

# Strategizing Climate Change for Bhutan

National Environment Commission  
Royal Government of Bhutan  
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# Executive Summary

## Background

In 2005, the Regional office of UNEP, Bangkok, received a request from the Government of Bhutan for assistance under the BSP. After a mission was conducted to assess and discuss the capacity needs of the National Environment Commission (NEC), it was agreed that cooperation with the NEC would be pursued under a three-year rolling plan with annual review. The following were identified as the specific needs for 2005-2007 and UNEP was approached for assistance:

- Development of National Environment Strategy
- Assessment of environment security, including food, water and energy
- Pilot organic farming to promote sustainable agricultural development
- Study the potential of hydrogen economy in Bhutan

Under a MOU signed between UNEP's Regional Office and the National Environment Commission, Royal Government of Bhutan, the NEC was expected to carry out the development of a National Sustainable Development Strategy (NSDS). The NSDS would be built on existing policies and planning mechanisms such as the "Middle Path", "Bhutan Vision 2020" and the draft 10<sup>th</sup> Five Year Plan. It was also recommended that the NSDS consider issues such as sustainable land management, climate change, disaster management, energy sustainability, globalization and infrastructure development in order to guide sectors in the formation of their environment chapters for the 10<sup>th</sup> Five Year Plan.

However, during the inception workshop for the NSDS, different stakeholders informed the meeting that there were already several processes and systems underway and that the formulation of a NSDS at this stage may not be appropriate. The stakeholders suggested that it would be better to wait for the new processes and systems (e.g. finalization of the 10<sup>th</sup> Five Year Plan, the institution of constitutional monarchy etc.) to be completed before formulating the NSDS or updating the existing National Environment Strategy, the "Middle Path". This was suggested so that the new NSDS would address issues pertinent to the new developments.

Therefore, in June 2008, the NEC and the UNEP made the following amendments in the MoU to address the above concerns.

- National Climate Change Strategy
- Report on pilot study on organic farming
- Report on potential of hydrogen economy in Bhutan

As a comprehensive National Climate Change Strategy could entail more work and require greater financial commitments, UNEP and NEC agreed that a White

Paper on Climate Change to assess what is being done currently to address climate change might be appropriate at this stage. Moreover, a comprehensive Climate Change Strategy would require more detailed assessments in terms of vulnerability, adaptation and mitigation to the impacts of climate change. It was thus recognized that these assessments would be a result of the process of the Second National Communication (SNC) that is being implemented right. Therefore, formulating the comprehensive National Climate Change Strategy should be undertaken after the completion of the SNC.

This concept paper on a National Climate Change Strategy was undertaken under the amended MoU and with the financial and technical support of UNEP. The exercise was coordinated by Dr. Subrato Sinha in UNEP, Bangkok and by Ms. Tshewang Zangmo and Mr. Thinley Namgyel in NEC, Bhutan.

## **Introduction**

Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level. Observed decreases in snow and ice extent are also consistent with warming. Mountain glaciers and snow cover on average have declined in both hemispheres. The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) released in 2007, states unequivocally that the world is warming and that human activity – rather than just natural variations – is contributing to current levels of warming. The impact on subsistence agricultural practices and water resources are of particular concern. Climate change will exacerbate existing economic, political, and humanitarian stresses. It will compound existing water scarcity problems, increase the number of people suffering water stress, and reduce access to safe drinking water. It will have an impact on rain-fed agriculture, affecting both local cropping patterns and international production and trade<sup>1</sup>.

In order to effectively participate in, and fully benefit from, a new climate change and development paradigm, developing countries will be required to engage a variety of government, private sector and civil society stakeholders to garner broad-based support at the local, national, regional and global level. Additionally, they will have to co-ordinate across key economic sectors because actions to promote increased resilience to the impacts of climate change and a lower-GHG emission economy fall across a variety of sectors, such as energy, agriculture, health, water resources and infrastructure. Developing countries – in particular those with medium and small economies – will need to be assisted in

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<sup>1</sup> IPCC (2007): “Climate Change 2007 - The Physical Science Basis Contribution of Working Group I to the Fourth Assessment Report of the IPCC”, Cambridge University Press, Cambridge, UK.

implementing innovative approaches and capitalizing on the opportunities that a new climate regime may offer<sup>2</sup>.

Bhutan falls within the IPCC's South Asia sub-continental region which stretches to latitude 50°N. Averaged temperature and precipitation changes are derived from a dataset of 21 global models. For the A1B scenario<sup>3</sup>, the models show a median increase of 3.3°C by 2100, with increases in daily minimum and maximum temperatures. The largest warming will take place at higher altitudes, for example over the Himalayas, as surface albedo will decrease with the melting of snow and ice. A 5% decrease in precipitation is projected in the dry season, and an 11% increase for the rest of the year. In summary, the IPCC climate change projections to 2100 for the South Asia sub-continental region, including Bhutan, consist of the following:

- Increase in average temperatures with relatively warmer weather at higher altitudes and during the dry season;
- Increase in average annual precipitation and with a higher relative increase in the wet season and a decrease in the dry season;
- No conclusive indication of changes in climate variability and occurrence of extreme weather events;
- Continued spatial variation in temperatures and precipitation due to complex local topography.

The current evidences of climate change in Bhutan are primarily extreme weather events, but impacts from incremental changes are likely to be evident in the coming decades. The impacts of climate change depend primarily on the people's vulnerability, which is determined by factors including poverty, remoteness, governance, capacity and awareness, natural resources management and other factors that pose challenges to achieving national development targets<sup>4</sup>.

Currently climate-related impacts are observed on the glaciers and attention is on the risk of glacial lake outburst floods (GLOF). Future climate change will have potential impacts on development and livelihoods in Bhutan. The impacts of climate change are likely to be mainly felt in the agriculture, hydropower, infrastructure (including roads and urban services), and health sectors.

The consequences of climate change include an increase in mean average temperature leading to higher temperature peaks as well as milder winters. The impacts in agriculture, glaciers and health are uncertain but potentially serious. The other significant changes will be felt in the precipitation pattern with erratic rainfall, later arrival of the rain, geographical shifts in rainfall distribution, which

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<sup>2</sup> UNDP (2008): Climate Change at UNDP. Scaling Up to Meet the Challenge

<sup>3</sup> The IPCC A1B scenario shows balance across all sources, where 'balanced' is defined as not relying too heavily on one particular energy source, on the assumption that similar improvement rates apply to all energy supply and end use technologies.

<sup>4</sup> Source: Climate Change Screening of Danish Development Assistance with Bhutan, May 2008

can lead to flash floods and drought in the dry season in combination with lower glacier run-off. The impacts on agriculture, hydropower and drinking water supply are uncertain but potentially serious.

Moreover, Bhutan's Tenth Five Year Plan (10<sup>th</sup> FYP) highlights environment as a cross-cutting issue that is intimately intertwined with poverty reduction and calls for all sectors, agencies, *Dzongkhags* and *Gewogs* to mainstream environmental issues in all their policies, plans, programmes and projects and build adequate mitigation measures to minimize any adverse impact on the environment. The 10<sup>th</sup> FYP also recognizes the direct link between disasters and the situation of poverty and emphasizes the need for measures for the prevention and mitigation of disasters in all plans, wherever possible. The 10<sup>th</sup> FYP also recognizes the need for building social capital and recommends that community-based self-help and voluntary organizations be promoted while formulating development strategies, programmes and projects to institute mechanisms for sustainable local economic development.

Considering these challenges, there is an expressed need for Bhutan to formulate a long-term strategy to address the vulnerability to climate change at the national, local and sectoral levels. The strategy will provide a holistic framework with overall objectives of enhancing resilience, reducing vulnerability as well as increasing sustainability. Bhutan has also made commitments to various global conventions and declarations, including UNFCCC, Kyoto Protocol, MDG, and the Joint Plan of Implementation (JPOI). The strategy will enable the country to address the provisions under the global and regional commitments. Such a strategy will also help donors identify and mobilize resources to support mitigation and adaptation strategies in their areas of interest<sup>5</sup>.

This paper is the second step in this direction. The Climate Screening of Danish Assistance to Bhutan was the first step. The work done in the climate screening exercise was very comprehensive and addressed how Bhutan should move forward in addressing climate change in years to come. This paper is mostly a reflection of their work although the reflections were corroborated through interviews with relevant stakeholder agencies. It is hoped that until a comprehensive strategy for addressing climate change is developed, donors will use this document to identify priority areas for support.

## **Findings and Recommendations**

The climate change screening of Danish Development assistance in Bhutan carried out by DANIDA lists a set of findings and comprehensive recommendations that highlight interventions necessary for Bhutan to enhance its adaptive capacity to climate change. As a follow up to the climate screening exercise, DANIDA is already supporting a project "Support to Enhancing Adaptive Capacity to Climate Change" based on some of the recommendations.

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<sup>5</sup> 10<sup>th</sup> FYP Main Document, Planning Commission, 2006

The following findings and recommendations are based on the discussions with the various stakeholders during the course of this exercise and also include the recommendations of the climate change screening exercise.

## **Findings**

The following were some of the findings of the Danish Climate Change screening exercise which were further voiced by the stakeholders at discussions and meetings with them during the course of this study.

### **Awareness of Climate Change**

There is awareness of basic climate change issues at the ministerial level. National visions, strategies, plans and legislation generally make little or no reference to climate change. Policy makers agree that climate change will increasingly be a cause of concern and that specific actions have to be incorporated in development plans to address. Technical knowledge of climate change is limited to project staff, and has not been disseminated beyond the environment sector to health, education, agriculture or energy. There is also limited research on climate change carried out in Bhutan and low research capacity to do such work. The media and NGOs are expected to play a vital role in promoting better understanding of climate change and also implement adaptation projects at the grassroots. Concerns were raised by media professionals that they would like to be more involved in addressing climate change but lacked in-depth knowledge and understanding of the subject. They expressed the need for awareness programs and more exposure to regional and international forums such as the COP.

### **National Policy Documents**

Bhutan's Vision 2020 and the "Middle Path" along with the development philosophy of "Gross National Happiness" have been vital instruments for raising the profile of environmental conservation amongst policy makers and the general public. However, there is an urgent need to rewrite/revise these documents to make them more sensitive to climate change.

### **Climate Change Focal Point Capacity**

The National Environment Commission (NEC) does not have staff assigned to climate change issues on a full-time basis. Climate change projects are implemented on a project basis without any longer term institutional planning. The National Climate Change Committee (NCCC), a technical-level task force, convenes for project implementation only, e.g. to prepare National Communications. The capacity of climate change focal persons in other stakeholder agencies also needs to be enhanced to strengthen the NCCC.

### **Climate Change in the 10<sup>th</sup> Five Year Plan**

The draft 10<sup>th</sup> Five Year Plan (2008-2013) does not make specific reference to 'climate change' in the main document (volume 1). In the programme profiles

(volume 2), one programme makes specific reference to climate change (MEA/18: 'Assessment and Monitoring of Climate Change Induced and Geological Hazards') and several are indirectly relevant (e.g., MEA/13: 'Strengthening of National Hydrological and Meteorological Services' with a link to NAPA priority #3).

### National Adaptation Programme of Action (NAPA)

The NAPA prepared in 2006 provides the priorities for immediate and urgent adaptation to climate change in Bhutan. As of December 2008, Bhutan was the only country that received funds from the LDCF for NAPA. The strength of Bhutan's NAPA is that its contents reflect the genuine priorities of the stakeholder agencies as they were involved at every stage of the NAPA formulation. With the availability of more funds to fund NAPA projects in LDC countries, Bhutan could access funds for a few more projects prioritized in NAPA. However, the NAPA document itself might need to be updated in the coming years to keep it in sync with the priorities of stakeholder agencies.

### Climate Change and Hydropower Development

Large-scale hydropower has been the main driver and the backbone of Bhutan's economy. Hydropower development plans to 2022 foresee investments totaling USD 3.3 billion for an additional capacity of 3.8 GWe. Revenues from electricity generation already account for an estimated 22% of GDP. Despite Bhutan's political and financial commitment to hydropower development, there is no data available nor any studies planned on the potential negative impacts of climate change on the country's hydrological flows, and existing and future hydroelectricity plants. Run-of-the-river hydropower plants, as constructed in Bhutan, do not operate reservoirs, and are highly dependent on natural run-off, and thus susceptible to climate change and variations.

### Glacial Lake Outburst Floods (GLOF)

The glacier retraction and creation of glacial lakes with potential outburst floods is a major concern in Bhutan. The GLOF risks get attention from RGoB and from donor support mainly coordinated through the forthcoming LDCF-funded project covering three out of nine NAPA priority projects.

### Climate Data, forecasting and modeling capacity may be a constraint to Climate Change Adaptation

The meteorological services are managed by the Hydro-Met office of the Department of Energy in the Ministry of Economic Affairs. While the meteorological services are mainly directed at hydropower, there will be scope to further develop the capacity to collect and manage climate data that can service different sectors, including agriculture and also contribute to the early warning of floods and climate change modeling.

### Assessments of Vulnerability and Adaptation

Due to limited data availability, the Initial National Communication was unable to conduct climate change projections as part of a vulnerability and adaptation assessment. Most meteorological and hydrological stations are located in inner and southern Bhutan, and require manual recording. Data are not collected for the northern higher mountains ranges. Given Bhutan's complex mountain topography, the existing network of meteorological and hydrological stations may not sufficiently reflect disparities in temperatures, precipitations, and flows over short distances. Modeling of the scenarios of climate change in Bhutan is yet to be undertaken.

### Disaster Management and Disaster Risk Reduction

The development of a disaster management framework and capacity is underway under the coordination of the Ministry of Home and Cultural Affairs. There is scope for further coordination of the activities in disaster risk reduction and climate change adaptation in particular at the local government level, e.g. on early warning systems and capacity of focal points, as well as among the coordinating agencies at national level.

### Forest Conservation and Carbon Storage.

Bhutan's carbon sequestration and storage capacity is the result of a national desire to prioritize forest conservation with a minimum of 60% coverage over economic opportunities through rapid industrialization. Bhutan has contributed to the global efforts of sequestering carbon through forest conservation but it has not been adequately recognized and rewarded by international climate change mechanisms. It is yet uncertain how and if Bhutan will be able to gain from the new attention on Reduced Emissions from Deforestation and Degradation (REDD) under the UNFCCC. There is also concern that a National Forest Inventory should be conducted to verify forest stock, actual percentage of land area under forest cover as per international definitions of forest cover and sequestration and storage capacity for green house gases.

### Climate Change and Agriculture

Concerns were raised about the potential impacts of climate change on land use and soil fertility as well as adaptation to climate change risks in crop management and seed varieties. Concerns were also expressed that while the Ministry of Agriculture is aware of the risks of climate change, the Ministry currently does not yet possess adequate baseline data to assess risks and vulnerabilities on the sector.

### Climate sensitive Health Impacts

Although the health sector is highly vulnerable to climate change, more resources both financial and technical are needed to monitor the potential impacts of climate change on diseases rates and vector populations. A proposal was submitted by the Ministry to UNDP for prospective funding under the Special Climate Fund.

### Water Resource Management and Climate Change



Both the energy (hydropower) and agriculture sectors are highly sensitive to climate change. In both cases, the driving factor will be the availability of water resources. Water availability in Bhutan is dependent on rainfall and snowmelt, as well as glacial melt runoff. Water management will be one of the most prominent areas for adaptation in Bhutan. Currently there is no ministry of water resources or similar institutional home for water resource management, although NEC has a mandate to coordinate water issues. The Bhutan Water Partnership (BtWP) is established with a secretariat at the Royal Society for Protection of Nature (RSPN).

### Opportunities for Carbon Financing

Since the approval of the e7<sup>6</sup> micro-hydroelectricity project, there has been little activity in the area of CDM or voluntary carbon offset projects. Stakeholders involved in greenhouse gas mitigation activities do not have technical knowledge of compliance markets (CDM) and non-compliance markets (VER standards). Thus, opportunities for financing greenhouse gas mitigation activities in energy and forestry through voluntary carbon financing have not been properly explored in Bhutan. An ADB project “Bhutan Clean Power Export Development Project, ADB TA 7157”, will begin in early 2009. The project has a component on developing the emission baseline and a CDM manual. Relevant stakeholders, besides the energy sector, should capitalize on the project to develop their capacity and expertise on CDM.

### Coordination of Climate Change.

There is awareness that coordination is needed among government agencies, among donors, and between RGoB and donors. There have not been any forums where climate change issues are discussed regularly. This has resulted in a situation where donors and government agencies are unaware of climate change relevant activities carried out within different ministries and by various development partners.

### Functioning of the Designated National Authority (DNA) for the CDM under the Kyoto Protocol.

There has been no support programme to the establishment of a DNA for the national approval of CDM projects in Bhutan. There are no specific guidelines or procedures for the approval of CDM activities. Considering the planned large-scale hydropower projects, there may be a need to develop a more comprehensive assessment framework that would enhance the contribution of CDM activities to national happiness and sustainable development.

### Attendance at Workshops and Meetings

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<sup>6</sup> e7 Fund for Sustainable Energy Development, a consortium of electric utilities from G7 countries, which aims to promote sustainable energy development and reduce GHG emissions. The e7 has later become e8. <http://www.e8.org/index.jsp?numPage=121&numFiche=50>

Concern was raised that attendance at meetings and workshops on climate change are not consistent and relevant. To keep abreast of negotiations and developments at SBSTAs and other important meetings and workshops, it was felt that participation at such forums should be more streamlined and professional.

## **Recommendations**

### **1) National Climate Change Committee**

In order to ensure that climate change is addressed as a cross sectoral issue, there is the need for a National Climate Change Committee or Commission. The present National Environment Commission served as the Commission for Climate Change for the Initial National Commission but this mandate is now not visible for the existing Commission. The structure of the NEC fits the roles of a Climate Change Committee. However, the mandate to address climate change should be spelt out in the Terms of Reference for the Commission and other relevant stakeholders, especially representatives from the health sector included on the Commission. As NEC has plans to draft regulations for the National Environment Protection Act this year, these aspects should be considered when looking at the composition and the Terms of Reference for the Commission.

### **2) Establishment of Climate Change Unit in NEC**

This unit could coordinate the support for institutional capacity development, organisation and coordination of climate change activities. The unit could also be responsible for coordinating and collaborating with the National Committee on Disaster Management (NCDM) and MoHCA on all issues relevant to the common agendas of climate change adaptation and disaster risk reduction.

### **3) Establishment of a Technical National Climate Change Committee**

In order to mainstream climate change within stakeholder agencies and to enhance the participation of these stakeholder agencies in climate change related activities, a Technical National Climate Change Committee should be established to support the NEC. The Technical Climate Change Committee could:

- make recommendations to the NEC on issues related to climate change, and also to express the concerns of key stakeholders.
- design and participate in a process leading to the formulation of a national climate change policy and a national implementation strategy.
- propose what studies need to be undertaken in support of the national climate change policy process, what their scope, timetable, budget and deadlines should be, and within the limits of the available funds, advise the NEC to perform them, and review and disseminate the results.
- guide the implementation of UNFCCC commitments

- develop clear cut country position on various issues
- communicate developments within the national and international climate change arena to stakeholders.
- assist with a structured process of capacity building and technology transfer/ development.

#### 4) Research and capacity development on climate change

There is still a strong need for capacity development on climate change and especially on research on climate change.

#### 5) Need for Support to Develop Bhutan's position for COP 15 and the post-2012 rules of the UNFCCC.

In order to effectively participate in, and fully benefit from a new climate change and development paradigm, Bhutan needs financial and technical support to develop clear positions for COP 15 and on the post-2012 rules of the UNFCCC.

#### 6) Capacity development for meteorological and hydrological services and climate modelling.

Despite Bhutan's political and financial commitment to hydropower development, there is no data available nor any studies planned on the potential negative impacts of climate change on the country's hydrological flows, and existing and future hydroelectricity plants. Run-of-the-river hydropower plants, as constructed in Bhutan, do not operate reservoirs, and are highly dependent on natural run-off, and thus susceptible to climate change and variations. There is a dire need for capacity development for meteorological and hydrological services and climate modeling.

#### 7) Need for capacity development within the Ministry of Economic Affairs (MEA) to collect and manage climate data and develop climate models and forecasting.

Support is needed for the Ministry of Economic Affairs (MEA) to develop the capacity to collect and manage climate data and develop climate models and forecasting.

#### 8) Need for support to address climate sensitivity in the agriculture and forest sectors.

Support is needed in the Ministry of Agriculture to prepare the agricultural sector for present and future climate variability and climate change.

## 9) National Forest Inventory

There is also concern that a National Forest Inventory should be conducted to verify forest stock, actual percentage of land area under forest cover as per international definitions of forest cover and sequestration and storage capacity for green house gases. It is yet uncertain how and if Bhutan will be able to gain from the new attention on Reduced Emissions from Deforestation and Degradation (REDD) under the UNFCCC but scientific data on Bhutan's forests will be needed to strengthen Bhutan's negotiation capabilities at such forums.

## 10) Need for support for Climate Change Adaptation in integrated Water Resource Management.

Improved inter-sectoral coordination of water resource management and utilization is a priority program for the Royal Government. Although the preparation of the Water Act is already supported through EUSPS, future support is needed for the coordination and implementation of integrated water resource management.

## 11) Mainstreaming Climate Change

GNHC facilitates mainstreaming environment into policies and programmes of Bhutan. NEC supports the development of procedures and tools for environmental mainstreaming. Guidelines for Environmental Mainstreaming have been developed by the NEC and the GNHC. Additional activities may include addressing climate change proofing of development activities in the annual rolling plan, incorporating climate change into environmental impact assessment procedures, and addressing climate change proofing in the Policy Formulation Protocol of the RGoB.

## 12) Development of a National Climate Change Strategy (NCCS)

As most of Bhutan's donors are sensitizing their assistance to climate change, it might be an appropriate time for Bhutan to develop a national climate change strategy. Climate change is a cross cutting issue that could affect the overall socio-economy development as well as many specific sectors including energy, transport, agriculture, forestry, water resources and health. The NCCS will provide a framework for the 'climate proofing' of national development plans<sup>7</sup> and also provide a basis for seeking donor assistance.

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<sup>7</sup> UNEP (2008) Draft Concept Paper: Climate Change Study

### 13) Revising or Climate Sensitizing the National Environment Strategy

The “Middle Path”, Bhutan’s National Environment Strategy, was published in 1999. In the current development context, there is a need to revisit the avenues for sustainable development listed in the strategy and to “climate proof” the national environment strategy. Within the framework of the institutional and political changes that have taken place in Bhutan, it is timely to revise/upgrade or rewrite the National Environment Strategy.

### 14) Climate Change-related Projects

Three projects prioritized under the Bhutan NAPA are already being implemented. These three projects consume as much as 50% of the NAPA project budget. If there are funding opportunities under the LDCF or the special adaptation fund, the NAPA project list should continue to be the basis for developing climate-change related projects for funding through these windows. However, the health sector in the current NAPA is restricted to only emergency medicine. Disease surveillance, reporting and prevention of climate sensitive diseases need to be incorporated in the NAPA if there are opportunities to update NAPA.

The Health Sector has also submitted a project proposal to the Special Climate Change Fund (SCF) through UNDP. As there are no funds in the SCF, other sources need to be sought.

As a follow-up to the DANIDA Climate Screening exercise, DANIDA is implementing a project titled “Support to Enhancing Adaptive Capacity to Climate Change in Bhutan”. This project is for duration of one year (2008-2009) and addresses some of the more urgent and critical issues related to climate change in Bhutan. The climate screening exercise also recommends the development of a ‘climate change angle’ in the next phase of the Environment Urban Sector Program Support (EUSPS). This would place climate change as a central linking theme for the programme and could include many of the issues addressed in this document.

The Swedish Government, through its donor agency, the Swedish International Development Cooperation Agency (SIDA, is supporting the establishment of the Regional Climate Adaptation Knowledge Platform for Asia as a sustainable regional knowledge-sharing mechanism on climate change adaptation.

The Regional Climate Adaptation Knowledge Platform for Asia (Platform) will:

- Support efforts to integrate climate change adaptation measures into development processes and plans at the national and regional levels;

- Facilitate and enhance dissemination and application of streamlined methodologies, tools for adaptation planning and vulnerability assessments by engaging research institutions;
- Increase linkages between adaptation and the sustainable development agenda in the region;
- Support pilot studies of specific climate change and adaptation scenarios and promote best practices.

The Stockholm Environment Institute (SEI) and the UN Environment Programme (UNEP) have been identified as key partners in the implementation of the Platform and will work together with regional partners to develop the programme of activities<sup>8</sup>.

Right now Bhutan is not included as a focal country in the Platform's geographical focus for the period 2009 – 2012 but discussions should be held with SEI and UNEP to include Bhutan as a priority country in the Platform as many of the needs identified in this document (capacity building, increased research on climate change adaptation, support for COP15, climate modeling and the focus on water management) fit well with the Platform's aims and objectives.

#### 15) "Climate Change" as the central theme for the next Round Table Meeting (RTM) with Bhutan's Development Partners.

Assessing climate change vulnerability and implementing subsequent mitigation and adaptation strategies will be the focus of donor assistance in the coming years. The SNC, DANIDA projects on climate change and a National Climate Change Strategy could provide the basis of presenting climate change as the central theme for the next RTM with Bhutan's donors.

The following themes could be included for negotiations with Bhutan's donors:

- Emphasizing (i) climate data, modeling and early warning, (ii) integrated water resource management, and (iii) inclusion of decentralized awareness and actions on climate change to reduce vulnerability, e.g. in crop management and water resource utilization.
- Addressing the climate change risks on urban infrastructure, services and livelihoods.
- Developing transfer mechanisms from hydropower to upstream land-use and forest management to protect the natural resources and reduce climate change sensitivity, i.e. Payment for Environmental Services (PES).

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<sup>8</sup> Brochure on Regional Climate Adaptation Knowledge Platform for Asia, SEI, SIDA, UNEP

- Initiating the support to climate change adaptation and vulnerability reduction at the Geog level to develop institutional structures to address and support local adaptation to climate change. This may include community-based early warning systems and awareness raising. A harmonization of climate change adaptation and disaster risk reduction initiatives is required.
- Calling on national and external expertise to prepare technical notes and initiate research on climate and development in Bhutan.

## 1.0 Background

Bhutan is a small mountainous country located on the southern slopes of the eastern Himalayas. The country covers an area of 38,394sq.km and is made up of some of the most formidable regions in the world - mostly rugged and mountainous with elevations ranging from about 100m in the foothills to over 7500m towards the north. The conservation of the environment has been an integral part of Bhutan's development philosophy ever since the introduction of modern development in the 1960s. As a result, the country is today blessed with rich natural resources in the form of forests covering an estimated 72% of the country; abundant water in the form of runoff rivers and an exceptional diversity of flora and fauna. More than 28% of the country's total land area is under protected area management while another 9% have been declared as wildlife corridors. Furthermore, on 10 June 2008, the Wangchuck Centennial Park covering an area of 3,736sq.km was added to Bhutan's list of nine protected areas.

Bhutan's population has increased dramatically from an estimated 452,000 in 1984 to 634,982 in 2005<sup>9</sup>. Agriculture is the dominant sector in Bhutan providing livelihood, income and employment to more than 80% of the Bhutanese. Rural communities are therefore the most vulnerable group from the effects of climate change as farm productions are highly dependent on perennial streams and the timing of the monsoons for irrigation purposes. In addition, the rugged and steep terrain makes it difficult to both expand productions and market farm surpluses. The main cash crops of the farmers (rice, potatoes, chilies, apples and oranges) are all highly sensitive to water and temperature variations<sup>10</sup>. Dry land crops such as wheat, buckwheat, maize and barley are the major food source for the farmers; both for family consumption and for livestock. Dry land crops are however entirely dependant on rainfall thus making the farmers even more vulnerable to climate risks.

Hydropower has been an enormous natural resource endowment for the country. While it is estimated that the country has the potential to generate up to 30,000MW of electricity, barely 3% of this potential has been harnessed so far. Much of the electricity is exported to India to generate income to finance development activities in the other sectors. It has been the primary source of energy for domestic consumption and local industrial power needs and constituted the major national export and revenue earner for over the last two decades. The sector has been the proverbial engine of growth for the economy and the catalytical hub around which all round socio-economic development has been possible. Today, the sector continues to drive the economy and contributes close to a quarter of the country's GDP and around 40% of total national

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<sup>9</sup>RGOB National Statistics Bureau December 2005, Statistical Yearbook of Bhutan 2005, NSB Thimphu  
Bhutan

<sup>10</sup> Ministry of Agriculture (2005)



revenue<sup>11</sup>. The economic benefits deriving from future hydropower development - secured under the Indo-Bhutan Agreement for the long-term development of hydropower - will further strengthen the economy to make Bhutan even more prosperous and self-reliant than before. Additionally, while making sustainable economic development in the country a reality, hydropower development in the country has been pursued in a manner that is environmentally friendly and socially responsible. Bhutan's clean energy exports greatly help in reducing fossil fuel burning and greenhouse gas emissions thereby contributing to a healthier global environment. The eco-friendly aspects of Bhutan's hydropower development are so evident that several of Bhutan's hydropower projects could be considered for carbon credit gains as these green exports do help offset industrial pollution in the region. Moreover, these mainly run of the river hydropower projects virtually do not require any displacement of communities nor the inundation of large tracts of riparian ecosystems. Indeed, the continued sustainable exploitation of hydropower will depend a great deal on the state of the environment and in particular, the condition of the country's watersheds. The conservation of the environment is thus in itself a very strong economic rationale for the long term utilization of hydropower resources in Bhutan.

In the social context too, hydropower development has various spin-off benefits and can help raise the quality of lives and reduce poverty around regions where power projects are built. The massive level of support infrastructure including social service facilities, electricity, road and other economic infrastructure that are built while constructing a hydropower project confers immense and immediate social benefits and economic opportunities for local and regional communities. There is no question that development of hydropower resources for exports to India will remain at the core of Bhutan's economic development strategy.<sup>12</sup>

## **2.0 Bhutan and the United Nations Framework Convention on Climate Change (UNFCCC)**

Bhutan ratified the United Nations Framework Convention on Climate Change (UNFCCC) in August 1995 and the Kyoto Protocol in August 2002. The Initial National Communication (INC) to the UNFCCC was submitted in November 2000. The INC covered numerous topics, including: national circumstances related to climate change; a GHG emission inventory; assessment of vulnerability and adaptation to climate change; policies and other measures to address climate change; education, training and public participation; and recommended research. Because of data constraints, the INC did not conduct any mitigation analysis, GHG emission projections, or temperature and precipitation projections under different IPCC emission scenarios using Global Circulation Models (GCM). The preparation of the Second National Communication (SNC) began in August 2007.

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<sup>11</sup> Gross National Commission (2008): Tenth Five Year Plan. RGoB. Thimphu. Bhutan

<sup>12</sup> Source: Gross National Commission (2008): Tenth Five Year Plan. RGoB. Thimphu. Bhutan

## 2.1 National Adaptation Program of Action

The National Adaptation Program of Action (NAPA) was prepared with a grant from the Least Developed Countries Fund (LDCF) and published in May 2006. Bhutan's NAPA includes nine priority adaptation projects selected among 55 projects originally proposed. Further details of NAPA are provided under 11.0 – *Climate change related Programs and Projects in Bhutan*.

## 3.0 Observed Climate Patterns and Climate variability<sup>13</sup>

Bhutan may be broadly divided into three geographic areas and corresponding climatic zones: the southern foothills, inner Himalayas and higher Himalayas. The southern foothills, only 20km wide, rise from 100m above sea level to 1500m.

**Table 1: Climatic regions of Bhutan**

| Region             | Climate                                      | Elevation      | Precipitation   |
|--------------------|--|----------------|-----------------|
| Southern foothills | Subtropical, high humidity, heavy rainfall   | 100 to 1500 m  | 2500 to 5550 mm |
| Inner Himalayas    | Cool winters, hot summers, moderate rainfall | 1500 to 3000 m | 1000 to 2500 mm |
| Higher Himalayas   | Alpine, cool summers, cold winters           | 3000 to 7550 m | 500 to 1000 mm  |

*Source: Climate Change Screening of Danish Development Assistance with Bhutan, May 2008*

The climate is hot and humid in the southern foothills, with temperatures ranging from 15 to 30°C throughout the year and precipitation between 2,500 and 5,550mm. The inner Himalayas, which rise to 3000m, constitute, with their broad valleys, the economic and cultural heartland of the Kingdom. The central inner Himalayas are characterized by a cool temperate climate with an annual average precipitation of 1,000mm. The higher Himalayas constitute the northernmost and highest mountain ranges with elevations up to 7,550m. These northern regions, under perpetual snow, are sparsely populated and have an alpine climate with average annual precipitation of 400mm.

Bhutan's climate is determined by the summer southwest monsoon blowing from the Indian Ocean (late June through late September), and variations in topography and elevation. The monsoon accounts for 60 to 90% of the country's total precipitation. There are substantial disparities in temperatures and precipitations from one valley to another. The south-western and southern valleys are the warmest zones. Below freezing temperatures in the winter occur in the central, west-central and northern mountains.

The southern valley of Bhutan receives the highest annual precipitation, while low precipitation occurs in central and northern Bhutan. Monthly average rainfall

<sup>13</sup> Source: Climate Change Screening of Danish Development Assistance with Bhutan, May 2008

for the period 1996-2005 was highest during the monsoon months of June, July and August. July recorded an average rainfall of 414mm. Average monthly rainfall in the months of November through February ranged from 10mm (December) to 23mm (February)<sup>14</sup>.

**Table 2: Maximum and minimum monthly temperatures (degrees C) and rainfall (mm) (1996-2005)**

|                      | Minimum | Maximum | Yearly Mean |  |
|----------------------|---------|---------|-------------|--|
| Maximum Temperatures | 4       | 34      | 22          |  |
| Minimum Temperatures | -12     | 31      | 13          |  |
| Average Temperatures | -1      | 32      | 17          |  |
| Rainfall (mm)        | 0       | 5684    | 157         |  |

Source: RSPN (2006)

A study of temperature and rainfall from 44 meteorological stations across Bhutan over the period 1990-1999 show that the highest temperature recorded is 37.2 degrees Celsius at Pheuntsholing and the lowest temperature is -8.2 degrees Celsius at Drukgyel Dzong. While there is an inverse correlation between altitude and average temperatures, observations in Paro and Mongar indicate little difference due to local variations from the orientations of the valleys and mountain ranges. The annual observation of monthly precipitation show a unimodal nature with maximum in July and minimum in January; Around 70% of the precipitation of Bhutan is generated by the monsoons while pre-monsoon activities generate about 20% of the precipitation<sup>15</sup>.

Given the scarce resources, proper equipment, lack of capacity and trained manpower - projecting climate change in a meaningful and systematic manner is an extremely difficult task. Reliable data exists for only about 10-12 years beyond which observations are not reliable to make any firm conclusions. Climate predictions would at least need a few decades of observations. However, the analysis of available meteorological station data for Bhutan for the past 13 years shows an increasing trend in precipitation variability across the country. The temperature over the past 5 years has been above the 1990-2003 mean values.

#### **4.0 Observed Climate Extremes<sup>16</sup>**

<sup>14</sup> RSPN 2006

<sup>15</sup> Source: National Circumstances, Second National Communication

<sup>16</sup> Source: Climate Change Screening of Danish Development Assistance with Bhutan, May 2008

Bhutan's mountain climate can be as rugged as its topography. Monsoon floods and associated landslides, as well as Glacial Lake Outburst Floods (GLOFs) are the most common natural hazards, and periodically result in loss of lives, livelihoods and infrastructures.

In April and May 2008 severe windstorms struck the 6 eastern Dzongkhags and Sarpang Dzongkhag. More than 500 households were affected by the windstorms, which destroyed more than 100 acres of maize and several hundred houses.

#### 4.1 Floods and landslides

Floods and landslides are annual occurrences in the southern and eastern foothills of Bhutan. The monsoon brings torrential rains from June to September, as the clouds originating in the Indian Ocean are blocked from traveling further north by the Himalayas. The topography of the foothills characterized by steep narrow gorges and river valleys makes them prone to local flash floods of high volume and short duration. Landslides and floods also lead to the unstable formation of natural dams and lakes, which later burst as their structure fails.

The south-eastern monsoon floods of the year 2004 affected some 1,500 households, 300 hectares of farmland, and damaged or destroyed 160 houses. The maize, rice and potato crops were lost to the floods in the affected areas, which also washed away 2000 orange trees. Given Bhutan's population size and cultivated land area, these losses are significant on a national scale.

### **5.0 Vulnerability Due to Climatic Change within the key sectors<sup>17</sup>**

The preparation of Bhutan's NAPA was an opportunity to examine the country's climate change related vulnerabilities given its unique geographical setting. The NAPA process not only followed the guidelines set by the LDC Expert Group but was also conducted in a transparent manner and involved five main working groups (Agriculture, Forestry and Biodiversity, Health, Water Resources and Energy, and Natural Disasters and Infrastructure). Over 30 task force members representing many different sectors participated in the NAPA exercise. The sector vulnerability assessment shown in the following tables are the final results of the consultative group meetings, field consultation workshops and discussions amongst the NAPA taskforce members.

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<sup>17</sup> Source: Climate Change Screening of Danish Development Assistance with Bhutan, May 2008

**Table 3: Sector Vulnerability Assessment**

| Sector                                       | Vulnerabilities  |
|--|--|
| <p><b>Forestry &amp; Bio-diversity</b></p>   | <ul style="list-style-type: none"> <li>• Drought in combination with increased lightning risks triggering forest fires</li> <li>• Change in phenological characters of plants/ Loss of endemic species</li> <li>• Change in migratory patterns of the trans boundary wildlife,</li> </ul> <p>(All resulting in loss/degradation of forest ecosystem and reduction of alpine range lands. Furthermore, possible increase of vector-borne disease in wildlife due to warming)</p>  |
| <p><b>Agriculture</b></p>                    | <ul style="list-style-type: none"> <li>• Crop yield instability/loss of production and quality (due to variable rainfall, temperature, etc.)/Decreased water availability for crop production/Increased risk of extinction of already threatened crop species (traditional crop varieties)</li> <li>• Loss of soil fertility due to top soil erosion and runoff/Loss of fields due to flash floods, land slides and rill &amp; gully formations/ Soil nutrient loss through seepage</li> <li>• Crop yield loss (flowers &amp; fruit drop) to hailstorms/Deteriorated produce quality (fruit &amp; vegetables) by untimely incessant heavy rains and hailstorms</li> <li>• Delayed sowing (late rainfall)/Damage to crops by sudden early (paddy) and late spring (potato) frost (ref. seasons shifting)</li> <li>• Outbreak of pests and diseases in the fields and storages where they were previously unknown</li> <li>• Damages to road infrastructures (food security) – <i>see also natural disaster &amp; infrastructure sector</i></li> </ul> |
| <p>Natural Disaster &amp; Infrastructure</p> | <ul style="list-style-type: none"> <li>• <i>Debris-covered glaciers forming huge moraine dam lakes that ultimately lead to GLOFs (i.e. flash floods and landslides, heavy siltation of the rivers, and other geotechnical hazards)</i></li> </ul> <p><b>GLOF will affect ‘essential’ infrastructure):</b></p> <ul style="list-style-type: none"> <li>- <b>Hydropower</b> systems (generation plants, transmission and distribution infrastructure) – the main export product, and furthermore:</li> <li>- Industrial estates/infrastructures</li> <li>- Human settlements: urban, sub-urban and rural settlements.</li> </ul>  |

|                            |  |
|----------------------------|--|
|                            | <p>- <i>Historical and cultural monuments: dzongs, monasteries, chortens, etc.</i></p> <p>- <i>Public utilities: roads, bridges and communications.</i></p> <p>* <i>Receding debris-free glaciers lead to reduction of water resources (possible shortages/variations) – see also Water resources sector</i></p>   |
| Water Resources (& Energy) | <ul style="list-style-type: none"> <li>• Temporal &amp; spatial variation in flow, affecting notably electricity production/exports due to disruption of average flows for optimum hydropower generation</li> <li>• Increased sedimentation of rivers, water reservoirs and distribution network, affecting notably irrigation schemes' productivity/ agricultural crop yields</li> <li>• Reduced ability of catchment areas to retain water/increased runoffs with enhanced soil erosion (deterioration of environment)</li> <li>• Deterioration of (drinking) water quality (<u>see also Health sector</u>)</li> </ul> |
| Health                     | <ul style="list-style-type: none"> <li>• Loss of life from frequent flash floods, GLOF and landslides (recent Trashigang floods and landslides)</li> <li>• Spread of vector-borne tropical disease (malaria, dengue) into more areas (higher elevations) with warming climate</li> <li>• Loss of safe (drinking) water resources increasing water borne diseases.</li> </ul>   |

Source: Bhutan NAPA

## 6.0 Anticipated Impacts of Climate change<sup>18</sup>

### 6.1 On Forests and Biodiversity

Because of the changes in the temperature creating competition between high elevation tree species and new arrivals, climate change could have enormous impacts on forests and forest resources in Bhutan. 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 could also reduce tree survival by benefiting insects or pests. Warmer winters would imply reduce snow cover and less carryover of water to the growing season resulting in the drought induced forest decline (*IPCC, 1996*). Some of these have already been reported by studies done by the RNR research Division on the fir trees.

<sup>18</sup> Climate Change Screening of Danish Development Assistance with Bhutan, May 2008

Bhutan is part of one of the 10 global biodiversity “hotspots”. Though today its rich biodiversity resources make a large contribution to the economy, human activities are increasingly threatening the entire existing ecosystem. In addition, several species are already endangered by climate change and extreme events.

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*)

## 6.2 On Agricultural Activities

Though the main crops of Bhutan are rice, wheat, maize and potato, as many as nine varieties (*dru-naa-gu*) of crops are cultivated in general in Bhutan. Upland crop production practices 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.

The increase in temperature will shift the cultivating zone further into higher elevations which mean that crops that are sensitive to low temperature can be introduced into higher elevation thereby affecting the related cropping patterns. Warming may have positive impact on crop yields if moisture is not a constraint, but increases in the occurrence of extreme events or pests may offset any potential benefits. The increase in pestilence of alien/invasive pests and diseases would affect both crops and live stocks. The increase in temperature, despite a reduction in humidity, can reduce the ability of farmers to work indicating that the low-income rural populations that depend on traditional agricultural systems or on marginal lands are particularly vulnerable to climate change.

## 6.3 On Water Resources

Though Bhutan has easy access to rivers, streams and natural pond water, they are mainly dependent on glaciers, snow, forests and seasonal rainfall averaging 1000 mm per year. Vulnerable to scarcity of water due to climate change may render the country although Bhutan did not record water shortages till now.

The IPCC also expresses high confidence that water supplies stored in glaciers and snow cover are projected to decline in the course of the century, thus reducing water availability during warm and dry periods in regions supplied by

melt water from major mountain ranges. Besides, increased precipitation intensity and variability are projected to increase the risk of flooding and drought in any areas<sup>19</sup>. Such an event will not only reduce the potential of catchments to retain water, but also cause water quality to deteriorate. Thus 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.

The Third IPCC report also highlights that changes in water quantity and quality due to climate change will affect food availability, stability, access and utilization<sup>20</sup>.

#### 6.4 On Glacial Lake Outbursts

The northern region of Bhutan has numerous snow-clad mountains and glaciers. The increase in temperature caused by global warming will result in the retreat of glaciers, increasing the volume of such lakes and ultimately causing glacial lake outburst floods (GLOF) with potential for major catastrophes. The October 1994 flash flood on the Pho Chhu river following a glacial lake outburst in the Lunana area was one such example. The 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 downstream.

#### 6.5 On Human Health

Though the relationship between health and climate change in Bhutan is little known, a predicted increase in temperature by 2<sup>0</sup>C is likely to affect health not only because of heat stress but also because of increased outbreaks of vector-borne diseases. Similarly, favorable conditions created by an increase in rainfall and flooding for water-borne diseases can increase vulnerability to health hazards. Another significant climate change-related health concern is the increase of waterborne diseases such as gastroenteritis and diarrhea, which are associated with poor water quality and turbidity during rainy seasons.

#### 6.6 On Landslides

Since the southern Bhutan fall within major fault lines of different geological formations, the region is highly unstable and susceptible to landslides. Heavy rainfall combined with external disturbances like construction of roads, mining and deforestation causes landslides that disrupt the economy and social communications. This impact is significant to Bhutan given the fact that Bhutan depends largely on its road network for transport and trade.

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<sup>19</sup> IPCC (2007), Executive Summary

<sup>20</sup> IPCC (2007), Executive Summary



## 7.0 National Institutions related to Climate Change<sup>21</sup>

The National Environment Commission (NEC) is the national focal point for climate change. The NEC also acts as the Designated National Authority (DNA) for the Clean Development Mechanism (CDM) of the Kyoto Protocol.

A Deputy Minister heads the NEC, which functions as an autonomous high-level inter-ministerial agency of the RGoB. The NEC does not have a department dedicated to climate change, nor staff assigned on a full-time basis to climate change issues. The INC (2000) was prepared by the NEC, which then formed the National Climate Change Committee (NCCC), a technical level task force. The NCCC is not a permanent entity and only convenes for project implementation, e.g. to prepare national communications or the NAPA. In the absence of climate change activities funded by donors, the NCCC is not operational.

## 8.0 Policies Related to Climate Change

So far, national visions, strategies, plans and legislation generally make little or no reference to climate change. Policies developed in the past two years discuss climate change more explicitly, including for example the draft Water Act (2008)<sup>22</sup>. Currently, there is no comprehensive national climate change policy<sup>23</sup>.

The “Middle Path” was adopted as Bhutan’s National Environment Strategy in 1999 and outlines three main avenues of sustainable economic development: expanding hydropower, increasing agricultural self-sufficiency and expanding the industrial base. Although climate change has direct impacts on all of these avenues, the strategy makes no specific mention of climate change.

“Bhutan 2020: A vision for peace, prosperity and happiness”, is a strategic document aimed at guiding the formulation and implementation of Bhutan’s development plans. The document provides a broad framework for the five-year development plans and advocates the following:

- Maintaining the forest area
- Developing environmentally friendly power generation, notably hydroelectricity
- Increasing food self-sufficiency, without converting forests to agriculture
- Developing industries.

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<sup>21</sup> Climate Change Screening of Danish Development Assistance with Bhutan, May 2008

<sup>22</sup> Climate Change Screening of Danish Development Assistance with Bhutan, May 2008

<sup>23</sup> Climate Change Screening of Danish Development Assistance with Bhutan, May 2008

The Environmental Assessment Act (EA Act, 2000), National Environmental Protection Act (NEPA), Forest and Nature Conservation Act 1995 and the Mines and Minerals Act 1995 are some of the existing legislations on environment. The Solid Waste Management Act is the first environmental legislation that was passed after Bhutan became a constitutional monarchy.

## 9.0 Climate Change and Development Plans

The concept of Gross National Happiness (GNH) is the overarching theme of Bhutan's development path. The philosophy seeks to optimize the happiness of the Bhutanese people by pursuing a development path that balances socio-economic development, environmental conservation and cultural preservation and by ensuring good governance. Policy documents such as Bhutan's "Vision 2020", "Middle Path" and the Five Year Plan documents all reflect the kingdom's aspirations for sustainable development. Climate change is therefore of strategic relevance to this vision to pursue sustainable development and GNH and should be deliberated upon more elaborately.

Among the highest priorities of the RGoB is the achievement of the MDG Goal to Eradicate Extreme Poverty and Hunger by Year 2015. An estimated 36% of the population lives under the poverty line of Nu 740 per capita per month (USD 17). The poverty reduction strategy of the RGoB is to first build roads to remote communities thereby enhancing access to other social facilities such as schools, hospitals, and power supplies (BPRSP, 2003). Poverty reduction is therefore the main theme of the 10<sup>th</sup> FYP (2008-2013). There is no specific reference to 'climate change' in the 10<sup>th</sup> FYP main document (volume 1). In the programme profiles (volume 2), one programme makes specific reference to climate change (MEA/18: 'Assessment and Monitoring of Climate Change Induced and Geological Hazards') and several are indirectly relevant (e.g. MEA/13: 'Strengthening of National Hydrological and Meteorological Services').<sup>24</sup>

## 10.0 Disaster Risk Management

The National Disaster Management Framework was published in 2006. The key objectives of the Framework are to:

- Promote a disaster risk management approach with an emphasis on prevention, mitigation and preparedness, instead of an *ad hoc* reactive approach to dealing with disasters;
- Recognize the respective roles of different organizations in disaster risk management and provide all possible support to their work within the national framework for disaster risk management; and

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<sup>24</sup> Climate Change Screening of Danish Development Assistance with Bhutan, May 2008

- Establish linkages between disaster risk management and the other on-going activities in different development sectors.

The national focal point for disaster management is the Ministry of Home and Cultural Affairs (MoHCA). Other agencies that have relevant responsibilities and are involved in disaster management and risk include:

- The Department of Local Governance (DLG) of MoHCA coordinates disaster management programmes and activities at the Dzongkhags and other local level.
- The Department of Geology and Mines (DMG) is responsible for monitoring including zoning of natural hazards like GLOF, landslides and earthquakes and contributes to early warning.
- The Department of Energy (DoE) is responsible for energy development, including hydropower. Through the Flood Warning Section (FWS), the DoE aims to prevent disasters by issuing timely warning of floods. The Hydro-Met Services Division under the DoE is responsible for planning and design of the Hydro-met network for collection of Hydro-Met data required for hydropower planning, flood and weather.
- Ministry of Agriculture (MoA) monitors impacts on crops. Agriculture-related disasters are usually confined to local levels and nationwide disasters have not yet occurred in Bhutan.
- Standards and Quality Control Authority under the Ministry of Works and Human Settlement established in 2000 address earthquake risk management through planning and building codes.

The National Disaster Risk Management Framework recognizes the linkage with climate change: *“Adoption of a disaster risk management framework assumes importance due to emerging trends pointing towards climate change and global warming at an alarming rate. The potential threat from some of the existing hazards viz. Glacial Lake Outburst Floods (GLOFs), flash floods, landslides, forest fires etc. is likely to exacerbate. At the same time, the rapid pace of urbanization as witnessed during the past two decades is causing larger concentration of people and resultant economic activity in hazard-prone areas further compounding the risk”* (MoHCA, 2006: 5).

Reference is made to the NAPA and is listed a disaster management initiatives undertaken by NEC (p.59-60). It is noted that one of the NAPA priorities is a Disaster Management Strategy but not how this relates to the National Disaster Risk Management Framework. Nonetheless, recognition of disaster risk reduction as a part of adaptation to climate change reflects that the RGoB is already making these important linkages.

## **11.0 Climate Change related Programmes and Projects in Bhutan**

Although environmental conservation has always been among the highest priorities of the RGoB's development agenda, it must be noted that the emphasis so far has been on the conservation of the Kingdom's natural heritage with relatively few explicit links to climate change issues in policies, development planning or activities implemented. While climate change impacts have not been ignored by the government, few specific actions have been taken so far to assess or address these. Policy makers appreciate and agree that climate change will increasingly be a cause of concern for Bhutan. Technical knowledge of climate change is still limited to project staff, and has not been disseminated beyond the environment sector to health, education, agriculture or energy.

Until recently, most projects related to climate change were implemented by the National Environment Commission under the aegis of the UNFCCC (INC, NAPA, NCSA, SNC etc.). The development of Bhutan's NAPA not only involved stakeholders in identifying vulnerabilities due to climate change within their sectors but also prioritizing mitigation and adaptation projects. Although the NEC as the national focal agency for climate change spearheaded the NAPA process and submits project proposals to the LDCF, NAPA projects are implemented by stakeholder agencies that have total ownership of the projects.

DANIDA completed a climate screening of Danish development assistance to Bhutan in May 2008. As a follow up to the recommendations of the climate screening exercise, a project "Support to Enhancing Adaptive Capacity to Climate Change" is currently being implemented. The project is aimed at addressing opportunities for reducing vulnerabilities to climate change in Bhutan and attempts to fill in important gaps within the Ministry of Agriculture, the National Environment Commission and the Ministry of Economic Affairs

NGOs like the RSPN and the Tarayana Foundation are also involved in implementing climate change-related projects at the grassroots level. RSPN is part of the CLACC (Capacity Strengthening of Least Developed Countries for Adaptation to Climate Change) network and works closely with the network to address climate change. Under the theme of climate change, GEF/SGP has supported numerous projects to create awareness on climate change at the grassroots and to reduce consumption of fuel wood. Projects funded by GEF/SGP are implemented by NGOs like RSPN and the Tarayana Foundation, women's Groups and religious institutions.

The Asian Development Bank (ADB) has also initiated a Technical Assistance Project, "Bhutan Clean Power Export Development Project, ADB TA 7157", which has capacity building in the area of CDM as an important component. The establishment of an emission baseline and development of CDM manuals will be some of the major activities.

The following table presents a list of climate change related activities in Bhutan. A more detailed Table is provided as Annex 1: Climate Change Related Projects.

**Table 4: Climate Change related Projects**

| Organization                       | Type       | Name of the Project  | Funding   | Remarks                                     |
|------------------------------------|------------|--|---|---|
| National Environment Commission    | Government | Enhancing Global Environmental Management in Bhutan's Local Governance System (of the Rio Conventions).                                    | GEF/UNDP  | Approved by GEF in February 2008. On-going. |
|                                    |            | Second National Communication to UNFCCC (SNC).   | GEF/UNDP  | On-going.                                   |
|                                    |            | Environmental Mainstreaming.   | UNEP/UNDP   | On-going.                                   |
|                                    |            | National Adaptation Programme of Action to Climate Change (NAPA).  | LDCF/UNDP   | Completed in 2006.                          |
|                                    |            | National Capacity Self Assessment for Global Environmental Management  | GEF   | Completed                                   |
|                                    |            | Initial National Communication to UNFCCC (INC).  | GEF/UNDP  | Completed in 2000.                          |
|                                    |            | Climate Change Studies In Bhutan   | Netherlands Climate Change Studies Assistance program | Completed                                   |
|                                    |            | Climate Change Adaptation Needs Assessment: Agriculture Sector   | National Greenhouse Gas Project – Phase II            | Completed                                   |
|                                    |            | National technology Needs Assessment for Industry Sector in Bhutan   | National Greenhouse Gas Project – Phase II            | Completed                                   |
|                                    |            | Climate Screening of DANIDA Projects   | DANIDA  | Completed                                   |
|                                    |            | Strengthening Institutional organization and coordination of climate change in Bhutan  | DANIDA (post climate screening)                       | Ongoing                                     |
|                                    |            | Enhancing Research and Capacity Development on Climate Change  | DANIDA  | Ongoing                                     |
|                                    |            | Strengthening of Position of Bhutan for post 2012 rules of climate change  | DANIDA  | Ongoing                                     |
|                                    |            | Building synergies with other multilateral agreements  | DANIDA  | Ongoing                                     |
| Terminal Phase-Out Management Plan | UNDP/GEF   | Ending Phase   |   |   |
| Ministry of Economic Affairs       | Government | Reducing climate change induced risks and vulnerabilities from Glacial Lakes Outburst Floods in the Punakha, Wangdue and Chamkhar Valleys. | LDCF/GEF/UNDP/Austria                                 | On-going.                                   |
|                                    |            | Community Micro-Hydro for sustainable Livelihoods.   | GEF/UNDP  | On-going.                                   |
|                                    |            | National Renewable Energy Policy and Programme   | GEF/UNDP  | On-going.                                   |

|  |            |   |   |                         |
|--|------------|---|---|-------------------------|
|  |            | for Sustainable Development.  |   |                         |
|  |            | Micro Hydel project, Chendebji  | E7  | (CDM) Completed         |
|  |            | Dagachu Hydropower Project  | ADB etc.  | (CDM) Review process    |
|  |            | Enhancing Capacity for Hydro-meteorological services and climate modeling   | DANIDA  | Ongoing                 |
| Ministry of Economic Affairs           | Government | Climate Screening of DANIDA Development Assistance  | DANIDA  | Completed               |
| Ministry of Economic Affairs           | Government | Regional Climate Change, Energy Ecosystems Project  | UNDP  | Ongoing                 |
| Ministry of Home and Cultural Affairs  | Government | Preparatory assistance for Disaster Management  | GEF/UNDP  | Completed in 2006.      |
|  |            | Reducing climate change induced risks and vulnerabilities from Glacial Lakes Outburst Floods in the Punakha, Wangdue and Chamkhar Valleys.  | LDCF/GEF/UNDP/Austria   | Ongoing                 |
| Ministry of Health                     | Government | Health Response to Climate Change and Climate Variability   | LDCF/GEF/UNDP/WHO   | Project proposal.       |
| Ministry of Agriculture                | Government | Climate Sensitivity Analysis in the Agriculture and Forestry Sectors  | DANIDA  | Project Document Signed |
| RSPN                                   | NGO        | Capacity Strengthening of Least Developed Countries for Adaptation to Climate Change  | International Institute of Environment and Development (IIED), UK | Ongoing                 |
|  |            | Approach towards Sustainable Fuel Wood Consumption to assist Community Primary Schools  | GEF/SGP, MOE  | Completed               |
|  |            | Study on vulnerable sectors and communities in Thimphu  | International Institute of Environment and Development (IIED), UK | Underway                |
|  |            | Study on the Health and Climate Change - An exploratory study on climate change and diseases sensitive to climate change where the threat of malaria has been spelled out as a major threat from human induced climate change impact. | International Institute of Environment and Development (IIED), UK | Completed               |
| Mendrelgang Farmers Association (MFA), | (MFA)      | Capacity Building on Climate Change:  | GEF/SGP   | Completed               |
| Tsirang Women Group                    | NGO        | Biomass Fuel Efficiency Project   |   | Completed               |
| 21 Community Lhakhangs;                | NGO        | Improved Community Cooking Stove – an Alternative to mitigate fuel wood pressure in North Trashigang  |   | Completed               |
| Zilukha Nunnery                        | NGO        | Promoting Alternative Energy through Use of Solar Water Heater (SWH) in Zilukha Nunnery, Thimphu  |   | Completed               |
| Merak Sakten                           | NGO        | Community-Based Initiative to Energy Conservation in Merak & Sakten   |   | Completed               |
| Schools                                |            | Sustainable Use of Fuel Wood in Wama, Pangthang, and Udaric in Mongar   |   | Completed               |
| Community Schools                      |            | Environmental Management and Conservation in Gasa Dzongkhag   |   | Completed               |
| Kidhekhar Buddhsit Institute           | NGO        | An Approach to Sustainable Living in Kidhekhar Buddhist Institute in Mongar   |   | Completed               |
| Samdrupjongkher                        | Government | Introduction to Fuel Efficient Stoves to reduce the consumption of fuelwood almost by 50% thereby saving a number of trees in Samdrup Jongkhar  |   | Completed               |

|                                       |            |   |  |           |
|---------------------------------------|------------|---|--|-----------|
| Bajo Higher Secondary School          | Government | Green House and Weather Station project in Bajo Higher Secondary School (BHSS), Wangdue |  | Completed |
| Wama, Pangthang, and Udaric in Mongar |            | Sustainable Use of Fuel Wood in Wama, Pangthang, and Udaric in Mongar                   |  | Completed |

## 11.1 National Adaptation Program of Action

Bhutan's NAPA includes nine priority adaptation projects selected among 55 projects originally proposed. The projects are ranked according to four criteria: (1) human life and health saved by the intervention; (2) arable land saved by the intervention; (3) essential infrastructure; and (4) estimated costs. The budget for the identified nine priority projects for urgent and immediate action is USD 7.9 Million<sup>25</sup>. The NAPA is conceived as a tool to attract foreign assistance, not only from the UNFCCC, but also from bilateral donors. Brief project profiles were developed for the six priority projects.

The Global Environment Facility (GEF) approved the project "Reducing Climate Change-induced Risks and Vulnerabilities from Glacial Lake Outburst Floods in the Punakha-Wangdi and Chamkhar Valleys" for funding in March 2008. The project is a combination of 3 NAPA priority projects (priorities 2, 7 and 8) and covers approximately 50% of the identified Bhutan NAPA priority budget. The funding is from the LDCF (USD 4.2 Million) for additional costs of adaptation. The co-financing is provided the RGoB (USD 2.6 Million), by the Austrian Development Agency (USD 0.8 Million), WWF (USD 30,000) and UNDP (USD 526,000).

**Table 5: Summary of Priority NAPA Projects**

| Title of Proposed Project   | Main Objective   | Main outputs  | Budget (US\$)  |
|---|--|---|----------------|
| 1- Disaster Management Strategy – planning for food security and emergency medicine to vulnerable communities | Implementation of Emergency Food Security & Medicine/First Aid components of NDMS in some pilot districts (East Bhutan)  | Rapid communication, immediate response & distribution networks for emergency needs in place; Lives saved; Awareness on relationship between bad land management and disasters,                 | 619, 110.00    |
| 2- Artificial Lowering of Thorthormi Lake   | GLOF prevention: Lower water table of Thorthormi lake by excavating artificial channel- widening of existing outlet channel  | Required civil works built; Water level monitored; staff trained to undertake similar projects elsewhere  | 3, 188, 942.00 |
| 3- Weather Forecasting System to Serve Farmers and Agriculture  | Provide (i) weather and seasonal forecasts in support of production decisions of farmers, (ii) agro-meteorological early warning system against inclement weather, (iii) special advisories at different production stages | Optimally distributed network of synoptic stations; More accurate weather forecasts up to 15 days based on operational meso-scale LAM model optimized for Bhutan; associated extension services | 420, 000.00    |
| 4- Landslide Restoration & Flood Prevention (Pilot Schemes in Critical  | Effectively intervene in major landslide and flood affected areas before these become dangerous for  | Proper land management practices developed, implemented and shared by communities in a series of pilot districts incl. Chaskhar (Mongar),   | 894, 179.00    |

<sup>25</sup> Source: NEC (2006), "Bhutan NAPA" RGoB, Thimphu, Bhutan

| Areas)   | human livelihood   | Ramjar (Trashiyangtse) and others (ref. DoR)   |                     |
|--|--|--|---------------------|
| 5- Flood Protection of Downstream Industrial and Agricultural Area | Effectively intervene in major landslide and flood affected areas before these become dangerous for human livelihood   | Proper land management practices developed implemented and shared by Local Authorities and Investors in Pasakha (Chukha) Industrial and Geelphu Agricultural area.   | 853, 488.00         |
| 6- Rainwater Harvesting  | Safeguard farmers from water shortages during dry periods and irregularities in the monsoon rainfall, thereby improving household food security and income of farmers living in vulnerable areas | Higher crop and animal productivity under rain fed agriculture; Safe drinking water and less health problems; Increase in rural income; Synergy with actions under the convention on desertification; Environmental benefits like reduced soil erosion, soil salinity and recharge ground water. | 895, 000.00         |
| 7- GLOF Hazard Zoning (Pilot Scheme - Chamkhar Chu Basin)          | Awareness raising for GLOF risks and possible preventative measures  | High quality hazard zonation map delineating areas with high risk etc. areas; materials for public information; tools for the decision makers on spatial planning, building permits, etc.  | 232, 493.00         |
| 8- Installation of Early Warning System on the Pho-chu River Basin | Warning of Punakha valley Settlement/ Essential Infrastructure in case of actual GLOF  | Technical EW system in place & operated; Hazard Zonation; Awareness across the valley  | 400, 000.00         |
| 9- Promote Community-based Forest Fire Management and Prevention   | Conserve land, water resources and wood production (incl. tree species that are fast growing and more resistant to insect damages, diseases and phenomena like fires)                            | Village level forest fire management institutionalized and implemented; Forest fire equipment well established and managed; Reduced incidence of fires; in Mongar and perhaps Wangdi-phodrang districts  | 423, 000.00         |
| <b>Total NAPA Budget:</b>  |  |  | <b>7,926,212.00</b> |

Source: NAPA (2006)



## 12.0 Findings<sup>26</sup>

The following were some of the findings of the Danish Climate Change screening exercise which were further voiced by the stakeholders at discussions and meetings with them during the course of this study.

### 12.1 Awareness of climate change

There is awareness of basic climate change issues at the ministerial level. National visions, strategies, plans and legislation generally make little or no reference to climate change. Policy makers agree that climate change will increasingly be a cause of concern and that specific actions have to be incorporated in development plans to address. Technical knowledge of climate change is limited to project staff, and has not been disseminated beyond the environment sector to health, education, agriculture or energy. There is also limited research on climate change carried out in Bhutan and low research capacity to do such work. The media and NGOs are expected to play a vital role in promoting better understanding of climate change and also implement adaptation projects at the grassroots. Concerns were raised by media professionals that they would like to be more involved in addressing climate change but lacked in-depth knowledge and understanding of the subject. They expressed the need for awareness programs and more exposure to regional and international forums such as the COP.

### 12.2 National Policy Documents

Bhutan's Vision 2020 and the "Middle Path" along with the development philosophy enshrined in 'Gross National Happiness' have been vital instruments for raising the profile of environmental conservation amongst policy makers and the general public. However, there is an urgent need to rewrite/revise these documents to make them more sensitive to climate change.

### 12.3 Climate change focal point Capacity

The National Environment Commission (NEC) does not have staff assigned to climate change issues on a full-time basis. Climate change projects are implemented on a project basis without any longer term institutional planning. The National Climate Change Committee (NCCC), a technical-level task force, convenes for project implementation only, e.g. to prepare National Communications.

### 12.4 Climate change in the 10<sup>th</sup> Five Year Plan

The draft 10<sup>th</sup> Five Year Plan (2008-2013) does not make specific reference to 'climate change' in the main document (volume 1). In the programme profiles (volume 2) one programme makes specific reference to climate change (MEA/18: 'Assessment and Monitoring of Climate Change Induced and Geological

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<sup>26</sup> Source: Climate Change Screening of Danish Development Assistance with Bhutan, May 2008

Hazards’) and several are indirectly relevant (e.g., MEA/13: ‘Strengthening of National Hydrological and Meteorological Services’ with a link to NAPA priority #3).

## 12.5 National Adaptation Programme of Action (NAPA)

The NAPA prepared in 2006 provides the priorities for the immediate and urgent adaptation to climate change in Bhutan. Bhutan is the only country that has received funds from the LDCF for NAPA so far. The strength of Bhutan’s NAPA is that its contents reflected the genuine priorities of the stakeholder agencies as they were involved at every stage of the NAPA formulation. With the availability of more funds to fund NAPA projects in LDC countries, Bhutan could access funds for a few more projects prioritized in NAPA. However, the NAPA document itself might need to be updated in the coming years to keep it in sync with the priorities of stakeholder agencies.

## 12.6 Climate change and hydropower development

Large-scale hydropower has been the main driver and the backbone of Bhutan’s economy. Hydropower development plans to 2022 foresee investments totaling USD 3.3 billion for an additional capacity of 3.8 GWe. Revenues from electricity generation already account for an estimated 22% of GDP. Despite Bhutan’s political and financial commitment to hydropower development, there is no data available nor any studies planned on the potential negative impacts of climate change on the country’s hydrological flows, and existing and future hydroelectricity plants. Run-of-the-river hydropower plants, as constructed in Bhutan, do not operate reservoirs, and are highly dependent on natural run-off, and thus susceptible to climate change and variations.

## 12.7 Glacial lake outburst floods (GLOF)

The glacier retraction and creation of glacial lakes with potential outburst floods is a major concern in Bhutan. The GLOF risks get attention from RGoB and from donor support mainly coordinated through the forthcoming LDCF-funded project covering three out of nine NAPA priority projects.

## 12.8 Climate data, forecasting and modeling capacity may be a constraint to climate change adaptation

The meteorological services are managed by the Hydro-Met office of the Department of Energy in the Ministry of Economic Affairs. While the meteorological services are mainly directed at hydropower, there will be scope to further develop the capacity to collect and manage climate data that can service different sectors, including agriculture and also contribute to the early warning of floods and climate change modeling.

## 12.9 Assessments of vulnerability and adaptation

Due to limited data availability, the Initial National Communication was unable to conduct climate change projections as part of a vulnerability and adaptation assessment. Most meteorological and hydrological stations are located in inner

and southern Bhutan, and require manual recording. Data are not collected for the northern higher mountains ranges. Given Bhutan's complex mountain topography, the existing network of meteorological and hydrological stations may not sufficiently reflect disparities in temperatures, precipitations, and flows over short distances. Modeling of the scenarios of climate change in Bhutan is yet to be undertaken.

#### 12.10 Disaster management and disaster risk reduction

The development of a disaster management framework and capacity is underway under the coordination of the Ministry of Home and Cultural Affairs. There is scope for further coordination of the activities in disaster risk reduction and climate change adaptation in particular at the local government level, e.g. on early warning systems and capacity of focal points, as well as among the coordinating agencies at national level.

#### 12.11 Forest conservation and carbon storage.

Bhutan's carbon sequestration and storage capacity is the result of a national desire to prioritize forest conservation with a minimum of 60% coverage over economic opportunities through rapid industrialization. Bhutan has contributed to the global efforts of sequestering carbon through forest conservation but it has not been adequately recognized and rewarded by international climate change mechanisms. It is yet uncertain how and if Bhutan will be able to gain from the new attention on Reduced Emissions from Deforestation and Degradation (REDD) under the UNFCCC. There is also concern that a National Forest Inventory should be conducted to verify forest stock, actual percentage of land area under forest cover as per international definitions of forest cover and sequestration and storage capacity for green house gases.

#### 12.12 Climate change and agriculture

Concerns were raised about the potential impacts of climate change on land use and soil fertility as well as adaptation to climate change risks in crop management and seed varieties. Concerns were also expressed that while the Ministry of Agriculture is aware of the risks of climate change, the Ministry currently does not yet possess adequate baseline data to assess risks and vulnerabilities on the sector.

#### 12.13 Climate sensitive health impacts

Although the health sector is highly vulnerable to climate change, more resources both financial and technical are needed to monitor the potential impacts of climate change on diseases rates and vector populations. A proposal was submitted by the Ministry to UNDP for prospective funding under the Special Climate Fund.

#### 12.14 Water resource management and climate change

Both the energy (hydropower) and agriculture sectors are highly sensitive to climate change. In both cases, the driving factor will be the availability of water resources. Water availability in Bhutan is dependent on rainfall and snowmelt, as

well as glacial melt runoff. Water management will be one of the most prominent areas for adaptation in Bhutan. Currently there is no ministry of water resources or similar institutional home for water resource management, although NEC has a mandate to coordinate water issues. The Bhutan Water Partnership (BtWP) is established with a secretariat at the Royal Society for Protection of Nature (RSPN).

### 12.15 Opportunities for carbon financing

Since the approval of the e7<sup>27</sup> micro-hydroelectricity project, there has been little activity in the area of CDM or voluntary carbon offset projects. Stakeholders involved in greenhouse gas mitigation activities do not have technical knowledge of compliance markets (CDM) and non-compliance markets (VER standards). Thus, opportunities for financing greenhouse gas mitigation activities in energy and forestry through voluntary carbon financing have not been properly explored in Bhutan. An ADB project “Bhutan Clean Power Export Development Project, ADB TA 7157”, will begin in early 2009. The project has a component on developing the emission baseline and a CDM manual. Relevant stakeholders, besides the energy sector, should capitalize on the project to develop their capacity and expertise on CDM.

### 12.16 Coordination of climate change.

There is awareness that coordination is needed among government agencies, among donors, and between RGoB and donors. There have not been any forums where climate change issues are discussed regularly. This has resulted in a situation where donors and government agencies are unaware of climate change relevant activities carried out within different ministries and by various development partners.

### 12.17 Functioning of the Designated National Authority (DNA) for the CDM under the Kyoto Protocol.

There has been no support programme to the establishment of a DNA for the national approval of CDM projects in Bhutan. There are no specific guidelines or procedures for the approval of CDM activities. Considering the planned large-scale hydropower projects, there may be a need to develop a more comprehensive assessment framework that would enhance the contribution of CDM activities to national happiness and sustainable development.

### 12.18 Attendance at Workshops and meetings

Concern was raised that attendance at meetings and workshops on climate change are not consistent and relevant. To keep abreast of negotiations and

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<sup>27</sup> e7 Fund for Sustainable Energy Development, a consortium of electric utilities from G7 countries, which aims to promote sustainable energy development and reduce GHG emissions. The e7 has later become e8. <http://www.e8.org/index.jsp?numPage=121&numFiche=50>

developments at SBSTAs and other important meetings and workshops, it was felt that participation at such forums should be more streamlined and professional.

## **13.0 Recommendations<sup>28</sup>**

The climate change screening of Danish Development assistance in Bhutan carried out by DANIDA lists a set of comprehensive recommendations that highlight interventions necessary for Bhutan to enhance its adaptive capacity to climate change. As a follow up to the climate screening exercise, DANIDA is already supporting a project “Support to Enhancing Adaptive Capacity to Climate Change” based on some of the recommendations. The following recommendations are from the Danish climate change screening exercise and were corroborated during discussions with stakeholder agencies.

### **13.1 National Climate Change Committee**

In order to ensure that climate change is addressed as a cross sectoral issue, there is the need for a National Climate Change Committee or Commission. The present National Environment Commission served as the Commission for Climate Change for the Initial National Commission but this mandate is now not visible for the existing Commission. The structure of the NEC fits the roles of a Climate Change Committee. However, the mandate to address climate change should be spelt out in the Terms of Reference for the Commission and other relevant stakeholders, especially representatives from the health sector included on the Commission. As NEC has plans to draft regulations for the National Environment Protection Act this year, these aspects should be considered when looking at the composition and the Terms of Reference for the Commission.

### **13.2 Establishment of Climate Change Unit in the NEC**

As the climate change focal point, NEC could coordinate the support for institutional capacity development, organisation and coordination of climate change. This may include:

- Establishing a full-time and functional climate change unit (focal point) at NEC, including preparing the terms of reference, objectives, tasks and budget of the climate change unit by NEC.
- Establishing a forum for exchange and discussion of information on climate change with government and non-government stakeholders. The forum can be coordinated with current consultations related to the on-going preparation of the Second National Communication. RSPN is also engaged in coordination and networking on climate change.

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<sup>28</sup> Source: Climate Change Screening of Danish Development Assistance with Bhutan, May 2008

- Providing support to develop further ideas for climate change adaptation activities to be supported by external source, e.g. from UNFCCC/GEF adaptation funds. This should be aligned with the GNHC as the GEF operational focal point.
- Coordinating and collaborating with the National Committee on Disaster Management (NCDM) and MoHCA on all issues relevant to the common agendas of climate change adaptation and disaster risk reduction.
- Preparing an annual national workshop on climate change to raise awareness at all levels of society. Activities may also include introduction of climate change materials in formal education.
- Supporting the NEC to collect information about all climate change projects and research, and to maintain a database of climate change research and information on Bhutan. This may be integrated in the Environmental Management Information System. It will also be relevant to coordinate with the disaster management database maintained by MoHCA.
- Supporting the establishment of climate change units within the Environmental Units of the Ministry of Agriculture, Ministry of Economic Affairs, Ministry of Health and the Ministry of Economic Affairs.

### 13.3 Establishment of a Technical National Climate Change Committee

In order to mainstream climate change within stakeholder agencies and to enhance the participation of these stakeholder agencies in climate change related activities, a Technical National Climate Change Committee should be established to support the NEC. The Technical Climate Change Committee could:

- To make recommendations to the NEC on issues related to climate change, and also to express the concerns of key stakeholders.
- To design and participate in a process leading to the formulation of a national climate change policy and a national implementation strategy.
- To propose what studies need to be undertaken in support of the national climate change policy process, what their scope, timetable, budget and deadlines should be, and within the limits of the available funds, advise the NEC to perform them, and review and disseminate the results.
- To guide the implementation of UNFCCC commitments
- To develop clear cut country position on various issues
- To communicate developments within the national and international climate change arena to stakeholders.

- To delegate functions and responsibilities to stakeholders
- To assist with a structured process of capacity building and technology transfer/ development.

A sample Terms of Reference for the Committee is annexed as Annex 2.

### 13.4 Research and capacity development on Climate Change

As the climate change focal point, NEC could coordinate support for research and capacity development, along with the Council of Research and Extension and other institutions. This may include:

- Developing capacity of technical staff and awareness of climate change for local government (Dzongkhag and Geog level) and for civil society.
- Providing seed capital to develop research proposal and small studies on climate change in Bhutan relevant for decision making, capacity development and awareness creation in Royal University of Bhutan (RUB) and other relevant institutes. Supporting researchers and students to study climate change science in neighbouring countries with strength in this field (e.g. Bangladesh, India, Indonesia, Malaysia, Philippines or Thailand).
- Developing capacity of technical staff and decision makers in the most relevant line ministries, commissions and governing bodies, including National Environment Commission (NEC), Ministry of Agriculture, Ministry of Works and Human Settlement, Ministry of Economic Affairs (especially Department of Energy and Department of Geology and Mines) and Ministry of Home and Cultural Affairs on climate change (e.g. through attendance at the bi-annual regional climate risk management training course organised by the Asian Disaster Preparedness Centre (ADPC) in Bangkok and other training opportunities on climate change).

### 13.5 Need for support for the development of Bhutan's Position for COP 15 and the Post-2012 rules of the UNFCCC.

Support is needed for the NEC to coordinate the development of the RGoB's position on the successor to the post-Kyoto framework at the Conference of the Parties (COP) to the UNFCCC to be held in Copenhagen in 2009. This may include:

- Organising pre- and post- COP meetings with the climate change forum or similar in Bhutan from COP 14 onwards.
- Coordinating positions with other LDC countries.
- Developing a position on a reform for CDM rules for LDCs including the role and eligibility of forest conservation (REDD).

- Supporting media, NGOs to attend COPs and regional “Prepcom” meetings.

### 13.6 Capacity development for meteorological and hydrological services and Climate Modelling.

Support is needed for the Ministry of Economic Affairs (MEA) to develop the capacity to collect and manage climate data and develop climate models and forecasting. The support could include:

- Improving capacity to analyze weather data and to collect weather data with additional measuring stations where gaps are identified.
- Improving capacity development to prepare early warning and hazard forecasting for the agriculture sector as well as other sectors and urban centres (NAPA priority project). Some initiatives on GLOF early warning are forthcoming with the support from the LDCF for adaptation to climate change.
- Improving capacity for climate change modeling.
- Supporting continued regional networking (e.g. SAARC/SACEP, ICIMOD and ADPC) including participation in climate change projects with regional institutions.

### 13.7 Support is needed to address Climate Sensitivity in the Agriculture and Forest sectors.

Support is needed for the Ministry of Agriculture to prepare the agricultural sector for present and future climate variability and climate change. This could include:

- Supporting research and improvement of crop management, including selection of crop varieties and introduction of crops better adapted to climate change by the Renewable Natural Resources (RNR) Research Centres in order to reduce farmers’ vulnerability to water and temperature variability and their capacity to adapt to and reduce climate change risks.
- Improving management and utilization of land and water resources including pilot development on efficient and low-cost water harvesting to reduce vulnerability to variability in water availability for agriculture.
- Building on traditional knowledge in rural areas on coping mechanisms in the agricultural sector.
- Implementing integrated watershed management, including forest rehabilitation in vulnerable locations, particularly in upper catchments, e.g. through pilot development in selected sensitive upper watersheds with vulnerable downstream sites.

### 13.8 National Forest Inventory

There is also concern that a National Forest Inventory should be conducted to verify forest stock, actual percentage of land area under forest cover as per



international definitions of forest cover and sequestration and storage capacity for green house gases. It is yet uncertain how and if Bhutan will be able to gain from the new attention on Reduced Emissions from Deforestation and Degradation (REDD) under the UNFCCC but scientific data on Bhutan's forests will be needed to strengthen Bhutan's negotiation capabilities at such forums.

### 13.9 Need for support to Climate Change adaptation in Integrated Water Resource Management.

Although, the preparation of the Water Act is already supported through EUSPS, future support is needed for the coordination and implementation of integrated water resource management, for example through NEC, BtWP and other institutions, once the Water Act is promulgated.

### 13.10 Mainstreaming Climate Change<sup>29</sup>

GNHC facilitates mainstreaming environment into policies and programmes of Bhutan. NEC supports the development of procedures and tools for environmental mainstreaming. Guidelines for Environmental Mainstreaming have been developed by the NEC and the GNHC. Additional activities may include addressing climate change proofing of development activities in the annual rolling plan, incorporating climate change into environmental impact assessment procedures, and addressing climate change proofing in the Policy Formulation Protocol of the RGoB.

### 13.11 Development of a National Climate Change Strategy (NCCS)

As most of Bhutan's donors are sensitizing their assistance to climate change, it might be an appropriate time for Bhutan to develop a national climate change strategy. Climate change is a cross cutting issue that could affect the overall socio-economy development as well as many specific sectors including energy, transport, agriculture, forestry, water resources and health. Bhutan has already developed many national policies related to economy, social and environment but the impacts of climate change have not been addressed properly in the existing policies and plans. It is increasingly recognized that climate change should be dealt within the framework of sustainable development. Climate change needs to be mainstreamed into national and sectoral development plans. The inclusion of 'climate proofing concept' in national development plan would ensure the effective mainstreaming of climate change into national and sectoral development plan and policies. The NCCS will provide a framework for the 'climate proofing' of national development plans<sup>30</sup> and also provide a basis for seeking donor assistance.

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<sup>29</sup> 'Mainstreaming' here refers to the inclusion of environment and/or climate change in the procedures guiding project and programme design and implementation. In the short-run the 'mainstreaming' refers to the use of existing procedures, e.g. for environmental impact assessment. In the longer run 'mainstreaming' also refers to the development of new procedures targeting the inclusion of environment and/or climate change.

<sup>30</sup> UNEP (2008) Draft Concept Paper: Climate Change Study

The Development of a National Climate Change Strategy might be carried once the SNC has finished the vulnerability assessments and developed strategies for mitigation and adaptation. There is a strong inclination from the United Nations Development Program and the United Nations Environment Program to support the development of such a strategy.

### 13.12 Revising or Climate Sensitizing the National Environment Strategy

The “Middle Path”, Bhutan’s National Environment Strategy, was published in 1999. In the current development context, there is a need to revisit the avenues for sustainable development listed in the strategy and to “climate proof” the national environment strategy. Within the framework of the institutional and political changes that have taken place in Bhutan, it is timely to revise/upgrade or rewrite the National Environment Strategy.

### 13.13 Climate Change-related Projects

Three projects prioritized under the Bhutan NAPA are already being implemented. These three projects consume as much as 50% of the NAPA project budget. If there are funding opportunities under the LDCF or the special adaptation fund, the NAPA project list should continue to be the basis for developing climate-change related projects. However, the health sector in the current NAPA is restricted to only emergency medicine. Disease surveillance, reporting and prevention of climate sensitive diseases need to be incorporated in the NAPA if there are opportunities to update NAPA.

The Health Sector has also submitted a project proposal to the Special Climate Change Fund (SCF) through UNDP. As there are no funds in the SCF, other sources need to be sought.

As a follow-up to the DANIDA Climate Screening exercise, DANIDA is implementing a project titled “Support to Enhancing Adaptive Capacity to Climate Change in Bhutan”. This project is for duration of one year (2008-2009) and addresses some of the more urgent and critical issues related to climate change in Bhutan. The climate screening exercise also recommends the development of a ‘climate change angle’ in the next phase of the Environment Urban Sector Program Support (EUSPS). This would place climate change as a central linking theme for the programme and could include many of the issues addressed in this document.

The Swedish Government, through its donor agency, the Swedish International Development Cooperation Agency (SIDA), is supporting the establishment of the Regional Climate Adaptation Knowledge Platform for Asia as a sustainable regional knowledge-sharing mechanism on climate change adaptation.

The Regional Climate Adaptation Knowledge Platform for Asia (Platform) will:

- Support efforts to integrate climate change adaptation measures into development processes and plans at the national and regional levels;
- Facilitate and enhance dissemination and application of streamlined methodologies, tools for adaptation planning and vulnerability assessments by engaging research institutions;
- Increase linkages between adaptation and the sustainable development agenda in the region;
- Support pilot studies of specific climate change and adaptation scenarios and promote best practices.

The Stockholm Environment Institute (SEI) and the UN Environment Programme (UNEP) have been identified as key partners in the implementation of the Platform and will work together with regional partners to develop the programme of activities<sup>31</sup>.

Right now Bhutan is not included as a focal country in the Platform's geographical focus for the period 2009 – 2012 but discussions should be held with SEI and UNEP to include Bhutan as a priority country in the Platform as many of the needs identified in this document (capacity building, increased research on climate change adaptation, support for COP15, climate modeling and the focus on water management) fit well with the Platform's aims and objectives.

A tentative budget with fund commitments (where relevant) is provided as Annex 3 at the end of the report.

### 13.14 “Climate Change” as the central theme for the next Round Table Meeting (RTM) with Development Partners

Assessing climate change vulnerability and implementing subsequent mitigation and adaptation strategies will be the focus of donor assistance in the coming years. The SNC, DANIDA projects on climate change and a National Climate Change Strategy could provide the basis of presenting climate change as the central theme for the next RTM with Bhutan's donors.

The following themes could be included:

- Emphasizing (i) climate data, modeling and early warning, (ii) integrated water resource management, and (iii) inclusion of decentralized awareness and actions on climate change to reduce vulnerability, e.g. in crop management and water resource utilization.

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<sup>31</sup> Brochure on Regional Climate Adaptation Knowledge Platform for Asia, SEI, SIDA, UNEP

- Addressing the climate change risks on urban infrastructure, services and livelihoods.
- Developing transfer mechanisms from hydropower to upstream land-use and forest management to protect the natural resources and reduce climate change sensitivity, i.e. Payment for Environmental Services (PES).
- Initiating the support to climate change adaptation and vulnerability reduction at the Geog level to develop institutional structures to address and support local adaptation to climate change. This may include community-based early warning systems and awareness raising. A harmonization of climate change adaptation and disaster risk reduction initiatives is required.
- Calling on national and external expertise to prepare technical notes and initiate research on climate and development in Bhutan.

## **Annex 2: Sample Terms of Reference of the Technical Committee on Climate Change<sup>32</sup>.**

- 1) The Committee will be called the National Climate Change Committee.
- 2) The main objectives of the Committee on Climate Change will be to address climate change by:
  - Raising awareness amongst the people, private and public sectors on the impacts and opportunities arising from climate change, and the actions they can take;
  - Building competency in Bhutan to better respond to climate change such as through promoting research and development of low-carbon technologies;
  - Understanding Bhutan's vulnerability to climate change and facilitating the adaptation actions needed.
  - To examine and evaluate current research of relevance to Bhutan in climate and climate-change impacts
  - To examine and advise on the acquisition and analysis of climate change data for Bhutan, and to take all possible steps to ensure that an adequate climate monitoring infrastructure is maintained
  - To provide an expert group capable of furnishing advice and guidance to policy makers in Bhutan on issues related to climate change
  - To provide informed judgment on potential impacts of climate change and on appropriate responses and mitigation measures
  - To maintain links with the relevant international organisations and in particular to act as the adhering national body for the UNFCCC.
  - To promote increased research activity in Bhutan in climate and climate-change impacts
- 3) The Committee will seek funding to support activities in climate-change impacts, such as post graduate research, conference participation and the organisation of conferences and symposia within Bhutan.
- 4) The Committee will encourage the widest possible co-operation between scholars, for example, by sponsoring conferences and seminars.
- 5) The Committee will propose to the government names of individuals for appointment to the Committee and terms of their appointments.
- 6) The Committee will be interdisciplinary and composed of individuals with a wide range of expertise in climate and climate-change impacts.
- 7) Members of the Committee will serve for four years. A staggered rotation system will apply with half the members being appointed every two years.
- 8) The Committee will work from Academy House and will be supported where practicable by the staff of the Academy.

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<sup>32</sup> Source: Terms of Reference for Singapore's Climate Change Committee and Terms of Reference for Ireland's Climate Change Committee

### Annex 3: Tentative Budget to Implement the Listed Recommendations during 2009 – 2010

|   | Recommendation   | Tentative Budget | Donor  | Remarks  |
|---|--|------------------|--|--|
| 1 | Establishment of Climate Change Unit in the NEC  | US\$ 82,000.00   | Committed by DANIDA under Support to Enhancing Adaptive Capacity to Climate Change project | <ul style="list-style-type: none"> <li>- A fully functional climate change unit established at NECS by end 2008.</li> <li>- A forum for exchange and discussion of information on climate change with government and non-government stakeholders formed by end 2008</li> <li>- Annual national workshop on climate change conducted from 2008</li> <li>- A database of climate change research and information on Bhutan created by end 2008</li> </ul>  |
| 2 | Research and capacity development on Climate Change  | US\$ 126,650.00  | Committed by DANIDA under Support to Enhancing Adaptive Capacity to Climate Change project | <ul style="list-style-type: none"> <li>- Two local government technical staff and 1 from the civil society trained on Climate Risk Management in ADPC in November 2008</li> <li>- 3 research proposals on climate change and development links developed and initiated</li> <li>- Two local government technical staff trained in calibration and monitoring of emission monitoring equipment in transport sector.</li> <li>- Common reporting software on vehicle</li> </ul>  |
| 3 | Support for the development of Bhutan's Position for COP 15 and the Post-2012 rules of the UNFCCC. | US\$ 92,650.00   | Committed by DANIDA under Support to Enhancing Adaptive Capacity to Climate Change project | <ul style="list-style-type: none"> <li>- 1 pre- and 1 post- COP 14 meetings organised in 2008</li> <li>- 1 pre- and 1 post- COP 15 meetings organised in 2009</li> <li>- The position on a reform for CDM rules for LDCs including the role and eligibility of forest conservation developed.</li> <li>- Government and Non-Government stakeholders from Bhutan attend the COP 15 meeting in November/December 2009</li> </ul>   |
| 4 | Capacity development for meteorological and hydrological services and Climate Modelling.           | US\$368,925.00   | Committed by DANIDA under Support to Enhancing Adaptive Capacity to Climate Change project | <ul style="list-style-type: none"> <li>- Data book published &amp; distributed</li> <li>- Additional hydro-meteorological stations identified by end 2008</li> <li>- Hydro-meteorological stations established</li> <li>- Communication system for real time data transmission between synoptic stations and main operator centre established</li> <li>- National weather and flood forecasting &amp; warning centre established</li> <li>- Initial version of weather and flood advisories format developed and issued</li> <li>- Capacity of staff in data collection and analysis enhanced</li> <li>- An improved level of professional competence through systematic training</li> </ul> |

|    |  |                              |  |   |
|----|--|------------------------------|--|---|
| 5  | Support to address Climate Sensitivity in the Agriculture and Forest sectors.  | US\$ 173,611.00              | Committed by DANIDA under Support to Enhancing Adaptive Capacity to Climate Change project | <ul style="list-style-type: none"> <li>- 2 research protocols for improvement of crop management including selection of crop varieties and introduction of crops better adapted to climate change</li> <li>- A study to document traditional knowledge on coping mechanisms to climatic risks in the agricultural sector initiated by end 2008</li> </ul> |
| 6  | National Forest Inventory  | US\$ 2.7 million             | No commitment.   | Tentative budget for the National Forest Inventory. Details are still being worked out by the Department of Forestry Resources. This figure includes capacity building, equipment, etc.   |
| 7  | Support to Climate Change adaptation in Integrated Water Resource Management.  | US\$ 50,000.00               | No commitment  |   |
| 8  | Climate Change-related Projects<br>Remaining NAPA Projects = US\$ 4,104,777<br>Health Proposal to GEF = US\$ 896,000 | Approximately US\$ 5 million | No commitment  |   |
| 9  | Mainstreaming Climate Change   | US\$ 150,000.00              | No commitment.   | <ul style="list-style-type: none"> <li>- climate change proofing of development activities in the annual rolling plan</li> <li>-incorporating climate change into environmental impact assessment procedures</li> <li>- addressing climate change proofing in the Policy Formulation Protocol of the RGoB.</li> <li>- Capacity building</li> </ul>        |
| 10 | Development of a National Climate Change Strategy (NCCS)   | US\$ 150,000.00              | No commitment.   | <ul style="list-style-type: none"> <li>-cost for consultancy services, workshops and printing etc.</li> <li>The vulnerability assessments and mitigation and adaptation strategies will emerge from the results of the SNC</li> </ul>   |
| 11 | Revising or Climate Sensitizing the National Environment Strategy  | US\$ 150,000.00              | No commitment.   | <ul style="list-style-type: none"> <li>-cost for consultancy services, workshops and printing etc.</li> </ul>   |
| 12 | Building Synergies with other Multi lateral Agreements   | US\$ 25,000.00               | Committed by DANIDA under Support to Enhancing   | <ul style="list-style-type: none"> <li>-2 instructors at technical institute trained on capture of ODS and high GWP gases and maintenance of such equipment</li> </ul>  |

|  |  |  |   |   |
|--|--|--|---|---|
|  |  |  | Adaptive Capacity to Climate Change project | - 2 training of trainers for customs monitoring identification of ODS and high GWP gases for cross border transport<br>- 3 technical staff trained in conversion of machines from ODS to non-ODS with low GWP gases |
|--|--|--|---|---|

**Total Budget: 9,068,836.00**

| <b>Total Budget Required</b> | <b>Committed by Donors already</b> | <b>Funds Still Needed.</b>      | <b>Remarks</b>   |
|------------------------------|------------------------------------|---------------------------------|--|
| US\$ 9,068,836.00            | US\$ 868,000.00                    | US\$ 8,200,000.00 approximately | This amount however also includes approximately US\$ 5 million to fund the remaining NAPA projects and US\$ 2.7 million for the National Forestry Inventory. |



### Annex 3: Tentative Budget to Implement the Listed Recommendations during 2009 – 2010

**Table 6: Tentative Budget for Major Climate Change Activities for 2009 – 2010**

|   | <b>Recommendation</b>  | <b>Tentative Budget</b> | <b>Donor</b>   | <b>Remarks</b>   |
|---|--|-------------------------|--|--|
| 1 | Establishment of Climate Change Unit in the NEC  | US\$ 82,000.00          | Committed by DANIDA under Support to Enhancing Adaptive Capacity to Climate Change project | <ul style="list-style-type: none"> <li>- A fully functional climate change unit established at NECS by end 2008.</li> <li>- A forum for exchange and discussion of information on climate change with government and non-government stakeholders formed by end 2008</li> <li>- Annual national workshop on climate change conducted from 2008</li> <li>- A database of climate change research and information on Bhutan created by end 2008</li> </ul>  |
| 2 | Research and capacity development on Climate Change  | US\$ 126,650.00         | Committed by DANIDA under Support to Enhancing Adaptive Capacity to Climate Change project | <ul style="list-style-type: none"> <li>- Two local government technical staff and 1 from the civil society trained on Climate Risk Management in ADPC in November 2008</li> <li>- 3 research proposals on climate change and development links developed and initiated</li> <li>- Two local government technical staff trained in calibration and monitoring of emission monitoring equipment in transport sector.</li> <li>- Common reporting software on vehicle</li> </ul>  |
| 3 | Support for the development of Bhutan's Position for COP 15 and the Post-2012 rules of the UNFCCC. | US\$ 92,650.00          | Committed by DANIDA under Support to Enhancing Adaptive Capacity to Climate Change project | <ul style="list-style-type: none"> <li>- 1 pre- and 1 post- COP 14 meetings organised in 2008</li> <li>- 1 pre- and 1 post- COP 15 meetings organised in 2009</li> <li>- The position on a reform for CDM rules for LDCs including the role and eligibility of forest conservation developed.</li> <li>- Government and Non-Government stakeholders from Bhutan attend the COP 15 meeting in November/December 2009</li> </ul>   |
| 4 | Capacity development for meteorological and hydrological services and Climate Modelling.           | US\$368,925.00          | Committed by DANIDA under Support to Enhancing Adaptive Capacity to Climate Change project | <ul style="list-style-type: none"> <li>- Data book published &amp; distributed</li> <li>- Additional hydro-meteorological stations identified by end 2008</li> <li>- Hydro-meteorological stations established</li> <li>- Communication system for real time data transmission between synoptic stations and main operator centre established</li> <li>- National weather and flood forecasting &amp; warning centre established</li> <li>- Initial version of weather and flood advisories format developed and issued</li> <li>- Capacity of staff in data collection and</li> </ul> |

|    |  |                              |  |   |
|----|--|------------------------------|--|---|
|    |  |                              |  | analysis enhanced<br>- An improved level of professional competence through systematic training   |
| 5  | Support to address Climate Sensitivity in the Agriculture and Forest sectors.  | US\$ 173,611.00              | Committed by DANIDA under Support to Enhancing Adaptive Capacity to Climate Change project | - 2 research protocols for improvement of crop management including selection of crop varieties and introduction of crops better adapted to climate change<br>- A study to document traditional knowledge on coping mechanisms to climatic risks in the agricultural sector initiated by end 2008 |
| 6  | National Forest Inventory  | US\$ 2.7 million             | No commitment.   | Tentative budget for the National Forest Inventory. Details are still being worked out by the Department of Forestry Resources. This figure includes capacity building, equipment, etc.   |
| 7  | Support to Climate Change adaptation in Integrated Water Resource Management.  | US\$ 50,000.00               | No commitment  |   |
| 8  | Climate Change-related Projects<br>Remaining NAPA Projects = US\$ 4,104,777<br>Health Proposal to GEF = US\$ 896,000 | Approximately US\$ 5 million | No commitment  |   |
| 9  | Mainstreaming Climate Change   | US\$ 150,000.00              | No commitment.   | - climate change proofing of development activities in the annual rolling plan<br>-incorporating climate change into environmental impact assessment procedures<br>- addressing climate change proofing in the Policy Formulation Protocol of the RGoB.<br>- Capacity building                    |
| 10 | Development of a National Climate Change Strategy (NCCS)   | US\$ 150,000.00              | No commitment.   | -cost for consultancy services, workshops and printing etc.<br>The vulnerability assessments and mitigation and adaptation strategies will emerge from the results of the SNC   |
| 11 | Revising or Climate Sensitizing the National Environment Strategy  | US\$ 150,000.00              | No commitment.   | -cost for consultancy services, workshops and printing etc.   |
| 12 | Building Synergies with other  | US\$ 25,000.00               | Committed by   |   |

|  |                          |  |   |   |
|--|--------------------------|--|---|---|
|  | Multi lateral Agreements |  | DANIDA under Support to Enhancing Adaptive Capacity to Climate Change project | -2 instructors at technical institute trained on capture of ODS and high GWP gases and maintenance of such equipment<br>- 2 training of trainers for customs monitoring identification of ODS and high GWP gases for cross border transport<br>- 3 technical staff trained in conversion of machines from ODS to non-ODS with low GWP gases |
|--|--------------------------|--|---|---|

**Total Budget: 9,068,836.00**

| <b>Total Budget Required</b> | <b>Committed by Donors already</b> | <b>Funds Still Needed.</b>      | <b>Remarks</b>   |
|------------------------------|------------------------------------|---------------------------------|--|
| US\$ 9,068,836.00            | US\$ 868,000.00                    | US\$ 8,200,000.00 approximately | This amount however also includes approximately US\$ 5 million to fund the remaining NAPA projects and US\$ 2.7 million for the National Forestry Inventory. |

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## List of Persons Met

| Name  | Position and Organization  |
|---|--|
| <b>National Environment Commission</b>        |  |
| 1. Dasho Nado Rinchhen                        | Deputy Minister, NEC   |
| 2. Mr. Sonam Yangley                          | Director General, NEC  |
| 3. Mr Tshering Tashi                          | Joint Director, NEC  |
| 4. Mr. Thinley Namgyel                        | Senior Environment Officer, NEC                                  |
| 5. Mrs. Tshewang Zangmo                       | Program Officer, NEC   |
| 6. Ms. Sonam Lhaden Khandu                    | Program Officer, NEC   |
| 7. Mr. G. Karma Chhopel                       | Water Resources Specialist, NEC                                  |
| 8. Mr. Karma C. Nyedrup                       | Head, Environmental Assessment Division, NEC                     |
| 9. Mr. Yeshey Penjor                          | Senior Environment Officer, NEC                                  |
| <b>Gross National Happiness Commission</b>    |  |
| Mr. Karma Tsheteem                            | Secretary, GNHC  |
| <b>Ministry of Agriculture</b>                |  |
| 10. Mr. Chencho Norbu                         | Director, Department of Agriculture, MOA                         |
| 11. Mr. Lobsang Dorji                         | DFO, Thimphu   |
| 12. Mr. Nyedup Penjor                         | PPD, MoA   |
| <b>Ministry of Health</b>                     |  |
| 13. Mr. Gyembo Dorji                          | Environment and Health Officer, Ministry of Health               |
| <b>Ministry of Home and Cultural Affairs</b>  |  |
| 14. Mrs. Karma Dema                           | Program Officer, Ministry of Home Affairs                        |
| 15. Ms. Sonam Deki                            | Assistant Program Officer, Ministry of Home and Cultural Affairs |
| <b>Royal Society for Protection of Nature</b> |  |
| 16. Mr. Lam Dorji                             | Executive Director, RSPN   |
| 17. Mr. Dago Tshering                         | Program Officer, RSPN  |
| <b>Liaison Officer of Denmark</b>             |  |
| 18. Mr. Tek Bahadur Chhetri                   | Senior Program Officer, LOD                                      |
| <b>United Nations Development Program</b>     |  |
| 19. Mr. Karma Rapten                          | Environment Cluster  |
| 20. Ms. Sonam Rabgye                          | APO, Environment Cluster   |
| 21. Mrs. Tirtha Rana                          | GEF Small Grants Program   |

## Annex 1: Climate Change Related Projects

| Organization                    | Type       | Name of the Project   | Objectives/Outputs etc.   | Remarks   |
|---------------------------------|------------|---|---|---|
| National Environment Commission | Government | Enhancing Global Environmental Management in Bhutan's Local Governance System (of the Rio Conventions). | <p><b>Objective</b></p> <p>The Project Objective is to enhance global environmental management by mainstreaming the provisions of the Rio Conventions into enhanced decentralized environmental management</p> <p><b>Achievements and Expected results</b></p> <p>The project objective will be achieved through the following outcomes</p> <ul style="list-style-type: none"> <li>• Enabled central-level framework to enhance decentralized capacity for environmental management and implementation of the provisions of the 3 Rio Conventions</li> <li>• Enabled decentralized institutional framework and personnel to enhance local environmental management, which include implementation of the Rio Conventions' provisions.</li> <li>• Existing Environmental Information Management System enhanced to backstop national policy and decision making in response to global environmental management needs as per the provisions of the Rio Conventions</li> </ul>                      | <p>Approved by GEF in February 2008.</p> <p>Implementing Partner : NEC</p> <p>Implementation period: 2008 - 2011</p> <p>Budget : USD 1,040,382</p> <p>Funding Agency:<br/>GEF/DANIDA/Bilateral/RGoB</p> <p>Project Execution: NEX</p> |
|                                 |            | Second National Communication to UNFCCC (SNC).  | <p><b>Objective</b></p> <ul style="list-style-type: none"> <li>• To enable the Royal Government of Bhutan (RGOB) to fulfill its reporting obligations with regard to the development of inventories of greenhouse gas (GHG) sources and sinks.</li> <li>• To enable RGOB to fulfill its reporting obligations with regard to the identification of options for mitigating climate change thereby enhancing national capacity to identify, analyze, and formulate viable GHG mitigation measures.</li> <li>• To enable RGOB to fulfill its reporting obligations with respect to its vulnerability to future climate change.</li> <li>• To enable RGOB to fulfill its reporting obligations with respect to options for adapting to climate change.</li> <li>• To enable Bhutan to prepare national plans for mitigation and adaptation for fulfilling its reporting requirements to the FCCC Secretariat.</li> <li>• To enable RGOB to fulfill its reporting obligation with respect</li> </ul> | <p>Implementing Partner: NEC</p> <p>Implementation period: 2007 – 2010</p> <p>Budget: USD 405,000</p> <p>Funding Agency: UNDP/GEF</p> <p>Project Execution: NEX</p>   |

|  |   |   |  |
|--|---|---|--|
|  |   | <p>to communicating information under Article 12 of the FCCC</p> <p><b>Expected Results</b></p> <p>The SNC is expected to produce a document which will be Bhutan's Second National Communication to the UNFCCC</p> <p>Project Outcomes include:</p> <ul style="list-style-type: none"> <li>• National Circumstances</li> <li>• National Greenhouse Gas Inventory</li> <li>• Programmes containing measures to facilitate adequate adaptation to climate change</li> <li>• Programmes containing measures to mitigate climate change</li> <li>• Other relevant information (e.g. research and systematic observation, technology transfer, education and public awareness, capacity building)</li> <li>• Constraints &amp; Gaps; Related Financial, technical, &amp; capacity needs</li> <li>• Compilation, Production of communication, including Executive Summary &amp; its translation</li> </ul> |  |
|  | Environmental Mainstreaming.  | <ul style="list-style-type: none"> <li>• Capacity Building</li> <li>• Development of Guidelines for Environmental mainstreaming</li> </ul>  | <p>Implementation period: 2007 – 2009</p> <p>Budget: USD 190,000</p> <p>Funding Agency: UNEP/UNDP</p> <p>Project Execution: NEX</p>        |
|  | National Adaptation Programme of Action to Climate Change (NAPA).     | <p>The Formulation of Bhutan's "National Adaptation Programme of Actions (NAPA)" is an effort to look at such coping mechanisms in a scientific manner. The NAPA findings are aimed at addressing the immediate threats of climate change by putting in place long- term preventive measures.</p>   | <p>Implementation period: 2003 – 2006</p> <p>Budget: USD 328,400.00</p> <p>Funding Agency: GEF/LDCF</p> <p>Project Execution: NEX</p>      |
|  | National Capacity Self Assessment for Global Environmental Management | <p>Specifically, the objectives of the National Capacity Self-Assessment were to:</p> <ul style="list-style-type: none"> <li>• undertake and complete a comprehensive assessment of capacity building issues, needs and priorities at the individual, institutional and systemic levels within and across the thematic</li> </ul>   | <p>Implementation period: 2002 – 2003</p> <p>Funded by GEF.</p> <p>Implementing Partner: NEC.</p> <p>Budget: USD 200,000 approximately</p> |



|  |   |   |   |
|--|---|---|---|
|  |   | <p>areas of biodiversity, climate change and land degradation, with particular attention to national obligations to the Rio Conventions and linkages with broader national sustainable development concerns;</p> <ul style="list-style-type: none"> <li>• produce a written account of this assessment and its results in the form of an NCSA Report; and</li> <li>• produce a Plan of Action to address the capacity development priorities identified through the NCSA and to monitor and evaluate the implementation of those priorities.</li> </ul> |   |
|  | Initial National Communication to UNFCCC (INC).                                       | Information on Greenhouse Gas (GHG) Inventory for 1994, vulnerability assessment and national climate change action plan for mitigation of GHG emission and adaptation to possible climate change effects. This review is considered crucial because the assessments carried out will serve as an important planning tool by providing information on climate risks to development during the future national and sectoral planning processes.  | <p>Implementation period: 1996 – 2003</p> <p>Funded by UNDP/GEF</p> <p>Implementing Partner: NEC.</p> <p>Budget: USD 295,000 approximately</p>  |
|  | Climate Change Studies In Bhutan  | Climate Change Vulnerability and Adaptation for Rice Production in Bhutan   | <p>Implementation period: 2006 – 2008</p> <p>Funded by: Netherlands Climate Change Studies Assistance program.</p> <p>Implementing Partner: CORE, MOA</p> <p>Budget: EU, 6000 (approximately)</p> |
|  | Climate Change Adaptation Needs Assessment: Agriculture Sector                        | Climate Change Adaptation Needs Assessment: Agriculture Sector  | <p>GHG Project (Phase II)</p> <p>Completed 2003</p>   |
|  | National technology Needs Assessment for Industry Sector in Bhutan                    | National Technology Needs Assessment for Industries in Bhutan   | <p>GHG project (Phase II)</p> <p>Completed 2003</p>   |
|  | Climate Screening of DANIDA Projects  | Output of the assignment was a brief climate change screening report of DANIDA supported sector projects in Bhutan.   | <p>April 2008</p> <p>Funded by: DANIDA</p>  |
|  | Strengthening Institutional organization and coordination of climate change in Bhutan | Institutional organization and coordination of climate change in Bhutan strengthened.   | <p>Implementation period: 2008 – 2009</p> <p>Funded by DANIDA</p> <p>Implementing Partner: NEC</p>  |

|  |   |  |   |
|--|---|--|---|
|  |   |  | Budget: DKK 471,785.00  |
|  | Enhancing Research and Capacity Development on Climate Change             | Research and capacity development on climate change enhanced   | Implementation period: 2008 – 2009<br>Funded by DANIDA<br>Implementing Partner: NEC<br>Budget: DKK 729,461.00   |
|  | Strengthening of Position of Bhutan for post 2012 rules of climate change | Position of Bhutan for the post2012 rules of the climate change Convention strengthened.   | Implementation period: 2008 – 2009<br>Funded by DANIDA<br>Implementing Partner: NEC<br>Budget: DKK 533,652.00   |
|  | Building synergies with other multilateral agreements                     | - 2 instructors at technical institute trained on capture of ODS and high GWP gases and maintenance of such equipment<br><br>- 2 training of trainers for customs monitoring identification of ODS and high GWP gases for cross border transport<br><br>- 3 technical staff trained in conversion of machines from ODS to non-ODS with low GWP gases   | Implementation period: 2008 – 2009<br>Funded by DANIDA<br>Implementing Partner: NEC<br>Budget: DKK 140,123.00   |
|  | Climate Change Strategy   | National Climate Change Strategy   | Ongoing. Result of amended MoU with UNEP.   |
|  | Terminal Phase-Out Management Plan  | <b>Objective</b><br>Ensure full compliance of Bhutan with the Montreal Protocol control milestone for 2007 – 2010<br><b>Achievements and Expected Results</b><br><ul style="list-style-type: none"> <li>• Technical assistance, training, retrofitting incentive programme and equipment support for servicing in the Refrigeration and Air Conditioning Sector.</li> <li>• Provide appropriate equipment support to servicing establishments and providing incentives for retrofitting of CFC-based refrigeration and air conditioning equipment</li> </ul> | Implementing Partner : NEC<br><br>Implementation period: January 2007 – December 2008<br><br>Budget : USD 75,000<br><br>Funding Agency: UNDP/UNEP<br><br>Project Execution: NEX |

|                              |            |  |  |  |
|------------------------------|------------|--|--|--|
|                              |            |  |  |  |
| Ministry of Economic Affairs | Government | Reducing climate change induced risks and vulnerabilities from Glacial Lakes Outburst Floods in the Punakha, Wangdue and Chamkhar Valleys. | <p>The objective of the project is to reduce climate change-induced risks of Glacial Lake Outburst Floods (GLOFs) in the Punakha-Wangdi and Chamkhar Valleys.</p> <p><b>Project Outcomes:</b></p> <p>The project has the following outcomes:</p> <p>OUTCOME1: Improved national, regional, and local capacities to prevent climate change-induced GLOF disasters in the Punakha-Wangdi and Chamkhar Valleys</p> <p>OUTCOME 2: Reduced risks of GLOF from Thorthormi Lake through an artificial lake level management system</p> <p>OUTCOME 3: Reduced human and material losses in vulnerable communities in the Punakha-Wangdi Valley through GLOF early warnings</p> <p>OUTCOME 4: Enhanced learning, evaluation and adaptive management</p> | <p>Implementing Partner: DGM (MoEA)/DMD (MoHCA)</p> <p>Implementation period: 2008 – 2012</p> <p>Budget : USD 7,351,274</p> <p>Funding Agency: UNDP/GEF/RGoB/Austria/WWF</p> <p>Project Execution: NEX</p> |
|                              |            | Community Micro-Hydro for sustainable Livelihoods.   |  | <p>On-going.</p> <p>Funded by: GEF/UNDP</p>  |
|                              |            | National Renewable Energy Policy and Programme for Sustainable Development.  |  | <p>On-going.</p> <p>Funded by: UNDP/GEF</p>  |
|                              |            | Micro Hydel project, Chendebji   |  | <p>(CDM) Completed</p> <p>Funded by: E7</p>  |
|                              |            | Dagachu Hydropower Project   |  | <p>(CDM) Review process.</p> <p>ADB etc.</p>   |
|                              |            | Enhancing Capacity for Hydro-meteorological services and climate modeling  | <ul style="list-style-type: none"> <li>- Data book published &amp; distributed</li> <li>- Additional hydro-meteorological stations identified by end 2008</li> <li>- Hydro-meteorological stations established</li> </ul>  | <p>Implementation period: 2008 – 2009</p> <p>Funded by DANIDA</p> <p>Implementing Partner: MEA</p>   |

|                                       |            |  |   |   |
|---------------------------------------|------------|--|---|---|
|                                       |            |  | <ul style="list-style-type: none"> <li>- Communication system for real time data transmission between synoptic stations and main operator centre established</li> <li>- National weather and flood forecasting &amp; warning centre established</li> <li>- Initial version of weather and flood advisories format developed and issued</li> <li>- Capacity of staff in data collection and analysis enhanced</li> <li>- An improved level of professional competence through systematic training</li> </ul> | Budget: DKK 2,125,000.00  |
| Ministry of Economic Affairs          | Government | Climate Screening of DANIDA Development Assistance   |   | Completed<br>Funded by: DANIDA  |
|                                       |            | Regional Climate Change, Energy Ecosystems Project   |   | Ongoing<br>Funded by: UNDP  |
|                                       |            | Bhutan Clean Power Export Development Project  | <ul style="list-style-type: none"> <li>-CDM Manuals</li> <li>-Establish Emission Baseline</li> </ul>  | Expected to start in May 2009<br>Budget: 5 man months for the CDM Component<br>Funded by: ADB TA 7157 |
| Ministry of Home and Cultural Affairs | Government | Preparatory assistance for Disaster Management   |   | Completed in 2006<br>Funded by: GEF/UNDP  |
|                                       |            | Reducing climate change induced risks and vulnerabilities from Glacial Lakes Outburst Floods in the Punakha, Wangdue and Chamkhar Valleys. |   | Ongoing<br>Funded by: LDCF/GEF/UNDP/Austria   |
| Ministry of Health                    | Government | Health Response to Climate Change and Climate Variability  |   | Project proposal.   |

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|--|------------|---|---|---|
| Ministry of Agriculture                | Government | Climate Sensitivity Analysis in the Agriculture and Forestry Sectors  | 2 research protocols for improvement of crop management including selection of crop varieties and introduction of crops better adapted to climate change<br><br>- A study to document traditional knowledge on coping mechanisms to climatic risks in the agricultural sector initiated by end 2008 | Implementation period: 2008 – 2009<br>Funded by DANIDA<br>Implementing Partner: MEA<br><br>Budget: DKK 1,000,000.00 |
| RSPN                                   | NGO        | Capacity Strengthening of Least Developed Countries for Adaptation to Climate Change (CLACC)  |   | Ongoing<br>Funding: International Institute of Environment and Development (IIED), UK                               |
|  |            | Approach towards Sustainable Fuel Wood Consumption to assist Community Primary Schools  |   | Completed<br>Funded by: GEF/SGP, MOE  |
|  |            | Study on vulnerable sectors and communities in Thimphu  |   | Funded by: International Institute of Environment and Development (IIED), UK<br>Underway                            |
|  |            | Study on the Health and Climate Change - An exploratory study on climate change and diseases sensitive to climate change where the threat of malaria has been spelled out as a major threat from human induced climate change impact. | 1. To describe the current distribution and burden of climate sensitive disease.<br><br>2. To examine the evidence of climate change and health effects particularly with vector borne diseases and infectious disease.   | Completed<br>Funded by: International Institute of Environment and Development (IIED), UK                           |
| Mendrelgang Farmers Association (MFA), | (MFA)      | Capacity Building on Climate Change:  |   | Completed<br>Funded by: GEF/SGP   |
| Tsirang Women Group                    | NGO        | Biomass Fuel Efficiency Project   |   | Completed<br>Funded by: GEF/SGP   |
| 21 Community Lhakhangs;                | NGO        | Improved Community Cooking Stove – an Alternative to mitigate fuel wood pressure in   |   | Completed   |

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|                                       |            | North Trashigang   |  | Funded by: GEF/SGP              |
| Zilukha Nunnery                       | NGO        | Promoting Alternative Energy through Use of Solar Water Heater (SWH) in Zilukha Nunnery, Thimphu   |  | Completed<br>Funded by: GEF/SGP |
| Merak Sakten                          | NGO        | Community-Based Initiative to Energy Conservation in Merak & Sakten  |  | Completed<br>Funded by: GEF/SGP |
| Schools                               |            | Sustainable Use of Fuel Wood in Wama, Pangthang, and Udaric in Mongar  |  | Completed<br>Funded by: GEF/SGP |
| Community Schools                     |            | Environmental Management and Conservation in Gasa Dzongkhag  |  | Completed<br>Funded by: GEF/SGP |
| Kidhekhari Buddhist Institute         | NGO        | An Approach to Sustainable Living in Kidhekhari Buddhist Institute in Mongar   |  | Completed<br>Funded by: GEF/SGP |
| Samdrupjongkhar                       | Government | Introduction to Fuel Efficient Stoves to reduce the consumption of fuelwood almost by 50% thereby saving a number of trees in Samdrup Jongkhar |  | Completed<br>Funded by: GEF/SGP |
| Bajo Higher Secondary School          | Government | Green House and Weather Station project in Bajo Higher Secondary School (BHSS), Wangdue  |  | Completed<br>Funded by: GEF/SGP |
| Wama, Pangthang, and Udaric in Mongar |            | Sustainable Use of Fuel Wood in Wama, Pangthang, and Udaric in Mongar  |  | Completed<br>Funded by: GEF/SGP |

## Glossary<sup>33</sup>

### **Adaptation (to climate variability and change) –**

Policies, actions, and other initiatives designed to limit the potential adverse impacts arising from climate variability and change (including extreme events), and exploit any positive consequences.

**Adaptive capacity** – The potential for adjustments, processes (both natural and human), practices, or structures to moderate or offset the potential for damage, or take advantage of opportunities, created by variations or changes in the climate.

**Climate change** – Trends or other systematic changes in either the average state of the climate, or its variability (including extreme events), with these changes persisting for an extended period, typically decades or longer (i.e., longer term). Climate change may be due to natural internal processes or external forcings, 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.

**Climate extreme** – A climatic event that is rare within its reference statistical distribution for a particular place. Typically “rare” is interpreted as an event that is below the 10th percentile or above the 90th percentile. An extreme climate event may be due to natural internal processes within the climate system, or to variations in natural or anthropogenic external forcing.

**Climate proofing** – a shorthand term for identifying risks to a development project, or any other specified natural or human asset, as a consequence of climate variability and change, and ensuring that those risks are reduced to acceptable levels through long-lasting and environmentally sound, economically viable, and socially acceptable changes implemented at one or more of the following stages in the project cycle: planning, design, construction, operation, and decommissioning.

**Climate variability** – Variations in climatic conditions (average, extreme events, etc.) on time and space scales beyond that of individual weather events, but not persisting for extended periods of, typically, decades or longer (i.e., shorter term). Variability may be due to natural internal processes within the climate system

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<sup>33</sup> Source: Asian Development Bank. 2005. Pacific Studies Series. *Climate Proofing: A Risk-based Approach to Adaptation*. Manila.

(internal variability), or to variations in natural or anthropogenic external forcing (external variability).

**Consequence** – The end result or effect caused by some event or action. A detrimental consequence is often referred to as an “impact.”

**Enabling environment** – The enabling environment for adaptation comprises the high-level and robust systems and capabilities that foster the adaptation process, including innovation, revitalization of traditional knowledge and practices, application of human knowledge and skills, policies, financing, legislation and regulations, information, markets, and decision support tools. It encourages and supports the climate proofing of development projects and related initiatives, as well as being supportive of the wider sustainable development process.

**Global climate model** – A numerical representation of the global climate system based on the physical, chemical, and biological properties of its components, their interactions and feedback processes, and accounting for all or some of its known properties. Global climate models are applied, as a research tool, to study and simulate the climate. They are also used for operational purposes, including monthly, seasonal, and interannual climate predictions.

**Greenhouse gases** – Those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiant heat energy at specific wavelengths within the spectrum of infrared radiation emitted by the Earth’s surface, the atmosphere, and clouds. This property causes the greenhouse effect. Water vapor, carbon dioxide (CO<sub>2</sub>), nitrous oxide (N<sub>2</sub>O), methane (CH<sub>4</sub>), and ozone (O<sub>3</sub>) are the principal greenhouse gases in the Earth’s atmosphere. Several entirely human-made greenhouse gases can also be found in the atmosphere, such as halocarbons and other chlorine- and bromine-containing compounds.

**Incremental cost (of adaptation)** – The additional costs arising from reducing climate risks through adaptation, when preparing for and implementing a policy, plan, or action.

**Likelihood** – The probability, or statistical chance, of a given event occurring within a specified period of time.

**Mainstreaming (of adaptation)** – The effective and equitable integration of adaptation activities into the preparation and implementation of policies, plans, and other instruments concerned with economic development, social progress, and/or environmental protection.



**Mitigation (of climate change)** – Policies, actions, and other initiatives that reduce the net emissions of greenhouse gases (q.v.), such as CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, that cause climate change through global warming.

**Projection** – Any description of the future, and the pathway that leads to it.

**Risk** – The combination of a hazardous event occurring, and the impact or consequence of that event.

**Scenario** – A plausible and often simplified course of anticipated events or a probable future condition, based on a coherent and internally consistent set of assumptions about key driving forces and relationships, constructed for explicit use in investigating the potential consequences of changes from current conditions.

**Sea-level rise (fall)** – An increase (decrease) in the mean level of the ocean, persisting for an extended period, typically decades or longer. Eustatic sea level rise is a change in global average sea level brought about by an alteration to the volume of the world ocean. Relative sea-level rise occurs where there is a net increase in the level of the ocean relative to local land movements. Climate modelers largely concentrate on estimating eustatic sea-level change; risk assessors focus on relative sea-level change.

**Sea-level change** – Trends and other systematic changes in mean sea level, persisting for an extended period, typically decades or longer (i.e., longer term).

**Vulnerability (to climate variability and change)** – The extent to which a natural or human system is susceptible to sustaining damage resulting from climate variability and change, despite human actions to moderate or offset such damage. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.