rich in wide variety of flora and fauna as compared to the rest of the world: Five thousand flowering plants; 199 mammals; 567 birds; 120 reptiles; 734 amphibians. Besides, we have large number of unidentified flora and fauna. Bangladesh is uniquely endowed with natural resources. So, it is highly necessary to conserve both renewable and non-renewable natural resources for the sake of present and future generations. Management of both renewable and non-renewable resource has to be given top priority.

4.7 LOCAL KNOWLEDGE TO CONSERVING NATURAL RESOURCES

Local knowledge refers a body of knowledge built up by a group of people through generations of living in close contact with nature. A broader definition is that indigenous knowledge is the knowledge used by local people to make a living in a particular environment. These are simple but convenient definitions. However, indigenous knowledge is much more complex. In fact, a variety of terms have been used to describe this form of unique knowledge. These have included such terms as “local knowledge,” “traditional knowledge,” “indigenous traditional knowledge,” “indigenous technical knowledge”, “traditional environmental knowledge”, “rural knowledge”, “traditional ecological knowledge”, and so forth. However, these terms have similar meanings. But while there may be similarities in indigenous knowledge systems, indigenous knowledge is specific to communities and local environments.

The importance of Local/Indigenous Knowledge (LINK) and its potential in facilitating the sustainable use and conservation of natural resources have been repeatedly emphasized in international discourse on sustainable development in the past two decades. In 1992, Agenda 21 of the Rio Earth Summit highlighted the importance of holistic, traditional knowledge of lands, natural resources, and the environment developed over many generations by local/indigenous people (UN, 1992). The United Nations proclaimed 1993 as the “International Year for the World’s Indigenous Peoples,” presenting a unique opportunity to facilitate international cooperation to help preserve and share local/indigenous knowledge for sustainable resource management and conservation (UN, 1990). The Johannesburg Plan of Implementation, adopted at the
World Summit on Sustainable Development in 2002, again drew people’s attention to the vulnerability of local, traditional, and/or indigenous knowledge.

The communities in the areas of Bangladesh is used a variety of innovative, effective, and in some cases unique indigenous knowledge approaches to environmental conservation. The government of Bangladesh has also initiated to address and consider the mechanism of ethno/local knowledge to conserving natural resources. The main objectives of this initiative are to (BCAS, 2005):

- Facilitate sustainable conservation and management of natural resources and habitats through strengthening of community-based management of the resources.
- Introduce various economic and community welfare activities which are operated and managed by their community organizations
- Assist the communities to empower themselves in order to collectively address their problems and needs

Some major initiatives to consider the mechanisms of ethno/local knowledge for conserving natural resources are described below:

- Integrated Protected Area Co-management (IPAC)
- Community Based Natural Resource Management (CBNRM)
- Village Common Forest Management (VCF)
- Environmental Flow Assessment Protocol for Bangladesh
- Protected Area (PA) management

**Integrated Protected Area Co-management (IPAC)**

Collaborative management, or Co-Management, is an approach used by government technical agencies to collaborate with local communities and other stakeholders in the conservation of forest lands, wetlands and other natural resources. To implement this approach, co-managers engage local stakeholders through a participatory process that empowers them with a voice and well defined role in decision making and provides sufficient economic incentives to engage their interest in the successful achievement of agreed upon natural resource management objectives.

The Integrated Protected Area Co-management (IPAC) has embarked upon the strategic goal of scaling-up natural resource co-management at the policy and operational level by achieving recognition, acceptance and integration of this approach by the GOB into its management tactics. The overall IPAC objective is to promote and institutionalize an integrated protected area co-management system for sustainable natural resources management and biodiversity conservation that results in responsible, equitable economic growth and good environmental governance. Under IPAC, carefully crafted, integrated, activities are being implemented over significantly larger areas to: develop a protected area strategy that applies to ecologically and economically significant areas, build technical capacity within national and local level institutions for protected area co-management, and expand the geographic area of Bangladesh under co-management to ensure the long-term success of the models developed for freshwater and forest ecosystems. Institutionalization and successful implementation of IPAC will also address a series of short, medium and long term climate change mitigation and adaptation issues.
Community Based Natural Resource Management (CBNRM)

The Community Based Natural Resource Management (CBNRM) approach combines conservation objectives with the generation of economic benefits for rural communities. The three key assumptions being that: locals are better placed to conserve natural resources, people will conserve a resource only if benefits exceed the costs of conservation, and people will conserve a resource that is linked directly to their quality of life. When a local people's quality of life is enhanced, their efforts and commitment to ensure the future well-being of the resource are also enhanced.

A problem of CBNRM is the difficulty of reconciling and harmonizing the objectives of socioeconomic development, biodiversity protection and sustainable resource utilization. The concept and conflicting interests of CBNRM, show how the motives behind the participation are differentiated as either people-centred (active or participatory results that are truly empowering) or planner-centred (nominal and results in passive recipients). Understanding power relations is crucial to the success of CBNRM. Locals may be reluctant to challenge government recommendations for fear of losing promised benefits.

CBNRM is based particularly on advocacy by nongovernmental organizations working with local groups and communities, on the one hand, and national and transnational organizations, on the other, to build and extend new versions of environmental and social advocacy that link social justice and environmental management agendas with both direct and indirect benefits observed including a share of revenues, employment, diversification of livelihoods and increased pride and identity.

Village Common Forest Management (VCF)

Under Village Common Forest (VCF) Management approach, Indigenous communities of Bangladesh are managing forests around their homesteads in a sustainable way despite exclusion of customary rights on government managed reserved forests. Bangladesh, as one of the forest poor countries in the world, is continuously struggling to conserve its forest resources. However, community managed Village Common Forest (VCF) represents an influential model of forest management, serving multi-functions to the dependent indigenous communities. VCFs are enriched with more biodiversity than that of Government forests. Moreover, indigenous management of resources in VCFs were sustaining a balance between exploitation and conservation.

Having no other alternatives for livelihood, indigenous people of Chittagong Hill Tracts (CHT) have introduced a new form community managed forest management system, which is commonly known as Village Common Forest (VCF). Village Common Forest (VCF) is a natural forest other than the government forest around the households of the ethnic communities and managed to fulfill their daily demands. The birth of community-managed VCF in the CHT is a direct result of resource constraints caused by deforestation and the prevention of entry into and use of the resources of the newly acquired reserved forests (which were promptly declared as off limits to local people). These constraints led local communities to devise newer and more sustainable modes of the natural resources conservation and management. One such innovation, drawing
upon indigenous traditional methods of forest fallow and Jhum cultivation, gave birth to the VCF during the first quarter of the 20th century.

In spite of continuous degradation of forest resources VCFs are found well stocked. VCF plays important role in conserving forest resources as well as fulfilling other demands of the forest dependent communities. The indigenous communities are managing VCFs around their homesteads for the following reasons:

- To maintain tree cover and protect the environment in the face of rapid deforestation.
- To maintain a diversity of plant and animals (including herbs and plants used in herbal medicine), which have significant potentiality in modern medical science.
- To sustain a supply of wood and bamboo required for house construction and fuel consumption.
- To reduce the pressure on government managed reserved forest for forest products.
- To preserve the drinking water sources as many VCFs contain headwaters of streams natural springs and other aquifers.
- The VCFs are also related to the religions, cultural beliefs, rituals and ceremonies of man indigenous people.

**Environmental Flow Assessment Protocol for Bangladesh**

The concept of environmental flow is new in Bangladesh. Therefore, a national level protocol has been suggested for establishment of the concept in Bangladesh. Additionally, a protocol for environmental flow assessment has been developed. The protocol is based mainly on the expert assessment considering the dearth of data regarding environmental flow.

It is concluded that a unique method that relies primarily on expert opinion and local knowledge, and considers local water management practices should be followed for environmental flow assessment in the coastal regions of Bangladesh. The flow assessment protocol must include a scope for active interaction among experts from different fields, and among experts and local people. Although there may be significant difference of opinion among the experts at the initial stage of interaction, eventually they should be able to reach a consensus on how much flow is required for sustenance of the ecosystem with due consideration to other competing water uses. Local knowledge of flow requirement for different components of the ecosystem should be also an important consideration in flow assessment.
**Protected Area (PA) management**

Protected areas are "areas especially dedicated to the protection and maintenance of biological diversity and associated cultural resources, which are managed through legal or other effective means", "designated or regulated and managed to achieve specific conservation objectives". PAs have long been considered as the cornerstone of all national and regional conservation strategies. While it is often argued that they are the most effective and widespread measure for conserving forests and biodiversity, the importance of complementary off-reserve management has also been acknowledged. Three types of protected area were defined under the Bangladesh Wildlife Preservation Act, 1974 with the objective of conserving biodiversity (in-situ) and the natural environment (ex-situ) within various forest type.

**In-situ (on site)** conservation includes the protection of plants and animals within their natural habitats or in protected areas. Protected areas are areas of land or sea dedicated to protection and maintenance of biodiversity. For example: e.g., National Parks, Wildlife Sanctuaries, Biosphere Reserves, etc.

**Ex-situ (off site)** conservation is the conservation of plants and animals outside their natural habitats. These include Botanical Gardens, Zoo, Gene Banks, DNA Banks, Seed Banks, Pollen Banks, Seedling and Tissue Culture etc.
Climate change is one of the most important global environmental issues of our generation. The IPCC Definitions of Climate Change is "Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcing, or to persistent anthropogenic changes in the composition of the atmosphere or in land use.

Climate change has strong link with global warming, which is again associated with “Enhanced greenhouse effect”- considered as the result of human activities that have increased atmospheric concentrations of greenhouse gases and aerosols since the pre-industrial era.

If we look at Banglades, the climate of Bangladesh could also be changed throughout this century because the atmosphere already has ‘elevated levels’ of greenhouse gases. Bangladesh’s drought-prone areas (Barind) are warmer and drier than 50 years ago and current projections suggest that Bangladesh will become hotter, its nights will be warmer and it will face frequent droughts due to increased rainfall variations.

The module discusses the salient points of climate change like Climate change and its causes, Sectoral impacts and variability, Risk assessment, adaptation and mitigation as well as national and international response.
SESSION-05: UNDERSTANDING CLIMATE CHANGE

5.1 Climate & Climate Change (CC)
5.2 Causes of CC
5.3 Climate Change and Bangladesh: Geographical Location, Natural setting, physical infrastructure, socio-economic condition
5.4 Projected climate change impacts and Sectoral impacts
5.5 Managing Climate Risk Framework
5.7 National and International Response
5.0 UNDERSTANDING CLIMATE CHANGE

5.1 CLIMATE AND CLIMATE CHANGE

Climate change is one of the most important global environmental issues of our generation. It is distinct from natural climate variability in that it exists because of human activities that have altered the composition of the Earth’s atmosphere. Climate change can lead to things such as desertification, more intense storms, melting of the polar ice caps, and rising sea levels, changing the physical face of the Earth and the pattern of our everyday lives. While the possible consequences of climate change are alarming, there are many ways for every individual to take part in preventing these consequences from reaching their most dangerous potential.

The IPCC Definitions of Climate Change is “Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcing, or to persistent anthropogenic changes in the composition of the atmosphere or in land use. Note that the United Nations Framework Convention on Climate Change (UNFCCC), in its Article 1, defines climate change as: ‘a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods’. The UNFCCC thus makes a distinction between climate change
attributable to human activities altering the atmospheric composition, and climate variability attributable to natural causes.” (Source: Glossary, IPCC AR4, 2007)

Today's climate change is different from past climate change in several important ways:

**Natural causes are not responsible.** None of the natural causes of climate change, including variations in the sun's energy and the Earth’s orbit, can fully explain the climate changes we are seeing today. **People's activities are the main cause.** By burning lots of fossil fuels like coal, oil, and natural gas, people are overloading the atmosphere with carbon dioxide and adding to the greenhouse effect. People are also adding other heat-trapping greenhouse gases, such as methane and nitrous oxide, to the atmosphere. **Greenhouse gases are at record levels in the atmosphere.** For hundreds of thousands of years, the concentration of carbon dioxide in the atmosphere stayed between 200 and 300 parts per million. Today, it's up to nearly 400 parts per million, and the amount is still rising. Along with other greenhouse gases, this extra carbon dioxide is trapping heat and causing the climate to change.
5.2 CAUSES OF CLIMATE CHANGE

The Earth would be much colder if not for the ‘greenhouse’ gases that provide a blanket that warms the atmosphere. Some of the gases in the atmosphere transmit the short-wave radiation from the Sun to the Earth, warming its surface. Some of this warmth is emitted in the form of long-wave (infrared) radiation from the Earth to the atmosphere and some of the gases in the atmosphere absorb and re-emit radiation of this wavelength, effectively enhancing the warming of the lower atmosphere. These gases are called greenhouse gases because their effect is similar to the function of a glass greenhouse that heats up as infrared radiation is trapped by the glass. The main greenhouse gases are carbon dioxide, methane, nitrous oxide and water vapour all of which occur naturally in the atmosphere.

The gases that contribute directly to the enhanced greenhouse effect as a result of anthropogenic activities are carbon dioxide, methane and nitrous oxide emitted from combustion of fossil fuels, deforestation and agriculture, and sulphur hexafluoride, perfluorocarbons and hydrofluorocarbons are arising from industrial processes. Some other gases, including carbon monoxide, nitrogen oxides and volatile organic compounds, contribute indirectly to global warming through chemical reactions in the atmosphere. The contribution of each of the greenhouse gases to global warming is dependent on its Global Warming Potential (GWP), expressed as Carbon Dioxide Equivalent (CO2 E). The GWP takes into account:

- the amount of radiation that the gas absorbs,
- the time that the gas stays in the atmosphere before reacting or being dissolved in rainwater or the ocean,
- the current concentration of the gas in the atmosphere,
- and any indirect effects of the gas (eg. methane will produce ozone gas in the lower atmosphere and water vapour in the stratosphere).

GWP of nitrous oxide is 298 times that of carbon dioxide and methane is 25 times that of carbon dioxide when considered over 100 years (Solomon et al. 2007).

The following figure—taken from assessment report 4, IPCC (2007)—shows us that how the atmospheric concentration of GHGs is increasing over the years. The **global atmospheric concentration of CO2** increased from a pre-industrial value of about 280ppm to 379ppm in 2005. The annual CO2 concentration growth rate was larger during the last 10 years (1995-2005 average: 1.9ppm per year) than it has been since the beginning of continuous direct atmospheric measurements (1960-2005 average: 1.4ppm per year). (IPCC AR4 2007). The next figure is showing us the increasing trends are found in temperature, sea level and the melting of snow cover.

![Diagram-3.4](image-url)
The Role of long-lived GHGs: Human activities result in emissions of four long-lived GHGs: CO2, methane (CH4), nitrous oxide (N2O) and halocarbons (a group of gases containing fluorine, chlorine or bromine).

Global anthropogenic GHG emissions

Atmospheric concentrations of GHGs increase when emissions are larger than removal processes. Global atmospheric concentrations of CO2, CH4 and N2O have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years. The atmospheric concentrations of CO2 and CH4 in 2005 exceed by far the natural range over the last 650,000 years. Global increases in CO2 concentrations are due primarily to fossil fuel use, with land-use change providing another significant but smaller contribution. It is very likely that the observed increase in CH4 concentration is predominantly due to agriculture and fossil fuel use.

The global atmospheric concentration of CH4 has increased from a pre-industrial value of about 715ppb to 1732ppb in the early 1990s, and was 1774ppb in 2005.
The global atmospheric N2O concentration increased from a pre-industrial value of about 270ppb to 319ppb in 2005 (IPCC AR4 2007). Many halocarbons (including hydrofluorocarbons) have increased from a near-zero pre-industrial background concentration, primarily due to human activities. The increase in concentration of greenhouse gases in the atmosphere has altered the earth’s radiative balance, resulting in more of the sun’s heat being absorbed and trapped inside the earth’s atmosphere, producing global warming. Without mitigation measures, the concentration of CO2 in the atmosphere is expected to increase average global temperature by 1 to 6°C. (Solomon et al. 2007) To avert catastrophic impact it is generally agreed that atmospheric CO2 concentration should be constrained to 550 ppm, which is believed will limit the temperature increase to 2°C.
Global and continental temperature change

North America

Europe

Asia

Africa

South America

Australia

Global

Global Land

Global Ocean

models using only natural forcings
models using both natural and anthropogenic forcings

observations
How the enhanced climate variability is related to El Niño and La Niña?

Though first noticed by 16th century fishermen on the Pacific coast of South America, these phenomena, El Niño and La Niña, were not scientifically documented until the 1920s when scientists noticed periodic occurrences of these in every three to seven years in the eastern Pacific. But research found that since 1970s, El Niño and La Niña have been occurring with more frequency and intensity. Some scientists believe that the increased intensity and frequency—now every two to three years—of El Niño and La Niña events in recent decades is due to warmer ocean temperatures resulting from global warming. In a 1998 report, scientists from NOAA explained that higher global temperatures might be increasing evaporation from land and adding moisture to the air, thus intensifying the storms and floods associated with El Niño.

5.3 CLIMATE CHANGE AND BANGLADESH: GEOGRAPHICAL LOCATION, NATURAL SETTING, PHYSICAL INFRASTRUCTURE, SOCIO-ECONOMIC CONDITION
5.4 PROJECTED CLIMATE CHANGE IMPACTS AND SECTORAL IMPACTS

The vulnerability context varies across the country. The contexts may be characterized by geographical region with predominant ecosystem. The present vulnerability of the country is related to flood (riverine and flash flood), drought, salinity, cyclone and storm surges, and river bank and soil erosion which will be aggravated by climate change and sea level rise. The northwestern region of Bangladesh is prone to seasonal drought where extreme temperature and erratic behavior of rainfall are key issues related to climate change. Salinity intrusion, sea level rise, and cyclone and storm surges are key issues for the low lying coastal area. The floodplain ecosystem spread over mostly in the central region of the country which will face frequent and intense flood due to climate change. The north-eastern and hilly areas of the country will face more devastating flash flood. A summary of the characteristics of the climate related vulnerability context by major geographical regions and ecosystems are given below.

Table-

<table>
<thead>
<tr>
<th>Types of Geographic al Areas with Dominant Ecosystems</th>
<th>Climate Change Vulnerability Context and Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floodplain (freshwater aquatic ecosystem, fisheries, Transplanted Aman)</td>
<td>Changes in Flooding Characteristics</td>
</tr>
<tr>
<td></td>
<td>Coverage of inundated area in monsoon season will increase</td>
</tr>
<tr>
<td></td>
<td>Changes in depth and duration of inundation (depth of water will be higher)</td>
</tr>
<tr>
<td></td>
<td>Changes in recession period of flood water (waterlogging)</td>
</tr>
<tr>
<td></td>
<td>Changes in flood frequency (more frequent and intense flood)</td>
</tr>
<tr>
<td>Drought Prone (dryness, moisture stressed condition)</td>
<td>Changes in Drought Characteristics</td>
</tr>
<tr>
<td></td>
<td>Changes in drought intensity (more area under severe drought)</td>
</tr>
<tr>
<td></td>
<td>Changes of extent of drought prone area (expansion of area)</td>
</tr>
<tr>
<td></td>
<td>Changes in timing of drought (erratic behaviour of rainfall and</td>
</tr>
</tbody>
</table>
### Coastal Zone
Changes in Coastal Characteristics
- Expansion of salinized areas
- Increase in salinity intensity
- Increase drainage congestion and coastal flooding
- Cyclone and storm surges

### Haor Basin (tectonically depressed area)
Changes in Haor Basin Characteristics
- Changes in timing of flash flood
- Changes in recession period

### Hilly Region
Changes in distribution of rainfall and intensity
- Changes in erosion of top soil
- Increase possibility of landslide

| Table: Summary of Vulnerability Context | Source: May 2009 Policy Study on The Probable Impacts of Climate Change on Poverty and Economic Growth and the Options of Coping with Adverse Effect of Climate Change in Bangladesh. General Economics Division, Planning Commission, Government of the People's Republic of Bangladesh & UNDP Bangladesh |

The above mentioned vulnerability context of climate change is likely to affect agriculture sector including crops, livestock and fisheries; freshwater for drinking and agricultural purpose; and rural infrastructure including water supply and sanitation, and rural roads. However, The following table shows level of impacts of climate change on different sectors.

### Impacts on Crop and Agriculture sector
Agricultural crop of Bangladesh is influenced by seasonal characteristics and different variables of climate such as temperature, rainfall, humidity, day-length etc. It is also often constrained by different disasters such as floods, droughts, soil and water salinity, cyclone and storm surges. Several studies indicated that climate is changing and becoming more unpredictable every year in Bangladesh. There is a strong possibility that moisture content of the topsoil in the north-western region would decrease substantially resulting from decrease in winter precipitation and higher evapotranspiration. Degradation of productive land including quality and physical loss are key concerns for coastal agriculture due to salinity intrusion and sea level rise. Drainage congestion and water logging is very likely in the coastal region as a result of combined effect of higher sea water levels, subsidence, sedimentation of estuary branches, higher riverbed levels and reduced sedimentation in flood-protected areas.

The higher temperatures and changing rainfall patterns coupled with increased flooding, rising salinity in the coastal belt, droughts in the northwest and southwest, and drainage congestions are likely to reduce crop yields and crop production. IPCC estimates that, by 2050, rice production in Bangladesh could decline by 8 percent and wheat by 32 percent.
Table: Perception of Present Level of Impacts related to Climate Change on Crop Agriculture in the Flood and Flash Flood Affected Areas;

<table>
<thead>
<tr>
<th>Major Changes and Impacts</th>
<th>Crop loss/yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Soil quality degradation by sand deposition due to bank erosion</td>
<td>10</td>
</tr>
<tr>
<td>• Improve soil health by deposition of silts and SOM</td>
<td>20</td>
</tr>
<tr>
<td>• Changes in flooding characteristics (increased frequency, severity, duration and extent)</td>
<td>30</td>
</tr>
<tr>
<td>• Changes in crops/cropping patterns with new varieties</td>
<td>15 (increase)</td>
</tr>
<tr>
<td>• Damage of Aus, Aman by riverine flood and river bank erosion</td>
<td>30</td>
</tr>
<tr>
<td>• Damage of Boro Rice by flash flood in basin areas</td>
<td>40</td>
</tr>
<tr>
<td>• Delay sowing of pulses and vegetables</td>
<td>30</td>
</tr>
<tr>
<td>• Increase waterlogged area</td>
<td>20</td>
</tr>
<tr>
<td>• River bank erosion causing decrease of cultivable land</td>
<td>20</td>
</tr>
<tr>
<td>• Increasing incidence of pests and diseases</td>
<td>10</td>
</tr>
</tbody>
</table>

Source: May 2009 Policy Study on The Probable Impacts of Climate Change on Poverty and Economic Growth and the Options of Coping with Adverse Effect of Climate Change in Bangladesh. General Economics Division, Planning Commission, Government of the People’s Republic of Bangladesh & UNDP Bangladesh

Table: Perception of Present Level of Impacts related to Climate Change on Crop Agriculture in the Drought Affected Areas

<table>
<thead>
<tr>
<th>Major Changes and impacts</th>
<th>Crop loss/yield reduction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decreasing soil moisturizer that affect crop production systems</td>
<td>20</td>
</tr>
<tr>
<td>Changes in drought characteristics (time/duration, severity and extent)</td>
<td>20</td>
</tr>
<tr>
<td>Degradation of soil physical properties</td>
<td>20</td>
</tr>
<tr>
<td>Increasing soil-related constraints</td>
<td>25</td>
</tr>
<tr>
<td>Cultivable paddy land is transferring to high value crops especially in Barind areas</td>
<td>16</td>
</tr>
<tr>
<td>Changes in crops/cropping patterns with new varieties</td>
<td>10 (increase)</td>
</tr>
<tr>
<td>Aman crop is affected by drought</td>
<td>30</td>
</tr>
<tr>
<td>Wheat is affected by drought and shorter winter period</td>
<td>20</td>
</tr>
<tr>
<td>Rabicrops/vegetables, pulses being affected due to moisture stress and fogginess</td>
<td>30</td>
</tr>
<tr>
<td>Fruit dropping due to moisture stress, B deficiency and fogginess</td>
<td>30</td>
</tr>
<tr>
<td>Increasing incidence of pests and diseases</td>
<td>15</td>
</tr>
</tbody>
</table>

Source: May 2009 Policy Study on The Probable Impacts of Climate Change on Poverty and Economic Growth and the Options of Coping with Adverse Effect of Climate Change in Bangladesh. General Economics Division, Planning Commission, Government of the People’s Republic of Bangladesh & UNDP Bangladesh
## Table: Perception of Present Level of Impacts related to Climate Change on Crop Agriculture in the Coast Areas

<table>
<thead>
<tr>
<th>Major Changes and Impacts</th>
<th>Crop loss/yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Increasing soil salinity with extent and severity</td>
<td>20</td>
</tr>
<tr>
<td>• Swelling/heavy clays/salt crusting in land preparation</td>
<td>15</td>
</tr>
<tr>
<td>• Degradation of soil physical/chemical properties due to prolonged water stagnancy creating micro-nutrient deficiencies of S and Zn wetland rice cultivation.</td>
<td>25</td>
</tr>
<tr>
<td>• Increasing soil-related constraints (viz. swelling/cracking clays, soil wetness) that create problems in land preparation</td>
<td>30</td>
</tr>
<tr>
<td>• Late planting of rabi crops due to delaying in recession of flood water and soil wetness</td>
<td>20</td>
</tr>
<tr>
<td>• Damage of standing crops (khesari, soybean, groundnut) due to moisture stress and salinity</td>
<td>30</td>
</tr>
<tr>
<td>• Increasing water-logged areas keeping more cultivable land as fallow in Rabi, Kharif-I and Kharif-II season</td>
<td>Fallow: 50%</td>
</tr>
<tr>
<td>• Changes in crops/cropping pattern with varieties</td>
<td>10 (increase)</td>
</tr>
<tr>
<td>• Rainfed aus crop is affected by drought and salinity</td>
<td>30</td>
</tr>
<tr>
<td>• Boro and wheat is affected by salinity</td>
<td>20</td>
</tr>
<tr>
<td>• Conversion of crop land into shrimp culture</td>
<td>30</td>
</tr>
<tr>
<td>• Increasing incidences of pests and diseases</td>
<td>20</td>
</tr>
<tr>
<td>• Decreasing income source of the poor in coastal areas</td>
<td></td>
</tr>
</tbody>
</table>

Source: May 2009 Policy Study on The Probable Impacts of Climate Change on Poverty and Economic Growth and the Options of Coping with Adverse Effect of Climate Change in Bangladesh. General Economics Division, Planning Commission, Government of the People’s Republic of Bangladesh & UNDP Bangladesh

Experts have also expressed their views on changing cropping pattern. Changes in characteristics such as untimely and prolonged flooding, erratic rainfall, temperature variation, prolonged drought, changes in the length of winter and summer seasons have identified as climate change related drivers. Key experts informed that the length of winter season is decreasing whereas summer is increasing. Present cropping seasons are also facing uneven distribution of rainfall and temperature variation which is leading seasonal adjustment in the cropping pattern and in most cases these are temporary changes. Moreover, crop land is transferring to horticulture especially in the drought prone area. This reduces rice crop production considerably at local level but significant implication is limiting rural livelihood opportunities in crop agriculture.

**Fisheries Sector**

There is limited quantitative assessment of impacts of climate change on fisheries but it is anticipated that aquaculture will be affected adversely due to increased flooding and lack of availability of water in the dry season. While production may increase in open water fisheries as a result of monsoon flood. Therefore, total production of freshwater fishes may remain same. It is also expected that composition of coastal fisheries may change overtime as a result of coastal inundation and salinity intrusion. It is also anticipated that livestock will face fodder crisis in the coastal and heat related stress in the north-west region of the country.
Existing Impacts: Climate change will have both negative and positive impacts on fisheries. The positive impact is possible increase in the open water fisheries during flood. It appears that the impacts would not be remarkable in national context rather it would affect investment at individual level. The key experts’ interviews and consultation workshops revealed that flood and cyclone affect culture fisheries severely while affect of other shocks such as drought, salinity intrusion, erratic rainfall, heat wave, cold wave, fogginess is low to moderate. Flood causes fish loss damaging pond dykes, hatcheries, nurseries and embankments. It also affects fish production through disease outbreaks and pond siltation. Fish production may also be hampered by affecting breeding ground of fish due to siltation of fish habitat. These affect livelihoods of fishermen and fish farmers.

Coastal aquaculture and fisheries are severely affected by cyclone and storm surges. Cyclone causes destruction of fishers’ lives and properties (boats, nets etc.). It damages fish landing and marketing centres, aquaculture infrastructure including embankments, sluice gate, hatcheries, and nurseries. In the drought prone areas, fish production decreases due to drying up of inland water bodies or limited availability of water. It also affects fish stock, growth and breeding of fishes. Moreover, drought causes disease outbreaks, reduction of fisheries seasons and declination of natural broods. Salinity intrusion affects freshwater fisheries by decreasing inland water bodies. It decreases income and nutrition of rural poor but has positive impacts on coastal shrimp culture. Erratic rainfall adversely affect natural spawning of fish including major carp spawning in Halda river and Kaptai lake and ultimately fish production and fishers. Cold wave and fogginess also adversely affect fisheries. Cold wave affects breeding performance and growth of fish species which reduces fish production. Besides, fogginess causes fish mortality in aquaculture pond and small water bodies due to depletion of dissolve oxygen.

Future Impacts: It is likely that fisheries sector will face the similar problem related to climate change including variability and extreme. Key difference will be frequency, intensity and scale of the problem. Similar to the present situation, flood will have both positive and negative impacts in future. Flood will affect aquaculture infrastructure, pond siltation, habitat of fish breeding at larger scale while increased area under inundation and long duration is likely to increase open water fisheries. Drought will affect fish growth, breeding & production, increase disease vulnerability, reduce fishing season and reduce broods of natural SIS. Probable impacts of cyclone are almost similar to existing impacts but severity will be increased which will affect poverty at wider scale. Salinity intrusion and erratic rainfall will also affect fish production.

Impacts on Livestock Sector

Assessment of impacts of climate change on livestock is also limited. However, it is suggested that extreme temperature and climate change related natural disasters would affect livestock significantly. High temperature would affect livestock in a number of ways: causes great discomfort as in the case of human, decreases feed intake and alters nutrient metabolism leading to high loss of energy and the combined effects of discomfort and nutrient metabolism reduces their productivity, resulting in financial loss for the farmers. Apart from extreme temperature, natural disasters such as cyclone and tidal surge as mentioned above, also cause immense loss and sufferings to livestock through destruction of forage crops as well as housing.
Deaths of livestock due to cyclone and storm surge are huge in the coastal area. Flood, cyclone and sea level rise have major impacts on livestock. Flood causes loss of livestock, damage pasturelands which increase fodder scarcity and diseases of livestock. Cyclone and storm surge causes huge loss of animal lives and shelters, damage of fodder, poor health and disease outbreak. Ultimately it results reduction of livestock population. Sea level rise and associated coastal inundation leads to inundation of pastureland and increase animal feed scarcity and increase incidence of animal diseases. It also reduces animal rearing coverage. Drought hampered the production of livestock, increase management cost through incidence of diseases and increase food scarcity which results poor health of livestock. Besides, salinity intrusion, temperature variation and heat wave cause harm to livestock affecting fodder land and health of poultry and other domesticated animals.

It is difficult to have perception on the impacts of climate change, variability and extremes on livestock because there is no baseline information on these exist. But it is easily perceived that death and production of livestock will decrease considerably with increasing intensity and frequency of shocks. Production of livelihood will also hampered due to decrease of grazing lands, increase death of livestock etc. These will lead to decrease health status affecting meat and milk production.

**Impacts on Forestry Sector**

Cyclone and storm surges along with salinity intrusion are the major shocks for forestry sector, stated by the key experts. Cyclone damages forest and scale of damage depends on severity of cyclone and storm surges. The supper cyclone Sidr destructed one quarter of the Sundarbans and almost 100% afforested trees along its path. It has been observed that all the trees at road sides as well as homesteads of about 10 to 15 years old have been destructed by the Sidr. It means, 10-15 years of investments of individuals on homestead forestry as well as afforestation have been simply diminished within only a few hours. Salinity intrusion has also adverse effects on freshwater forest ecosystem. It affects adversely the flora and fauna composition. Flood and river bank erosion moderately affect forest and cause loss of biodiversity, mortality of flood susceptible trees and plants and destroy both aquatic and terrestrial ecosystems.

In the north-western part of the country, drought badly affects trees and plants due to moisture stress of the soil. Branches and leaves of trees are dried up due to lack of moisture and excessive evapo-transpiration. Besides, erratic rainfall, heat wave, and temperature variation cause harm to germination of seeds and transfer of species from one place to another. Temperature variation brings changes in species of natural hill forest. A large number of people depend on forest resources particularly on the natural forest and forest product. Forestry sector will be affected by climate induced shocks and changes at higher scale. Flood will cause loss of trees.

**Impacts on Water Supply and Sanitation sector**

The contexts of vulnerability of water and sanitation to climate change stimuli including variability and extremes vary from region to region within the country. It is likely that the gradual change phenomena such as temperature rise and erratic behaviour of rainfall will lead to increased water demand and drought while sea level rise and salinity intrusion will deteriorate water quality in the coastal region. Climate change
related extreme events particularly cyclone and storm surge will damage water supply and sanitation infrastructure particularly in the coastal region.

Increase in summer temperature will increase water demand in the urban area for drinking and bathing as well as industrial water demand for cooling system. The competition of demand may aggravate the current conflict between domestic and industrial water supplies in the urban areas. Situation will be different in the rural area where availability and quality of rivers and artesian wells and pond water in the dry season will be deteriorated. Shortage of safe drinking water is likely to become more pronounced, especially in the coastal belt and drought prone areas in the north-west of the country. It is also likely that saline water boundary will be pushed more towards inland and vast areas will face severe water crisis in future. People now having access to fresh water will no longer enjoy this service. Due to cyclone and storm surge, huge volumes of saline water will come to the land area and contaminate freshwater ponds. These will severely damage the existing drinking water sources. For instance, ponds for the Pond Sand Filters (PSF) and dug wells may be flooded with saline water. It may also contaminate hand tube wells and other sources as well.

It is likely that unavailability and low quality will accentuate the prevailing drinking water crisis in the dry season. This will impose hardship on women and children, who are responsible for collecting drinking water for their families. Saline drinking water may also result in increase health hazards, especially for pregnant women. It appears that climate change is likely to adversely affect women more than men. Climate is controlled mainly by the combined effects of atmosphere and hydrosphere. Naturally water is affected by climate change, variability and extremes. Climate change affects water sector in different ways. In the monsoon, excessive rainfall causes flood and water logging which results in scarcity of drinking water, water borne diseases’ outbreak, damage of crops, infrastructure (embankments, roads, educational and social institutes), reduces income sources and livelihood options, and death of human beings and other animals. In the dry season, lack of rainfall causes scarcity of water for drinking, household activities and irrigation as well as diseases like dehydration, scabies and other infectious diseases. In the coastal area, cyclone and salinity intrusion affect fresh water sources severely.

Cyclone damages water infrastructure, increases contamination of fresh water sources with saline water, causes water pollution which results in scarcity of drinking water and water for irrigation. Besides this, back water effects and coastal inundation reduces sources of fresh water and thus food production and other livelihoods are also affected. Water and sanitation will face severe impacts of climate change in future. Scarcity of drinking and irrigation water will be the major issue which will affect lives and livelihoods of the poor. Excessive water in the monsoon will damage settlements and infrastructure, disease outbreaks and even death at higher scale compared to the existing situation, whereas lack of rainfall in the monsoon will cause scarcity of water for drinking and sanitation. Drought will also create scarcity of water for irrigation which will affect crop production and decrease livelihood options of the poor. Cyclone and salinity in the coastal region will increase damage of fresh water sources and agricultural land which will also affect the livelihoods of the poor. Besides that, water borne diseases will affect human health severely.
Impacts on Industry and Infrastructure Sector
Climate change, variability and extremes have large impacts on Industry and Infrastructure. Flood and cyclone are the two major climatic events which affect this sector severely. Flood has great impacts on small and medium industries, including handloom. The key experts informed that handloom industries in Pabna, Sirajganj and Bogra are severely affected by flood and river bank erosion almost every year. Investment by handloom owners is lost. Loom workers lose their income for two to three months and often migrate to greater cities for carrying their livelihoods. This creates huge pressure on cities’ utility services, health, sanitation and sewerage systems. The women workers involved in handloom become fully unemployed during flood. They cannot either earn or migrate to other places. Other industries also suffer due to disruption of roads and communication systems, power supply networks etc.

Drought also affects industrial production causing health stress of worker, seasonal migration due to scarcity of water and decreases in the number of workers in the drought season etc. In the coastal area, industry and infrastructure are mainly affected by cyclone and storm surge. Climate change events, especially cyclone have both direct and indirect impacts on industry. It destroys buildings of industries and machineries in one hand; on the other hand, it destroys roads and other communication networks, power supply networks, water supply networks, and causes health degradation and death of workers. Moreover, salinity has large scale impacts on industry. The Khulna Paper Mill was closed due to increase water salinity of the river. It also affects machineries and materials of industries and causes loss of large investments. Erratic rainfall causes urban drainage congestion which also affects production of industries. Tourism industries are affected by coastal erosion, coastal inundation, cyclone and storm surge, scarcity of fresh water availability in the coastal region etc.

Impact on Health Sector
Many scientists already anticipated that more frequent and more intense and severe weather events will result in increased deaths, injuries and disease in developed countries like Canada, but the biggest impact will be felt in low-lying, heavily populated areas such as Bangladesh, particularly when coupled with sea level rise attendant upon global warming (Canadian Association of Physicians for the Environment, 2004). According to IPCC (2001, 2007), the global warming would increase the vector borne and water borne diseases in the tropics. Best-estimate climate change scenario indicates that the incidences of dengue may increase threefold in Indonesia (ADB, 1994b in IPCC, 1997). In fact, the increasing trend and variation of dengue occurrences are consistent with the corresponding trend and variation of temperature, which infers that the anticipated future warming in Bangladesh might increase the dengue occurrence (NAPA Study note).

Impact Perception: Human health suffers from different climatic variability and shocks in different ways. The experts informed that health is affected, especially during and after shocks like flood and cyclone. Slow onsets of climatic system have also impacts on health. Flood affects sources of drinking water and sanitation system through contamination which lead to out break of diarrhoea, cholera, skin diseases including scabies, drowning, snake bite and even death. Cyclone, sea level rise and salinity intrusion cause outbreaks of diarrhoea, cholera and other water borne diseases, use of saline water causes hypertension, increase blood pressure, corrosive effects due to salt in air, scabies and other skin diseases. Besides that, drought, erratic rainfall and
temperature variation increase vector borne diseases, heat stroke, malnutrition, fever etc. Cold wave creates respiratory problem, especially that of children and the old.

It is already proven that different types of diseases breakout during and after flood. In future, these impacts will be more frequent and severe since intensity and frequency of flood will increase. Similarly, cyclone and storm surge will affect human health and lives severely with the increasing intensity and frequency of cyclone. Besides this, temperature variation, erratic rainfall will increase incidence of vector borne diseases like dengue, malaria. Lack of fresh water in drought prone and coastal areas will increase malnutrition, extreme poverty, bring changes in occupation, increase migration etc.

**Impact on the Education Sector**
Flood has multi dimensional impacts on education. Impacts of slow onset or climate variability on education are not remarkable but the rapid onsets like flood and cyclone have severe impacts on education. It damages school buildings and houses, displaces children and detaches them from schools, loss of study materials, use of schools as shelters in the non-flooded areas hamper continuation of education, and increases the rate of dropout. In a sense, education is totally disrupted during flood in the affected areas. Cyclone is another devastating shock for education. It damages education infrastructure, increases poverty, increases drop out rate etc. Drought has also negative impacts on education. Children of the drought affected areas are engaged in income generating activities and suffer from malnutrition. Scarcity of drinking and other water resources also lead to low attendance of the children in their schools. These impacts will affect the poor very severely because the rich could migrate and settle in the cities but the poor do not have that capacity. Salinity will affect education in a different way, i.e. opportunity of shrimp farming and fry collection will encourage the poor children to be engaged in these activities to carry on with their livelihood.

<table>
<thead>
<tr>
<th>Key issues</th>
<th>Probable Impacts</th>
<th>Identified impacts</th>
<th>Poverty</th>
<th>Economic growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flood</td>
<td>School building will damage Book and other materials lost</td>
<td>Very Severe</td>
<td>Very Severe</td>
<td>Very Severe</td>
</tr>
<tr>
<td>Drought</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Cyclone</td>
<td>Destruction of infrastructure School damage Material lose</td>
<td>Very Severe</td>
<td>Very Severe</td>
<td>Very Severe</td>
</tr>
<tr>
<td>Coastal inundation</td>
<td>People who are educated, rich, they will migrate to better cities or country, but the poor, uneducated and unskilled people will suffer severely</td>
<td>Very Severe</td>
<td>Very Severe</td>
<td>Moderate</td>
</tr>
<tr>
<td>Salinity</td>
<td>Opportunity of shrimp farming and fry collection has increased, but the overall situation will be severe</td>
<td>Very Severe</td>
<td>Very Low</td>
<td>Very Low</td>
</tr>
</tbody>
</table>

Table: Impacts of different disasters on Education Infrastructure and subsequent impacts; Source: May 2009 Policy Study on The Probable Impacts of Climate Change on Poverty and Economic Growth and the Options of Coping with Adverse Effect of Climate Change in Bangladesh. General Economics Division, Planning Commission, Government of the People’s Republic of Bangladesh & UNDP Bangladesh)
5.5 MANAGING CLIMATE RISK FRAMEWORK

Risk Assessment

Risk is the result of interactions of physically defined hazard with the properties of the exposed systems - i.e. their sensitivity or social vulnerability. Risk can also be considered as the combination of an event, its likelihood, and its consequences - i.e. risk equals the probability of climate hazard multiplied by a given systems vulnerability (adaptation policy frameworks for climate change, 2005).

Risk Assessment is a structured and auditable process of identifying potentially significant events, assessing their likelihood and impacts, and then combining these to provide an overall assessment of risk, as a basis for further decisions and action.

(Source: CDMP 2009 Practicing Gender & Social Inclusion in Disaster Risk Reduction, Government of the People’s Republic of Bangladesh.)

The development of risk evaluation criteria will help in making judgments about which risks need to be treated. Risk identification involves identifying and description of hazards, vulnerability, capacity, and environment of the community. The purpose of identifying risks is to develop risk statements for later analysis and evaluation.

(Source: CDMP 2009 Practicing Gender & Social Inclusion in Disaster Risk Reduction, Government of the People’s Republic of Bangladesh.)
In order to analyze the risk the likelihood and consequences of natural hazards are to be considered. To estimate the likelihood of a natural hazard, some aspects can be considered: how often the hazard is occurred, the duration of time and the history of the hazard. On the other hand, to estimate consequences, the severity of a potential effect that could result from a hazard can be considered. Risk levels confirmation and risk acceptability are the two issues which are the results of the risk analysis, addressed in risk evaluation. In this process different risks are prioritized for referral to other agencies and needed treatment by the Emergency Management Personnel.

In the risk management process, at first whether the Risk is acceptable to community or not is determined through different stakeholders and community people consultation. If a risk is accepted, this fact needs to be reviewed periodically and subject to further analysis and evaluation. Where a risk is not acceptable, then it needs to be treated. Treating risks is to reduce their likelihood and harmful consequences to the community and environment through a process of selecting and implementing risk treatment options that modify the characteristics of the hazards, the community or the environment. Monitoring and review are essential for the Risk Management as this is a continuous process. The entire Risk Management process is based on good Communication Consultation with different stakeholders, community people and Risk Management Personnel.

The National Framework to manage Climate Risks:

![Managing Climate Risk Framework](image)

Source: CDMP Component 4B, CHANGING THE WAY WE DEVELOP, Climate Change Cell, Bangladesh, February 2008 Room 514, Paribesh Bhaban, E-16 Agargaon, Dhaka-1207, Bangladesh.

Assessing the Climate Change Risks
The process of priority setting for climate change preparedness efforts will be based on estimation of climate risk to systems in particular planning areas. Risk is defined and described here as:

Risk = Consequence x Probability

Three issues are to be considered here:

Consequence of an impact

What are the known or estimated consequences (economic, ecological, social, cultural and legal) of a particular climate change impact? For example, consider how costly failure of a flood wall can be or how coastal ecosystems and development will be affected by different projections of sea level rise. This estimation may be qualitative (high, medium, low) and/or quantitative (e.g., $18 million for the failure of a flood wall). Any assessment of consequence should also factor in the estimated scale of the impact, such as the size of the population or land area affected by a projected climate change impact.

Probability or likelihood of an impact

How likely is it that a projected impact will occur? Some climate change impacts, such as increasing average temperatures and sea level rise, are virtually certain. The degree to which these changes affect existing problems or lead to new problems should be evaluated in the vulnerability assessment. Probability can be assessed qualitatively (high, med, low), particularly in cases where resources are limited, information is limited, or the consequences of the impacts are small.

Risk Perception and Risk Tolerance

How risk is viewed (risk perception) and accepted (risk tolerance) will play a significant role in the risk evaluation. Risk perception and tolerance can vary widely between individuals, over time, and/or with different thresholds. Community meetings and interviews with government leaders may provide insight into what risks are and are not acceptable, and at what thresholds these distinctions are made.

Other considerations that can affect basic estimations of risk are the planning time frame, the geographic scale of the risk assessment, and attitudes towards risk. The degree to which any of these factors significantly alters the conclusions of the risk assessment should be considered.

What is Adaptation

Initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects. Various types of adaptation exist, e.g. anticipatory and reactive, private and public, and autonomous and planned. Examples are raising river or coastal dikes, the substitution of more temperature-shock resistant plants for sensitive ones, etc. (IPCC 2007)

What is Mitigation

Mitigation is the effort to reduce loss of life and property by lessening the impact of disasters. This is achieved through risk analysis, which results in information that provides a foundation for mitigation activities that reduce risk, and flood insurance that protects financial investment.
The following table of sample risk assessment. It is good practice to describe why a high, medium, or low rating was assigned to a given system. Each qualitative statement can be converted into a numeric score (high=5, medium-high=4, medium=3, medium-low=2, and low=1) to develop risk scores for each impact.

### 13.2 Community Based Adaptation and Mitigation

In related terms, a community is a group of individuals and households living in the same location and having the same hazard exposure, who can share the same objectives and goals in disaster risk reduction. The community referred to are local villages and the community members may have varying perception of risk depending on social class, education, age, gender, etc. Poor communities in poor countries like Bangladesh, are most vulnerable to climate change and are already feeling its impacts, but have contributed least to the problem. Helping them to adapt to climate change is vital, but identifying steps to take and ensuring that this information reaches communities at risk is a major challenge. Community-based adaptation (CBA) is a tool for achieving this. Community based adaptation and mitigation covers a broad range of interventions, measures, activities, projects and programs to reduce disaster risks, which are primarily designed by people in at-risk localities and are based on their urgent needs and capacities. Simply put, its aim is to 1) reduce vulnerabilities and increase capacities of vulnerable groups and communities to cope with, prevent or minimize loss and damage to life, property, and the environment, 2) minimize human suffering, and 3) hasten recovery.

IPCC defined adaptation as *Initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects* (IPCC AR4, 2007). Adaptation does also mean “doing development better”; or changing existing policies and practices and adopting new policies and practices so as to secure millennium development goals in the face of climate change and its associated impacts. Adaptation is true necessity, but Mitigation is also needed, which reduces and limits the destructive and disruptive effects of hazards on the elements at risk. Mitigation Measures range from the physical such as engineering works like bridges, protective dikes, embankments, and safe building design to the non-structural interventions such as community risk assessment, community risk reduction planning, public awareness, food security programs, group savings, cooperatives, crop insurance, strengthening community disaster management organizations and advocacy on disasters and development issues, legislation and land use zoning. Mitigation and prevention interventions are directly linked to development planning. Disaster mitigation is intrinsic to sustainable development” (Twigg et al, 2000).

CBA begins by identifying the communities in the developing world that are most vulnerable to climate change. These are generally very poor, depend on natural resources and occupy areas already prone to shocks such as floods or droughts. Once a community’s vulnerability has been established, using the best available science on climate change impacts, the process of engagement with the communities can begin.

However, the following adaptation measures have been suggested for Bangladesh to address adverse effects of climate change including variability and extreme events based
on existing coping mechanisms and practices. The suggested future adaptation strategies are:

1. Reduction of climate change hazards through coastal afforestation with community participation.
2. Providing drinking water to coastal communities to combat enhanced salinity due to sea level rise.
3. Capacity building for integrating climate change in planning, designing of infrastructure, conflict management and land-water zoning for water management institutions.
4. Climate change and adaptation information dissemination to vulnerable community for emergency preparedness measures and awareness rising on enhanced climatic disasters.
5. Construction of flood shelter, and information and assistance centre to cope with enhanced recurrent floods in major floodplains.
6. Mainstreaming adaptation to climate change into policies and programmes in different sectors (focusing on disaster management, water, agriculture, health and industry).
7. Inclusion of climate change issues in curriculum at secondary and tertiary educational institution.
8. Enhancing resilience of urban infrastructure and industries to impacts of climate change.
9. Development of eco-specific adaptive knowledge (including indigenous knowledge) on adaptation to climate variability to enhance adaptive capacity for future climate change.
10. Promotion of research on drought, flood and saline tolerant varieties of crops to facilitate adaptation in future.
11. Promoting adaptation to coastal crop agriculture to combat increased salinity.
12. Adaptation to agriculture systems in areas prone to enhanced flash flooding in North East and Central Region.
13. Adaptation to fisheries in areas prone to enhanced flooding in North East and Central Region through adaptive and diversified fish culture practices.
14. Promoting adaptation to coastal fisheries through culture of salt tolerant fish special in coastal areas of Bangladesh.
15. Exploring options for insurance and other emergency preparedness measures to cope with enhanced climatic disasters.

5.6 NATIONAL AND INTERNATIONAL RESPONSE

14.1 International Horizon


The United Nations Conference on the Human Environment (also known as the Stockholm Conference) was an international conference convened under United Nations auspices held in Stockholm, Sweden from June 5-16, 1972. It was the UN’s first major conference on international environmental issues, and marked a turning point in the development of international environmental politics.

14.1.2 Earth Summit 1992
The United Nations Conference on Environment and Development (UNCED), also known as the Rio Summit, Rio Conference, Earth Summit (Portuguese: Eco '92) was a major United Nations conference held in Rio de Janeiro from 3 June to 14 June 1992. 172 governments participated, with 108 sending their heads of state or government. Some 2,400 representatives of non-governmental organizations (NGOs) attended, with 17,000 people at the parallel NGO "Global Forum" (a.k.a. Forum Global), who had Consultative Status. The issues addressed included:

- systematic scrutiny of patterns of production — particularly the production of toxic components, such as lead in gasoline, or poisonous waste including radioactive chemicals
- alternative sources of energy to replace the use of fossil fuels which are linked to global climate change
- new reliance on public transportation systems in order to reduce vehicle emissions, congestion in cities and the health problems caused by polluted air and smog
- the growing scarcity of water

An important achievement was an agreement on the Climate Change Convention which in turn led to the Kyoto Protocol. Another agreement was to "not carry out any activities on the lands of indigenous peoples that would cause environmental degradation or that would be culturally inappropriate". The Earth Summit resulted in the following documents:

- Rio Declaration on Environment and Development
- Agenda 21
- Convention on Biological Diversity
- Forest Principles
- Framework Convention on Climate Change (UNFCCC).

Both Convention on Biological Diversity and Framework Convention on Climate Change were set as legally binding agreements.

14.1.3 The Rio Declaration on Environment and Development 1992

The Rio Declaration on Environment and Development, often shortened to Rio Declaration, was a short document produced at the 1992 United Nations "Conference on Environment and Development" (UNCED), informally known as the Earth Summit. The Rio Declaration consisted of 27 principles intended to guide future sustainable development around the world.

14.1.4 Agenda 21 (1992)

Agenda 21 is an action plan of the United Nations (UN) related to sustainable development and was an outcome of the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, Brazil, in 1992. It is a comprehensive blueprint of action to be taken globally, nationally and locally by organizations of the UN, governments, and major groups in every area in which humans directly affect the environment.
14.1.5 United Nations Framework Convention on Climate Change 1992

The United Nations Framework Convention on Climate Change (UNFCCC or FCCC) is an international environmental treaty produced at the United Nations Conference on Environment and Development (UNCED), informally known as the Earth Summit, held in Rio de Janeiro from June 3 to 14, 1992. The objective of the treaty is to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. The treaty itself set no mandatory limits on greenhouse gas emissions for individual countries and contains no enforcement mechanisms. In that sense, the treaty is considered legally non-binding. Instead, the treaty provides for updates (called "protocols") that would set mandatory emission limits. The principal update is the Kyoto Protocol, which has become much better known than the UNFCCC itself. Setting no immediate restrictions under UNFCCC serves three purposes:

- it avoids restrictions on their development, because emissions are strongly linked to industrial capacity
- they can sell emissions credits to nations whose operators have difficulty meeting their emissions targets
- they get money and technologies for low-carbon investments from Annex II countries.

14.1.6 Convention on Biological Diversity (CBD) 1993

The Convention on Biological Diversity (CBD) was signed at the Earth Summit in Rio de Janeiro, Brazil, in 1992 and entered into force on 29 December 1993. It is the first global agreement to cover all aspects of biological diversity: the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of benefits arising from the use of genetic resources. (http://www.cbd.int/secretariat/)
The Convention has three main goals:

1. conservation of biological diversity (or biodiversity);
2. sustainable use of its components; and
3. fair and equitable sharing of benefits arising from genetic resources

14.1.7 The United Nations Convention to Combat Desertification 1996

The United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa is a Convention to combat desertification and mitigate the effects of drought through national action programs that incorporate long-term strategies supported by international cooperation and partnership arrangements.

14.1.8 Kyoto Conference (1997) and The Kyoto Protocol

The Kyoto Protocol is a protocol to the United Nations Framework Convention on Climate Change (UNFCCC or FCCC), aimed at fighting global warming. The UNFCCC is an
international environmental treaty with the goal of achieving the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

The five principal concepts of the Kyoto Protocol are:

- **Commitments to the Annex-countries.** The heart of the Protocol lies in establishing commitments for the reduction of greenhouse gases that are legally binding for Annex I countries. Dividing the countries in different groups is one of the key concepts in making commitments possible, where only the Annex I countries in 1997, were seen as having the economic capacity to commit themselves and their industry. Making only the few nations in the Annex 1 group committed to the protocols limitations.

- **Implementation.** In order to meet the objectives of the Protocol, Annex I countries are required to prepare policies and measures for the reduction of greenhouse gases in their respective countries. In addition, they are required to increase the absorption of these gases and utilize all mechanisms available, such as joint implementation, the clean development mechanism and emissions trading, in order to be rewarded with credits that would allow more greenhouse gas emissions at home.

- **Minimizing Impacts on Developing Countries by establishing an adaptation fund for climate change.**

- **Accounting, Reporting and Review in order to ensure the integrity of the Protocol.**

- **Compliance.** Establishing a Compliance Committee to enforce compliance with the commitments under the Protocol.

### 14.1.9 World Summit on Sustainable Development 2002

The World Summit on Sustainable Development, WSSD or Earth Summit 2002 took place in Johannesburg, South Africa, from 26 August to 4 September 2002. It was convened to discuss sustainable development by the United Nations. WSSD gathered a number of leaders from business and non-governmental organizations, 10 years after the first Earth Summit in Rio de Janeiro. (It was therefore also informally nicknamed "Rio+10").

### 14.1.10 The Bali Road Map 2007

After the 2007 United Nations Climate Change Conference on the island Bali in Indonesia in December, 2007 the participating nations adopted the **Bali Road Map** as a two-year process to finalizing a binding agreement in 2009 in Copenhagen. The conference encompassed meetings of several bodies, including the 13th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 13) and the 3rd Meeting of the Parties to the Kyoto Protocol (MOP 3 or CMP 3).

### 14.1.11 SAARC Declaration on Climate Change 2007

The SAARC member states are determined to contribute to this global effort, in line with the principle of common but differentiated responsibilities. Given our vulnerabilities,
inadequate means and limited capacities, we need to ensure rapid social and economic development in our region to make SAARC climate change resilient. Development provides the best form of adaptation. We also believe that developed countries must assume greater commitments in line with their responsibility. SAARC believes that the way forward must include:

- Adequate resources to tackle climate change without detracting from development funds.
- Effective access to and funding assistance for the transfer of environment-friendly technologies and for adaptation.
- Binding GHG emission reduction commitments by developed countries with effective timeframes.
- Equitable burden sharing.


The 2009 United Nations Climate Change Conference, commonly known as the Copenhagen Summit, was held at the Bella Center in Copenhagen, Denmark, between 7 December and 18 December. The conference included the 15th Conference of the Parties (COP 15) to the United Nations Framework Convention on Climate Change and the 5th Meeting of the Parties (MOP 5) to the Kyoto Protocol. According to the Bali Road Map, a framework for climate change mitigation beyond 2012 was to be agreed there. The conference was preceded by the Climate Change: Global Risks, Challenges and Decisions scientific conference, which took place in March 2009 and was also held at the Bella Center. The negotiations began to take a new format when in May 2009 UN Secretary General Ban Ki-moon attended the World Business Summit on Climate Change in Copenhagen.

On 18 December after a day of frantic negotiations between heads of state, it was announced that a "meaningful agreement" had been reached between on one hand the United States and on the other, in a united position as the BASIC countries (China, South Africa, India, and Brazil). However, there were many controversies regarding the outcome of COP 15.

14.1.13 COP-16 (2010)

The 2010 United Nations Climate Change Conference was held in Cancún, Mexico, from 29 November to 10 December 2010. The conference is officially referred to as the 16th session of the Conference of the Parties (COP 16) to the United Nations Framework Convention on Climate Change (UNFCCC) and the 6th session of the Conference of the Parties serving as the meeting of the Parties (CMP 6) to the Kyoto Protocol. The outcome of the summit was an agreement adopted by the states’ parties that called for a large "Green Climate Fund", and a "Climate Technology Center" and network. It looked forward to a second commitment period for the Kyoto Protocol.

Outcome:

Adaptation: It decides to establish the Cancun Adaptation Framework and the Adaptation Committee, invites Parties to strengthen and, where necessary, establish
Mitigation: Developing country Parties will take nationally appropriate mitigation actions in the context of sustainable development, supported and enabled by technology, financing and capacity-building, aimed at achieving a deviation in emissions relative to "business as usual" emissions in 2020. It decides to set up a registry to record nationally appropriate mitigation actions seeking international support and to facilitate matching of finance, technology and capacity-building support to these actions. Once support has been provided they are called internationally supported mitigation actions (ISMAs), that will be subject to international measurement, reporting and verification.

Finance: It takes note of the collective commitment by developed countries to provide new and additional resources, including forestry and investments through international institutions, approaching USD 30 billion for the period 2010–2012 and recognizes that developed country Parties commit, in the context of meaningful mitigation actions and transparency on implementation, to a goal of mobilizing jointly USD 100 billion per year by 2020 to address the needs of developing countries.

Technology: In technology development and transfer, decides to establish a Technology Mechanism, which will consist of a Technology Executive Committee and a Climate Technology Centre and Network. The Climate Technology Centre and Network and the Technology Executive Committee shall relate so as to promote coherence and synergy. The Technology Executive Committee shall further implement the framework of the Convention (technology transfer framework) and Committee shall comprise 20 expert members. The Climate Technology Centre shall facilitate a Network of national, regional, sectoral and international technology networks, organizations and initiatives

Capacity-building: It reaffirms that capacity-building is essential to enable developing country Parties to participate fully in addressing the climate change challenges, and to implement effectively their commitments under the Convention.

14.2 National Horizon

14.2.1 Standing Orders on Disaster, Ministry of Food and Disaster Management
Disaster Management Bureau (January 2010)

The Standing Orders on Disaster in the current format was first published in 1997 in Bangla. The present publication named “Standing Orders on Disaster” is the manifestation of Government’s commitment to enhance capability at all tiers of our administrative and social structures for coping with a recovering from disasters. It is a guidebook for all concerned for coping with an recovering from disasters most efficiently.

The BCCSAP is designed as a 'living document. This is because there are still uncertainty about the timing and exact magnitude of many of the likely impacts of climate change. The BCCSAP is presented in two parts. The first part provides the background based on physical and climatic contexts, core socio-economic realities and policies in the country and the consequent rationale for a strategy on climate change. The thrust of the strategy is on sustainable development, poverty reduction and increased well-being of all vulnerable groups in society with special emphasis on gender sensitivity. The second part elaborates a set of programmes based upon six pillars or broad areas of intervention (not necessarily mutually exclusive) which have been elaborated in the first part. The BCCSAP sums up Bangladesh’s current thinking on desirable activities to build climate resilience into the economy and society of Bangladesh through adaptation to climate change as well as mitigation for a low carbon development path.

14.2.3 National Adaptation Programme of Action (NAPA) -Final Report-November 2005

The National Adaptation Programme of Action (NAPA) for Bangladesh has been prepared by the Ministry of Environment and Forest (MOEF), Government of the People’s Republic of Bangladesh as a response to the decision of the Seventh Session of the Conference of the Parties (COP7) of the United Nations Framework Convention on Climate Change (UNFCCC). The NAPA is the beginning of a long journey to address adverse impacts of climate stimuli including variability and extreme events and to promote sustainable development of the country. The NAPA of Bangladesh draws upon the understanding gathered through discussion with relevant stakeholders in four sub-national workshops and one national workshop, prior research, background papers prepared by Six Sectoral Working Groups (SWG) i.e. a) Agriculture, Fisheries and Livestock coordinated by Bangladesh Agricultural Research Council (BARC), b) Forestry, Biodiversity and Land-use coordinated by IUCN, Bangladesh, c) Water, Coastal Zone, Natural Disaster and Health coordinated by Water Resources Planning organization (WARPO), d) Livelihood, Gender, Local Governance and Food Security coordinated by Bangladesh Institute for Development Studies (BIDS), e) Industry and Infrastructure coordinated by Department of Environment (DoE), and f) Policies and Institutes coordinated by Bangladesh Centre for Advanced Studies (BCAS), and expert judgments.
Disaster can be define as, the occurrence of a sudden or major misfortune which disrupts the basic fabric and normal functioning of a society, or community. Disaster impacts may include loss of life, injury, disease and other negative effects on human physical, mental and social well-being, together with damage to property, destruction of assets, loss of services, social and economic disruption and environmental degradation. Generally, disasters are of two types – Natural and Manmade.

Disaster risk management is defined as a series of actions (programmes, projects and/or measures) and instruments expressly aimed at reducing disaster risk in endangered regions, and mitigating the extent of disasters. Disaster risk management includes assessment risk, vulnerability and hazard; disaster response, prevention and mitigation; and disaster preparedness.

Bangladesh is exposed to natural hazards, such as, floods, river erosion, cyclones, droughts, tornadoes, earthquakes, water logging, landslide etc. But the nature of occurrence, season and extent of effect of the hazards are not the same in all places.

The module discusses the salient points of Understanding Terminologies and topologies, Disaster Preparedness and Management, Local, national and international perspective, Different initiatives by global community and Policy and strategy
SESSION-6: DISASTER PREPAREDNESS AND MANAGEMENT

6.1 Understanding disaster
6.2 Concept of Hazard, Risk, Vulnerability and Disaster
6.3 Types of disaster: natural and manmade
6.4 Disaster risk management
6.5 Variability of disaster due to climate change
6.1 Understanding Disaster

**Disaster** can be defined as, the occurrence of a sudden or major misfortune which disrupts the basic fabric and normal functioning of a society, or community. An event or series of events which gives rise to casualties and/or damage or loss of property, infrastructure, essential services or means of livelihood on a scale which is beyond the normal capacity of the affected community's ability to cope with out aid. (UNDP). A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources.

Disasters are often described as a result of the combination of: the exposure to a hazard; the conditions of vulnerability that are present; and insufficient capacity or measures to reduce or cope with the potential negative consequences. Disaster impacts may include loss of life, injury, disease and other negative effects on human physical, mental and social well-being, together with damage to property, destruction of assets, loss of services, social and economic disruption and environmental degradation. (Source: UNISDR Terminologies). Disaster occurs when Hazards meet Vulnerability. Some terms related with disaster.

6.2 Concept of Hazard, Risk, Vulnerability and Disaster
Concept of Hazard (H)

**Hazard** is defined as the potential occurrence, in a specific time period and geographic area, of a natural phenomenon that may adversely affect human life, property or activity to the extent of causing a disaster.

Only a few hazards, earthquakes for example, occur as purely natural phenomena; most others, such as forest fires, floods and landslides, can come about with and without human intervention. The hazards that pose risks to human settlements are often categorized as geological, climatic, environmental, epidemic, or industrial.

The hazards are characterized by the followings:
- The event is not directly caused by humans
- The event directly affects humans
- The event often accompanied by a violent release of energy, and
- The event is sometimes beyond prediction in the short to long term

Concept of Vulnerability

**Vulnerability** denotes the inadequate means or ability to protect oneself against the adverse impacts of natural events and, on the other hand, to recover quickly from their effects.

Most of disaster mitigation work is focused on reducing vulnerability, and in order to act to reduce vulnerability, development planners need an understanding of which elements are most at risk from the principal hazards which have been identified.

The losses caused by a hazard, such as a storm or earthquake, will be proportionally much greater to more vulnerable populations – those living in poverty, with weak structures, and without adequate coping strategies. The vulnerability is described generally at three levels:
- **Human vulnerability** is the relative lack of capacity of a person or community to anticipate, cope with, resist, and recover from the impact of a hazard.
- **Structural or physical vulnerability** is the extent to which a structure or service is likely to be damaged or disrupted by a hazard event.
- **Community vulnerability** exists when the **elements at risk** (defined below) are in the path or area of the hazard and susceptible to damage by it.

The probability that a hazard will or will not occur, and its magnitude when it does occur also contributes to risk. Methods of predicting various hazards and the likelihood and frequency of occurrence vary widely by type of hazard. To be able to reduce hazards or prepare for them, we have to ascertain their potential. To a certain extent, it is possible to obtain quite a full picture of possible hazards from the history of past events. To
exactly identify the possible size of the hazard, however, this information must be supplemented by professional assistance and modern technology.

**Concept of Risk**

The relationship of these elements can be expressed as a simple mathematical formula which illustrates the concept that the greater the potential occurrence of a hazard and the more vulnerable a population, then the greater the risk. **Risk** is the expected losses to a community when a hazard event occurs, including lives lost, persons injured, property damaged and economic activities or livelihoods disrupted.

**Hazard × Vulnerability = Risk**

UNDP defines risk as the probability of harmful consequences — casualties, damaged property, lost livelihoods, disrupted economic activity, and damage to the environment — resulting from interactions between natural or human-induced hazards and vulnerable conditions. Risk is a function of hazard and vulnerability. It is important to know how to develop useful estimates of the degree of risk for any type of hazard in any geographic location. There are three essential components to the determination of risk, each of which should be separately quantified:

- The **hazard occurrence probability**: the likelihood of experiencing a particular hazard in a given location or region within a specific timeframe.
- The **elements at risk**: identifying and making an inventory of people or buildings or other elements which would be affected by the hazard if it occurred, and, where required, estimating their economic value.
- The **vulnerability** of the elements at risk: determining the potential level of injury to people or damage that buildings or other elements would sustain if they experience a particular hazard.
6.3 Types of Disaster: Natural and Manmade

Disaster is a sudden, calamitous event bringing great damage, loss, and destruction and devastation to life and property. The damage caused by disasters is immeasurable and varies with the geographical location, climate and the type of the earth surface/degree of vulnerability. This influences the mental, socio-economic, political and cultural state of the affected area. Generally, disasters are of two types – Natural and Manmade. A natural disaster is a consequence when a natural calamity affects humans and/or the built environment. On the other hand, man-made disasters are disasters resulting from man-made hazards (threats having an element of human intent, negligence, or error; or involving a failure of a man-made system), as opposed to natural disaster resulting from natural hazards.

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<thead>
<tr>
<th>Medium</th>
<th>Natural</th>
<th>Human</th>
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<tr>
<td>Earth</td>
<td>Avalanches</td>
<td>Road and train accidents</td>
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<td></td>
<td>Earthquakes</td>
<td>Ecological irresponsibility</td>
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<td>Erosion (River Bank and Coastal)</td>
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<td>Eruptions</td>
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<td>Toxic mineral deposits</td>
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<td>Air</td>
<td>Blizzards</td>
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<td>Cyclones</td>
<td>Hijackings</td>
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<td>Meteorite and planetary activity</td>
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<td>Ice Storms</td>
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<td>Thermal shifts</td>
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<td>Dust storms</td>
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<td>Fire</td>
<td>Lightning</td>
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<td>Water</td>
<td>Drought</td>
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<td>Storms</td>
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<td>Tsunami</td>
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<td>People</td>
<td>Endemic disease</td>
<td>Civil Strife</td>
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<td>Epidemics</td>
<td>Criminal extortion by viruses and poisons</td>
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<td></td>
<td>Famine</td>
<td>Guerrilla warfare</td>
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<td>Overpopulation</td>
<td>Hostage taking</td>
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<td>Plague</td>
<td>Sports crowd violence</td>
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<td>Terrorism</td>
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<td>Warfare</td>
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6.5 DISASTER RISK MANAGEMENT

Disaster risk management is defined as a series of actions (programmes, projects and/or measures) and instruments expressly aimed at reducing disaster risk in endangered regions, and mitigating the extent of disasters. Disaster risk management includes assessment risk, vulnerability and hazard; disaster response, prevention and mitigation; and disaster preparedness.

16.1 Assessment of Vulnerability

The purpose of assessing vulnerability is to be able to take appropriate actions to reduce vulnerability before the potential for damage becomes actual. Vulnerability from the perspective of disaster management means assessing the threats from potential hazards to the population and to infrastructure. Correctly assessing vulnerability is important for making meaningful risk assessments and ultimately for reducing the impact of disasters.

A vulnerability assessment is the process of identifying, quantifying, and prioritizing (or ranking) the vulnerabilities in a system. Vulnerability assessment has many things in common with risk assessment. Assessments are typically performed according to the following steps:

* Cataloging assets and capabilities (resources) in a system.
* Assigning quantifiable value (or at least rank order) and importance to those resources
* Identifying the vulnerabilities or potential threats to each resource
* Mitigating or eliminating the most serious vulnerabilities for the most valuable resources

The matrix can be filled out for an individual, a community or a larger entity, such as a country. Complete the matrix by considering a particular hazard and an individual’s or community’s exposure, relevant to the factors listed in the left column. Estimate the community’s capacity to withstand the effects of the hazard for each factor. Factors for which the community has a limited capacity to withstand a hazard indicate areas of vulnerability that need to be addressed.
Who: *for example, individual, community, country*:
Hazard: *(name of particular hazard)*

<table>
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<tr>
<th>Factors</th>
<th>Exposure</th>
<th>Capacity to Withstand</th>
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<tr>
<td>Proximity</td>
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<tr>
<td>Economic class</td>
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<tr>
<td>Social status</td>
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<td>Political status</td>
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<tr>
<td>Psychological condition</td>
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*(Source: Vulnerability and Risk Assessment, UNDP)*

**Hazard Assessment**

**Hazard Assessment** is the process of estimating, for defined areas, the probabilities of the occurrence of potentially-damaging phenomenon of given magnitude within a specified period of time. Hazard Assessment is sometimes called Hazard Evaluation or Hazard Analysis. The process of hazard assessment is used to determine the likelihood of occurrence of a particular hazard at a particular intensity. For example, seismologists may estimate the probability of a major earthquake occurring in Mexico City within the next ten years. Hazard assessment studies are based on available scientific information, such as geological and topographical maps, climate data, aerial photographs and satellite imaging. In addition, historical records of past occurrences of hazards of varying intensities, including oral accounts from long-term community residents, are an important tool in hazard assessment. The process of Hazard Analysis includes:

**Identification of Possible Hazards** – Possible hazards might be identified through: Response history, Hazard survey, Local disaster history, Current scientific knowledge, Environmental sensing etc.

**Characterize Each Hazard** – Hazards are not identical, not uniform, not exclusive and not transposable. The hazard should be identified in the context of time and place. Characterizing hazard must consider detail criteria: magnitude and intensity range; time and season; duration; timeline of development; place and extent of impact area; frequency; predictability; and secondary effect that are related to and can be triggered by or trigger other events

**Rating Hazard or Hazard Assessment** – Hazard assessment or rating is very difficult process due to wide range of variability in the hazard data i.e. where, when, what and how bad the event occurred. Hazard may be accessed through qualitative or quantitative way:

**Communicates the Result** – The process includes: (i) Typically a written report that describes the method used, identifies the hazards, and ranks them. Report should clearly identify the time period for which it is valid, other restrictions to the scope, and underlying assumptions, (ii) Distribute the report to the key stakeholders, (iii) Use the report as the basis for vulnerability assessment. *(Source: Emergency Management Process Series No. 1, Walter G. Green)*
Assessment of Risk

UNDP defines risk as the probability of harmful consequences—casualties, damaged property, lost livelihoods, disrupted economic activity, and damage to the environment resulting from interactions between natural or human-induced hazards and vulnerable conditions. Risk assessment is a process to determine the nature and extent of such risk, by analyzing hazards and evaluating existing conditions of vulnerability that together could potentially harm exposed people, property, services, livelihoods and the environment on which they depend. It is a basic instrument of disaster risk management used to study the factors of disaster risk and provide the basis for planning and implementing measures to reduce risks and impacts of disasters.

Disaster Risk analysis and identification

A comprehensive risk assessment not only evaluates the magnitude and likelihood of potential losses but also provides full understanding of the causes and impact of those losses. Risk assessment, therefore, is an integral part of decision and policy-making processes and requires close collaboration among various parts of society.
Step 1: Understanding of current situation, needs and gaps to assess what already exists, avoid duplication of efforts, and builds on existing information and capacities. This is done through a systematic inventory and evaluation of existing risk assessment studies, available data and information, and current institutional framework and capabilities.

Step 2: Hazard assessment to identify the nature, location, intensity and likelihood of major hazards prevailing in a community or society.

Step 3: Exposure assessment to identify population and assets at risk and delineate disaster prone areas.

Step 4: Vulnerability analysis to determine the capacity (or lack of it) of elements at risk to withstand the given hazard scenarios.

Step 5: Loss/impact analysis to estimate potential losses of exposed population, property, services, livelihoods and environment, and assess their potential impacts on society.

Step 6: Risk profiling and evaluation to identify cost-effective risk reduction options in terms of the socio-economic concerns of a society and its capacity for risk reduction.

Step 7: Formulation or revision of DRR strategies and action plans that include setting priorities, allocating resources (financial or human) and initiating DRR programmes.

Disaster Risk Management Process

Disaster risk management comprises the whole systematic and conceptual framework of measures that are closely linked to each other and that are taken before and after a natural hazard occurs with the aim of limiting or avoiding adverse impacts of a natural event on society. The central aim is the reduction of the disaster risk for people living in the regions that are exposed to natural hazards. Reducing the disaster risk involves: reducing the post disaster impact, reducing the vulnerability of the population and preventing the occurrence of new hazards.

(Source: Disaster Risk Management and Mitigation, (ADPC, 2002))
**Search and Rescue**
Search and rescue are the first step after the disaster impact. The Search and rescue means is the search for and provision of aid to people who are in distress or imminent danger due to the havoc of disaster.

**Relief**
Disaster relief is about meeting the immediate needs of communities and individuals affected by disasters or major incidents of varying degree. The intention of relief is to create a bridge for those affected to return to normal life as soon as possible.

The most common forms of relief are the provision of shelter, clothing, food, water, medication and security. Relief should be provided with dignity, sensitivity and respect for those affected. However, it should not be provided in a manner that will create dependency. Everyone has the right to life with dignity - and respect for their human rights. The Municipality, humanitarian agencies and all other role players have the responsibility to provide assistance in a manner that is consistent with human rights, including the right to participation, nondiscrimination and the provision of information.

**Damage and Need Assessment and Analysis**
The clear and concise assessment of damages, losses and injuries in the aftermath of a disaster is a prerequisite for the effective planning and implementation of relief and recovery.

**Rehabilitation – Physical and Psychological**
Rehabilitation refers to the actions taken in the aftermath of a disaster to enable basic services to resume functioning, assist victims’ self-help efforts to repair physical damage and community facilities, revive economic activities and provide support for the psychological and social well being of the survivors. It focuses on enabling the affected population to resume more-or-less normal (pre-disaster) patterns of life. It may be considered as a transitional phase between immediate relief and more major, long-term development.

The social and psychological both recovery of the affected population are important task of post disaster risk management.

**Reconstruction: Prevention and Mitigation**
Post-disaster reconstruction is a complex process. It requires multi-sectoral involvement, very significant resources and a wide range of skills. The prevention and mitigation measure have to take through reconstruction.

**Preparedness Planning**
Preparedness is typically understood as consisting of measures that enable different units of analysis—individuals, households, organizations, communities, and societies—to respond effectively and recover more quickly when disasters strike. Preparedness efforts also aim at ensuring that the resources necessary for responding effectively in the event of a disaster are in place, and that those faced with having to respond know how to use those resources. The activities that are commonly associated with disaster
Preparedness include developing planning processes to ensure readiness; formulating disaster plans; stockpiling resources necessary for effective response; and developing skills and competencies to ensure effective performance of disaster-related tasks.

Preparedness is commonly viewed as consisting of activities aimed at improving response activities and coping capabilities. However, emphasis is increasingly being placed on recovery preparedness—that is, on planning not only in order to respond effectively during and immediately after disasters but also in order to successfully navigate challenges associated with short- and longer-term recovery.

**Capacity Building: Training and Practice**

Capacity building, in the context of the disaster risk management paradigm, generally encompasses the factors of capability, which translates into a coping mechanism, which in turn makes a vulnerable group resilient. To understand capacity building as part of the disaster risk management process, we must examine the factors it encompasses.

Capacity building should be viewed from the variety of perspectives and must integrate all concerns with the central focus on addressing the vulnerability factor, this would also mean assessing the needs in relation to the current capacities. It is important that our understanding of capacity building emanates from the platform of:

- Human Resources, which would include skills – crafts and labor; knowledge – technical and indigenous; and character – attitudes and motivations.
- Common Property Resources. Principally the natural resource and the environment – terrestrial and aquatic.
- Sustainable use of resources. Utilizing resources in the context of sustainable development.
- Socio – Economic Equity. Equal opportunities regardless of race, creed, faith, and gender.

**Early Warning: Advice for Natural Hazards**

Early warning (EW) is “the provision of timely and effective information, through identified institutions, that allows individuals exposed to hazard to take action to avoid or reduce their risk and prepare for effective response.”, and is the integration of four main elements, (from International Strategy for Disaster Reduction (ISDR), United Nations (UN), 2006):

1. **Risk Knowledge**: Risk assessment provides essential information to set priorities for mitigation and prevention strategies and designing early warning systems.
2. **Monitoring and Predicting**: Systems with monitoring and predicting capabilities provide timely estimates of the potential risk faced by communities, economies and the environment.
3. **Disseminating Information**: Communication systems are needed for delivering warning messages to the potentially affected locations to alert local and regional governmental agencies. The messages need to be reliable, synthetic and simple to be understood by authorities and public.
4. **Response**: Coordination, good governance and appropriate action plans are a key point in effective early warning. Likewise, public awareness and education are critical aspects of disaster mitigation.
6.6 Variability of disasters in Bangladesh due to climate change

Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcing, or to persistent anthropogenic changes in the composition of the atmosphere or in land use. The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as: ‘a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods’. The variability of disaster indicates the changes of frequency, intensity and coverage of disaster caused by climate change. Due to the climate change the pattern of climatic and weather related disaster increases with their frequencies, intensity and coverage. The changes in climatic factors also creating multi-hazards:

<table>
<thead>
<tr>
<th>Climatic Factors</th>
<th>Impacts, Risk and Vulnerability</th>
</tr>
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| Higher maximum temperature, more hot days and heat waves or cold days and cold waves | • Changes in seasons; cropping patterns and loss of agriculture  
• Water resources depletion  
• Adverse Effect on Human health and working potentials  
• Ecosystems and bio-resource  
• More people will die due to hot or cold wave |
| More intensive precipitation events | • Increase Chances of Flash Flood  
• Increase local flood and elongated flooding period  
• Increase urban disasters such as water logging  
• Create water logging and affect standing crops  
• Washout aquaculture and fishes  
• Induced landslide in the hilly area  
• Increase River Erosion |
| Decreasing of seasonal rainfall | • Damage or decrease crop yield/production  
• Dry out pond which affect fish production  
• Increase diseases and pest  
• Decrease fruit setting as well as decrease production  
• Increase drought coverage and in elongated period |
| Sea level change | • Inundation of low lying land by saline water  
• Loss of cultivable land result decrease of crop production  
• Affect freshwater fish culture  
• Loss of biodiversity  
• Extreme scarcity of drinking water  
• Climate Refugee and Migration  
• Increase coastal erosion  
• Frequency of cyclone with tidal surge increase with intensity and coverage area  
• The timing of the cyclone disaster changed |
| Salinity intrusion | • Decrease crop production  
• Degradation of soil  
• Damage freshwater fish production  
• Increase human diseases like diarrhea etc. |

(Source: Climate Change Impact and Disaster Vulnerabilities In The Coastal Areas Of Bangladesh)
INTRODUCTION

Poverty, environmental degradation, climate change and disaster are multi-dimensional in nature and causally interlinked. The environment-poverty nexus is a two-way relationship. Environment affects poverty situations in three distinct dimensions: by providing sources of livelihoods to poor people, by affecting their health and by influencing their vulnerability. On the other hand, poverty also affects environment in various ways: by forcing poor people to degrade environment, by encouraging countries to promote economic growth at the expense of environment, and by inducing societies to downgrade environmental concerns, including failing to channel resources to address such concerns.

However, development becomes sustainable if it is pursued on several fronts – the political, social, economic, and environmental. Because, the Poverty-Environment-Climate Change-Disaster (PECD) nexus encompasses a variety of social and political as well as economic factors that obstruct the achievement of the international goals (Millennium Development Goals).

The module discusses the salient points of Understanding PECD Nexus and mainstreaming. Poverty and its implication on development, Environmental degradation and sustainable development, Climate change implication and sustainable development as well as Disaster Resilience implication and development.
SESSION-7: UNDERSTANDING PECD NEXUS

7.1 Context of PECD Nexus analysis
7.2 Factors encompasses PECD Nexus
7.3 Relationship among Poverty, Environment, Climate and Disaster
7.4 Mainstreaming PECD in development process
7 UNDERSTANDING PECD NEXUS

7.1 CONTEXT OF PECD NEXUS ANALYSIS

Empirical evidence shows that poverty, environmental degradation, climate change and disaster are multi-dimensional in nature and causally interlinked. It has also different form and nature in rural and urban contexts e.g. in rural areas, critical issues relate to access to natural resources such as land, forests, or fisheries and their sustainable use but in urban zones, the poverty-environment agenda centers on questions relating to the use of natural resources such as water or air as sinks for the disposal of human and industrial wastes, and their impact on the poor. The nexus is also freighted by a number of myths that implicitly discriminate against the poor and threaten environmental sustainability, one of their major resources in today’s world.

Poor people are isolated from economic opportunities and have less access to basic social services. Resource degradation is an acute problem with some 60% of the world’s poorest people living in ecologically vulnerable areas (Angelsen, 1997). The situation is worst day by day due to degradation of environment resulting climate change and frequent disaster. In many developing countries, declining rates of yield growth and accelerating resource degradation contribute greatly to conflict over natural resources. Food insecurity and malnutrition are critical concerns. Therefore, Environmental sustainability and poverty reduction is the core of the MDGs, in order to properly understand the sustainable development-MDG linkage, it is essential to grasp the PECD nexus. The nexus starts with some relationships of poverty and environmental conditions, including a brief quantitative account of the impact of environmental degradation on poor people.

In most of the developing countries a large number of population are poor and depend on an over-exploited and degrading natural resource base. Therefore, industrial and urban growths to improve economic livelihoods are essential for poverty reduction but it has serious threats to environmental and human health. So, it is a two interlinked causal processes-

- *Poverty affecting environmental conservation;*
- *Degraded environment affecting the poor.*
The environment-poverty nexus is a two-way relationship. Environment affects poverty situations in three distinct dimensions: by providing sources of livelihoods to poor people, by affecting their health and by influencing their vulnerability. On the other hand, poverty also affects environment in various ways: by forcing poor people to degrade environment, by encouraging countries to promote economic growth at the expense of environment, and by inducing societies to downgrade environmental concerns, including failing to channel resources to address such concerns. Moreover, the vulnerability of the poor in a hazardous environment is set to be worsened by Climate Change. Climate change has very severe and adverse economic, environmental, social, and human consequences. It is thus an extremely crucial issue for developing world having significant implications on development, including achievements of MDGs.

However, development becomes sustainable if it is pursued on several fronts – the political, social, economic, and environmental. Because, the Poverty-Environment-Climate Change-Disaster (PECD) nexus encompasses a variety of social and political as well as economic factors that obstruct the achievement of the international goals (Millennium Development Goals). To overcome the challenges and factors, there were a series of global conferences on various aspects of sustainable development throughout the 1990s. The themes of these conferences covered a range of issues – education, children’s concerns, population, social development, human rights, human settlement, and gender issues. Some of these conferences set qualitative targets, some quantitative ones in their relevant areas. In the mid-1990s, drawing from all these, a set of International Development Goals (IDGs) was proposed — which were first adopted by the OECD/DAC in 1996. All these initiatives were consolidated and given a new momentum at the UN Millennium Summit in September 2000. At that Summit, 149 Heads of State and representatives from some 180 countries adopted a set of goals - known as Millennium Development Goals (MDGs) - to overcome basic human deprivation around the world. The goals are time-bound, to be achieved by 2015, with the base year of 1990. In 2002, the World Summit on Sustainable Development (WSSD) looked closely at the linkage between sustainable development and achieving the MDGs. If sustainable development can be defined as a development path and pattern in which the choices of the present generation are enlarged without restricting the choices of future generations, the concept implies three issues:

- Enlargement of human choices at any point would depend on economic, political, social, institutional and environmental contexts. Thus sustainability encompasses more than environment.
- The concept of sustainability is a dynamic intergenerational notion.
- The abstract concept of sustainable development needs to be operationalized, which requires, among other things, measurable indicators and quantifiable targets, a framework for inter-temporal cost-benefit analysis.

A look at these goals immediately confirms that human poverty is at the centre of the MDGs. Sustainable development reflects a broad-based concept, which sometimes lacks operational specificity. The MDGs, being time-bound quantitative targets in many areas of sustainable development, help concretize the notion. If the world can halve extreme poverty, adequately feed people, ensure universal access to safe water, reduce child mortality and maternal mortality by two-thirds and three-fourths respectively, can enroll all its children in school, can reverse environmental degradation and the spread of
HIV/AIDS, it will ensure sustainable development. On the other hand, to achieve the MDGs, a country will need political, socioeconomic and environmental sustainability. The poor bear the brunt of most of the environmental problems caused by economic activities of the relatively better off people. Climate change has adverse impacts on poor people’s livelihoods as well as making it difficult to achievement of MDGs.

<table>
<thead>
<tr>
<th>Changes in Climate</th>
<th>Impact on Poverty</th>
<th>Impacts on MDGs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased temperature and changes in precipitation reduces agricultural and natural resources</td>
<td>Lowered industrial output and labor productivity, high inequality, impacts on trade, and fiscal and macroeconomic burdens lead to reduced economic growth, and its poverty-reducing effects</td>
<td>MDGs are less likely to be achieved</td>
</tr>
<tr>
<td>Changes in precipitation, run-off and variability leads loads to greater water stress</td>
<td>Reduced productivity and security of the poor’s livelihood assets, and reduced access for the poor to their livelihood assets</td>
<td></td>
</tr>
<tr>
<td>Increased incidence or intensity of climate related disasters leads to damage to infrastructure</td>
<td>Less effective coping strategies among the poor, and increased vulnerability of them, school dropout may increase</td>
<td></td>
</tr>
<tr>
<td>Temperature, water and vegetation changes contribute to increased prevalence of disease</td>
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Source: DFID, 2004

7.2 FACTORS ENCOMPASSES PECD NEXUS

Development schemes often sacrifice longer-term environmental sustainability for short-term economic benefits and job creation, and that over-exploitation of natural resources harms ecosystem health and in time reduces economic output. Environmental protection has a strong poverty dimension, given that the rural poor disproportionately depend on natural resources for their subsistence livelihoods. Public support is a critical factor; efforts to reduce pollution and conserve natural resources are unlikely to succeed if they unfairly restrict opportunities for local people to work and feed their families.

Taken together, these dynamics suggest that integrated programming is necessary to simultaneously improve livelihoods for the poor and protect the environment. The evidence also demonstrates that the poverty-environment nexus involves two-way interactions. Efforts to protect ecosystems and address other environmental problems can affect poor people’s access to resources, and conversely, reducing poverty can affect the sustainability of environmental systems. However, development becomes sustainable if it is pursued on several fronts – the political, social, economic, and environmental. And it is the interaction of policies and outcomes in all these dimensions that makes sustainability real.
• Political sustainability encompasses reproducibility of power structures and governance mechanisms, along with the evolution of institutions and the institutional framework that would carry out the tasks ensuring that the present generation maximizes its choices but not at the cost of opportunities for future generations.

• Social sustainability reflects social norms, values and culture, social structures and social cohesion, which are conducive to ensuring enlargement of choices of all segments of society in an equitable manner. If development is to be sustainable, it has to be owned by the entire society in terms of its philosophy, modus operandi and direction. Such ownership will facilitate the commitment to, and understanding of the need for, not compromising the opportunities of future generations while undertaking development for the present time.

• Economic sustainability addresses economic production and distribution as well as reproduction of the population. Economic sustainability requires building of human capabilities in an equitable manner through universal access to basic social services, equal economic opportunities, fairness in access to productive resources, sustained economic growth, etc. Thus equity, sustained growth and quality of life are three major dimensions of economic sustainability.

• Environmental sustainability deals with natural resources — exhaustible and renewable — and ecosystem services and the reproducibility of global ecosystems services and ecological resources. The overuse of natural resources and environmental degradation shrink the opportunities of future generations. Environmental sustainability emphasizes the proper use of natural resources and regeneration of the ecosystem so that future generations have the same opportunities as the present ones.

7.3 RELATIONSHIP AMONG POVERTY, ENVIRONMENT, CLIMATE AND DISASTER

Poverty, Environment, Climate change and Disaster are closely bound together. Environment matters a lot to poor people. Their well-being is strongly related to the environment in terms of health, earning capacity, security, physical surroundings, energy services and decent housing. In rural areas, poor people may be particularly concerned
with their access to and control over natural resources, especially in relation to food security.

Some of the environmental degradation reflects truly global concerns, such as global warming and the depletion of the ozone layer. Some is international, like acid rain, the state of the oceans, or the condition of rivers that run through several countries. Some is more localized, though it may often occur worldwide, like urban air pollution, water pollution, or soil degradation. Even though poor people also feel the impact of global environmental degradation, it is local environmental damage that affects the lives of poor people more.

The impact of environmental degradation is unequal between the poor and the rich. Environmental damage almost always hits poor people the hardest. The overwhelming majority of those who die each year from air and water pollution are poor people. So are those most affected by desertification and by the floods, storms and harvest failures brought about by global warming. All over the world, it is poor people who generally live nearest to dirty factories, busy roads and dangerous waste dumps. The loss of biodiversity is most severe for poor rural communities. Environmental degradation, by depleting the health and natural support systems of poor people, may make them even more vulnerable. Box 1 provides some quantitative estimates of the human impact of environmental degradation in the developing world. Because of the nature of the degradation, it is poor people in general who bear the brunt of this impact and with the poorest bearing the hardest burden. Impoverishment pushes them to the most ecologically fragile lands; they are at the bottom of the energy ladder and they are nearest to toxic dumps. Women also bear a disproportionate burden. Since mostly women and girls in developing countries stay indoors for cooking and other household work, they constitute 80% of the 1.8 million deaths from indoor pollution. The effect of biodiversity loss is the most severe for indigenous people, as they depend more on biodiversity for their livelihoods, energy, and medicine.

**BOX 1: IMPACTS OF ENVIRONMENTAL DEGRADATION IN THE DEVELOPING WORLD**
• Water-related diseases, such as diarrhoea and cholera, kill an estimated 3 million people in developing countries, the majority of whom are children under the age of five.
• Vector-borne diseases such as malaria account for 2.5 million deaths a year, and are linked to a wide range of environmental conditions or factors related to water contamination and inadequate sanitation.
• One billion people are adversely affected by indoor pollution.
• Nearly 3 million people die every year from air pollution, more than 2 million of them from indoor pollution. More than 80% of these deaths are those of women and girls.
• Nearly 15 million children in Latin America are affected by lead poisoning.
• As many as 25 million agricultural workers – 11 million of them in Africa – may be poisoned each year from fertilizers.
• More than one billion people are affected by soil erosion and land degradation. Some 250 million people are at risk from slash crop yields.
• Desertification already costs the world $42 billion a year in lost income.
• Over the last decade, 154 million hectares of tropical forests, covering almost three times the land area of France, have been lost.
• About 650 million poor people in the developing world live on marginal and ecologically fragile lands.


The well-being of poor people can be greatly improved through better management of the environment. Below are some aspects that help elucidate the nature of poverty environment linkages by demonstrating the contribution of the environment to human well-being, pro-poor economic growth and achievement of the MDGs.

Linkages of poverty with national development

Like many other developing countries in the world, poverty is one of the most significant concerns for sustainable development. Besides, due to geographical location, climate change and other natural disaster like flood, river erosion, drought, and cyclone make all development works ruin over the night.

Employment and the quality of employment are crucial for poverty reduction and in achieving growth with equity and pro-poor growth. The link between economic growth, employment and poverty reduction is thus a process in which output growth induces an increase in productive and remunerative employment, which, in turn, leads to an increase in the incomes of the poor and a reduction in poverty. Ensuring that growth is pro-poor requires high employment-intensity of growth and a rise in productivity which also depend on institutions, policies, laws and practices.

that positively affect the functioning of labour markets. A well-functioning institutional environment can support the virtuous circle and, in the process, facilitate pro-poor growth.

Although economic growth is typically thought of as the way to reduce poverty, its effectiveness in achieving this depends on the pattern of growth, essentially how particular sectors of the economy and workers benefit from growth. A high rate of economic growth, associated with a high degree of employment intensity, is a necessary condition for the reduction of poverty, but may not be sufficient. For poverty to be reduced, productivity and earnings (real wages, as well as returns from self-employment) must increase sufficiently to increase the incomes of the poor. The link between economic growth, employment and poverty reduction is thus a process in which output growth induces an increase in productive and remunerative employment, which, in turn, leads to an increase in the incomes of the poor and a reduction in poverty. The increase in incomes also finances investments in health and education that increase the productive capacity of the workforce, which improves sustainability. Success, however, will depend on the rate of economic growth, the output elasticity of demand for labour, and the ability of poor members of the labour force to respond to increasing demand for labour.

Ideally, there is a link between economic growth, employment and poverty reduction, which forms a virtuous circle, as Figure 2 illustrates. The stronger the links in the virtuous circle, the more likely it is that growth will be pro-poor. Although the circle does not have a defined beginning or end, the sequence can run from sustained rates of economic growth, which then, ideally, lead to sustained increases in productive capacity and generate employment opportunities, for waged and self-employed workers, irrespective of their sex, religion, ethnic or social group, or political opinion. Some of these opportunities may already exist, but they need to be upgraded, or new jobs involving higher technology and skill levels need to be created. Thus there is a need to integrate unemployed or underemployed workers into higher productive activities, so that they may obtain higher incomes. This income will allow families, businesses and society to invest in education and skill formation (for themselves or their children, thus for the future generation), as well as health, safety and other forms of social protection. These investments mitigate socioeconomic risks and empower the poor, thereby creating the necessary conditions for further investment, consumption, higher productivity and growth in the second round, and the completion of the virtuous circle of pro-poor growth (Islam, 2006).

In this respect role of government need to be strengthen in every respect of policy implication for pro poor growth. The most effective means of participating, contributing and benefiting in economic growth is through decent and productive employment. Thus policies are needed to ensure that the pace and pattern of economic growth leads to employment opportunities, and that the poor are sufficiently empowered to avail themselves of these opportunities.
The livelihoods framework is a tool to improve our understanding of livelihoods, particularly the livelihoods of the poor. It was developed over a period of several months by the Sustainable Rural Livelihoods Advisory Committee, building on earlier work by the Institute of Development Studies (amongst others). This section of the Guidance Sheets provides an introduction to the framework itself. The individual components of the framework are described in more detail in the subsequent sheets in this section. Practical questions and challenges of operationalising the approach will be covered in Section 3 and following.

**Understanding the framework**

The form of the framework is not intended to suggest that the starting point for all livelihoods (or livelihood analysis) is the *Vulnerability Context* which through a series of permutations yields *Livelihoods Outcomes*. Livelihoods are shaped by a multitude of different forces and factors that are themselves constantly shifting. People-centred analysis is most likely to begin with simultaneous investigation of people’s assets, their objectives (the *Livelihood Outcomes* which they are seeking) and the *Livelihood Strategies* which they adopt to achieve these objectives. Important feedback is likely between:

(a) *Transforming Structures and Process* and the *Vulnerability Context*; and
(b) *Livelihood Outcomes* and *Livelihood Assets*.

There are other feedback relationships that affect livelihoods which are not shown. For example, it has been shown that if people feel less vulnerable (*Livelihood Outcome*) they frequently choose to have fewer children. This has implications for population trends which might be an important part of the *Vulnerability Context*.

**Using the framework to help eliminate poverty**
The framework is intended to be a versatile tool for use in planning and management. It offers a way of thinking about livelihoods that helps order complexity and makes clear the many factors that affect livelihoods.

A more important task than perfecting the framework itself is putting the ideas that it represents into practice. If that calls for adaptation of certain boxes or revision of certain definitions to make the framework more useful, all the better; the framework becomes a living tool. Use of the framework is intended to make a distinct contribution to improving DFID’s ability to eliminate poverty. It is not simply a required step in project/programme preparation, nor does it provide a magic solution to the problems of poverty elimination. In order to get the most from the framework:

- The core ideas that underlie it should not be compromised during the process of adaptation. One of these core ideas is that (most) analysis should be conducted in a participatory manner.
- Use of the framework should be underpinned by a serious commitment to poverty elimination. This should extend to developing a meaningful dialogue with partners about how to address the underlying political and economic factors that perpetuate poverty.
- Those using the framework must have the ability to recognise deprivation in the field even when elites and others may want to disguise this and skew benefits towards themselves (this will require skill and rigour in social analysis).
7.4 MAINSTREAMING PECD IN DEVELOPMENT PROCESS

Poverty-Environment Mainstreaming is an iterative process of integrating poverty-environment linkages into policymaking, budgeting and implementation processes at national, sector and sub national levels. It is a multi-year, multi-stakeholder effort that entails working with government actors (head of state's office, environment, finance and planning bodies, sector and sub national bodies, political parties and parliament, national statistics office and judicial system), non-governmental actors (civil society, academia, business and industry, general public and communities, and the media) and development actors.

Poverty environment mainstreaming aims to reverse environmental degradation in ways that will benefit the poor and to enable sustainable economic development. Any poverty reduction effort must fully take into account the country’s vulnerability, susceptibility and capacity to manage climate risks and adaptation. This requires changing processes and decisions that impact on the environment - but past experience suggests that many of these processes and decisions are outside the direct control of environment institutions, and many of these currently undermine pro-poor environment outcomes. In Asia, key institutions that impact on pro-poor environment outcomes include Ministries of Finance as government spending rises, local government as decentralization increases and the private sector as trade and private investment grow. So it is vital that environment and climate issues that matter to the poor are “mainstreamed” into these institutions and political and economic processes and decisions. The indicators for successful poverty-environment-climate mainstreaming are institutions, policies and investments that do not undermine pro-poor environment outcomes, but positively contribute to both men and women.

Sustainable development depends in large measure on successfully integrating the environment into economic planning and decision-making, a process known as environmental mainstreaming. Early efforts in the 1990s to mainstream the environment into national planning—for example, through poverty reduction strategy papers (PRSPs)- aimed to ensure that economic decisions and plans took environmental priorities into account and addressed the impact of human activities on environmental services and assets.

Evidence suggests that these initial attempts to mainstream the environment into national planning had mixed success. A series of influential reviews by the World Bank showed that most of the PRSPs adopted by the world’s poorest countries in the 1990s did not sufficiently address the environment’s contribution to poverty reduction and economic growth (Bojö and Reddy 2003; Bojö et al. 2004).

Country governments and development actors responded by devoting greater attention to integrating the environment into PRSPs, with particular attention to mainstreaming poverty-environment linkages and making the case for addressing the contribution of the environment to human well-being, pro-poor economic growth and achievement of the MDGs to the ministries responsible for national development planning.
Mainstreaming into National Planning Processes

Environmental mainstreaming is defined as integrating poverty environment linkages into national development planning processes and their outputs, such as Poverty Reduction Strategy Papers (PRSPs) and Millennium Development Goal (MDG) strategies. It involves establishing the links between poverty and environment—including climate change—and identifying the policies and programmes to bring about better pro-poor environmental management. It is targeted at influencing national plans, budget processes, sector strategies and local level implementation—reflecting the need to integrate the valuable contribution of environmental management to improved livelihoods, increased economic security and income opportunities for the poor. The overall aim is to establish enduring institutional processes within government, from national to local levels, and within the wider stakeholder community, to bring about environmental mainstreaming that is focused on the government bodies responsible for poverty reduction and growth policies, and that strengthens the role of environmental agencies and non-governmental actors.

Indicators of Successful Environmental Mainstreaming

- Inclusion of poverty-environment linkages in national development and poverty reduction strategies.
- Strengthened capacity within finance/planning ministries as well as environmental agencies to integrate environment into budget decision-making, sector strategies and implementation programmes.
- Inclusion of poverty-environment linkages in sector planning and implementation strategies.
- Strengthened capacity in key sector ministries to include environmental sustainability into their strategies.
- Widened involvement of stakeholders in making the case for the importance of environment to growth and poverty reduction.
- Improved domestic resource mobilization for poverty-environment investments.
- Increased donor contributions to country-level environmentally sustainable investment.
- Improved livelihoods and access to environmental and natural resources for the poor.