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CLACC Bhutan

CAPACITY STRENGTHENING IN THE LEAST DEVELOPED COUNTRIES (LDCs) FOR ADAPTATION TO CLIMATE CHANGE (CLACC)

ADVERSE IMPACTS OF CLIMATE CHANGE ON DEVELOPMENT OF BHUTAN: INTEGRATING ADAPTATION INTO POLICIES AND ACTIVITIES

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Bangladesh Centre for advanced Studies (BCAS)
House 10, Road 16A, Gulshan-1, Dhaka– 1212
Bangladesh
Tel: + 880-2-8851237, 8852217
Fax: + 880-2-8851417
Email: info@bcas.net

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This book is prepared by Mozaharul Alam of Bangladesh and Dago Tshering of Bhutan under Capacity strengthening of Least Developed Countries (LDCs) for Adaptation to Climate Change (CLACC) Fellowship programme coordinated by International Institute for Environment and Development (IIED). The analysis and assessment contained herein are the vies authors.

Authors

Mozaharul Alam [1] and Dago Tshering [2]

1. Research Fellow, Bangladesh Centre for Advanced Studies (BCAS), Bangladesh
2. Field Coordinator, Royal Society for Protection of Nature (RSPN), Bhutan

FOREWORD

Capacity strengthening in the **L**east Developed Countries (LDCs) for **A**daptation to **C**limate **C**hange (CLACC) is a multi country project being implemented by the International Institute for Environment and Development (IIED) in association with four regional centres i.e. the Bangladesh Centre for Advanced Studies (BCAS), the African Centre for Technology Studies (ACTS) in Kenya, the Environmental Development Action in the Third World (ENDA) in Senegal and the Zimbabwe Environmental Research Organisation (ZERO) in Zimbabwe with financial support from a number of development partners.

The aim of the project is to support LDCs in their efforts to adapt to the impacts of climate change through long-term capacity strengthening activities with governments as well as civil society. The main objectives of the project are to a) strengthening the capacity of civil society in LDCs to adapt to climate change and enhancing adaptive capacity among the most vulnerable groups; b) establishing an information and knowledge sharing system to help countries to deal with the adverse impacts of climate change; and c) integrating adaptation to climate change into the work of key non-government institutions, and mainstreaming the National Adaptation Programmes of Action (NAPA) process with these institutions.

Fellows from CLACC regional partners have reviewed existing literature on environment and climate change, priority areas of the government, policies and development plans, and programmes and activities for assessing adverse impacts of climate change on development. They have reviewed the present level of activities and policy domain addressing climate change stimuli including variability and extreme events. The assessment has been carried out for 12 countries spread over South Asia, East Africa, West Africa, and Southern Africa. Apart from this, the assessment report has identified gaps and required measures for integrating adaptation in policies in short, medium, and long-term development activities for addressing adverse climate impacts and reducing vulnerability. The documents used in this assessment include a) the Initial National Communication to UNFCCC, b) Climate change impacts, vulnerability and adaptation study, c) National development policies and plans, d) Poverty

reduction strategy papers, e) National Adaptation Programme of Action (NAPA) documents, and e) Literature from international sources including UNFCCC. This assessment report can be used as background material for the preparation of NAPA and mainstreaming adaptation to climate change in other development policies, programme and measures, and to promote sustainable development.

The Bhutan Country Assessment Report on "Adverse Impacts of Climate Change on Development: Integrating Adaptation into Policies and Activities" is prepared by Mozaharul Alam, Research Fellow, Bangladesh Centre for Advanced Studies (BCAS) under the CLACC Fellowship Programme. The International Institute for Environment and Development (IIED) has provided the necessary support during the fellowship programme as host institute. Saleemul Huq, and Hannah Reid have provided guidance in the whole process and activities. This was made possible with financial support from the Dexter Trust and Royal Ministry of Foreign Affairs, Norway.

SUMMARY

Bhutan has a land area of 38,394 square kilometres, about the size of Switzerland. The country is not only landlocked but has one of the most formidable mountainous terrains in the world, ranging from 100 metres to 7,500 metres in height. The climatic conditions vary due to the mountainous nature of the country. The country is subject to the monsoon rain in the summer, with a relatively dry winter. About 72% of the land area is covered by forests of temperate and sub-tropical species that are a natural habitat of a diversity of flora and fauna. The country has one of the richest biodiversities in the world with about 3,281 plant species per 10,000 square kilometres and has been declared as part of one of the ten global biodiversity 'hotspots'.

Today, socio-economic conditions in Bhutan are very different from what they were in the sixties. The social indicators available have improved steadily since the 1960s. Life expectancy has risen from 37 years in 1960 to 66 years in 1997, while over the same period the population with access to safe water has risen from 31% to 63% (1999). However, the rural population still has only limited access to secondary social services and some remote areas still lack basic facilities. Another area of concern is the high population growth rate of 2.5%. Considering that 79% of the Bhutanese population live in rural areas, the present growth rate will have a considerable impact on social sector expenditure mainly because of remoteness and mountainous physiography of the country.

A major economic challenge for Bhutan stems from the fact of it being a least developed economy with special structural constraints and vulnerabilities. County Support Strategies of development partners have highlighted needs to shift towards developing a more monetised and globally integrated economy. As regards development issues, Bhutan constantly faces the challenge of being a landlocked country with a mountainous topography and scattered settlements which imply high costs for social services and development of infrastructure. This has added pressure to the national budget, diverting resources from direct investment in production. Bhutan will need to continue its drive towards improved productivity while

promoting the production of higher value products and seeking to expand in profitable market outlets.

From the existing development plans and vulnerability assessment report it is found that adverse effects of climate change including variability and natural disaster has a significant implication on the overall development of Bhutan. Six areas considered as most vulnerable to climate change are: (i) forests and biodiversity, (ii) agriculture, (iii) water resources, (iv) glacial lake outbursts, (v) health, and (vi) landslides. It appears that a temperature increase of 2^0C would shift the cultivating zone further into higher elevation and crops sensitive to low temperatures can be introduced into higher elevations with this temperature rise.

A number of win-win options and measures have been identified in the initial national communication. The noteworthy interventions are a) Community involvement and awareness are very important in using water resources more sustainably, b) Land use planning should be improved to promote afforestation in degraded water catchment areas, c) develop varieties of crops and livestock with greater resilience to limited arable land and extreme temperature events, d) Community-based forest management and afforestation projects which should be done in such a way as to contribute to its proper purpose, which includes national land conservation, water resource conservation, nature conservation, wood production and human living environment conservation, as well as contributing to the prevention of global warming.

The government of Bhutan has initiated process to prepare National Adaptation Programme of Action (NAPA) and identified key stakeholders for involvement. It is expected that the NAPA will suggest urgent and immediate measures to address adverse impacts of climate change and promote sustainable development.

Acronyms and Abbreviation

ABD	Asian Development Bank
ACTS	African Centre for Technology Studies
BCAS	Bangladesh Centre for Advanced Studies (BCAS)
CBS	Central Bureau of Statistics
CCF	Country Cooperation Framework
CDM	Clean Development Mechanism
CFUG	Community Forestry User Group
CLACC	Capacity strengthening in the Least developed countries for Adaptation to Climate Change
CSOP	Country Strategic Opportunities Paper
CST	Country Study Team
DFID	Department for International Development
DFRS	Department of Forest Research and Survey
DMH	Department of Hydrology and Meteorology
EC	Executive Committee
ENDA	Environmental Development Action in the Third World
EPC	Environment Protection Council
GCM	General Circulation Model
GDP	Gross Domestic Product
GLOF	Glacier Lake Outburst Flood
HMG/N	Her Majesty's Government, Nepal
ICIMOD	International Centre for Integrated Mountain Development
IFAD	International Fund for Agricultural Development
IIED	International Institute for Environment and Development
IPCC	Intergovernmental Panel on Climate Change
LDCs	Least Developed Countries
LI-BIRD	Local Initiatives for Biodiversity, Research and Development
MoA	Ministry of Agriculture
MoF	Ministry of Finance

MoPE	Ministry of population and Environment
MTEF	Medium Term Expenditure Framework
NAPA	National Adaptation Programme of Action
NDC	National Development Council
NPC	National Planning Commission
NSSD	National Strategy for Sustainable Development
NSTs	National Study Teams
NTFP	Non Timber Forest Product
RING	Regional and International Networking Group
SC	Steering Committee
SDAN	Sustainable Development Agenda for Nepal
SRES	Special Report on Emission Scenario
UFCBD	United Nations Convention on Biological Diversity
UFCCD	United Nations Convention on Combating Desertification
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
WECS	Water and Energy Commission Secretariat
WSSD	World Summit on Sustainable Development
ZERO	Zimbabwe Environmental Research Organisation

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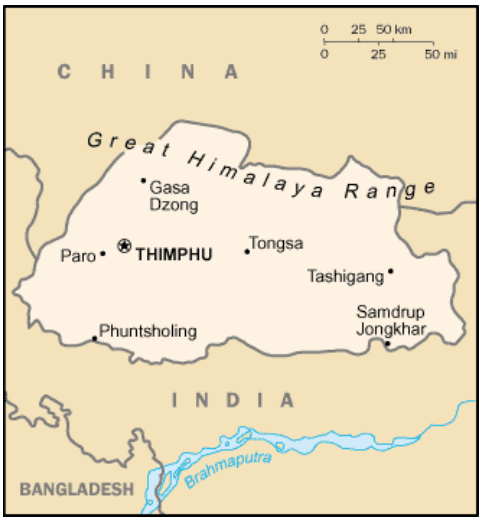
1 Country Background

1.1 Location and Geography

Figure 1. Geographic Location of Bhutan



Bhutan is a small Himalayan kingdom situated between China and India. A conscious policy of isolation complemented by formidable geographical barriers has enabled the kingdom to maintain its independence throughout its history.

The country is situated between $26^0$45'N and $28^0$10'N latitudes and $88^0$45'E and $92^0$10'E longitudes. It has a maximum longitudinal distance of 330 kilometres and a latitudinal distance of 180 kilometres. Bhutan is bordered by the Tibetan region of China on the north and by India on the west, south and east. The terrain is highly rugged; rising from an elevation of 100 meters above sea level in the south, and reaches over 7,550 meters in the north.

Geographically, Bhutan can be divided into three major areas: the southern foothills, inner Himalayas and higher Himalayas. The southern foothills rise from the plains to a height of 1,500 meters but are only about 20 kilometres wide. The inner Himalayas, meanwhile, gradually rise to about 3,000 meters and contain the broad river valleys of central Bhutan, the economic and cultural heartland of the country. The northern region comprises the main Himalayan range of the high mountains.

1.2 Land and Population

Bhutan has a land area of 38,394 square kilometres, about the size of Switzerland. The country is not only landlocked but has one of the most formidable mountainous terrains in the world, ranging from 100 metres to 7,500 metres in height. The climatic conditions vary due to the mountainous nature of the country. The country is subject to the monsoon rain in the summer, with a relatively dry winter.

About 72% of the land area is covered by forests of temperate and sub-tropical species that are a natural habitat of a diversity of flora and fauna. The country has one of the richest biodiversities in the world with about 3,281 plant species per 10,000 square kilometres and has been declared as part of one of the ten global biodiversity 'hotspots'.

The country is also endowed with a river system that has an estimated potential to generate 30,000 MW of hydroelectricity. The four major rivers, Amo Chhu, Wang Chhu, Punatsangchhu, and the Drangme Chhu and their tributaries have carved fertile valleys in central and western parts of the country, and provide irrigation to the southern and eastern plains before flowing into the Brahmaputra river basin. The steep and unstable terrain and the relatively young mountain system however render the country to be ecologically very fragile. Agricultural production is also severely constrained, as only around 16% of the land area is cultivable.

The current population of Bhutan is approximately 750 thousand with per capita Gross Domestic Product (GDP) of US$ 695 (UNDP, 2004). Bhutan's indigenous population is the Drukpa. Three main ethnic groups, the Sharchops, Ngalops and the Lhotsampas (of Nepalese origin), make up today's Drukpa population. Bhutan's earliest residents, the Sharchops (people of the east) reside predominantly in eastern Bhutan. Their origin can be traced to the tribes of northern Burma and northeast India. The Ngalops migrated from the Tibetan plains and are the importers of Buddhism to the kingdom. Most of the Lhotsampas migrated to the southern plains in search of agricultural land and work in the early 20th century.

The population is largely rural with 79% of the population still living in villages despite a growth in urban drift in recent years. It is estimated that 39.1% of the population is under the age of 15. While there are several language groups and communities, the country is essentially composed of two broad ethnic groups, the Drukpas who are mongoloid and are of Buddhist faith making up 80% of the population, and people of ethnic Nepalese origin who are mainly indo-aryan and of Hindu faith.

1.3 Climatic Condition

Bhutan has a wide range of altitudinal zones and micro-climatic conditions, which have created highly diverse ecosystems and a complex pattern of climatic conditions. It has three distinct climatic

zones corresponding broadly to the three main geographical divisions. The southern belt has a hot, humid climate, with temperatures remaining fairly even throughout the year—between 15^0C and 30^0C-and rainfall ranging between 2,500 and 5,000 millimetres. The central inner Himalayas have a cool, temperate climate, with annual average rainfall of about 1,000 millimetres, while the higher and more northern region has an alpine climate, with annual rainfall of around 400 millimetres. Much of this rainfall is concentrated in the summer, with the southwest monsoon accounting for 60 to 90% of total rainfall.

There is substantial variation within these broad ranges, and the climate and rainfall characteristics change dramatically from one valley to another, with consequent sharp changes in the composition of agricultural production. This diverse climatic condition has created seven major agro-ecological zones ranging from tropical and sub-tropical to alpine. The aspect of the valleys, steepness of the slopes, altitude and other physiographic factors influence precipitation, insulation and other microclimatic factors to create significant variations in vegetation and agricultural conditions within short distances.

1.4 Economic Situation

The economy of Bhutan, one of the world's smallest and least developed, is based on agriculture and forestry, which provide the main livelihood for more than 90% of the population. The economy is closely aligned with India's through strong trade and monetary links and dependence on India's financial assistance. The industrial sector is technologically backward, with most production of the cottage industry type. Most development projects, such as road construction, rely on Indian migrant labour. Bhutan's hydropower potential and its attraction for tourists are key resources that contribute significantly to the economy.

Consistent with the trend of recent years, economic activity remained cheerful with an estimated gross domestic product (GDP) growth rate of 7.7% in 2002, higher than the 7.2% recorded in 2001. GDP growth was mainly due to the contribution of the power sector, followed by the construction and transport sectors. The traditional sector comprising agriculture, animal husbandry and forestry continued to

[1] *Estimate varies significantly by sources. For example, 2.2 million as per UNDP Human Development Report, 2004*

predominate, accounting for roughly 34% of GDP. Contribution of mining and manufacturing industries is about 11%. Electricity, construction, trade and commerce, transport and communication, finance, government services and others contribution to GDP is about 55%.

The construction sector, with an estimated growth rate of 17.3%, had a major influence on the GDP growth rate during 2002. This was mainly due to the on-going construction of large hydropower projects such as Kurichhu, Tala and Basochhu. The agricultural sector as a whole performed well, exceeding the projected target by 1.3% over the plan period (97-02). Growth in other major sectors, which includes mining, manufacturing, trade and commerce and finance etc., fell short of the targeted growth rates. In particular, mining and manufacturing sectors fell significantly short of their targets, mainly due to the suspension of the Dungsam Cement Project.

However, the Government maintained a prudent macroeconomic management stance during 2002. Current fiscal (2002-2003) balance recorded a surplus of 1.2% of GDP. The estimated overall fiscal deficit narrowed to 4.8% of GDP in 2002, compared to 5.4% in the previous year and 11.1% in 2000. The trade account deficit decreased from 21% of GDP in 2001 to 18% of GDP in 2002 reflecting an increase in power exports to India and a decline in imports from India as some major hydropower projects neared completion. However, the current account turned from a surplus in 2001 to a deficit in 2002 due in equal measure to a fall in current transfers and a substantial decrease on account of lower interest income of financial sector assets held abroad.

As evident from the sectoral composition of the GDP, a gradual transformation of the Bhutanese economy has been taking place. In particular, the share of electricity, construction, trade and commerce and transport and communications sectors have grown and exceeded the projected targets. The agricultural sector, however, continued to dominate the economy and still accounted for around 34% of GDP at the end of the Eighth Plan.

1.5 Socio-economic Situation

In the absence of systematic household or income surveys it is difficult to provide a detailed assessment of poverty in Bhutan. Nevertheless, extreme poverty is relatively rare and few suffer from

hunger or homelessness. Due to land reforms in the early 1970s, income distribution is thought to be relatively even. Subsistence agriculture is still widespread while rural incomes and agricultural productivity remain low.

Today, socio-economic conditions in Bhutan are very different from what they were in the sixties. The social indicators available have improved steadily since the 1960s. Life expectancy has risen from 37 years in 1960 to 66 years in 1997, while over the same period the population with access to safe water has risen from 31% to 63% (1999). The gross primary school enrolment rate was estimated to be 72% in 1999, while the number of primary schools has increased from 11 in 1959 to 243 primary and community schools in 1999. The adult literacy rate is estimated to have risen from 23% in 1980 to 54% in 1994. Access to basic health has also improved considerably – whereas in 1961 Bhutan had only 4 hospitals and 11 dispensaries, by 1998 the health system consisted of 28 hospitals and 145 basic health units. However, the rural population still has only limited access to secondary social services and some remote areas still lack basic facilities. Another area of concern is the high population growth rate of 2.5%. Considering that 79% of the Bhutanese population live in rural areas, the present growth rate will have a considerable impact on social sector expenditure mainly because of remoteness and mountainous physiography of the country.

As regards gender issues, Bhutan is a comparatively balanced society. Women benefit from property rights and female ownership of agricultural land is relatively widespread. Girls' infant mortality rates are lower than boys' and female life expectancy is higher than male. Nevertheless, women are still underrepresented in government institutions and boys still tend to dominate higher education. With the assistance of several donors, the government is taking action to improve the situation of women. Given the comparatively favourable position of women in Bhutan, the EC has not made gender issues a general objective per se, but it looks carefully at this matter within the context of each individual co-operation initiative.

1.6 Resource Endowment and Condition

It is widely recognised that the resource availability and quality has strong linkage with economic growth and development. Development prospects are enhanced by the richness and quality of the natural

resource base. With the rapid pace of economic development, pressures on the natural environment continue to increase and are fuelled by a complex array of forces. They include population pressures, agricultural modernization, hydropower and mineral development, industrialization, urbanization, and infrastructure development. The following section briefly describes the key natural resources of the country and their use.

1.6.1 Land and Land Use

Land is one of the basic natural resources that provides habitat for terrestrial populations and support livelihoods. The land area of Bhutan can further be divided into regions with their distinct characteristics. These are;

- Western Bhutan: comprised of the Haa Valley (8860ft.), Paro Valley (7200ft.), Thimphu (7500ft.), the Punakha Valley and Wangdue Phodrang (4200ft.). This region is separated by high passes namely Cheli La (13,084ft.), Dochu La (10,007ft.), Pele La (10,825ft.) from Central region. Western Bhutan is known for its beauty and importance for the tourist sector. Orchards, cascading down magnificent mountains, the pristine rivers that flow through the main towns of Paro, i.e. Thimphu and Punakha, and unique two-story houses with brightly painted window designs are attraction for the tourist.

- Central Bhutan: the Black Mountains separate Western Bhutan from Central Bhutan. This region includes Trongsa and the rich broad valleys of Bumthang including Chumey, Choekhar, Tang and Ura valleys. The passes crossed are Yotang La (11,155ft.) Shertang La (11,723ft.) and Thrumshing La (12,465ft.). Central Bhutan is known for its buckwheat and apple production, sturdy stone houses, and plethora of monasteries. Broad valleys and sloping mountains make it the ideal place for walking. Beauties of the Bumthang valleys are legendary in Bhutan and attraction for tourists.

- Eastern Bhutan: comprises Mongar, Lhuentse, Trashigang and Trashi Yangste. Sengor Valley separates Central from Eastern Bhutan. After Thrumshing La, passes crossed are Kori La (7874ft.), Yongphu La (7185ft.) and Narphung La (5570ft.) at much lower altitudes than Western and Central. The forests

dissipate and the altitude is lower. The warmer climate is suitable for growing corn, rice, wheat, potatoes and surprisingly lemon grass. Eastern Bhutan is the least travelled area of the country and is where many of the kingdom's most ancient spiritual sights are found.

Only 16% of Bhutan's land is suitable for agriculture. Of this, 8% is under cultivation. The mountainous terrain and fragile ecology does not allow any expansion, limiting development in this sector to introducing high-yielding varieties, improving farming techniques and applying enhanced inputs. However, the agricultural production has increased despite the limitations of land.

Land degradation in the country is manifested primarily in displacement of soil material through water erosion and internal biophysical deterioration. Human induced activities mainly trigger soil erosion in the mountainous terrain. Loss of vegetation due to deforestation, over cutting beyond silviculturally permissible limits, livestock rearing, unsustainable fuel wood extraction, encroachment into forest land, forest fire, over grazing, extension of cultivation onto lands of low potential or high natural hazards, lack of adequate soil conservation measures and improper crop rotation are some of the important factors contributing to land degradation in Bhutan. Mining and quarrying, developmental activities like road construction; transmission lines, etc. also contribute to land degradation and loss of forest cover. Land-use change and land-use conversions and forest activities need continued monitoring for assessment of cumulative impacts from all developmental activities including roads, forestry and other extractive industries.

1.6.2 Water and Water Use

With the high precipitation and altitudinal variation, water resources—mainly in the form of rivers—are abundant in Bhutan. While the wide altitudinal difference provides many possibilities for hydropower generation, the main rivers are deeply incised and irrigated agriculture is limited to areas served by gravity from small perennial streams. The Power Master Plan estimates that rivers could provide 30,000 MW of electricity (1990-93). Because local requirements are still modest, the majority of energy produced will be exported, representing a large part of Bhutan’s total export revenue.

1.6.3 Forest and Biodiversity

The total forest area of the country is estimated at 2.9 million hectares (LUPP, 1995). Forests of Bhutan are divided into three major types, namely; broadleaf forest of 50%, conifer forest of 38% and scrub forest of 12% (DFS).

The Master Plan for Forestry Development (1991) has classified the forests of Bhutan into the following broad categories: Fir forest-The upper forest zone in the higher ridges between 2,700 meters and the tree line at 3,600-3,800 meters is dominated by almost pure stands of fir. Some hemlocks and birches also are present. Beard-like lichens and mosses generally decorate the fir forests, an indication of the pollution-free atmosphere.

Mixed Conifers -This forest type occupies the largest portion of the sub-alpine zone of the country, between 2,000 and 2,700 meters of elevation. Spruce, hemlock or larch, or a mixture of these, are the dominant species. Hemlock generally tends to occupy wetter slopes than spruce. Beard-like lichens and mosses also decorate these forests.

Chir Pine -This subtropical tree of dry, sandy soils predominates in the deep, dry valleys between 900 and 1,800 m. These forests are characterized by the highly seasonal monsoon climate, with annual burning of the understory grass. Chir pine usually occurs in pure forms and is extensively tapped for resin.

Blue Pine-This forest type is found in the temperate valleys between 1,800 and 3,000 meters. Blue pine is dominant, fast-growing and colonizing specie, especially in burnt and disturbed areas. It is found in a close canopy with almost no understory growth. Although blue pine forests are subjected to heavy biotic interference, grazing and forest fires, they regenerate with relative ease.

Broadleaf mixed with Conifer- In some parts of Bhutan the transition between broadleaf forest and conifer forest is very gradual, and there are extensive areas of mixtures of these types. These forests are generally of oak mixed with blue pine or upper hill forest mixing with hemlock or spruce. It has divided into three groups as follows.

- Temperate broadleaf forests dominate the temperate hillsides between 2,000 and 2,900 meters. This group is further divided into 2 subgroups, namely, evergreen oak forest and cool broadleaf forest.

- Subtropical hill forests occupy the subtropical hills between 1,000 and 2,000 meters. They are rich mixed forests with a wide variety of both subtropical and temperate genera.

- Tropical lowland forests occupy the low hills below 700 meters. They are broadly classified as semi-evergreen but vary from almost totally deciduous on dry exposed slopes to almost totally evergreen in moist sheltered valleys. Species diversity is very rich, and the forests are multi-storied.

The flora of Bhutan is exceptionally diverse as a result of the great range of altitudinal zones and varied climatic conditions. Forests of alpine scrub, fir, mixed coniferous species, temperate scrub and broadleaf species, many of which are unique to Bhutan, cover an estimated 72% of the country. About 47 indigenous species have been listed, and it is thought that many more are not identified (Bhutan, 2000). The vast wealth of flora is highly appreciated by both Bhutanese and the world outside.

1.7 Development Goals and Objectives

Gross National Happiness is the overarching development philosophy of Bhutan. With the inception of planned development in 1961, the country opened its doors to the forces of change and modernization. The Ninth Plan has noted that while the country is prepared for changes, it is essential to have a clear-cut perspective on the objectives and the guiding principles for change. It became evident quite early that for a holistic development of the society, it was essential that development be both social and economic and necessary to give equal importance to the spiritual, emotional and cultural needs as well as material well-being. It was also recognized that at heart of the society is the individual whose welfare and well-being must be provided for by society. This has led the Government to clearly stipulate that economic growth, while essential, is not an end in itself but one of many means for achieving holistic development. Development is viewed as a continuous process with a balance between the material and non-material needs of individuals and society.

Having accepted that the maximization of Gross National Happiness is a philosophy and objective of the country's development, it was necessary to more clearly identify the main areas, which would contribute most towards furthering this philosophy and objective.

Recognizing that a wide range of factors contribute to human well-being and happiness and that it may not be possible to fully and exhaustively define or list everything for the purpose of its development planning, the country has identified four major areas as the main pillars of Gross National Happiness. These are economic growth and development, preservation and promotion of cultural heritage, preservation and sustainable use of the environment, and good governance.

1.8 Brief Overview of Development Planning in Bhutan

Bhutan has been preparing its medium term national development plan known as the Five-Year Plan since 1961. It has already passed more than four decades of development. The recent development plan of Bhutan is guided by the document "Bhutan 2020: A Vision for Peace, Prosperity and Happiness", that sets out the national goals, broad targets and overall policy principles for the next two decades. This document was the culmination of intensive consultations between communities, Royal Government agencies and private and non-governmental organizations. It provides a clear framework for development of the five-year plans and is operationalized through the annual budgets approved by the National Assembly.

The planning process involves decision-making in formulating plans and programs, the responsibility of which is shared among a number of institutions. The main institutions are the Gewogs (villages), Dzongkhags (districts) and the central ministries and agencies. Most programs originate from the community level though nation-wide and thematic plans and programs originate from the agencies at the centre.

Planning is based on a matrix structure with area based planning undertaken at the Dzongkhag and Gewog level and sector based planning undertaken at the central level. The sectoral based planning at the ministries complement and support the area based Gewog and Dzongkhag programs. As a result of this approach, coordination is a key and common theme in the country's planning process.

The country's planning is a cyclical and continuous process that defines and refines future plans and programs at all levels. Resource availability is one significant factor around which the plans and programs eventually crystallize. Actual implementation begins with the approval of the five-year and annual plans by the National Assembly.

A key feature of the Ninth Plan (2002-2007) is a Gewog-based approach. This is expected to further strengthen the planning process with a special focus on Gewogs as the main basis for development planning. In addition, the introduction of the two-year rolling budget at the start of the Ninth Plan is also expected to strengthen the planning process further by providing a medium term framework that will improve linkages between annual and five-year plans as well as between changing priorities and resource availability.

1.9 Development Challenges

A major economic challenge for Bhutan stems from the fact of it being a least developed economy with special structural constraints and vulnerabilities. County Support Strategies of development partners have highlighted needs to shift towards developing a more monetised and globally integrated economy. Due to the direct linkage of the Bhutanese currency to the Indian rupee and large inflows of foreign aid and hydropower revenue, wages of unskilled workers have been pushed up, making exports (except from hydropower) less competitive and hampering efforts to diversify the economy. Bhutan is heavily dependent on one main trading partner which may not be desirable in the long term. However, political and geographical factors tend to favour trade with India and no major shift is envisaged in the short term, though trade with and via Bangladesh is increasing. Finally, the government's revenue base is still too narrow, relying mainly on energy exports.

As regards development issues, Bhutan constantly faces the challenge of being a landlocked country with a mountainous topography and scattered settlements which imply high costs for social services and development of infrastructure. This has added pressure to the national budget, diverting resources from direct investment in production. Bhutan will need to continue its drive towards improved productivity while promoting the production of higher value products and seeking to expand in profitable market outlets.

2 Climate Change, Impacts, Vulnerability and Adaptation

2.1 Changes in Temperature, and Rainfall

The literature reviewed by the CLACC fellows found that there is lack of data and information on Bhutan to tell about historical changes in temperature and rainfall pattern and also future changes. The Initial National Communication prepared by the National Environment Commission has presented qualitative assessment of adverse effects of climate change based on studies carried out elsewhere. However, it can be assumed that changes in temperature and rainfall in Bhutan would not be significantly different from Nepal.

The "best guess" scenario (IPCC) indicates that by the year 2100 temperature will have increased by 2^0C and glaciers retreated by 49cm, with rainfall increased by 4.1%. This is the basis for environmental sensitivities described with regard to climate change and glacial retreats, because Bhutan's entire northern highlands are either covered with glaciers or snow. All the runoff rivers and other water resources are snow/glacier-fed, and 80% of the population, infrastructure and agricultural land are in the most vulnerable mountain valleys.

2.2 Climate Change Impacts, Vulnerabilities and Adaptation

The initial national communication submitted to the United Nations Framework Convention on Climate Change stated that climate change will have significant impacts on Bhutan's mountainous ecosystem. In 1994, a glacier lake outburst in the Lunana region flooded and damaged everything in the lower valleys of Punakha and below, illustrating the high degree of Bhutan's vulnerability to glacier lake outburst.

As a Least Developed Country situated in a mountain ecosystem, Bhutan is therefore highly vulnerable to possible adverse climate change impacts. In the Bhutanese perspective, six areas considered most vulnerable to climate change are: (i) forests and biodiversity, (ii) agriculture, (iii) water resources, (iv) glacial lake outbursts, (v) health, and (vi) landslides. A brief sectoral vulnerability is presented below based on initial national communication.

2.2.1 Forests and Biodiversity

Bhutan is part of one of the 10 global biodiversity "hotspots". Today its rich biodiversity resources still make a large contribution to the economy. Unfortunately, human activities are increasingly threatening

all the existing ecosystems. In addition, several species are already endangered by climate change and extreme weather events.

The forestry and biodiversity sector assessment of Bhutan employs a general approach with no specification to clarify the impact of climate change. According to IPCC, climate change could have enormous impacts on forests and forest resources in Bhutan, with temperature changes creating competition between high-elevation tree species and new arrivals. Weedy species with a high ecological tolerance will have an advantage over cold-adapted species (IPCC, 1998). While warming may have positive effects on the growth of some trees, it also could reduce tree survival by benefiting insects or pests. Warmer winters would imply reduced snow cover and less carryover of water to the growing season, which could lead to drought-induced forest decline (IPCC, 1996).

The combination of climate change with the pressures of deforestation, land use changes, habitat degradation and fragmentation presents a significant threat to biodiversity. Climate change can affect biodiversity either directly, by changing the physiological responses of species, or indirectly, by changing the relationships between species (IPCC, 1996). For example, a change in the insect population could influence the evolution of plant biodiversity and vice versa. Ironically, the projected climate change, with some increase in rainfall and temperature, is favourable for the richness of diversity. This is because a warmer world has greater potential for plant productivity, together with a movement of many species towards higher latitudes. Some species, however, will die out or become extinct as temperatures exceed their tolerance limits. Sufficient water supply will mean enough water for plants and animals for their survival and production. An increase in rainfall, on the other hand, also will enhance soil erosion and will affect vegetation and other biodiversity (Bhutan, 2000).

2.2.2 Agricultural Activities

In Bhutan agricultural activities are broadly classified into livestock and crops. The main crops are rice, wheat, maize and potato. However, as many as nine varieties of crops are cultivated in general in Bhutan. Upland crop production, practiced close to the margins of viable production, can be highly sensitive to variations in climate (IPCC, 1996).Agricultural productivity is sensitive to two broad

classes of climate-induced effects: (a) direct effects from changes in temperature, precipitation or carbon dioxide concentrations, and (b) indirect effects through changes in soils, distribution and frequency of infestation by pests, insects, diseases or weeds. A temperature increase of 2^0C would shift the cultivating zone further into higher elevation. This means that crops that are sensitive to low temperatures can be introduced into higher elevations with this temperature rise. Although this may seem a useful aspect, a closer examination indicates that the landforms at this altitude are mainly steep slopes, unsuitable for agriculture. Related cropping patterns would be affected along with further degradation of hill ecosystem.

It is reported that warming may have positive impacts on crop yields if moisture is not a constraint, but increases in the occurrence of extreme events or pests may offset any potential benefits. Both crops and livestock would be affected by increased deadly disease of alien/invasive pests and diseases. An increase in temperature, despite a reduction in humidity, can reduce the ability of farmers to work. As a result, low-income rural populations that depend on traditional agricultural systems or on marginal lands are particularly vulnerable to climate change and livelihoods will be at risk.

In addition, climate change is expected to increase the severity and frequency of monsoonal storms and flooding in the Himalayas, which could aggravate the occurrence of landslides. Apart from the danger to life and property, some of the generated sediments may be deposited in the agricultural lands or in irrigation canals and streams, which will contribute to deterioration in crop production and in the quality of agricultural lands.

2.2.3 Water Resources

Bhutan has easy access to rivers, streams and natural pond water. These resources are dependent mainly on glaciers, snow, forests and seasonal rainfall averaging 1,000 mm per year. Although Bhutan did not record water shortages till now, climate change may render the country highly vulnerable to scarcity of water. Anglo *et al*. (1996), confirm that water resources in the tropical Asia region, covering Bhutan, are very sensitive not only to changes in temperature and precipitation but also to changes in tropical cyclones. Therefore, stringent measures need to be put in place to ensure the sustainability of the water supply.

An increase in rainfall intensity, which some models have projected, may increase runoff, enhance soil erosion on cleared land and accelerate sedimentation in the existing water supplies or reservoirs. Not only will such an event reduce the potential of a catchment to retain water, but it will also cause water quality to deteriorate. A reduction in the average flow of snow fed rivers, combined with an increase in peak flows and sediment yield, would have major impacts on hydropower generation, urban water supply and agriculture.

2.2.4 Glacial Lake Outbursts

There are numerous snow-clad mountains and glacial lakes in the northern region of the country. Increases in temperature caused by global warming will result in the retreat of glaciers, increasing the volume of such lakes and ultimately provoking glacial lake outburst floods (GLOFs) with potential catastrophes. The October 1994 flash flood on the Pho Chhu river following a glacial lake outburst in the Lunana area was one such example.

Possible significant impacts of glacial lake outbursts in the context of Bhutan include perturbation in the quantity of river water used for hydropower generation; destruction of settlements, infrastructure, and agricultural lands; and loss of biodiversity, and even human lives down-stream.

2.2.5 Human Health

It is reported in the national communication that the relationship between health and climate change is little known in Bhutan. A predicted temperature increase of 2^0C is likely to affect human health not only because of heat stress but also because of increased outbreaks of vector-borne diseases. Similarly, an increase in rainfall and flooding, which provide favourable conditions for water-borne diseases, also can increase vulnerability to health hazards. There have been several examples of malaria and cholera outbreaks in the recent past. However, developing a correlation between such outbreaks and climate change was not possible because of the absence of relevant data. Still, the persistent occurrence of malaria despite efforts toward its eradication provides an indication of Bhutan's vulnerability.

Another significant climate change-related health concern is the increase of water-borne diseases such as gastroenteritis and diarrhoea, which are identified with poor water quality and turbidity during rainy seasons.

2.2.6 Landslides

The Himalayan Mountains are considered young and still in the growing stage. Various parts of Bhutan especially the south fall within major fault lines of different geological formations making the region highly unstable and susceptible to landslide. This situation combined with heavy rainfall and external disturbance—e.g., construction of roads, mining, deforestation and so forth—causes landslides that disrupt the economy and social communications. Moreover, this impact is significant given the fact that Bhutan depends largely on its road network for transport and trade.

2.3 Vulnerability of households

Bhutanese life and culture are integrally related to the land and mountains. People in Bhutan have maintained a delicate balance between their lifestyles and the fragile mountain ecosystem, which could be seriously disrupted by climate change. Although current studies provide some indications of the likely impacts of climate change on the resources of Bhutan and livelihood of rural households, net impacts are likely to be cumulative. This cumulative effect can be determined by the synergistic interaction between the above impacts and the continual environmental and socioeconomic changes.

2.4 Adaptation Options

Bhutanese have traditionally existed in harmony with their biophysical environment which is reflected in their customs and traditions. The national communication has suggested that adaptation strategies should increase the ability of ecosystems and communities to cope with ongoing environmental stresses, anticipated climate change and climate variability. The least-cost options (economic, social and environmental) for adaptation to climate change are those related to activities that are either ongoing or likely to be easily implemented with local resources and accepted by the community. On the other hand, there are a number of "no-regrets" strategies related to the most severe effects and the greatest vulnerabilities, but some could be high-cost options. With proper planning and good timing, however, these strategies can be realized within a set time frame.

It is important that Bhutan suggested taking a "no-regrets" approach as adaptation strategies. In addition, the "no-regrets" strategies benefit both the society and the environment in the long-term, in spite of initial economic costs.

In the case of a glacier mitigation strategy, for example, regular monitoring is required to ensure timely remedial and preventive actions. In this case, intermediate steps may involve relocation of people to higher land to avoid inundation from flood surges. High-priority areas need to be identified for drawing up the impact mitigation strategy.

The initial national communication stated that the sectoral adaptation measures needs to be qualitatively assessed in the future on the basis of the economic and environmental cost, cultural suitability and practicability. However, the following basic measures have to be undertaken, not only to meet climate change, but also in the context of the country's development process:

2.4.1 Human Health

1. A reliable and safe drinking water supply is essential. To ensure safe drinking water for all, the number of water treatment plants must be increased.
2. The development of proper waste disposal methods needs to be encouraged to minimize the existence of vector breeding habitats.
3. Regular cleaning and vaccination campaigns are conducted at sites where the mosquito vector is abundant. There is a need to further improve public health measures.

2.4.2 Water Resources

1. Community involvement and awareness are very important in using water resources more sustainably.
2. Land use planning should be improved to promote afforestation in degraded water catchment areas.
3. There is a need to extend, improve and maintain water supply infrastructure, including water tanks, pipes and so forth.

2.4.3 Agricultural Activities

1. There is a need to develop varieties of crops and livestock with greater resilience to limited arable land and extreme temperature events.

2. Quarantine surveillance should be increased against alien/invasive species with higher temperature optima and others, which may be adapted to higher elevations.
3. Agro-forestry or agro-silvo-pastoral systems may be utilized to reduce erosion and run-off on steep slopes. This could also be used to mitigate heat stress and respiration problems, as well as soil fertility loss.

2.4.4 Forests and Biodiversity

1. Community-based forest management and afforestation projects should be encouraged in areas where there is rich biodiversity. The method of forest management should be done in such a way as to contribute to its proper purpose, which includes national land conservation, water resource conservation, nature conservation, wood production and human living environment conservation, as well as contributing to the prevention of global warming.
2. Research in developing a sustainable socioeconomic system, which can ensure that society is in harmony with the natural environment, should be initiated.
3. Research in tree species that are fast-growing and more resistant to insect damages from diseases, natural phenomena and forest fire should be initiated.
4. Improvement to an appropriate database for natural resources such as forests—not only in the context of climate change but also for support to other development strategy frameworks—is urgently required.
5. Banning of export of raw timber products by the Royal Government in the recent years was one good example of adaptation measures for the sustainability of the forest cover.

2.4.5 Renewable Energy

1. Technology and financial support to hydropower potential access, including transmission and distribution.
2. Research for other renewable energy alternatives, including solar power.
3. Enhancement of the Power Master Plan.
4. Research for replacement petrol/diesel engine motor transport.

2.4.6 Institutional Issues

It is revealed from the secondary literature that further capacity building is needed in order to prepare comprehensive vulnerability assessment and to prepare adaptation strategies. It is also necessary to promote an awareness raising of Bhutan's vulnerability to climate change impacts. The following areas need immediate attentions.

1. Upgrading/improvement of meteorological organization/ infrastructures and education on general climate change issues.
2. Upgrading/integration into line Ministerial organizations of the Central Statistical Organization and training in database development/improvement, especially green sector, for future GHG inventories.
3. Training on vulnerability to climate change, especially in lower mountain valleys, and feasible adaptations that are culturally, environmentally and economically acceptable.
4. Strengthening institutions such as environmental NGOs as well as Government departments and ministries, especially MTI, MoA, MoC, Planning Commission, NEC and Dzongkhags.
5. Priority given to public awareness regarding vulnerabilities and adaptations.
6. Education of communities to understand their own vulnerabilities, to make suitable adaptations, and to subsequently decide on the most feasible mitigation.

3. Mainstreaming Adaptation to Climate Change

Recognition, by both national and international agencies, of the adverse impacts of climate change and extreme events on future development and an incorporation of this awareness in policy and strategy documents, can be seen as the beginning of mainstreaming adaptation to climate change. The next step is to shift from policy to action and fully integrate climate change adaptation measures into the wider development programmes - no easy task. This requires the participation and cooperation of different stakeholders (government policy makers, implementing agencies, development partners, private sector, and communities). The following section provide a brief review of the present status in terms of recognition of adverse impacts of climate change in policies, strategies and actions being implemented to address climate change, variability and extreme events. It also reviews the status and process regarding the preparing of the National Adaptation Programme of Action in Bhutan, as urgent and immediate actions need to be incorporated in the context of development and livelihoods.

3.1 Present Policies and Activities

3.1.1 Climate Change Concerns in Macro Policies and Plans

The Royal Government of Bhutan is a signatory of a number of multilateral environmental agreements including the United Nations Framework Convention on Climate Change and the Convention on Biological Diversity. It signed the UNFCCC in Rio de Janeiro in 1992, and ratified on 25 August 1995. The National Environment Commission was appointed the focal point for climate change activities in Bhutan and its commission members were designated as the National Climate Change Committee.

The Royal Government of Bhutan, through the Planning Commission, has developed a Vision Statement in the form of a strategy document giving its 20-year perspective. This visionary strategy is known as "Bhutan 2020: A Vision for Peace, Prosperity and Happiness". The emphasis on maintaining forest area, developing environmentally friendly power generating sources, increasing food self- sufficiency within the confines of a policy of non-conversion of forest land to agricultural land, and balancing regional and industrial development will serve to check deleterious environmental impacts associated with

development. It has mentioned vulnerability of soil erosion due to monsoon rain but no reference to future threats of intense monsoon rain due to climate change on sustainable development.

The Poverty Section of the Ninth Plan recognized climate induced disasters (like floods and landslides) can lead to greater poverty. In recent years, agricultural land and houses have been lost to floods and landslides in some communities. Other causes of poverty can be wild life depredations of crops, pest outbreak, and crop failure particularly for those whose holdings are very small. The huge roads that will be constructed under the ninth plan need better planning and vulnerability zoning before construction. The renewable natural resource management section of the tenth plan recognised that change in land use patterns combined with farm labour shortage will impact the growth in cereal production. Vulnerability to food shortages is a more pressing contemporary issue for Bhutan than the other dimensions of food security like access, availability and utilization. Pockets in the country are prone to flood, drought and other forms of natural disasters that causes temporary reduction in food production and supply. Over the last decade, depredation of crops by wildlife, particularly wild boars, has increased the vulnerability of the farmers' livelihood through out the country. Lack of adequate farm infrastructure is a major disincentive for increasing farm productivity and production. In the Ninth Plan, priority will be given to the development of farm infrastructure such as farm roads and irrigation channels, storage, processing and marketing facilities. It is found that the environment is the last section of the plan and explicit recognition of future climate change and related extreme events are missing.

3.1.2Climate Concerns in Sectoral Policies, Programmes and Projects

Bhutan has given special attention to the protection of the environment because of its unique flora, fauna and general bio-diversity. The Bhutanese authorities have been very consistent in preserving the country's environment making it one of the top policy priorities. Several donors, including Member States, have contributed more than USD 20 million (1998) to the Bhutan Trust Fund for conservation activities. All major development initiatives are thoroughly assessed in relation to their environmental impact. Bhutan's restrictive tourism policy is also an expression of the government's concern for the environment, although cultural preservation may also play a part. The main threats to the environment could be rapid population growth, uncontrolled industrialisation and unsustainable cultivation methods in agriculture.

National Forests Policy, 1974 and Forests and Nature Conservation Act 1995 talked about forest management, conservation and protection but future threats related to climate change and extreme events are missing. The policy does not mention climate change explicitly but the forestry sector is one of the vulnerable sectors in Bhutan.

The Government and people of Bhutan have shown an extraordinary commitment to the conservation of natural resources and the balance between economic development and environmental conservation-The Middle Path. The preservation of the country's rich natural resources can be attributed to the enlightened leadership of His Majesty the King and the strong conservation ethic of the people. His Majesty the King has categorically stated that development must not take place at the expense of our natural resources. The highest legislative body, the National Assembly mandated that the country should maintain at least 60% of the land area under forest cover (National Forest Policy, 1974) for all time to come.

During the Eighth Plan, the Royal Government formulated the National Environment Strategy (NES). Finalized in 1998, the NES is a policy document designed to guide environmental conservation in Bhutan. The Environmental Assessment Act, 2000 approved by the National Assembly, ensures that environmental assessments will be implemented for all activities that have potentially significant environmental impact. Formulation of the National Environmental Action Plan and the National Environmental Protection Act are currently underway.

Conservation of natural resources continues to remain a priority for the Royal Government. At present Bhutan has 72% of its land area under forest cover that includes 26% as protected areas and biological corridors comprise an additional 9% of the land area. The country has very high levels of biological diversity at the ecosystem, species and genetic levels. Bhutan ranks in the top ten of countries with the highest species density (species richness per unit area) in the world, and it has the highest fraction of land in protected areas and the highest proportion of forest cover of any Asian country.

3.1.3 Climate Concerns in Donor Strategies and Activities

It is found that a number of development partners are assisting Bhutan to improve the social and economic situation of Bhutan along with natural resource management. The European Community Country

Strategy Paper for Bhutan has mentioned that the Bhutanese economy remains subsistence-oriented and centred around agriculture. Although the country is well-endowed with natural resources (hydropower, dense forests and mineral deposits such as limestone and dolomite), utilisation of these resources is hampered by the extreme geography and climate. This is a kind of recognition of extreme weather events but explicit attention and necessary measures to address future climate change and extreme events are missing in the strategy document.

The Austrian Development Cooperation (ADC) implemented a project on Glacial Lake Outburst Flood mitigation measures from 1999–December 2002 and SDS supports the introduction of environmentally friendly road construction concepts in all agencies (public and private) involved in road construction. Both have future benefit to address adverse impacts of climate change and variability.

The World Wide Fund for Nature is working on a number of fields including the Sakteng Wildlife Sanctuary (2003–2005) that aims to develop a 5-year conservation management plan for the Sakteng Wildlife Sanctuary through the collection of baseline information on vegetation, wildlife and socioeconomic aspects of the sanctuary; implementing integrated conservation and development activities; and building of basic infrastructure and human resources capacity.

The Integrated Conservation and Development Program Project of WWF develops and supports a village community in Trongsa, Bumthang and Trashigang to reduce dependence on natural resources through increasing food and cash crop production, intensifying livestock production, protecting forests, and developing local leadership by ensuring the local community's needs in health and education, agriculture, forestry, livestock, communication, energy and local governance.

The Global Environment Facility through UNDP is implementing the National Capacity Self-Assessment Project (2003–2004) that is to prepare a national assessment of capacity building that Bhutan needs to meet national obligations under United Nations environmental conventions (Climate Change and Biodiversity).

From the above key activities it is found that recognition of the importance of natural resource management and addressing natural

disaster is emerging in the activities in development partners and international environmental non-government organizations. However, explicit attention is still missing in order to address future threats and needs.

3.2 National Adaptation Programme of Action (NAPA)

Preparation of the National Adaptation Programme of Action (NAPA) is the first official initiative for mainstreaming adaptation to national policies and actions for addressing adverse impacts of climate change and reduce vulnerability to climate stimuli including extreme events. It will be a document of project portfolio giving emphasis on the most urgent and immediate needs of the country and implementation of these projects and activities will reduce both vulnerability and the cost that otherwise will occur if addressed later.

Bhutan has prepared a project document to initiate the National Adaptation Program of Action (NAPA) with participation from a multi-disciplinary team, coordinated by the National Environment Commission (NEC). However, the activities are yet to be started and development of the actual NAPA is expected to begin shortly. The Steering committee headed by Planning Commission will oversee the overall activities and the NAPA team will carry out the real activities and prepare the document. The composition of the NAPA team will be as follows.

> NAPA Team Composition: Members of Initial National Communication, Additional members from other sectors including, finance, planning and NGOs…, Sectoral working groups, most experts dealing with climate change.

3.2.1 Priority Sectors

Bhutan has identified five sectors stated in the initial national communication that are closely link with economic growth and social development. The sectors are a) agriculture, b) water resources, c) forests and biodiversity, d) natural disasters, and e) human health.

4. Concluding Remarks

Bhutan is a small kingdom having about 750 thousand population with per capita Gross Domestic Product of US$ 695 which is highest among the South Asian LDC countries. Significant economic progress and social development has been achieved over the years and found increased share electricity, trade and commerce, and communication to national economy. It has also been reported that the country is facing a number of challenges for achieving national development goals and objectives. Mountainous topography and scattered settlements imply high costs for social services and development of infrastructure and added pressure to the national budget.

From the existing development plans and vulnerability assessment report it is found that adverse effects of climate change including variability and natural disaster has a significant implication on the overall development of Bhutan. Six areas considered as most vulnerable to climate change are: (i) forests and biodiversity, (ii) agriculture, (iii) water resources, (iv) glacial lake outbursts, (v) health, and (vi) landslides. It appears that a temperature increase of 2^0C would shift the cultivating zone further into higher elevation and crops sensitive to low temperatures can be introduced into higher elevations with this temperature rise. But considering the landforms at this altitude are mainly steep slopes and therefore unsuitable for agriculture. Therefore existing cropping patterns would be affected along with further degradation of hill ecosystem due to temperature changes. Possible significant impacts of glacial lake outbursts include perturbation in the quantity of river water used for hydropower generation, destruction of settlements, infrastructure, and agricultural lands, and loss of biodiversity, and even human lives downstream.

It is found that low economic strength, inadequate infrastructure, level of social development, lack of institutional capacity, and agro-based rural economy make the country more vulnerable to climate change. Apart from this additional pressure on hydropower industry due to changes in the water regime and increased natural disasters will hamper production leading to reduction of export to India and ultimately economic growth will face constraint.

A number of policy documents have identified existing challenges including the broader environment and natural resource management

explicitly climate change in the development plans and strategies both in government and donor agencies. Several strategies mention the mitigation potential of Bhutan's hydropower and forestry sector. It is important to note that several donors and the government are in fact actively engaged in projects to reduce the risk of GLOFs but over the next decade up scaling of such activities is necessary to address the future threats. Ignorance of potential climate induced impacts will limit and or slow down the achievement of overall development.

A number of win-win options and measures have been identified in the initial national communication. The noteworthy interventions are a) Community involvement and awareness are very important in using water resources more sustainably, b) Land use planning should be improved to promote afforestation in degraded water catchment areas, c) develop varieties of crops and livestock with greater resilience to limited arable land and extreme temperature events, d) Community-based forest management and afforestation projects which should be done in such a way as to contribute to its proper purpose, which includes national land conservation, water resource conservation, nature conservation, wood production and human living environment conservation, as well as contributing to the prevention of global warming.

A number of areas for research including a) developing a sustainable socioeconomic system, which can ensure that society is in harmony with the natural environment, b) tree species that are fast-growing and more resistant to insect damages from diseases, natural phenomena and forest fire should be initiated.

The National Adaptation Programme of Action (NAPA) appears to be the first attempt to bring together different stakeholders including government and civil society. It has rightly included the planning commission and given charge to coordinate the NAPA for Bhutan. Development partners may be included in the consultation process who will play a vital role in the implementation of the projects and activities that will be identified in the NAPA document. Involvement of donors and development agencies, different sectoral stakeholders from the very beginning will help mainstreaming adaptation to climate change.

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MOZAHARUL ALAM is a Research Fellow at the Bangaldesh Centre for advanced Studies where he is working on global environment change and sustainable development issues with a special focus on climate change impacts, vulnerability, adaptation and mainstreaming issues. He is also working on building the capacity of least developed counties in South Asia in the above areas.

Bangladesh Centre for Advanced Studies (BCAS) ,
House 10, Road 16A, Gulshan-1, Dhaka 1212, Bangladesh

Tel: +880-2-8851237
Fax:+880-2-8851417
Email: mozaharul.alam@bcas.net

DAGO TSHERING is a Field Coordinator at the Royal Society for Protection of Nature and working in Phobjikha Conservation Area in implementing the Integrated Conservation and Development Program (ICDP). He is working directly with the grass-root communities and has lots of experience in social science besides environmental subjects.
Royal Society for Protection of Nature (RSPN), P.O. Box 325, Thimphu, Bhutan.

Tel: +975-2-322056
Fax: +975-2-323189
Email: dagot@rspn-bhutan.org

About CLACC

Capacity strengthening in the Least Developed Countries (LDCs) for Adaptation to Climate Change (CLACC) is a multi country project being implemented by the International Institute for Environment and Development (IIED) in associating with four regional and International Networking Group (RING) partners i.e. the Bangladesh Centre for Advanced Studies (BCAS), the African Centre for Technology Studies (ACTS) in Kenya, the Environmental Development Action in the Third World (ENDA) in Senegal and the Zimbabwe Environmental Research Organization (ZERO) in Zimbabwe with financial support from a number of development partners.

The aims of the project is to support LDCs in their efforts to adapt to the impacts of climate change through long-term capacity strengthening activities with governments as well as civil society. The main objectives of the project are to a) strengthen the capacity of civil society in LDCs to adapt to climate change and enhance adaptive capacity among the most vulnerable groups, b) establish an information and knowledge sharing system to help countries to deal with the adverse impacts of climate change, and c) integrate adaptation to climate change into the work of key non-government institutions, and help mainstreaming adaptation in the government policy-making and programme development process.